GAMING SIMULATION TECHNIQUES IN THE STUDY OF ENVIRONMENTAL CHANGE AND DEVELOPMENT

By

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GLOSSARY

In brackets [ ] are definitions based on that of the Oxford English Dictionary, while any other definitions are to clarify usage of words in this thesis.

ACCOUNTING SYSTEM	This is used in this thesis to mean the formal representation of the game model including any models, simulations, heuristic devices or conventional accounting procedures.
ANALYSIS	[Resolution into simple elements]. In this thesis, this word has been used in accordance with the dictionary meaning. However, it could be explained further thus; the breaking down of physical planning 'systems' into components so as to study their mode of interdependencies, i.e. for deep understanding of the systems behaviour.
COMMUNICATION	[Act of imparting news, information given, intercourse, common door or passage or road or rail or telegraph or other connections between places]. In addition to this interpretation, this word has been used in this thesis to mean the interchanging of ideas, i.e. the act of giving as well as receiving information, probably extending to a level which could be termed "dialogue".
CRITIQUE	Discussion between players and operators about the game run; entails discussion not only about the run itself but also about the real world analogue.
DECISION RULES	Criteria on the basis of which decisions are made about resources and information to be transmitted or received or what actions are to be taken.
DESIGN	[Make preliminary sketch of picture; draw plan of building, etc, to be executed by others, conceiving mental plan for, construct the ground work or plot of work of art]. In the light of this definition, this word has been used in the thesis to describe the act of creativity.

ENVIRONMENT	[Surroundings, surrounding objects, region conditions or influences]. In addition to this interpretation, this word has been used in this thesis to mean the set of all elements, a change in whose attributes affect the system and also of those elements whose attributes are changed by the behaviour of the system.
EVALUATION	The act of determining the value, or of ascertaining some means of stating value, of an unknown in forms of that which is known.
EXPLORATION	[To explore; inquire into; examine by touch; examine by going through it]. This word has been used to mean the process of having a practical experience of, or to search by taking active part, i.e. learning by experiencing.
FEEDBACK	The transmission of information from the end result of a process to a centre controlling that process.
GAME	[Contest played according to rules and decided by skill, strength, or luck; scheme, understanding, etc, followed up like a game; policy, plan of action]. In addition to this interpretation, this word has been used in this thesis to mean an activity carried out by cooperating or competing decision makers seeking to achieve, within rules, their objectives.
GAME SPECIFIC LANGUAGE	A symbol set and its conventions of use, unique to a given game.
GESTALT	A structure or configuration of physical, biological or psychological phenomena so integrated as to constitute a functional unit with properties not derivable from its parts in summation.

HEURISTIC APPROACH	An exploratory approach to a problem which uses successive evaluation of trial and error to arrive at a final result.
LANGUAGE	[Whole body of words and methods of combination of words used by nation, people, or race; method of expression; words and their use; person's style of expressing himself; professional or sectional vocabulary; literary style, wording]. In addition to the above interpretation this word has been used in this thesis to mean a set of symbols and convention governing their use.
MINIMAX	When the pay off for A equals that of B
MODEL	A model is a method of transferring some relationship or process from its actual setting to a setting where it is more conveniently studied.
NON ZERO SUM GAME	A game in which the winner's gain is not necessarily at the cost of the loser.
PARTICIPATION	[Act of having share in something with person; have something of]. As used in the thesis, this word could be taken as meaning "the act of taking part in the process. Full involvement; the act of doing and learning simultaneously.
PLANNING	[Act of making plan; drawing, diagram, made by projection on flat surface, especially one showing relative position of parts of a building; making a large-scale detailed map of town or district; table indicating times; places, etc. Making of way of proceeding]. In addition to above meanings, this word has been used in the thesis to mean "the act of learning before action or the act of looking before leaping"
POLICY	Policy is a settled course of procedure which determines what decision is to be made on the basis of the available information pattern. In simple terms a policy tells us what to do next in the light of where we are and what we know.

PREDICT [Forecast; prophesy; foretell future events]. This word has been used in the thesis in accordance with above definitions.

PROCESS [Progress, course, being constructed as time goes on; course of action, proceeding, especially method of operation in manufacture]. This word has been used in the thesis to mean "a dynamic and flexible course of action, which continuously changes direction with time".

PUBLIC [Concerning the people as a whole; done by or for, representing the people; engaged in the affiars or service of the people; the members of the community in general]. In addition to the last definition, this word has been used to mean "every individual in the societyi.e. you and me.

RESOLUTION LEVEL This means in this thesis change in level of view point from which an individual system or group of system can be viewed to seek for agreement.

ROLE Character assigned to someone with prescribed pattern of behaviour. There are three types of roles in gaming simulation - (a) gamed role: individual present in the game with his decisions processed by the game accounting system, (b) pseudorole: individual present in the game with his decisions not processed by the accounting system, (c) simulated role: individual not present in the game, but role simulated by the accounting system.

RULES Action or behaviour incumbent on players, operator, and accounting system which cannot be altered.

SCENARIO 'Plot outline and setting of a game' in addition to the above interpretation this word is used in this thesis to mean all the necessary background information for a game or simulation.

SIMULATION	Dynamic representation which employs substitute elements to replace real or hypothetical components.
SIMULATORS	A simulator is designed to represent a real situation, to provide a participant with control over that situation, and to vary conditions during training so that the task can be made progressively more difficult.
STRATEGY	A strategy is a plan for arriving at a pre-determined goal at minimum costs. This definition given above holds in this thesis.
STRUCTURE	[Ways in which something is put together, organised; building; any complex whole; framework or essential parts of a building]. This word has been used in this thesis to mean that the structure of a model is the pattern of relationship between its constituent variables as distinct from the values or coefficients associated with them.
SYSTEM	A set of units with relationships among them, an intercommunicating network of attributes or entities forming a "complex whole", an "assembly of attributes", not a thing but a list of variables. Conceptual construct of behavioural systems subject to control by human beings, which is generalisable.
ZERO SUM GAMES	Games of pure competition or conflict generally called zero sum games because the sum of one side's gain and the other's loss will always be zero.

SYNOPSIS

This research is concerned with the use of operational models, especially gaming simulation techniques, in the study of environmental change and development. The main objective is to explore the potential of the technique as (i) a common language for learning and communication; (ii) a practical vehicle for user participation in design decision making process; (iii) an effective training device for developing a flexible planning style and (iv) a risk free environment for the formulation and testing of public policies.

The study is presented under three main parts. The first part consists of two sections. The first section is towards a theoretical foundation of gaming simulation in planning, followed by a review of some planning gaming simulation models in section two.

Part two is concerned with the application of the technique in planning. A number of experiments (seven) were undertaken in which so to speak, the actors and the plays are varied and useful rules (all games are defined by rules) are tested and developed. Experiments include several of the utilisation of gaming simulation models in teaching; community participation; development planning; policy formulation and testing. Among the models used in this research are (i) National Investment Decision Simulation, which is a simulated decision making system in Nigeria applied here to show the difficulties of decision making through the mechanism of investment allocation to achieve national objectives and to reflect how state (regional) government makes claims from National government through its physical resources. A post game delphi technique was used to develop components needed for planning, (ii) African Village Simulation - deals with the planner's style in developing nations and show how national planning schemes are perceived from the view points of the traditional and modern sectors. It explores the

potential of gaming simulation techniques as an effective training device for developing a flexible planning style. The relative value assigned to four socio-economic variables before and after play is assumed to reflect planning style to some degree. (iii) BUG - Built Up Game: introduces the reader to an attempt in understanding the complexities and the dynamics of urban community through gaming simulation. (iv) GUTS - is a game on urban transport simulation based on a computer model of an idealised city incorporating the most important variables and policy instruments encountered in reality. (v) Edinburgh Airport Simulation attempts to model the British public inquiry system in order first to explore the law and second to discover techniques for resolving different views and interests. (vi) Participatory design decision making - attempts to illustrate the potential of a computer aided simulation technique as a practical vehicle for user participation in the design making process. (vii) Gaming simulation in the planning process. This is some way a mixture between the traditional approach and a simulation. It attempts to combine the close resemblance to a well defined piece of professional work with the facility of feedback offered by simulation gaming.

Part three contains the main conclusions and the descriptions of those aspects needing further research work. Within the limits of the resources available and experiments carried out in this research are the following conclusions.

(i) Gaming simulation in planning provides a form of language through which the planner can communicate important concepts and ideas to his colleagues, clients and the public.

(ii) Participation resulted in attitude change. The most common types of attitude changes are greater realism and greater approval or disapproval of the real life persons whose role the participants play in the game.

(iii) As an important tool for the education of the planner and the public alike, there is evidence that it hightens the interest and motivation of participants (experiment 1, 2, 3, 4 and 5). Participation gave them insight, empathy and a greater understanding of the world as seen by decision makers. It is wondered whether in fact it is not just educational means but should be an integral part of practice to be considered.

(iv) The experiments suggests that simulation can be used to obtain citizen opinion about planning issues. It helps in. planning for the transformation of individual to group values and vice versa, and offers intellectual flexibility (Experiment 6).

(v) Most participants in all the experiments found simulation enjoyable and a worthwhile experience. The exploration of this technique can lead to more rapid development of the ability of the planner to handle abstract systems.

(vi) People without previous knowledge and experience of a problem can be members of a simulation group and still provide valuable information (Experiment 5).

(vii) The experiments suggests that gaming simulation in planning provides a safe environment for future testing. It offers participants an opportunity to experiment with different strategies and policies and to observe the projected consequences of their actions. The modelled milieu of a game can in effect be a laboratory, where ideas can be developed and tested prior to actual implementation and where the planner can accumulate a factual foundation on which to base his ideas.

PART I : GENERAL INTRODUCTION TO GAMING SIMULATION

1.1 INTRODUCTION

1.1.1 Complexity and Decision Making

The quest for better understanding of physical and social reality has presented mankind with an information crisis; problems of modern society are infinitely complex involving systems of interacting subsystems, challenging the capabilities of normal human comprehension. We find ourselves in an era of speciality with individuals being forced to compile and understand great quantities of information within their narrow discipline simply to maintain a position. The result is a modern day technical "Tower of Babel" which defies conventional jargon and traditional forms of communication.

Increasingly, people feel the need to be a part of the myriad of processes affecting their lives. The complexity of society, however, and the inevitable technological response to that complexity often preclude the individual from even entering the dialogue preceding a decision that will impact his or her own life.

Growing complexity results in special problems for professional decision makers who are required to act as though they thoroughly comprehend and understand the complex environmental decisions they are making. Though often equipped with large support staffs and effective data gathering capabilities, decision makers commonly decide issues on the basis of feeling rather than pure logic. Shelves of reports and the comprehensions of others are of little value unless the makers of policy can integrate such information toward some kind of holistic awareness and understanding.

While the problems of modern society have grown more and more complex, the modes of communication available for understanding and dealing with those problems have not changed significantly. Certainly the need continues for efficient modes of learning discrete units of information. But perhaps a more immediate need exists for more holistic language forms capable of developing comprehensions about general domains; mechanisms which not only communicate gestalt awareness about some reality, but which can develop a motiviation for learning as well.

1.1.2 Why Gaming Simulation

The real world is far from an ideal training ground as it is too risky, costly and difficult to experiment with reality. An example would be the training of pilots for certain emergencies, the proper handling of which might decide their survival. Similarly, some states of nature or social life are so rare and/or costly that the technique of simulation is seen a necessary state one has or which to deal with them. It is in this respect that gaming simulation techniques are applied in this study as a risk-free environment for policy testing.

Secondly, one finds that in many cases it is impossible to learn from the past. People interpret in different ways for different purposes. Expectations, resources, techniques and knowledge interact in space and time. How can one know cause and effect when at anytime there are infinite decisions and actions being prepared with different effects. With respect to the above the need exists to develop methods of communication where one can share and relate our experiences at particular times and determine regulations and investments in the light of different and common needs. It is in this context that one is led to the use of gaming simulation techniques as a means of communication and learning in this study.

Thirdly, much of the success of physical scientists come from their use of laboratory techniques. The social scientist today also needs laboratory techniques if he is to profitably study and improve man's complex environment. Because the planner lacks a laboratory he is not only unable to adequately test his ideas but is hindered in collating the factual base from which to formulate his ideas. He is also hampered by the nature of the complex scene which is not exclusively a social or economic or political phenomenon. Full comprehension is difficult with the tools of a single traditional discipline for multi-disciplinary approaches, When tried, have usually proved frustrating because the participants lacked either mutual frame of reference or a common language. Gaming simulation shows promise as a way to develop the planners laboratory. It is in this context that one seeks to explore the potential of gaming simulation as an effective training device (laboratory) for developing a flexible planning style.

Finally, planners are individuals concerned with creating environments that are congruent with the needs and life styles of the using populations. The past decade has witnessed the growth of knowledge about user needs, preferences and behaviour. This data was generated from studies that often represent a moment in the life space of a particular environment. While this rapidly growing resevoir of information has substantially contributed to the development of the planning profession, other methods for understanding user needs and values are equally important to capture the dynamic aspects of the environment. Gaming simulation represents one method. It is in this context that one seeks to explore the application of gaming simulation as a practical vehicle for user participation in design decision making.

1.1.3 The Objectives of this Research

Consequently, the objectives of this work has been to design, test and evaluate simple but dynamic gaming simulation models for studying the decision making processes in planning. There were a number of areas which it is thought should be researched so that a comprehensive assessment could be given about the feasibility of the use of gaming simulation techniques. These areas of research can be described as follows:

(i) To explore the potential of gaming simulation techniques as an on-going learning and communication process which will increase an understanding of the fundamental needs of citizens, private and public authorities in a competitive social system. When one thinks of any planning team as consisting of different interest, the need for a platform of communication becomes valid, can gaming simulation be used at this platform to improve communication between various experts, to facilitate discovering and learning about complex problems in a holistic or gestalt manner, and encourage alternative generation and testing in a safe environment.

(ii) To explore the potential of gaming simulation as an effective training device for developing a flexible planning style. Planners who are now engaged in development may be trained for a rigid planning style, and may be unable to assess social consequences with their present planning skills and orientations. Would it be possible to use gaming simulation as a tool for identifying social conflicts in the process of development? Is it possible to use gaming simulation models for training planners, decision makers, etc, to be aware of the need for flexibility in planning? These are some areas which this research is concerned with.

(iii) To explore the effectiveness of gaming simulation techniques as a practical vehicle for user participation in the design decision making process. The rate of technological change, and the complexity of issues generally excludes the ordinary citizen from participation in the design of built environment. This problem will remain troublesome unless the relationships between variables can be transformed. Simplified and communication so that knowledge can be shared and understood by everyone concerned (planners, designers, users, etc) on both the product level, concept level and system level. There is thus the need for astrategy of participation which (1) explicitly involves citizens in decision making roles, (2) is suitable for use with community groups, (3) minimises the reliance of citizens on professional expertise, but still (4) provides public officials with useful information. Would it be possible to use gaming simulation techniques to fulfil these requirements? This willbe one of the main tasks of this study.

(iv) To explore the potential of gaming simulation as an alternative approach to policy formation and testing. Can gaming simulation be effectively employed in actual policy application?

In general then the objective is to develop and test a planning language capable of conveying holistic thought or gestalt.

1.1.4. The Approach

There are two possible approaches to this study. One would have been to design, test and evaluate a single model under varying conditions with different participant groups. A second approach would be to design, test and evaluate several simulation models (focussing on different problems) with the appropriate participant groups. However, because of the scope of the objectives and because designing games is even more educational than playing them; and lastly because it is assumed that in the planning world we are in fact carrying out such varieties of games simultaneously the second approach has been adopted in this study.

Seven experiments were undertaken in which, so to speak, the stage, the actors and the plays are varied and useful rules (all games are defined by rules) are tested and developed. The outcome is an advice for planning education and for the design of planning systems.

1.2. DYNAMIC MODELS FOR SOCIAL SYSTEMS

Social sciences have been unable to attack socio-technical problems effectively. Why? Maybe because the tools and techniques, the methods and the general approach to social conflicts is narrow minded, limiting, too academic and too vague. Maybe because the observational method of studying social problems is not effective in that it does not allow for the intervention of the scientists in the conflicts, it does not allow for experimental work and therefore inference from an experimental situation. The observational method is descriptive in principle and in action. It limits the social scientist to a mere report of what he saw happening in X situation. It allows him to describe the phenomena and the context in which it happened.

Perhaps what is needed is just the opposite; a technique which is dynamic; an approach which allows not just for mere description and observation but for action, manipulation and control. That tool must be able to catch complex events and relationships; must be able to provide objective analysis of social conflicts or problems.

Of course, no algorithmic approach is possible in dealing with the social problems. No step by step method exists which could tell us how to find what we want or how to produce such and such effect. So, we must use the heuristic approach of narrowing down the field of search by inductive reasoning from past experience in similar problems. As a difference from algorithms in natual sciences or exact sciences, by which one follows a fixed and pre-established procedure to achieve certain expected results, in social sciences the great uncertainty that surrounds any problem must be reduced by increasing our knowledge of the situation; this increasing of our knowledge impies a range of activities from just observing a situation to random control of variables in experimental situations.

How can we experiment with organisation? How can we analyse social conflicts so as to be able to solve them? And if a possible solution is found, how do we know the effect we should expect? We cannot just play with social groups and make them pay for our lack of knowledge, our errors or wrong suggestions.

It is basic that social science finds a technique or a range of techniques which allows for an experimental approach, to build models of social systems as simplifications of the real world and to manipulate them by changing parameters, exercising pressures on certain areas, etc. Only then we will begin to understand the nature and characteristics of social problems.

From this point of view many people, like Long (1958), had suggested that Local Communities and other social groups may be viewed "as an ecology of games". It has also been suggested that much conflict and competition in society, even when it takes the form of struggle can be understood on the analogy of ritual contests and competitive games. In these last, there are elaborated rules which prescribe the limits within which players or teams can adopt strategies of outwitting and defeating their oponent' (Cohen, 1968). Cohen, however, is not very sympathetic to the idea of using the analogy to simulate most forms of human behaviour, maybe because it is only an analogy and it does not represent every aspect of social behaviour, maybe because we know very little and have very little experience in working with this rather new tool - generally called operational models.

As Olaf Helmer, 1966, points out, "The heuristic effect of collaborating on the construction and of a simulation model is particularly powerful when the simulation takes the form of an operation game where the participants act out the roles of decision-and-policy-making entities". Armstrong (1970) also suggests that "it is within the area of creating an awareness of the complex relationship between group interests and the outcome of a given course of action that use of gaming has its greatest potential....".

The use of operational models (of which gaming simulation is only one type), especially simulation research, has been subjected to two main views. The first one is a view by which the laws of human behaviour are constant. For those adopting this view simulation is technique to develop and test theories or predict alternative futures. The second view would stress the continuous-creation aspect of human behaviour and for them experiments in the laboratory would be part of the global simulation to discover and create more and new alternative behaviour. So while the former view may stress the correspondance between simulation and reality, the latter might question the relevance of present day realities to future alternatives smoke (1970).

Operational models help, no matter how narrow the speciality of those who help in the construction of the model, to consider different aspects of the problem which might not in normal conditions come to the surface when one is working in isolation. As Helmer (1966) points out, they induce an integrating effect comparable to what is known in purely analytical situations, as a system analysis. But operational models are useful not only to scientists and students of social conflicts and social organisations, they are also very useful as educational tools. If used in community action groups, operational models might help to inform the community of their rights, responsibilities and options and the different scales of citizen participation; to evaluate their actions and strategies, to teach members of the community of the complexity and 'modus Operandi' of the conflicts; to found new actions, to teach how other organisations work and how all of them are related. Operational models also help to take professionals across disciplinary boundaries. Like Jones (1969) suggests by passing the rigidity of professional boundaries by training and practice in multi-professional expertise.

1.2.1. Operational Models: Definition

What are models?

Models are representations of processes describing in simplified form some aspects of the real world, Jantsch (1967). Among the class "Model", those in which we are interested are the so-called simulation models, which allow the user (of the model) to represent in it by changing certain parameters - different conditions equivalent to situations in the real world. So by means of the model and the changes in it we can 'simulate' specific situations.

Simulation models can be of many types, paper and pencil or mathematic models (usually a set of equations representing certain parameters), computer models, (models whose manipulation requires the use of electronic computers). Others like urban land use models combining the mathematical, computers and the physical representations; physical models (like the ones used to train pilots), and operational models which work basically on very complex work with very specific and defined data. The parameters are known and their limits are mathematically representable. So, the mathematical model requires that the conduct of the real world system is transformed in sets of equations which are later on manipulated. The computer model works roughly on similar bases. However, those two types of models are not useful when undefined or unmeasurable parameters are present, and therefore its use has been limtied to problems in which some sort of algorith can be found. So, what kind of model can be used for the study of environmental change and development? One possible alternative mentioned by many people has been that of using a heuristic approach and some sort of model which although it does not provide answers straight away, narrows down the field of search by exploration. These kinds of models have been called operational.

This type of model is still in an under-developed state and its reliability in some cases may leave a lot to be desired. However, there is a greater chance that recommendations made with the help of this kind of model are more appropriate than those made without its help. In future forecasting for example, operational models applied to exploratory forecasting or normative forecasting have proved to be quite successful, especially in international politics, military arms deployment, etc.

1.2.2. Types of Models

This typology which one has attempted to present here is by no means exhaustive. I have only included those types of models which are more developed and are better known to scientists. The typology on the other hand does not pretend to be exclusive, or in other words, one of the types considered here might be included in some type other than operation; the differences are still too small to draw definite and clear lines.

Business Models: Business models are usually constituted by sets of relationships between the parameters of the problem - sometimes in the form of mathematic equations - and a computer whose job it is to check that all manipulations of parameters are within a range of possible alternatives and to evaluate each manipulation, giving to the group of users feedback about the consequences of their actions. Business Models are used mostly for educational purposes in Business Schools and Universities, although its use as an operational tool which recommends policies is increasing.

Rigid Computer Models: These are models whose primary elements are sets of equations and relationships introduced into a computer; by means of stored information related to historical background, previous actions, lateral disciplines related to the main body of knowledge of the programme, the computer (in most cases based on random selections) develops alternative outcomes. Its use as an operational tool has not yet been fully proved although it has been used extensively in Technological Forecasting. It should be emphasised that due to the extensive use of equations (mainly differential ones), analog computers are better suited to the job than digital computers.

Game Theory: Game theory - not to be confused with gaming - is basically used with the help of computers or desk calculators. They provide means of establishing the best strategy to follow in situations of conflict. The parameters are all known and measurable, and they include pure and mixed strategies which take into account chance events. They are mainly related to problems where the outcome of any course of actions is a defined 'pay off'.

One of its greatest limitations is that it does not handle a large number of parameters and cannot tackle, therefore, complex problems. (See 1.7.)

Gaming Simulation: Gaming simulation encloses a very wide range of techniques better known as games. They include in their use of computers or human subjects or both. It has been defined as a technique which its main usefulness is that it can be applied to very complex situations where immediate and simultaneous interactions between the different parameters is needed. Sometimes the computers are used to help the user or the observers in the monitoring of the process. Gaming simulation can be of two types: open or closed gaming.

Open gaming, or games without constraints, is mainly carried out without the use of computers, since the number of parameters and interactions is so great that it would be uneconomical or not even technically possible. Closed gaming is that type of game in which some parameters are controlled, for example, the 'information game' developed by John Rae (1969) at the Architectural Association, in which pieces of information are passed around until certain total information is completed. Gaming simulation has been used with some success, in both exploratory and normative forecasting and most of the important work has been developed at the Rand Institute, (USA).

1.2.3. A Short Introduction to Gaming Simulation

Of the four types of operational models, one is particularly interested in the use of gaming simulation, for the reason that problems in the social sciences, particularly planning, are of a kind often referred to as "complex", i.e. problems in which few, if any, parameters are known or measurable.

Jantsch (1967) states the following as one of the particular advantages of gaming: "It facilitates the determination of the important parameters and some empirical relationships of a given problem, so that models can be subsequently developed". His view of gaming simulation implies that the model is dynamic and that every session, every run or every experiment, reduces the field until objective decisions can be taken (heuristic). So one of the main purposes of gaming simulation - as Rackham (1969) points out - is to provide feedback to the controller of the exercise. As a result of this feedback it may be possible to modify the progress of the exercise in a way which optimises the learning experience for participants. Here, one of the main differences between gaming simulation and computer simulation is stressed; gaming simulation, because it relies on human subjects, admits irrational behaviour into the model of the real life situations and therefore accepts inconsistent factors as part of the main body of the situation, while in computer simulations those factors are introduced by the machine to simulate irrational behaviour in the form of random events. However, one of the main differences is that gaming simulation provides an environment in which learning takes place, whereas computer simulation provides a means for testing assumptions and making forecasts on the basis of those assumptions' (Armstrong 1970).

Gaming simulation is not a technique which pretends to give comprehensive and global answers to complex questions, but to answer mainly in an exploratory manner, small questions of immediate operational value.

Here the immediate question comes to mind, 'If gaming is useful in complex problems and it also induces learning in participants, could it be used to clarify complex decision making issues in conflict situations (Experiment 5) where many unknown parameters are involved? Could it be useful in user participation; in policy formulation and testing, etc?' These questions are put in the form of experimental study and is presented in Part II. However, before attempting to look at these studies, it is necessary to clarify an issue which is often confused. That is, the difference between games and simulations.

1.2.4. Models, Games and Simulations

In working with gaming simulation techniques there is one factor which is of major importance, that is, the relation between real world and the model used to simulate it. How representative of the real world should the model be? Which features of the real world should be included in the model and which ones left out? Many authors define models as representations of a system, usually the 'real' system, which they use to study the behaviour of that system, due to variations in the input to the model. Some others (Hermann, 1968) consider models as mere simplifications of a total reality, and others (Ackoff and Arnoff 1957) define models as no more than partial representations of reality. Beer (1966) is more ample on this subject and his description of models concerns us for reasons which will be made clear later. He says in "Decision and Control", "let us call this mental representation of the world a Model of the world. The term is appropriate; models of things may be more or less accurate, and thereby better or worse able to predict the behaviour of what is modelled".

Because models are simplifications of a real system they cannot behave in the same way as the real system. We must then introduce into the model those features of the real system which will make the model a "representative image" of the real world; this is a function of the use to which the model is going to be put. This concept of representativeness between the model and the real world has been amply developed by Hermann (1967). He calls this 'validation' and defines it as "any comparison between the representation of a system and specified criteria". This could be expanded by saying that one of the requirements of the validation criteria is not to be a replica of the real system but to help the users of the model in such a way as to detect alternatives for handling the problem. In other words, the validity of an 'operative model' is a function of the objectives the technique pursues. This means, of course, that the technique has many validation criteria as objectives. Hermann (1967) remarks that the validation of an operating model cannot be separated from the purpose for which it is designed and used.

Generally there is not one-hundred percent replication in a model building situation, since theoretically, a system which is identical to another is the system itself. Always the imitation of a reference system will produce distortions in the model. On the other hand, the one objective of using models in scientific studies is to analyse and monitor the behaviour of systems, in controlled conditions, (owing to the increasing complexity of higher level systems, we need models to make them manageable, J C Jones, 1969). If we reproduce or try to reproduce the system or observable universe in the laboratory, we will find that there is an intrinsic contradiction in the fact that the more we approach the "reference system", i.e. real world, the more our search becomes a non-sense and waste of time, since we could simulate the system in the system as a model; itself instead of building a replica of it. We could use the reference system as a model, but this is not always possible and beneficial so we must find an intermediate stage in which the model is a <u>valid representation of the reference system</u> but not so elaborated as to be the system itself. This concept is the dilemma of the operational researcher when attempting to solve a problem. Beer (1965) was the first to introduce this concept of simulation using the system; he called this "systemic research".

Simulation and games are operational gaming techniques which are part of that class called models, Hermann (1967), and as such are subjected to all the concepts mentioned above. But simulations and games are different from other kinds of models in that the elements of the model (parameters and relationships) are capable of changing and being modified as the game or simulation evolves. Some authors in this subject differentiate between simulations and games, but in most cases the terms are used alternatively and indiscriminately. For example, Brody (1963) and Guetzkow (1959) differentiate between machine, man and mixed man-machine process. They call simulations those techniques in which the decisions are made by machines (computers), and games those in which man is present in the process as a decision making element. The mixed process is called man-machine simulations. In other cases (Rapoport, 1964) simulations are defined as techniques in which the assessment of the situations and subsequent decisions are made following a set of planned formal rules. When human beings intervene in the decisions without formal rules it is described as a game. Furthermore, Dawson (1962) stated that all operating models are simulations but that those which use human beings are called games. For him then, games are a subset of the set 'Simulations'.

Shubik (1964) gives a different view which is based not so much on those who take part in it, but on the objectivity of the activity, so he states that "a game is invariably concerned with studying human behaviour or teaching individuals.....on the other hand a simulation is designed as a reproduction of a system or organism in which the actual presence of humans is not essential because their behaviour is one of the givens of the simulated environment".

In general these are the accepted views on the subject. In this study, nevertheless, the meanings of these concepts will be partially different for reasons of semantics which I hope will be made clear later.

In referring to the definitions of games and simulations in the Concise Oxford Dictionary, I read: "game - contest played according to rules and decided by skill, strength or luck". "Simulation - from the Latin simulare (similis: like), pretend to be, act like, resemble". In identifying these words more clearly, I referred to Roget's Thesaurus to find synonyms of words; I quote: "game - conflict, clash, warfare, controversy, quarrel, competition, rivalry, contest. Simulation - similar, resembling, alike, twin matching representation, assimilation". As we can see the meanings of these words do not differ by the intervention or not of human beings, but in the nature of the actions themselves. The confusion arises, however, in that both actions are reproduced in controlled conditions to study important features in the real world. The concept of a game is related to the traditional meaning, but with the use of computers in operational research the word simulation acquires a scientific meaning which it did not have before; when combining the two concepts the tendency is, instead of applying the words sophisticated or unsophisticated decision-making techniques, to refer to computers and man.

The following concepts are adopted in this study:

Simulation: A dynamic or operating model. Changes overtime in the system being investigated would be represented by changes overtime in the model.

Games: Those simulations which work wholly or partly on the basis of players' decisions, because the environment and activities of participants have the characteristics of games; players have goals, sets of activities to perform, constraints on what can be done, and pay-offs (good and bad) as are patterned from real life - that is, the roles, goals, activities, constraints and consequences and the linkages between them simulate those elements of real world system.

Gaming Simulation: Combines the two techniques simulation and games. The set of rules governing the play of the game and scenario setting the game environment act to constrain behaviours in the game so that the game activity simulates some more complex systems. "Gaming Simulation", then, is a hybrid form, including the performance of game activities in simulated contexts.

1.2.5. Games for Fun and Gaming Simulation

As a supplement to the above discussion it is felt that reference to familiar games would help to illuminate the whole concept of planning gaming simulation models. It is in this context that one seeks to discuss a few familiar games that most people have experienced to some degree during their childhood, and since, in terms of what one can learn from them in the design and development of public planning games.

Chess: Is an example of simulation, originally an academic game, of great antiquity. Here, two sides are engaged in conflict which is played out according to rules originally devised to simulate a military encounter. Chess consists of a defined space (subdivided into 8 by 8), times for moves (as in championship) and penalties, a defined objective and precise measurement of success and ending, pieces (players on the board) defined by power to make specific moves (to occupy a particular space or lands), any piece may take any other piece given the circumstance, the captured value of a piece is determined by experience (e.g. Queen equals say Castle, Knight and two Pawns), however the relative value of pieces changes in relation to the environment (e.g. the phase of game, e.g. opening, middle or end game), the pieces and their relations are a very subtle model of a particular society; the moves are sequential - it is important who starts (black or white).

In addition to the above, the moves and pieces are scaled down in chess to ensure that the rules of strategy can be learned through simulations which do not involve the physical danger of real battles. The essential nature of play is exemplified in that the inexperienced learner is enabled to avoid the worst and sometimes terrifying consequences of his wrong decisions. His sufferings and anxieties are scaled down to the dimensions of the chess board.

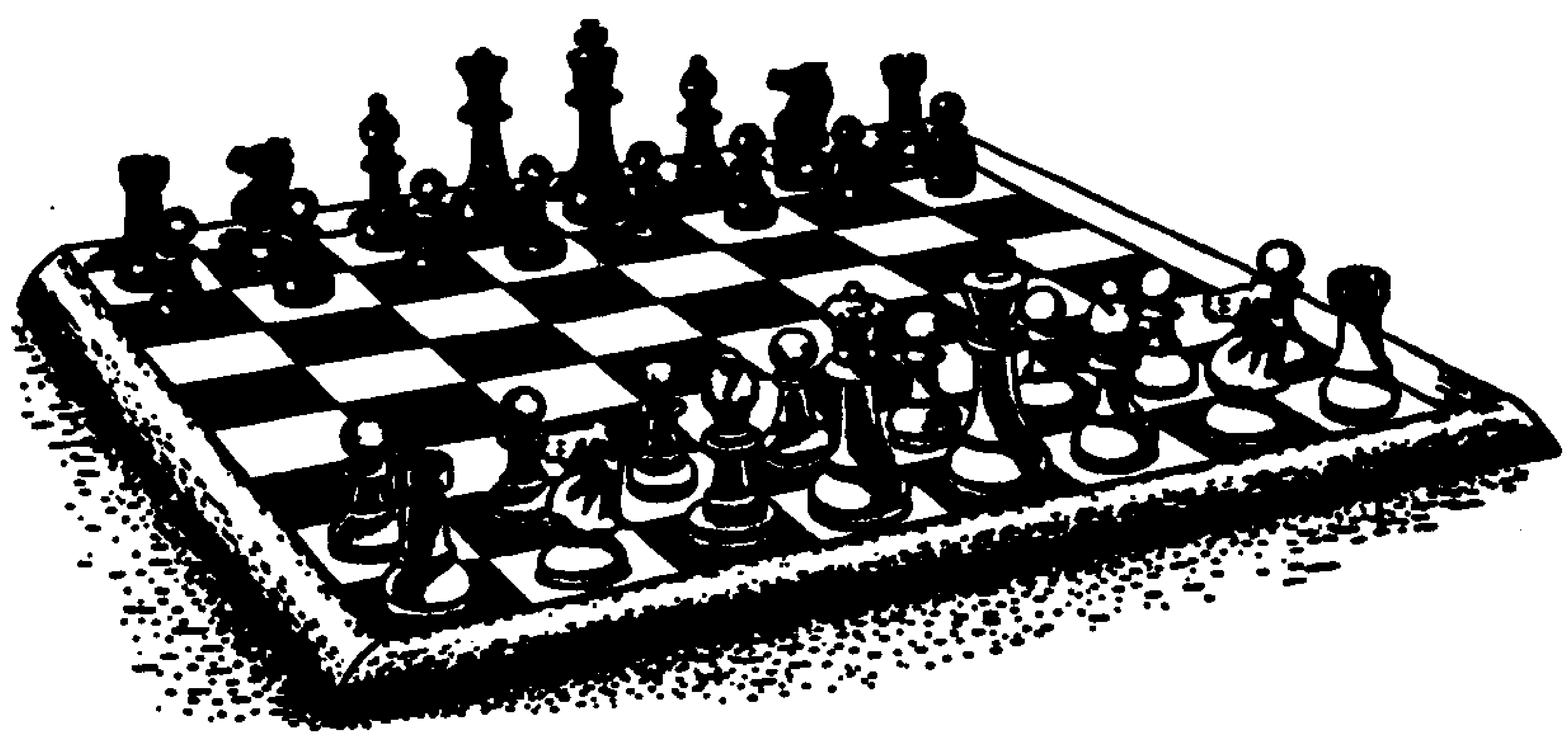


Figure 1: Chess Board and Playing Pieces

Monopoly: Is another example of a familiar game. The rules of this game refer to a simplified analogue model of speculating in real estate and property. Failing complete bankruptcy of opponents, the winner is satisfied if the balance of advantage in terms of points is on his side. Monopoly is a contest of 'n' players (2....?). It consists of defined space and land uses (a land use plan), objectives, e.g. winning is defined in terms of money (to buy land and developments). All players are developers and given equal cash to start, there is a sequence of buying land (with specific uses), of developing land, of clearing rents (from other players who use them), the use of land is determined randomly by dice including unforseen events (go to prison, etc), strategies may consist of (a) incremental-buying up low cost lands and developing rapidly, (b) buying up high cost lands and developing slowly, (c) a middle or mixed course.

Many land use simulation games (see page 90) have similar properties to Monopoly, which has a well defined land use plan to begin with and a much stronger user randomness later as in real life.

The lessons from familiar games described above includes the following:

(i) The objectives (measurements of winning and losing) differ in each game. A common objective of all games is to become a better player and to compare players' performance in relation to specific tasks.

(ii) The rules for each game differ but all games are defined by their rules.

(iii) Even within well defined rules there is great freedom of choice of move and almost infinite plays (in a game like chess).

(iv) A change in a rule changes the game structure and the skilled players (e.g. a reduction in the number of players in football would favour faster runners). By determining rules one is actually determining the behaviour of players and the players themselves, i.e. the process of natural selection.

(v) The variety of games that people play is important in replicating and developing the variety of characteristics essential to survival and the process of natural selection.

The above provides us with some basis for designing of planning gaming simulation models, perhaps the most important difference between public planning gaming models and other games is the need to discover the objectives (the results and measurements) and to determine the rules which determine them.

1.2.6. Historical Background of Gaming Simulation

While it is not the intention of this study to explore in detail the origin and development of gaming simulation it is felt that a brief introduction to the field would not be out of place.

War Gaming: Gaming, particularly war gaming, goes back thousands of years. Apparently it is no more coincidence that the earliest war games were played on boards much like chess is played today. In the eighteenth century the German army introduced maps and formalised rules and penalties for games. In the nineteenth century the idea of war games spread to the United States. In the twentieth century the axis powers made considerable use of war gaming in planning for World War II. One of the strategies played by the Japanese in September, 1944, simulated the December attack on Pearl Harbour. The result predicted the heavy losses that were to be suffered by United States forces.

Since World War II, military gaming has taken on a sophistication beyond belief. Simulation of conventional radar webs, inter-continental ballistic missile launches, satellite surveillance nets, and theatre-size electronic display boards representing the entire globe give an aura of science fiction to an unimaginably complex operation.

Since World War II, there has also been a flurry of activity in gaming research in areas other than the military. The most numerous, and probably the most effective results have been obtained in business management games.

Business Management Games: Emerged since the end of World War II and has its roots somewhere in the history of war games. However, their emergence was the result of several factors:- the advent of computers, the development of the mathematical theory of games (see pages 51-65) and increased incentives from the highly competitive business world. These circumstances culminated in the design of AMA "Top Management Simulation" which received instantaneous recognition as an important new approach to job induction. Almost overnight, gaming became a popular training activity for Universities working in this field, as well as industry and commerce.

One of the first British examples to become well known was the week-long British Training Airline Game used by the then British European Airways to train young executives and managers, a game acknowedging the descent from the AMA original. Several other games have since emerged dealing with management of a company at a senior level. Two examples are referenced: the "Scottish Management Game", which was designed by W C Robertson and others, as a game for fun as well as a learning game, and the Honeywell Management Game, which is similarly played. In 1976, a competition using this latter game was organised by the London and South East Operational Research Society (LASEORS), at their management centre at Chelwood, Sussex.

In schools, Universities and adult education, business and management games have become an accepted practice. The general aim of these games is to communicate management principles and business skills in such a diverse areas as marketing, labour relations, production stock controls, etc. The resources invested in business games appear to be immense and may even rival contemporary commitment to military gaming.

<u>Gaming Simulation in Social Sciences</u>: The development of war and business gaming influenced, in its turn, the evolution of ideas in the social sciences. Formalised 'think tanks' such as that initiated at the Research and Development Corporation of America (RAND), and associated advances in computer technology, operation and research and systems thinking began to influence many scholars in their approach to social phenomena. A more rigorous application of scientific methods ensued, and a discussion of social technology became common-place (Helmer 1965).

Early applications of this were in the field of political and 'Crisis' gaming, notably by Guetzkov at North Western University (1959). His Inter-Nation Simulation was refined and developed as a tool in the teaching of international relations over a number of years, and more recently it has been turned into kit form and used in America, Canada and English institutions.

Miles Copeland (1969) has written about the real-life implications of this type of study, and revealed its influence in some aspects of American foreign policy making. In some respects, the technique was used unwisely as a predictive device. Copeland himself was notably concerned in one of the first televised simulations in Britain, a Horizon BBC programme based on three-day simulation of the Arab-Israeli crisis held at St Anne's College, Oxford, in 1969.

<u>Gaming Simulation in Planning</u>: Gaming simulation models in planning has also expanded at a remarkable rate as planning has become more a total science and less exclusively concerned with the technological aspects of bricks and mortar. Hence, planners have built

upon the games developed by business analysts, economists, political scientists, organisational psychologists and sociologists to present a more balanced synoptic view of urban phenomena. In essence, their games are dynamic representations of selected aspects of the human settlement; they describe simply the milieu within which the planner works.

It is however not clear how and when gaming simulation was introduced into planning and related affairs. It appears, however, that a range of planning gaming simulation models were produced in USA - primarily as learning devices for practicing planners - based upon current military and business simulation exercises. These humble beginnings spawned a wide range of models which have been used in teaching, research and communication. Most notable in the field has been the work of Duke (Metropolis, Metro-Apex) and Feldt (CLUG) see pages 90—99 whose models became the foundation of the majority of the models developed since the mid-sixties.

In Great Britain and Europe however, it is the CLUG family of games which have had the greatest influence on the development of gaming simulation. Although often designed to suit educational purposes, the land use element of CLUG reappear in many modifications.

From the growth of gaming simulation techniques in the USA, and from its adoptions and modifications in Europe, the technique has developed along five-related paths.

(i) In conjunction with the development of urban modelling and the use of the computer in simulation, gaming is now applied as a research tool. An example is the Toronto Game Model. This game has five specific purposes "to introduce students to interplay amongst many of the major elements of urban system; second to develop a method for structuring information, in which values and constraints are explicit rather than implicit; third, to highlight specific alternative value systems; fourth, to compare and integrate the development of game processes with the evolution of urban design strategies; and finally to examine the validity of design alternatives through gaming.

(ii) As stated previously, it is in the field of education that gaming has developed the greatest - being used in a wide range of institutions and covering a spectrum from simple 'Monopoly' type games to complex computerised simulations. The most elaborate to date is METRO, developed as a teaching device for urban planners, which includes the 'TOMM' model for distribution of households and firms, a 'Monte Carlo' technique to simulate voter behaviour as well as a computer mapping technique. However, it is in the classroom that gaming simulation has been most widely accepted - using simple hardware, involving large numbers of people and requiring the minimum of computation.

(iii) Gaming simulation is also being used as a method of communication - involving lay people in simple simulations of planning problems. In this area gaming can be used as a teaching device or as a means of public participation. This field is however underdeveloped. In this research an attempt is made to explore the potential of gaming simulation as a vehicle for user participation in design.

(iv) Linked to the above application, gaming simulation is now being used in the field of perception. Although under-developed research is progressing along two lines - perception of the developmental process as well as perception at the urban design level.

(v) Finally, gaming simulation is also used in this research as an alternative approach to public policy formulation and decision making.

1.3. SYSTEMS THEORY AND GAMING SIMULATION

The conceptual basis for gaming simulation is borrowed in a large part from system theory, a field that has been developed only recently and one which permits rigorous analysis of physical systems and their operations. A typical system includes a clear statement od system objectives, an analysis of the objectives stated and the requirements placed on the system in achieving the objectives. Alternative system configurations are then devised which will meet system requirements. All components and subsystems of each alternative system are identified and evaluated for compatibility and effectiveness. A mathematical model is constructed in the case of complex systems by means of which system performance can be simulated, usually with the aid of a computer. Before system development is begun, the alternative systems are compared using the model, and a determination of the best system is made on the basis of a cost-benefit analysis.

When the attempt is made to apply systems approach to social systems, the analyst is faced with many difficult problems. He must at the outset determine the "essential elements of analysis" - those elements which, when quantified, describe the state of the system.

The selection of the essential elements of a social system will be subjective - a matter of choice on the part of the analyst - and many of those selected will probably be difficult to measure. In physical systems the components are tangible and measurable while in social systems there are many components which are neither. Significant results can sometimes be obtained by systems methods when large groups of people are involved as in the case of forecasting results of elections.

Many environmental changes, however, are often greatly influenced by individuals or small groups and in these situations, the system approach is not very satisfactory. The data required in the analysis of social systems tend to be more extensive and varied than those needed in the evaluation of physical systems. Usually a social system includes one or more physical system and these may be treated by systems theory using submodels and quantifiable data. Social systems require other types of data as well, such as values, attitudes, preferences, etc, the significance of which is difficult to express in the mathematical equations of typical systems model.

In the development of a methodology for environmental planning, it seems reasonable to apply systems theory to the physical subsystem which together comprise the physical environment; to resort to economic models which, in comparable situations, have been tested and found to be genuine worth and to leave the social components - especially those which are unmeasurable, intangible and markedly non-linear - to the art of gaming simulation.

Gaming simulation makes use of people playing their real world rules in a simulated environment. It is the task of the researcher to make this abstracted environment as realistic as possible. Gaming simulation can extend the system theory methodology by including intangibles and unmeasurable factors which have a significant effect on planning. It could do this by adding to the computer simulations, the judgement of the players who can subjectively weigh the intangible factors. In a typical game, players include decision makers, planners, investors, environmentalists, etc, from real life. From this dynamic process, since many factors are included, quantifiable or not, there result more reliable predictions of the consequences of strategies followed by the players in gaming simulation.

During the past few years, there has been an upsurge of interest in analysing, improving and teaching decision making techniques by using systems approaches to expand gaming simulation. This combined computer simulation with gaming. Both diplo-military and business gaming are intended to help administrators, politicians, and scientists better understand extremely complex social systems and then develop efficient problem solving strategies and research strategies. It is time to extend this technique to planning problems. Many can profit from gaming and simulation of social systems.

(a) Planners,

(b) The various professionals concerned with health, education, welfare, housing, transport or civil rights in society,

(c) Social scientists concerned with different aspects of society.

The problem of providing management for complex systems is taken up by a number of theorists including Anatol Rapoport (Rapoport and Harvath in Buckley, Reader in General Systems Theory), Alfred N Whitehead and Jay W Forester in Urban Dynamics. The realisation that is now coming forward is than in dealing with a complex and highly interdependent system, basic patterns of logical deduction and prediction do not work. In essence the scientific principle of analysis and breaking complex systems into their component parts appear to have been inadequate as a method of dealing with planning problems in complex systems. These theorists suggest, rather that one must rediscover the principles of generalism and systhesis which are inherent in some non-western and scientific philosophies. One must learn to think of the total system rather than in terms of its interactive parts.

If following the problems of scientific management and system manipulation laid down by 19th century adherents of new age or scientific philosophy, planning has sought to use the tools and philosophies which served the other natural sciences so well. These tools, suggests Whitehead and others, are inappropriate due to their inability to incorporate synthesis and total system viewpoints. A new method of approach and philosophical orientation is needed which combines the synthesis elements of some Eastern philosophy with precision and high specification of Western scientific philosophy. Forester suggests that the one solution to this dilemma and this search for new philosophical standpoint is simulation. The belief here is that gaming simulation is one such technique for making possible the simulation of all major elements of a system simultaneously, thus forcing them to interact in realistic patterns of interdependencies.

Thus it is anticipated that many of the basic elements of planning now found in planning practice, planning administrative procedures will soon begin to disappear. The traditional elements do not suffice to provide the comprehensive framework needed. Rather the answer will probably lie with each city, for example, developing a model of itself. In this fashion and with technique such as gaming simulation, policy makers, will have an opportunity to view the totality of their cities as it develops into a possible future. Not just the land use planning or population composition or business and economic structure but all of these elements operating simultaneously upon each other and producing diverse and often unanticipated results to public policy decisions being made.

1.4. GAMING SIMULATION AS A MODE OF HUMAN COMMUNICATION

1.4.1. Characteristics of Communication

Human interaction takes many forms. Duke (1975) suggests that the various modes of communication can be classified according to several characteristics which can be used in evaluating the utility of any particular mode with respect to the overall purpose of a specific communicative encounter. Table 1 represents a communication continuum of selected modes and suggests the relative value of each in terms of certain message characteristics.

Primitive modes of communication, though adaptive to a wide range of situations, can be used to convey only relatively simple messages. Not only are these primitive modes highly sequential in nature, but a universal meaning must exist for the symbols used and for the conventions governing the use of those symbols.

Advanced modes of communication are capable of conveying more complex messages due to greater meaning associated with the symbols employed and greater

TABLE 1 Classification of Various Modes of Human Communication (Abstracted from Duke, 1974)

	PRIMITIVE		ADVANCED				INTEGRATED	
	INFORMAL	FORMAL	SPOKEN	WRITTEN	TECHNICAL	ARTISTIC	MULTI-MEDIA	FUTURE'S LANGUAGE
EXAMPLES	GRUNTS HAND SIGNALS	SEMAPHORE LIGHTS FLAGS	CONVERSATION LECTURE SEMINAR	TELEGRAM LETTER BOOK	MATHEMATICAL NOTATION MUSICAL NOTATION SCHEMATICS	ACTING ART ROLE PLAYING	FILM TELEVISION	FLOW CHART HIGHWAY MAP ICONIC MODELS ARCHITECTURAL MODELS GAMING/SIMULATION

CHARACTERISTICS

LOW ← ABILITY TO CONVEY GESTALT → HIGH

LOW ← SOPHISTICATION → HIGH

LOW ← ABILITY TO CLOSE PERCEPTUAL GAP → HIGH

HIGH ← UNIVERSALITY OF USE → LOW

HIGH ← SPONTANEITY OF USE → LOW

HIGH ← DEPENDENCE ON SHARED REALITY → LOW potential for efficient feedback through the use of those symbols. While advanced modes of communication are probably the most widely used and accepted forms of human communication in contemporary society, they are limited in their ability to convey gestalt primarily because of their highly sequential nature (e.g. chapters of books have sequential structure as do words in a sentence).

Integrated forms of communication involve the coordinated use of more than one advanced mode and are thus not restricted by the limits of any one mechanism in the conveyance of gestalt. It is in this integration of advanced communication modes which closes the gap between existing reality and the perception of that reality.

Independent of its classification, any mode of communication is composed of three main elements: a language, a pattern of interaction among participants and a communication mechanism or technology.

A language according to Fearing (1953), consists of a set of signs or symbols together with certain conventions governing the use of those symbols. The message character of any language relates to the meaning associated with the symbols and/or the context within which the symbols are used. Once the objectives of a particular communicative session are established, the mode of communication having the language which allows the most effective exchange (message transmission) can be determined. When no existing language is acceptable, new or modified mechanisms may be generated.

Beyond a characteristic language, each mode of communication requires a pattern of interaction among participants which provides a basis for describing the transfer of messages (content of language) resulting from a particular interaction. These communication networks range from highly structured one-way message transfer to complex unstructured multilogue exchanges.

An impressive quantity of communication literature deals with the analysis of group composition and structure suggesting that the product of group interaction is a function of a large number of tangible and intangible variables to the extent that groups have unique and distinguishable characters in and of themselves. Specifically, McGrath (1974) suggests that any group can be characterised in terms of three structural variables: the work structure - role differences in terms of task activities or responsibilities; the power structure - role differences in terms of authority or influence; and communication structure - role differences in terms of communication channels. Of these three variables, the communication structure stands out as the one over which the highest (perhaps the only) degree of control might be realised.

Reports by Bavelas (1950), Levit (1951) and Shane (1954) suggests that any restriction of communication channels within a group will necessarily restrict the character and flow of the resulting message. Further studies indicates that group communication with restricted communication networks are much more vulnerable to sever inhibition by such factors as group member social status (Homans, 1950), attraction among individuals, (Festinger, Schachter and Back, 1950); participants interdependence (Back, 1952) and group size (Hollander, 1964).

The pattern of interaction (communication network) for a particular communication mode depends on the objectives of the communicative activity. With respect to communication for purposes of problem investigation, McGrath (1964) draws the following conclusions.

(i) For simple problems centralised communication networks (communication networks with one very centralised or primary member) produce faster and more accurate problem solving.

(ii) For more complex problems, the effectiveness of centralised networks depends on the leader's ability and utilisation of member skills.

The third element of communication modes, the communication technology, is the mechanism used in the actual message transfer from sender(s) to receiver(s). Normally, factors such as cost, convenience, availability, and reliability dictate the mechanism that will support any particular communication mode. Duke (1974) points out, however, that as the complexity of the communication activity increases, the complexity of the transfer mechanism may increase as well and more sophisticated mechanism configurations may be required.

A great deal of literature supports the claim that traditional modes of communication are not adequate for dealing with contemporary social problems which are both immediate and complex. Rhyne, (1975) argues that decisions are gestalt events and not logically determinable processes. Thus, communication modes which act to piece together discrete units of information will not be of great value in dealing with complex issues characterised by poorly understood and complicated inter-relationships. He calls for new modes of understanding capable of presenting decision makers at all levels with holistic appreciations of complex systems. Greenblat (1975) and Duke (1975) suggest that a systematic approach to the analysis of complex problems dictates that a framework for system appreciation must necessarily precede the analysis of detail. Without an appreciation for the whole system under investigation, the analysis of detail toward some problem solution has no direction. Research by Mar (1975) points out that the failure of existing communication modes in dealing with the complexity results, in part, from the segregation of academic disciplines. Similarly, Raser (1969) implies that knowledge is thus encoded in a variety of specialised languages and therefore can be neither communicated nor used effectively toward problem resolution. The predicament is complicated further by reports of exponentially increasing amounts of information and the implication that continued application of traditional modes of communication in dealing with new information will magnify the difficulty in making decisions of all kinds (see, for example, Duke 1974, Rhyne 1975, Raser 1969).

1.4.2. Communication Characteristics of Gaming Simulation

The potential for gaming simulation as a mode of communication allowing a gestalt exchange of ideas and information in the analysis of complex problems has been discussed by Greenblat (1975), Rhyne (1975), Raser (1969), Becker (1972), House (1972), Coleman (1966), and others. Most notable, Duke (1975) discusses the communication characteristics of gaming simulation and points out the utility of this mode as a "future language" capable of supporting the analysis of complex reality at any desired level.

Inherently, the existence of games is prompted by their unique ability to convey gestalt. Though several classical gaming techniques have been developed specifically designed to meet the needs of individual gaming exercises, it is through actual play that gestalt appreciation of some complex systems is realised.

One of the central characteristics of any game is a game-specific language; the set of signs and symbols used in the communication process together with the conventions governing their use. The game-specific language, though usually designed into the game proper, may in part be acquired inadvertently by participants during the course of play. It must be complete enough to enhance the exchange of ideas and information toward a gestalt understanding of the system under study and, at the same time, simple enough to be incorporated into use by participants. Whereas games become individual languages in and of themselves, few conventions are universally accepted throughout the field of gaming except for those employed by supportive communication modes, (Duke, 1974). Games can thus be designed for audiences with extremely diverse backgrounds as well as for groups with very narrow ranges of interest employing a specific disciplinary jargon.

The failure of a particular game to convey gestalt often results from the application of that game outside its intended context of use. Games are designed to m meet the needs of a particular user and, as such, are highly problem-specific.

The problem-specific nature of games, and the time required for design and construction, preclude the spontaneity of game development. Once the game is completed, however, the case or relative freedom of use is a function of the ability of the participants to learn the new and highly specialised language of the game. Well designed games used in the proper context are spontaneous by nature and, after overcoming initial frustration, participants often become totally involved in the mechanism.

Participants in gaming encounter (players) are engaged in different roles assuming different perceptions of the complex reality which the game has been designed to model. Since they are simultaneously involved in the play of the game, the resulting interaction (message interchange pattern) contains many simultaneous dialogues (multilogue), all pertaining to the complex issue.

The game represents a logical (though often highly abstract) model of a complex domain. The message character of the gaming session results from the interactive pulsing of information and/or circumstances into the game upon which players focus their attention for the purpose of problem investigation. Pulses of information may be specified by the game designer or by the players themselves or they may be induced by the circumstances developed during play. Regardless of their nature, pulses are organisational devices which stimulate player interaction focussed on some shared aspect of reality.

1.5. THEORETICAL FOUNDATION FOR SIMULATION AS A SOCIAL LEARNING ENVIRONMENT

What appears to be needed for research derived from this conception is the theoretical explanation of the components of social learning. Such statements appears below in four parts:

(a) The behaviour of living organism is oriented to the attainment of ends in situations, by means of the normatively regulated expenditure of energy. There are four points to be noted in this conceptualisation of behaviour -

(i) behaviour is oriented to the attainment of ends or goals or other anticipated states of affairs, (ii) it takes place in situations, (iii) it is normatively regulated, (iv) it involves expenditure of energy or effort in motivation (which may be more or less organised independently of its involvement in action).

(b) The four basic components of social action, then are (i) the generalised ends or values, which provide the broadest guide to purposive social behaviour, (ii) the regulatory rules governing the pursuit of these goals, rules which are to be found in norms, (iii) the mobilisation of individual energy to achieve the defined ends within the normative framework - how motivated individuals are organised into roles and organisation, (iv) the available situational facilities which the actor utilises as means, - these include knowledge of the environment, predictability of consequences of action, and skills.

(c) <u>Assumption One</u>: Man lives in a symbolic environment as well as a physical environment and can be stimulated to act by symbols as well as physical stimuli.

<u>Assumption Two</u>: Through symbols, man has the capacity to stimulate others in ways other than those which he is stimulated.

<u>Assumption Three</u>: Through communication of symbols, man can learn huge number of meanings and values - and hence ways of acting from other men.

<u>Assumption Four</u>: The symbols - and the meanings and the values to which they refer - do not occur only in isolated bits, but often

in clusters, sometimes large and complex. The term role is used to refer to a cluster of related meanings and values that guide and direct an individual's behaviour in a given social setting, including the relationship between all the individual roles that are an expected part of it.

General proposition one: through learning of a culture, men are able to predict each other's behaviour most of the time and gauge their own behaviour to the predicted behaviour of others. General proposition two: the individual defines (has a meaning) himself as well as other objects, actions and characteristics. General proposition three: thinking is the process by which possible symbolic solutions and other courses of action are examined, assessed for their relative advantages in terms of the values of the individual, and one of them chosen for action.

(d) A social learning environment (simulation) capsulises the above processes to make them fit for instruction in social studies and a suitable replacement for other methodologies and structures.

1.5.2. Learning Through Gaming Simulation

In a recent article, Moore and Anderson (1969) stated four underlying principles for the design of good educational environments.

(i) Perspective principles - A given environment is more productive if it permits and facilitates the taking of more perspectives towards the problem than another environment.

(ii) Autotelic principle - The environment must be safe for experimentation of even the most outrageous or improbable sort without high personal risk.

(iii) Productive principle - This implies the ability of the learner to deduce or make probable inference within the context of the educational environment. This requires an environment which is logically and coherently structured permitting the learner to make leaps of faith to some other perspective or level of thought.

(iv) Personalisation principle - That environment is most productive which permits the greatest responsiveness to the learner's activities; it is an environment that encourages the learner first to find a question and then find an answer.

Most existing games appear to have been constructed with the concept of an "environment for learning" as an underlying rationale. The rigidity of the early models and applications has given way to more flexible, more transient vehicles. Examination of a broad range of models suggests that they do apply the four principles suggested by Moore and Anderson, whether through intuition or deliberate design.

The "environment for learning" concept can be stated differently. The learner is more receptive to information if it is in response to a felt need and if it is presented in a context understood or perceived by the learner. The fragmentation of knowledge, which is best illustrated by the broad array of individual courses offered by learning institutions is a fairly recent phenomenon. The formidable increase in knowledge has necessitated this fragmentation, but man as a learner stems from a heritage where knowledge was a piece and new information was incrementally accrued in a real world context. In simpler times, man had a totality of perspective that was part of the fabric of life. As he advanced through life, he encountered in more or less interactive fashion, the same pattern supplemented by modification and change, brought by the course of time.

Great-grandfather knew the entire process for building his house; what materials to use and how to put them together. But his great-grandson would hardly think of starting to build a house without a blueprint. A blueprint, mental or physical, serves several functions. It stores all the information for building the house until it is needed. It can be used as a common set of reference points when great-grandson wants to discuss matters with a contractor. And it organises a myriad of details into a compact consistent whole so the information can be seen simultaneously; the relationships between bits of data are clear, and the information can be easily retrieved.

In gaming simulation, the "Concept Map" serves as a mental blueprint to help convey complex systems. The "concept map" classifies, sorts, and stores information, provides a heuristic language to be used as a common symbol structure for discussing a given complex system. Data conveyed through a conceptual map ceases to be mere bits of information; rather it becomes heuristic wisdom. However, a conceptual map is not assimilated as static structure or by static means; it is built up iteratively over time.

Learning or comprehension can be viewed as a circular process, or more properly, a spiral. Each concentric movement of 360° represents the acquisition of knowledge about a new topic, characterised by completeness at a given level of detail; the distance between the spiral rings represents elapsed time. The completion of a spiral ring implies a certain integrity or perspective to the knowledge acquired. It provides the context (reference point) for the next ring. To the extent that the gestalt is incomplete, comprehension and retention of further detail will be inhibited. The relevance of this spiral to a discussion about complex systems is two-fold, (i) it points out the necessity for establishing context before learning can take place, and (ii) it describes a learning process which synthesises increasing detail into over views or iterative gestalts.

Gaming simulation can be viewed as fitting this spiral concept since games proceed by permitting players to build up a more complete conceptual map during successive rounds of play.. The minor cycle takes the players through one entire iteration of the game environment. The major sequence starts with a series of cycles which introduce the player to the context of the game itself; followed by a second group of circles in which the player is encouraged to learn new material through the experience of several further interactions; followed by the final stage in which a critique is used to draw together the experiences which have been encountered in some deliberate and organised way. Players go through basically three stages of perception of the game environment.

(i) Initially, the player is put off by the complexity and by the array of information being presented.

(ii) The player enters into a stage where he is in control of, or at least at ease with, the environment, and during this time will explore with ingenuity a variety of options that come to mind within the context of the game.

(iii) The player develops a sophistication which exceeds the limit of the game and withdraws voluntarily from further participation.

These observations explain the notion of a learning spiral. The early iterations establish a basis of understanding or gestalt which serves as a reference in the subsequent cycles. As play continues and more complexity is introduced, the player asks questions and finds answers within the context of the game. As learning progresses the player recognises that the game as an abstraction can only mimic the world or reality being modelled, and turns his attention to the actual reality. At this point a critique is particularly effective because the participants of the game share a "language" derived from the game event, and this can be useful to them in exploring reality.

1.6. GAMING SIMULATION AS A TOOL FOR PARTICIPATION IN PLANNING

Participation can mean having a piece of something in common with others - sharing the cake; or doing something in common with others - playing a game of football. In the first sense participation must imply sharing the plan as product, in all likelihood the artefact or arrangement which the plan posits.
In the second sense it implies lending a hand in the process, being one of a planning team. There is also a third, and more fundamental, meaning of participation. It can denote being a part, rather than having or doing a part. In this sense participating means partaking of the essential nature of something. It

is assumed here that the subject of participation is a person, rather than machine, an organisation, or an idea; and that an opposition is implied between laymen and specialists called planners, designers, etc.

Public participation in the planning process has become an accepted political tenet, but in the sphere of professional planning there is a measure of scepticism concerning both its potential value and the extent to which it can be realised. Basically, this scepticism derives from an appreciation of the complexity of the problems planning faces, and a feeling that as a consequence the non-professional's contribution may be only peripheral. To reduce, if not remove, this scepticism some means is required to reproduce the complexity of the situation in terms comprehensible to the layman and to provide a forum in which the interests of the public and the professional may be represented. In this area the use of gaming simulation may help both in encouraging participation and making it a worthwhile exercise of value to the planners and the public alike.

Before any discussion on the use of games as a means of participation, a comparison of some of the more, and some of the less conventional techniques of participation, which may be used in urban and regional planning will not be out of place. The results of various studies seems to indicate that no one technique is adequate and that a combination of several is usually required. A recent review by Vindasius (1974) shows that each technique has advantages and disadvantages (Figure 2). The techniques presently in use includes the following:

(i) Informal local contact

(ii) Mass media

(iii) Publication

(iv) Surveys, questionnaires

(v) Workshops

(vi) Advisory committees

(vii) Public hearings

(viii) Public meetings

(ix) Public inquiry

(x) The Delphi method

(xi) Special task forces

(xii) Gaming simulation

While these might be ordered in several different ways as listed here they seem to indicate a gradual increase in commitment of time of those involved, and increasing possibilities for interaction between planners and the public, and hence increasing opportunities for mutual education as to perspectives. Gaming simulation although low in scope appear to be high in specificity, and degree of two way communication.

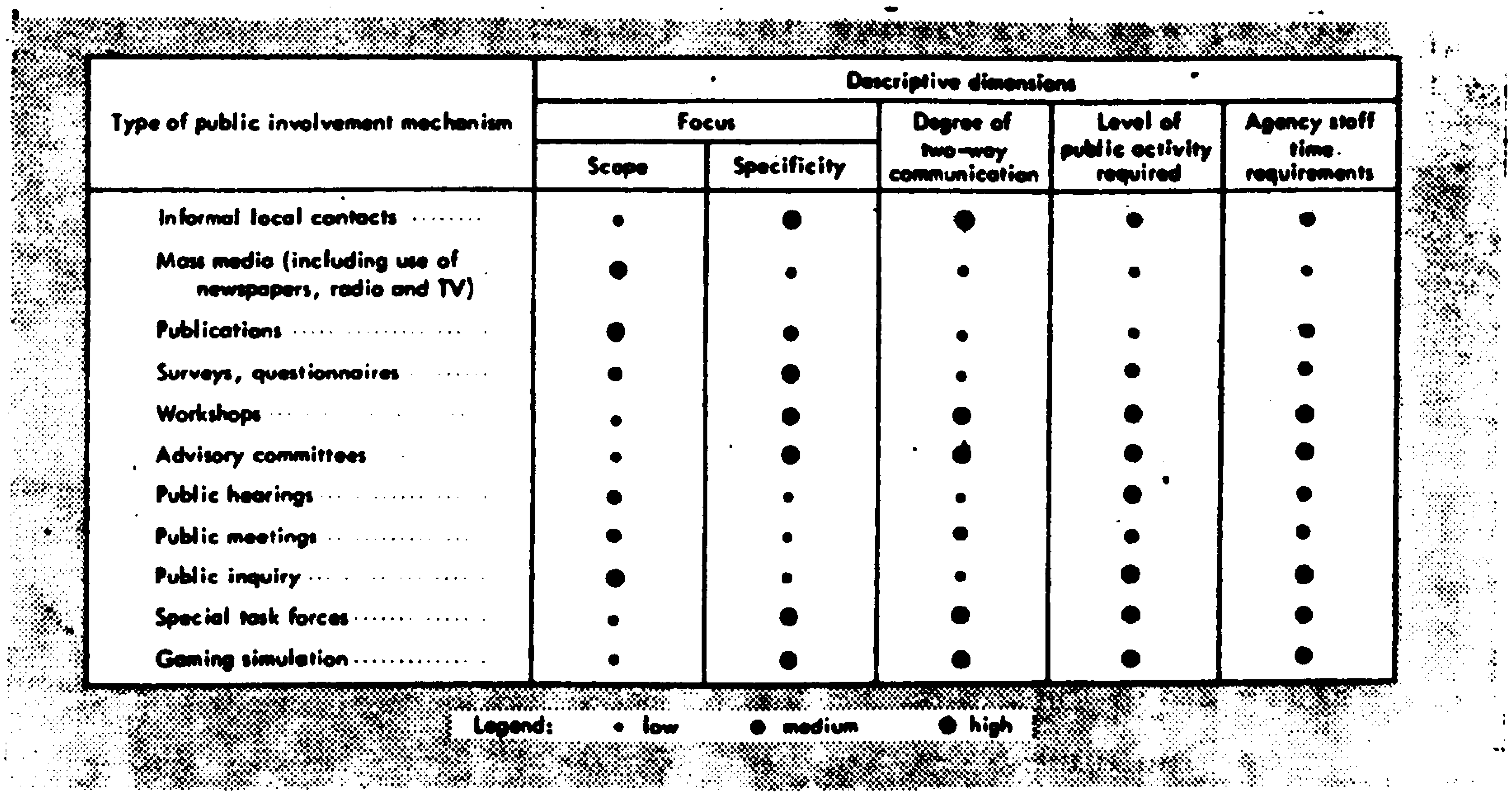


Figure 2 Descriptive dimensions of public involvement mechanisms

Secondly, in a report on public participation in water resources planning, Glasser et al (1975) evaluated some participatory techniques which are often used. As Table 2 illustrates, the various techniques were evaluated on the basis of their communication characteristics and their capability to deal with six resource, education and public participation objectives. The categories chosen and the ratings given are subjective, based on the collective experience of the three authors. The ratings are based on a simple set of numbers (1, 2 and 3) representing low, satisfactory and high degree of achievements, respectively. For example, a rating of '2' for 'degree of user sophistication' for public hearings means that the audience requires a satisfactory level of technical knowledge in order to participate effectively at the hearing. A zero means 'none' or not at all. A blank means not applicable.

The categories used by the authors are further defined (with comment) as follows: (i) 'Degree of public contact achieved' refers to the number of persons that the technique can reach; for example, a few people or a vast audience, (ii) the degree of impact on decision makers' assumes the ultimate decision makers are not present. It does not evaluate whether the decision makers are required to accept the public's input, but only the effect it may have on them: Very Little ('1') or Significant ('3'). Thus Arnstein's criterion for true public participation is not addressed, (iii) degree of user sophistication refers to the level of technical knowledge required by the audience. A '3' is given if the audience does not need to be literate, (iv) ease of use and preparation refers to the skill needed by agency personnel to implement the technique in public involvement programmes. Glasser et al have rated 'little skill needed' as '1'

TABLE 2

Communication Characteristics							Objectives of Education and Participation Techniques					
Degree of public contact achieved	Degree of impact on decision makers	Degree of user sophistication	Ease of use and preparation	Ability to respond to varied interests	Degree of two-way communication	Techniques for communicating and involving the people	Inform/educate	Identify problems and values	Get ideas/solve problems	Feedback	Resolved conflict/ research consensus	Implement solution
						A - LARGE GROUP MEETINGS						
2	1	2	2	0	0	1 Public Hearings	1	2		1		
2	1	2	2	0	1	2 Public Meetings	1	2		1		
						B - SMALL GROUP MEETINGS						
1	2	1	2	3	3	3 Advisory Body	3	3	2	3	2	2
1	3	1	2	3	3	4 Task Force		3	3	2	2	3
1	1	1	2	3	3	5 Workshops	2	3	3	2	2	
2	3	2	3	3	2	6 Delphi Exercises	1	2	3	3	3	
1	1	2	3	3	3	7 Gaming Simulation	3	3	3	3	3	
						C - MEDIA						
2	1	2	2	1	1	8 Information pamphlets, brochures	1	1				
2	1	3	3	1	1	9 Slide and film presentations	2					
2	1	3	2	2	2	10 Tape recorded information network	2	3	2	3		
3	1	3	1	2		11 Radio Talk Shows	2	2		2		
3	1	2	2	1	1	12 Press release and newsletters	1	1		1		
1	1	1	1	2	2	PUBLIC INQUIRIES	1	3		1		
2	2	2	3	2	1	QUESTIONNAIRE SURVEY	2	3		3	2	3

and 'special training required' as '3', (v) ability to respond to varied interests refers to the degree to which the technique can deal with varying points of view. If it can respond to only a few needs, a '1' is given, if many needs, a '3'. (vi) 'degree of two-way communication' refers to the possibility for dialogue between the planner and the public.

The objectives of resource education and public participation (second major category) are not explained by the authors, and seem to be quite straightforward.

From Table 2 it can be seen that gaming simulation is rated very high. Three of the six communication characteristics and five of the education and participation objectives have been given '3'.

A detailed understanding of the theory behind my approach to operational gaming and the problems of game construction is not essential for an appreciation of its application. It is here sufficient to state the essential requirements and characteristics of the game situation. These are (a) identification of the groups of people involved in the situation, e.g. industry, commerce, residents, politicians, local authority departments, etc; (b) the creation of a scenario or situation - as close as possible to the real life situation - in which the interest groups can pursue their interests and interact with other groups. Rules and procedures must be devised, together with means of recording the process of play and ensuring feedback of the implications of event (experiments III and VI).

In their applications gaming simulation can be used in two ways to aid public participation; first, by representatives of interested groups playing their own roles in the game situation; and by people playing roles other than those in which their real life interests are identified. In both cases gaming simulation may increase understanding of the planning problem, the first step in ensuring that participation is soundly based. Both ways will be tried in this study.

Certain general points can be made about the learning that takes place during gaming simulations, which are applicable to the issue of public participation. The complexity of the planning process and the magnitude of the decisions needing to be taken can be appreciated readily by the players. There are basically two reasons: the game situation can be structured so as to provide the closest approximation to an overall view of the 'total' situation that can be devised and in addition, by telescoping time so that play covers the equivalent of a number of years, it is possible to appreciate the dynamic nature of the situation.

More specifically, the simulation situation can provide an opportunity for people to learn something of the relationship of their own real life role to the total process: the planner can learn something of the impact of his actions on businessmen; the businessman may come to appreciate the consequences of his decisions for residents in an area. Equally important, participants can learn of likely reactions of other groups to decisions which they have taken.

In the game situation the process of understanding one's real-life role in relation to other peoples, and learning something of how other people view the situation, involves questioning of assumptions and exposure of value judgements that is not normally possible by other means. Given this learning process - or gaining "insight" - it becomes possible to lay a foundation of common understanding on the basis of which subsequent discussions are more pertinent to the problems to be faced. It is in this context that gaming simulation is applied in this research as a practical vehicle for participation.

1.7. GAMING SIMULATION FOR THE RESOLUTION OF CONFLICTS IN PLANNING POLICY

Individuals as well as societies live in permanent conflict with nature, with human beings and with themselves. Conflicts represent a particularly critical kind of problem, which cannot always be resolved simply with money, technology or power. In handling conflicts what is most needed is a careful study of the situation as it appears from various aspects and at various points in time and space. It is this polyvalent approach which is often lacking in planning whether it be concerned with spatial, economic or social problems. What is needed for research derived from this conception is the theoretical explanation of the components of conflicts in planning.

1.7.1. Conflict Between Man and Nature

One of the most striking forms of conflict is that between Man and Nature. In order to live man must continually appropriate, destroy and consume some of the substance of the natural world. At the same time, however, he must bear in mind that a sufficiently large proportion of Nature's resources must be left undisturbed to allow those which he has appropriated, destroyed and consumed to be endlessly regenerated.

		N	
		N1 Growth	N2 No Growth
M	M1 Growth	+10	-10
	M2 No Growth	0	0

Figure 3(a)

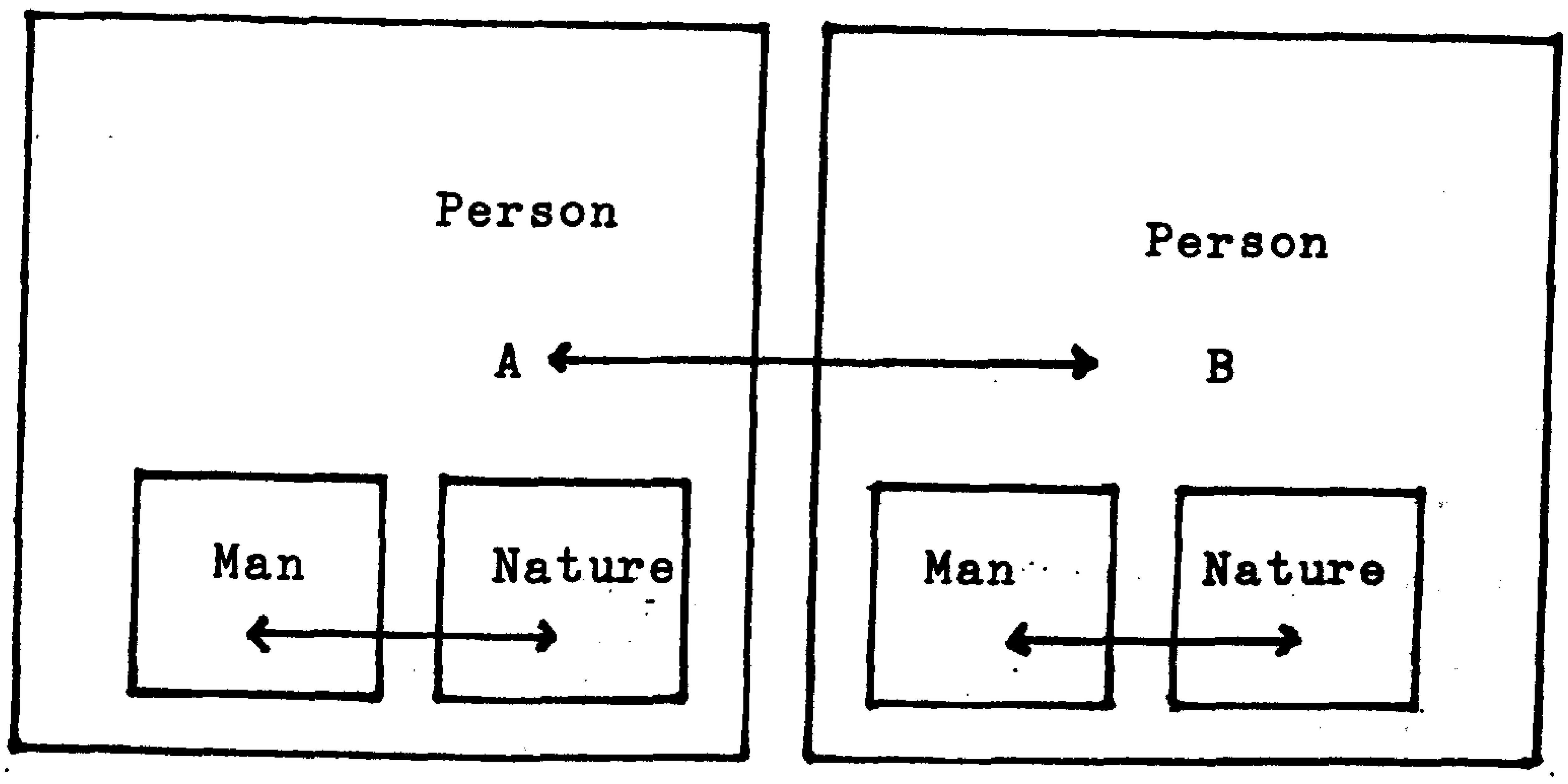


Figure 3(b)

Since John Van Neumann developed the game theory, such conflicts as man's contest against nature can be expressed mathematically. To take a highly simplified example, let us assume that it is possible for man M to allow population growth (strategy M1). Nature, on the other hand, may achieve growth in output of food supplies (strategy N1) or may not do so (strategy N2). (See Figure 3(a)).

For man the best combination would be $M1/N_1$, in which the population grows and nature delivers the corresponding output. One can give this possibility a value of +10. To the possibility of population growth without a corresponding growth in food supplies $M_1/N2$, we assign a value of -10. If there is no growth in M, we can say that it makes no difference to man whether nature grows or not. Both eventualities give 0 as the result for M.

If we know the degree of probability of Nature's growth (N1) or non growth (N2), we know with what degree of risk we can choose strategy M1. If we do not know the probability, then according to the rules of game theory, we choose strategy M2, by which we can lose nothing even though we cannot win anything either.

1.7.2. Conflicts Between Human Beings

The previous example was over-simplified. It is known that the problem under consideration is not a simple one of conflict between mankind as a whole and Nature as a whole. The natural world is made up of many regions, in which totally different circumstances can prevail, and mankind is composed of many different groups. In general, one region belongs to each group and vice versa.

In each of these units the conflict between Man and Nature takes place exactly as described above. So far this is purely a question of the same phenomenon being reproduced throughout the world. If, however, one considers the units composed of regions and the groups living in them as 'persons' within the meaning of game theory, one gets a new array of persons who are in opposition to one another.

If one assumes that two of these persons (they can be, for example, two nations) enter into some kind of competitive situation or relationship with one another, we have what game theory calls a two person game. Such a game can be either a zero-sum game or non-zero sum game. (See Figure 3(b)).

1.7.3. The Zero-Sum Game

Consider a game between a planner, who is to build a new suburb containing some flats and some houses, but has no way of finding out the preferences of the people who are going to live in it; and one of the future citizens, who wants to put his name down for a dwelling giving flats and houses priorities which will partly express his own wishes, and also make sure that he is successful in getting something. The planner can draw up a pay-off table on the basis of what he would 'win' if he built either all flats or all houses, and if the citizens wanted either all flats or all houses.

Planners Pay-Off Table

		Planners Gain If He Built	
		All Flats	All Houses
Citizens Want	All flats	+30	-15
	All houses	-10	+ 5

Let us suppose that the flats are cheaper to build or in some other way more desirable from the planner's point of view. If he built all flats and the citizens wanted all flats, he would stand to win, say 30, but if he built all flats, and the citizens wanted all houses, this might really have to be regarded as a loss of -10. On the other hand, if he built all houses and the citizens wanted all flats, he might lose even more, since the houses are more expensive to build; so let's say his loss is -15 if he builds all houses and the citizens want all houses - he wins again, but not as much as he did in the situation when both sides go for flats, since houses are more expensive, we rate his win therefore at +5.

The simplest way he can find out how to play safe is to make a graph, showing the results to him of the possible choices of the citizen. In Figure 4, if the citizen wants flats, the planner either gains 30 if he builds flats or loses 15 if he builds only houses. If he does a mixture of the two his gain will lie at the corresponding point on the line connecting these two points on the graph. Similarly, if the citizen opts for houses the planner's gain will lie somewhere on line 2. If the planner has no way of finding out before-hand which choice the citizen is going to make, his safest bet is to build the mix of flats and houses indicated by the point where these two lines cross; that is to say 2/3 houses and 1/3 flats.

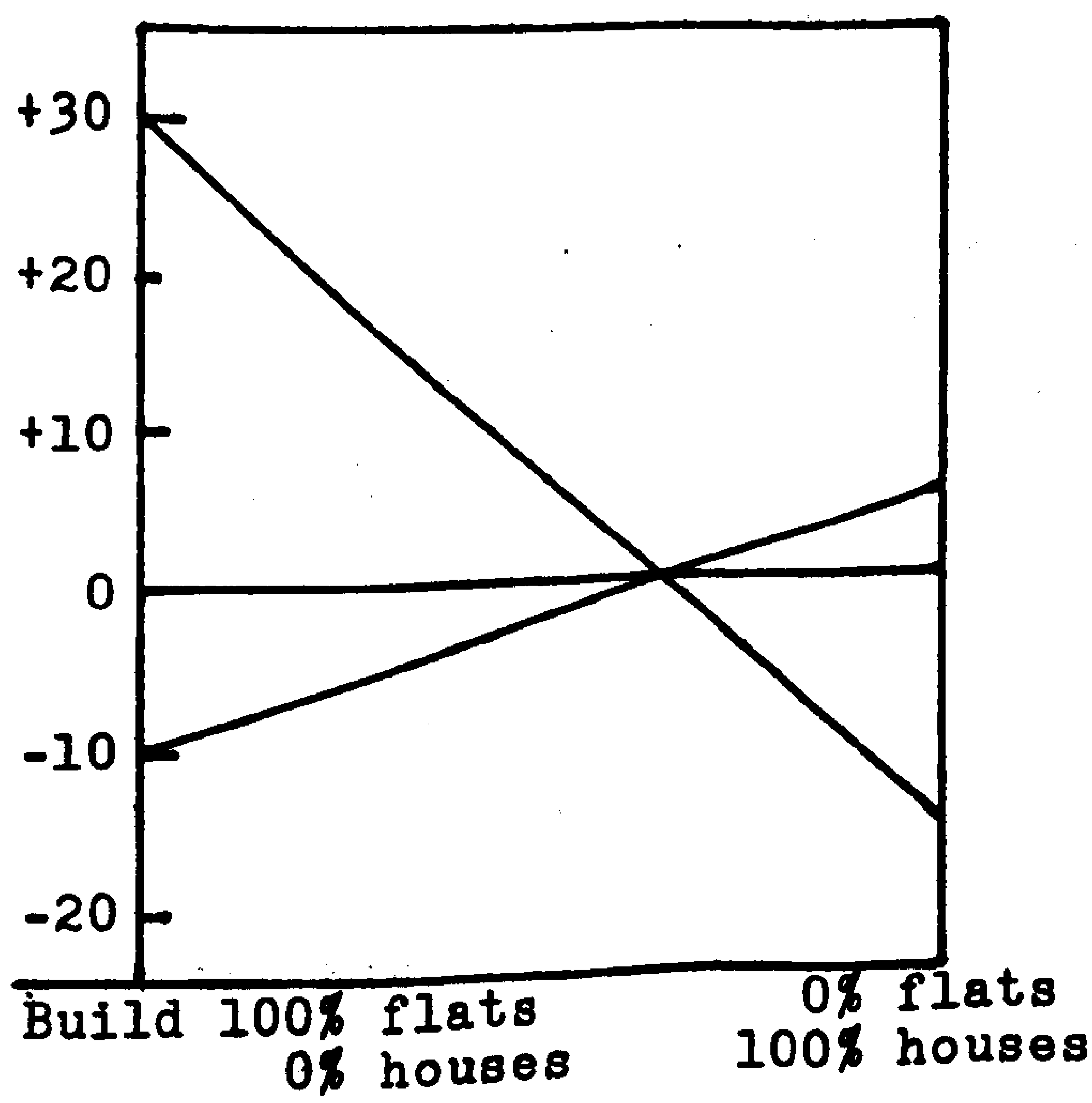


Figure 4.

What happens if we turn round and look at the situation from the citizen's point of view? When he tries to draw up his pay-off table he will take account not only of his own wishes, but also of the knowledge that flats are likely to be somewhat cheaper. Let us suppose in fact that this citizen prefers a flat anyway and, considering its cheapness, prefers it very much. Indeed to make things sinple, let us assume that he draws up a pay-off table of exactly the same values as the planner's pay-off table.

Citizen Pay-Off Table

		Planner Builds	
		All Flats	All Houses
	All Flats	+30	-15
	All Houses	-10	+ 5

But then to discover his optimum strategy, that is to say the safest priorities to give to houses and flats when he puts in his application, he has to draw a different diagram (Figure 5). He has to consider what would be the gains to him according to the various moves the planner might make. Again to play safe he should express a priority for flats of the degree corresponding to the place where the two lines cross. This turns out to be giving flats a rating of 3 and houses a rating of 1 (i.e. 75 percent for flats and 25 percent for houses).

The figures in this example have been chosen so that if both sides play safe neither side gains anything or loses anything. However, the whole business of drawing up play-off matrices of this kind, and then searching for the Minimax, or safest strategy, is all obviously artificial in relation to situations in real

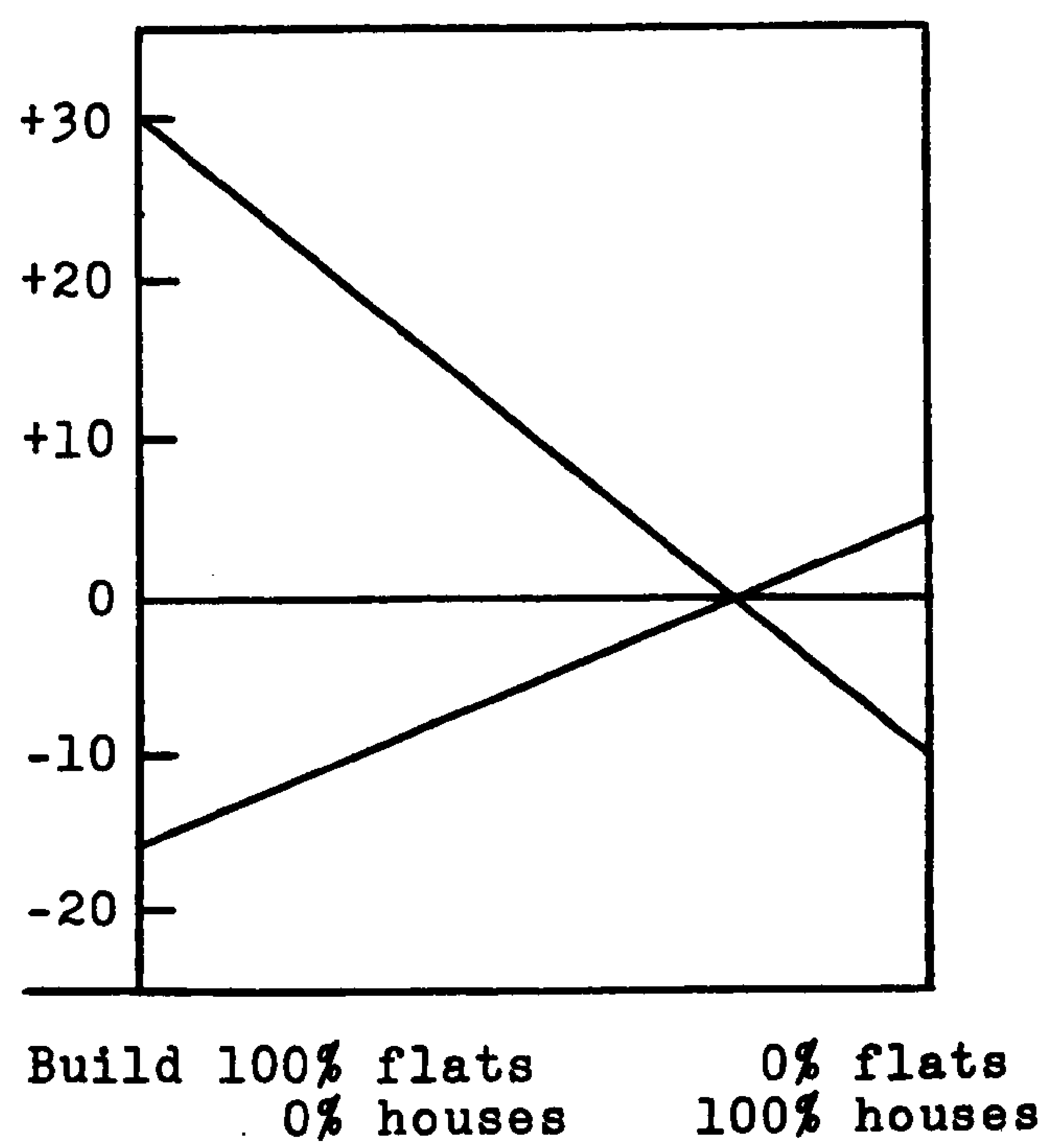


Figure 5

life. For instance, it leaves out the whole business of bluffing and all the other professional skills of real-games players.

1.7.4. The Non Zero-Sum Game

Let us look at an example, taken from the field of international tourism. We assume that A is a highly industrialised country with a strong currency, whose inhabitants are fond of relaxing in country B, an ideal holiday country with a weak currency. We further assume that A has only two possibilities to consider; either that its inhabitants will take their vacations in B (A1) or that they will not take their vacation there (A2). As far as B is concerned, it can either insist on the use of strong foreign currency only (B1) or impose no restrictions (B2).

	B1 Restriction	B2 No Restriction
A1 Vacation	+ 3 + 1	+ 1 + 2
A2 No Vacation	-10 - 1	-20 - 1

Figure 6

Let the values of the possible results for the two players be as in Figure 6. When tourists of A go to B, the combination A1/B1 is less desirable for A (+1) than A1/B2, where B refrains from imposing restrictions (+2); when the tourists of A do not go to B, A get a result of -1, whether B imposes restrictions or not.

From B's point of view, the best situation is A1/B1, where the tourists of A come on holiday and bring their valuable currency with them (+3). The situation A1/B2 where the tourists of A pay in weak economy, is still worth say, +1 to B. If no tourists at all come from A, B loses a great deal; this loss can be rated at, say, -10, as long as B can still demand foreign currency from other tourists (situation A2/B1) but at -20, if B cannot envisage even that possibility.

In accordance with the values of game theory, A now chooses strategy A1, because here the lowest possible result (+1) is better than the lowest result under strategy A2 (-1). B, on the other hand chooses B1, because it is still better to risk getting -10 than -20.

The solution, therefore, is that the tourists of A take their vacation in B and spend their own strong currency. The gain to A is +1; the gain to B is +3. B appears to gain more than A.

But this is not the end of the game. The following year, A has perhaps discovered that it has the power to force B to agree to a totally different solution. A can force B to allow A's nationals to take their vacation in B, without having any currency restrictions whatsoever. How does this come about?

Quite simply, A threatens to play strategy A2, accepting a loss of -1 for itself, in which case, B would suffer a loss of -10. This may not ruin B's economy in just one season, but if A continues to play strategy A2 in the following years, B will lose too much in the end, and will not fail to come to the conference table to sign an agreement allowing A's tourists to take their vacations in B without having to worry about any restrictions at all. Now, therefore, A gains +2 and B +1. Thus, the strategy that appears to be right, in the short term for B (B1) is not the same as the strategy that can be imposed by A in the long term (B2).

1.7.5. The 'N' Person Game

In reality, however, the assumption that one has made up to now - that only two persons are playing - is only very rarely true. Most often we have to deal with three person games, four person games or in general term 'n' person games.

As soon as more than two persons take part, a new element enters into the game: that of conditions between two or more parties. For this reason, a complex n-person game can often be reduced to a two person game. This is possible, however, only for a given point in time, because whenever a new situation arises, other conditions offering better advantages can always be formed. Hence the formation of conditions does not necessarily make a game simpler.

1.7.6. Conflict Within Man Himself

So far, one has always presupposed that all the objectives of all participants have been defined and known in advance. We assumed that we knew what value each possible result had for each of the competitors. So much so, indeed, that, although we talked of a 'game' no real players were in fact needed in order to solve the problem set. With the assumption we have made up to now, the conflicts could be presented and solved by purely mathematical means.

Now, however, we must do without these preliminary assumptions. In reality of course, we do not have direct knowledge of the competitor's values and objectives which are needed to solve the conflict. Nor can we continue to use mathematical method in order to discover them. From now on we need to experiment with living persons.

The difficulties we encounter in this area stem from two phenomena: (a) the values and objectives of human beings are unclear, (b) the values and objectives of human beings are changeable.

1.7.7. Unclear Values

Up to now, we have only considered conflicts that occur between one person and Nature, or between different persons. As soon as we seek to identify the values and objectives we need in order to work out the problems set by our games, we come up against yet another kind of conflict, namely conflicts which take place within one and the same person. The 'person' can be a human being, a social group or a nation.

In forming his conception of the value a particular situation holds for him, every person draws on at least two sources; it is here that cause of conflict lies. One source is personal experience. The other source is the person's confidence in the greater experience of higher authorities. If the two concord, which seldom happens, there is no difficulty. But if one experience does not coincide with the other, a clear objective is possible only if one of the experiences is so much stronger that it is capable of over-riding the other.

What most frequently happens, however, is that this inner conflict ends in a compromise, which is so vague that it is impossible to make use of the values in question for any planning purposes. Such is the outcome of many investigations undertaken with a view to ascertaining the values and objectives of a population. Our only real chance of carrying out an analysis will be found if we succeed in simulating these inner conflicts, as well as the inter-person conflicts already described, so as to observe them.

1.7.8. Changeable Values

The second phenomenon that complicates matters is the changeability of values and objectives. Let us take as a purely theoretical example the case of two peoples living in the same region. The characteristic of the region which is relevant to our purpose is its colour. The region is white.

Let us further suppose that neither group is happy in its white environment. Group A would prefer it to be yellow, while Group B would rather it were blue. So far, both objectives are clear and well defined. Now if both parties are determined that the environment shall not remain white, they both dismiss the idea of a 'no-action' strategy as a matter of course and begin to paint the environment in their desired colour. Group A paints it yellow, and Group B paints it blue.

The result of this is a green environment. It is not yellow as A wanted, nor is it blue, as B wanted, nor is it while, as it was formerly.

The situation is a new one. How do the parties evaluate this new situation? They have not previously considered such a possibility at all, and must therefore begin to ask themselves all over again: "Will we be happy in the green environment? If not, what alternative image do we have to the ideal environment?".

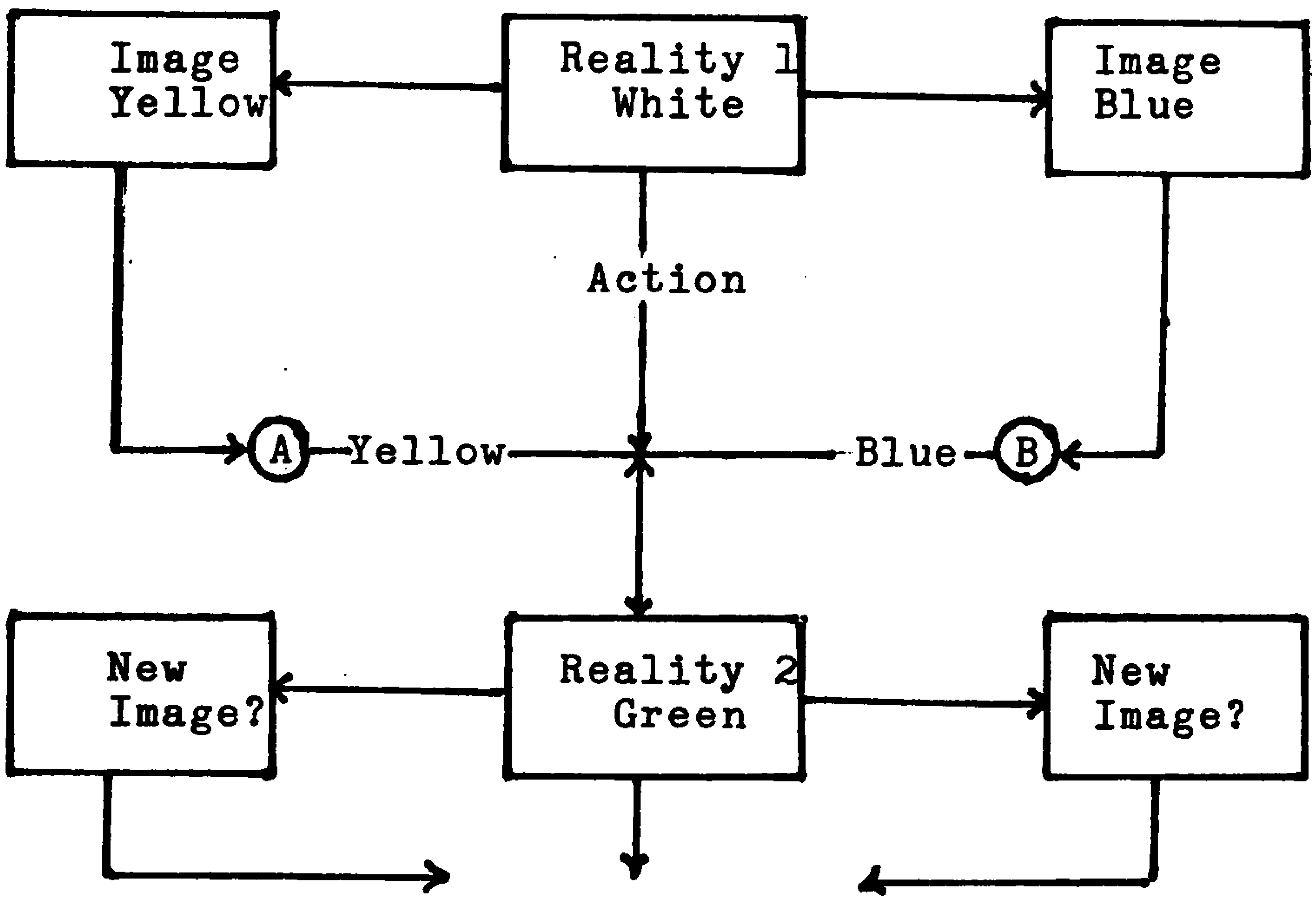


Figure 7.

Thereupon a situation can arise where A no longer wants the yellow environment to be the ideal, and B no longer wants the blue one. It may very well happen that both will formulate new objectives, these having occurred to them only after their experience of what happened to their yellow and blue images.

Thus, new values become established when unforseen situations arise. We cannot always be sure, therefore, that the same set of values will hold good in the games. (See Figure 7)

1.7.9. The Rationale For Gaming Simulation

Both phenomena - the vagueness and the changeability of values and objectives - have the same cause: this is the fact that man is capable of judging only those situations in which he actually finds himself or which he has already experienced in the past.

The difficulty is that in every planning process, no matter what kind of problem area, one is dealing with the future, and therefore with hypothetical situations, of which no one can have certain knowledge. Widespread uncertainty and conflicts about the very nature and future of planning decisions is now well established as a legitimate interest of the planning profession. Planning is by nature a forward looking endeavour. It reviews future possibilities in advance of their occurrance so as to increase the likelihood of achieving the particular possibilities which are desired. However, within this simple objective lie several imponderables; how do we measure facts that exist only in the future - and how do we assess these measures? How do we (planners) identify desired objectives - and how do we reconcile differences amongst them? And how do we anticipate the future anyway - how do we express our perceptions of the changing present?

The only thing planners can do is to stimulate future developments by means of a model, part of which represents the environment (region) in question, while the other part represents the living persons who are concerned with the development of that region, whether as decision-making authorities, entrepreneurs or residents.

We then let the representatives of the real decision-makers behave within the model as they would in real life, without giving them any indications as to what they should do, what they should desire or how they should evaluate the situations arising in the simulation exercise.

These persons are now compelled to use their own initiative to discover possible ways in which the merits of the various results of the simulation exercise can be measured and judged. They are then bound to behave as necessary for the achievement of the aims they themselves have formulated. At this point what we have already described may occur. The players come into conflict with Nature. They come into conflict with representatives of other interests. They form coalitions in order to be in a better position to attain their objectives. They formulate strategies, etc. It may also happen, however, that they find themselves in situations in which their inner conflict comes to the fore, when they do not know whether they should promote personal objectives or superior ones. It is a further possibility that a new situation will arise, which they have not yet met in real life and which compel them to devise new scales of values and develop new objectives designed to cope with the new situations.

What interests the scientist is how the decision-makers in the game do this, when they do it and why they do it. He will therefore record everything that happens during the simulation exercise. He will also note all reasons that are given in order to explain or justify actions and all the agreements that are concluded in order to make action possible. Only on the basis of such material can we proceed to bring our mathematics into play.

1.8. GAMING SIMULATION FOR POLICY ANALYSIS

Gaming simulation is an alternative approach to policy analysis particularly in severely stochastic situations involving a high degree of risk taking or to prepare policies to deal with crises. For a proper discussion of gaming simulation for policy analysis I would like to introduce the reader to the structure for policy making systems.

1.8.1. Structure For Policy Making Systems

A policy making system consists of:

(a) A set of policy makers who form purposeful subsystems of the system considered in the game;

(b) A set of variables used to define the objectives and constraints of the policy makers; and

(c) A set of relationships between the policy makers and the state variables.

The state of the policy-making systems at time 't' is described in terms of system variables X(t) and Y(t) defined as follows:

X(t) = a vector which consists of all decision or control variables, the values of which are determined by policy makers in period t;

Y(t) = a vector which defines the state of the physical system at the end of period t (state variables)

Z(t) = the history of the system up to period t, is defined by -

$Z(t) = \prod_{s=1}^{t} (X(s), Y(s))$ which is the cartesian product of previous values of X and Y. The current state of the policy making system is related to Z(t-1) by the following process function (omitting stochastically for notational simplicity):

$Y(t) = F(t, X(t), Z(t-1)$ with the systems constraints:

$H(t, X(t), Z(t-1) \leq b(t)$ ....(1)

As will be seen later, in a complex system Y(t) is hierarchically structured. The policy makers themselves in the system are also hierarchically structured. Included in Equation (1) are accounting identities (such as the level of resources still available) and restrictions on the system such as resource and technological constraints. The interactions among policy-making subsystems are governed by a set of institutional rules and procedures.

Suppose that we have n policy makers, Pi, i = 1, 2...n we define:

$X_i(t)$ = the decision variables controlled by policy maker Pi during period t. It is the mathematical projection of $X(t)$ on to some appropriate co-ordinates.

$\tilde{X}_i(t)$ = future decision variables of Pi; $X_i(t)$ = $\tilde{\Pi}_{s \geq t+1} X_i(s)$

$Y_i(t)$ and $\tilde{Y}_i(t)$ are the current and future state variables of concern to Pi.

b_i and $\tilde{b}_i$ are the current and future decision constraints set by Pi.

We next define the notion of policy cariables or monitor

$V_i(t)$ = current system variables important to fulfilling the objectives of Pi. $V_i(t)$ is equal to some mathematical projection of the history of the system Z(t).

$\tilde{V}_i(t)$ = future state variables important to fulfilling his objectives in period t. $\tilde{V}_i(t)$ is equal to some mathematical projection $\tilde{\Pi}_{s \geq t+1} [X(s), Y(s)]$.

We shall represent the pairs $[X_i(t), \tilde{X}_i(t)]$, $[Y_i(t), \tilde{Y}_i(t)]$, $[V_i(t), \tilde{V}_i(t)]$, and $[b_i(t), \tilde{b}_i(t)]$ by $\overline{X}_i(t)$, $\overline{Y}_i(t)$, $\overline{V}_i(t)$, and $\overline{b}_i(t)$ respectively. A policy is defined by the choice of $\overline{V}_i(t)$ and by its rate of change.

Each Pi has a set of objectives g(t) that are functions of $V_i(t)$ and may change over time. Thus how well a subsystem Pi attains his objectives is related not only to his history of the system $Z_i(t)$ but also to $\check{V}_i(t)$, the forecasted future state of the system. In addition, the decisions of other policy makers $X_j(t)_j = i$ are related to the objectives of Pi.

Policy maker Pi has a perception (or model) of how his and other policy makers' decisions would affect the future of the system, and hence his policy variables $\overline{V}_i(t)$. Thus, there is a perceived process function f_i such that:

$$\overline{Y}_i(t) = f_i \left[t, X(t), Z(t-1)\right] \text{ and subsystem perceived constraints: } h_i\left[t, \overline{X}(t), Z(t-1)\right] \leq b_i(t) \quad \ldots\ldots(2)$$

Although the form of the functions f_i and h_i are not usually known, this general formulation serves to characterise how purposeful subsystems interact.

In a policy making system, decision makers will attempt to influence, bargain or negotiate with others to achieve their objectives. Thus, in addition to direct control of his own $X_i(t)$, $b_i(t)$, a policy maker Pi has various degrees of indirect influence on $X_j(t)$, $b_j(t) = (j \neq i)$ through a set of institutional rules and procedures. Also Pi may have to compromise his multidimensional objectives g_i (a vector valued function) during the negotiation process. To represent this interactive decision process mathematically for each Pi, $i = 1, 2, \ldots n$, we have the following dynamic optimisation problem:

Find $\overline{X}_i(t)$ and $\overline{X}_j(t)$, $j \neq i$ which maximise $g_i\left[t, V_i(t)\right]$ subject to the process function and constraints:

$$\overline{Y}_i(t) = f_i\left[t, \overline{X}(t), Z(t-1)\right]_j h_i\left[t, \overline{X}(t), Z(t-1)\right] \leq \overline{b}_i(t) \quad \ldots\ldots\ldots\ldots(3)$$

and also subject to a set of structural constraints known as system interaction rules and procedures such as, for example, a utility rate hearing.

The latter constraints are messy and are not stated analytically here but will eventually need formalisation. Note that $X_i(t)$ represents a commitment by Pi concerning his future actions.

Therefore, in order for a policy-making system to evolve from one dynamically stable state $X(t), Y(t)$ to another $X(t+1), Y(t+1)$, two requirements must be met: All Pi must arrive at a set of decision which satisfy the 'perceived' constraints in Equation (3), and they should have arrived at a prescribed level for their objectives; their decision must satisfy the overall system constraint in Equation (1). What follows is an examination of how gaming simulation may be used to arrive at compromise solutions to Equation (3) by the interaction of policy makers in a gaming environment.

1.8.2. Gaming for Policy Analysis

Gaming simulation can be used to simulate the dynamic interactions in an actual policy making system.
The basic components of an operational game are: the decision environment; interactive decision making; an objective attainment evaluation (see Figure 8).

In systems terms, the decision environment is that which includes the acts of 'nature' and other decision makers not in the policy making system. This in some cases is controlled by a set of computer programs called the game operating system. Two types of decision environment could be identified: a reference environment in which historical trends are extrapolated without discontinuities; and a crisis environment in

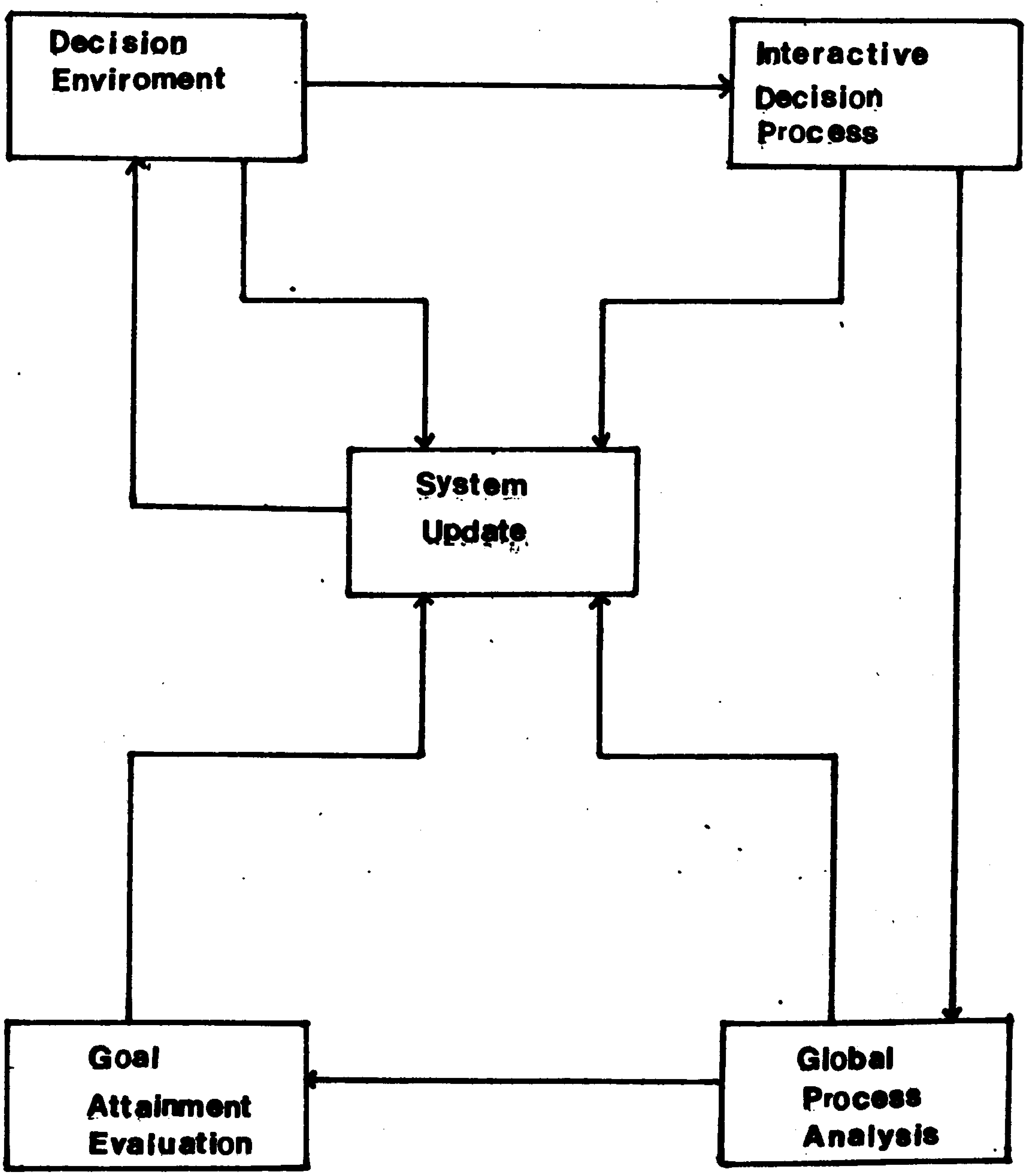


Fig 8 Game Components

which there are abrupt unanticipated changes in Xo(t) (the decision variables controlled by the game operating system), bo(t) (system decision constraints), the functional forms of F and H in each period or in the systems interaction rules and procedures. Therefore in policy analysis situations 'what if' questions conditions constitute a crisis environment.

Not all policy makers who affect the system should be included in a game. It is sometimes desirable to restrict the number of policy makers in order to make policy evaluations. Thus one can distinguish between two types of policy maker in a particular game; the active and the passive policy maker whose decision making is taken over by the game-operating system (i.e. X_i, b_i become part of Xo, bo respectively). In this sense, the decision environment is a passive policy maker. In some cases the game operating system contains behavioural models of the decision process in computer program form for each passive policy maker (a set of decision rules). Hence the status of a policy maker in a game is dependent upon a particular policy evaluation situation.

Operational gaming also includes an interaction decision process during which policy makers set objectives, formulate policies and influence the decisions of others (Figure 9). They can select their objectives g and determine policy variables Vi to maximise g_i. At the same time, a policy maker Pi also analyses how various policies (his own and anticipated policies of others) might affect his goal attainment. This involves the analysis of how Pi perceives the overall system (i.e. f_i and h_i in period t). As a result of his analysis, Pi may modify his decision and constraint variables $X_j(t)$, $b_j(t)$, ($j \neq i$) through the set of system interaction rules and procedures. As an illustration of this interactive decision process, a

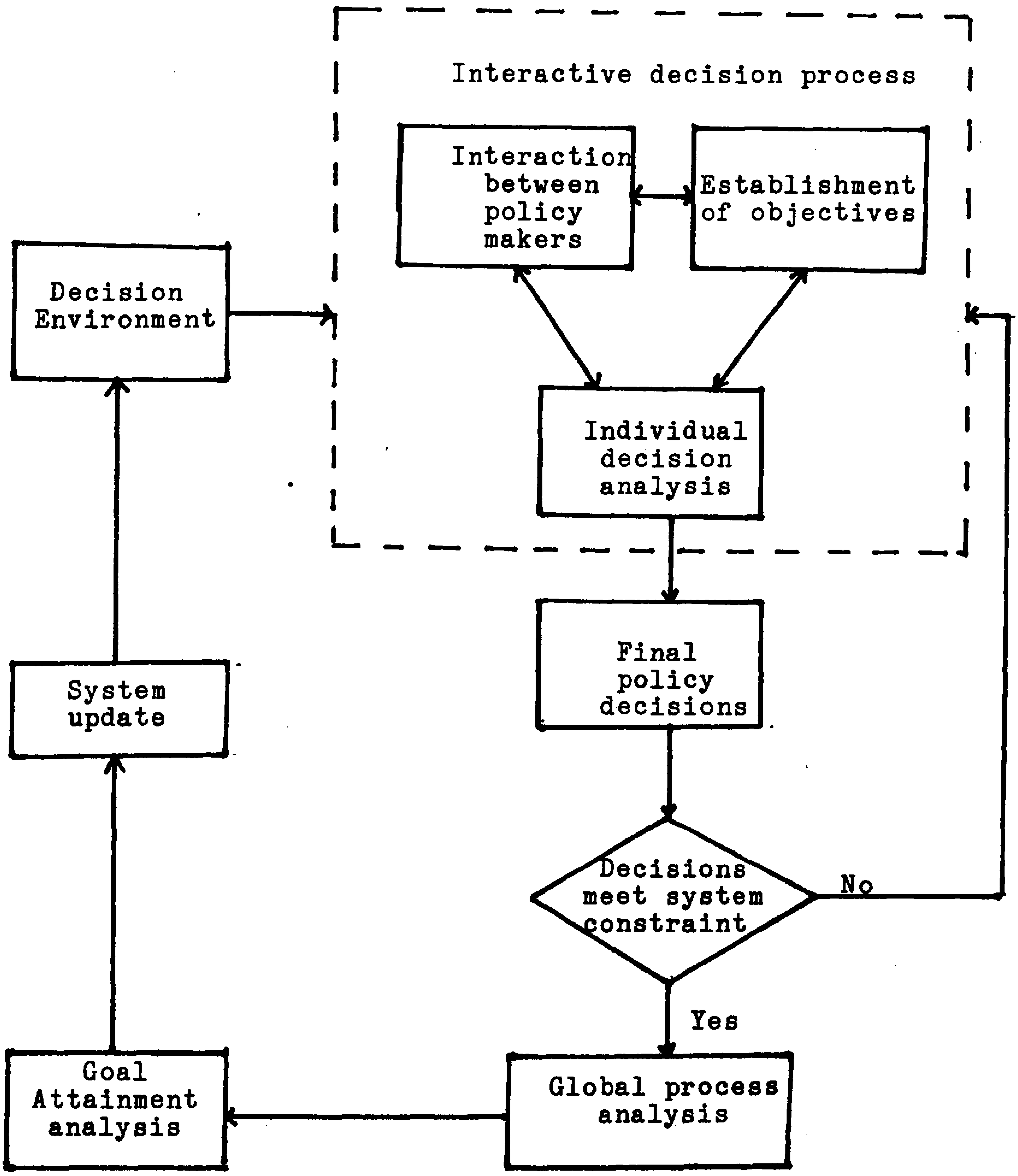


Fig. 9 : Dynamics of operational gaming for policy analysis.

regional electricity board controls the supply of electricity (represented by $X_1(t)$) to that region and influences local regulatory agencies in order to receive permission to install low-cost nuclear generation that would help to minimise cost. The electricity board may have records of the historical trends of the system variables leading up to the current decision period, i.e. historical cost, consumption patterns, etc, represented by Z(t) and estimates of the projected impact of proposed decisions, $f_i\left[t,\ X(t),\ X(t-1)\right]$ Also the board may be required to make future commitments, e.g. capital for expansion, represented by $X_i(t)$.

Some individual consumers, in addition to desiring low-cost electricity, may perceive a higher probability of nuclear hazards. Should a conflict exist, regulators may be required to resolve it.

This process of goal formulation of objectives, individual decision analysis and negotiation is not necessarily carried out in a sequence but rather iteratively. One could call it interactive decision process. It is contined until a joint feasible solution which satisfies all constraints in Equation (3) for all Pi is reached. The values of g_i must also be acceptable to every Pi.

The result of this process is a set of values of decision variables and constraints $X_i(t)$ and $b_i(t)$ for each Pi. The combined decisions are then checked to ensure that all systems constraints are met. Otherwise the interactive decision process is repeated (see Figure 9). Finally global impacts or external influences of all decisions are determined for the relation $Y(t) = F\left[t,\ X(t),\ Z(t-1)\right]$

Assessment of decisions by Pi, i = 1, 2, ...n, is made by how well $V_i(t)$ serves to maximise $g_i(t)$. Clearly there is an incentive for Pi to improve his performance and those of others in order to increase g_i. Thus interaction is useful.

In the next time period X(t) and T(t) lead to a new decision environment. This in turn initiates a new round of the interactive decision process among policy makers, and so on. In this manner operational gaming becomes a dynamic process (see Figure 9).

I now briefly describe a methodology for applying operational gaming to policy analysis for an individual policy maker. Different 'what if' questions that he supplies constitute a set of decision environment (or scenario) which the policy maker wishes to explore. Such environments would not be designed from the start. Indeed, they are modifications of the reference environment (scenario) which is an element of the initial design of the game. The policy maker participates not only in establishing the decision environment specifications (and therefore his own assumptions), but also in formulating his policies, specifying his objectives as well as testing his policies by participating in the game. Thus he becomes an integral part of the overall policy evaluation process, observing how others respond to his policies. The ability to influence and negotiate with other players gives him some control over the forces shaping the future of the system. After the game the policy maker would also participate in the policy evaluation process, facilitated by the set of his goal attainment g_i being made available in each period as a result of the game, His ability to evaluate policies would be enhanced by his personal experience in the game.

The context within which planning and environmental problems arise in society forms a complex and inter-related policy-making system in which there is a wide variety of decisions which encompass economic, environmental, technological, social and other factors. These factors are hierarchically inter-related. Policy makers differ in geographical scope (national, regional, local) and in objective. Their interactions are characterised by formal rules, regulations and procedures. Here in this research the focus will be at all levels.

From the above discussion it is clear that gaming simulation can be effectively employed in actual public policy testing situations. Attempt is made in this research to demonstrate this point.

1.9. TOWARDS A GENERAL THEORY OF GAME DESIGN

Before proceeding to discuss the concepts in designing planning gaming simulation models it would be worthwhile to introduce the reader to the general structure of planning gaming simulation models.

1.9.1. The Game Model

The game itself is a system, represented by a box, constructed by the game designer. It consists of a description of a world (total environment) and a situation within the world and so on, together with rules for the development of the situation (their scope depending on the purpose of the game), rules for playing (governing the behaviour of both the game controller and the players), material for presenting the game and recording play and so forth. Of all these only the game-world is represented specifically as a subsystem. It contains a game situation. Within the game situation there are many subsystems interacting with each other and this must be explicitly modelled.

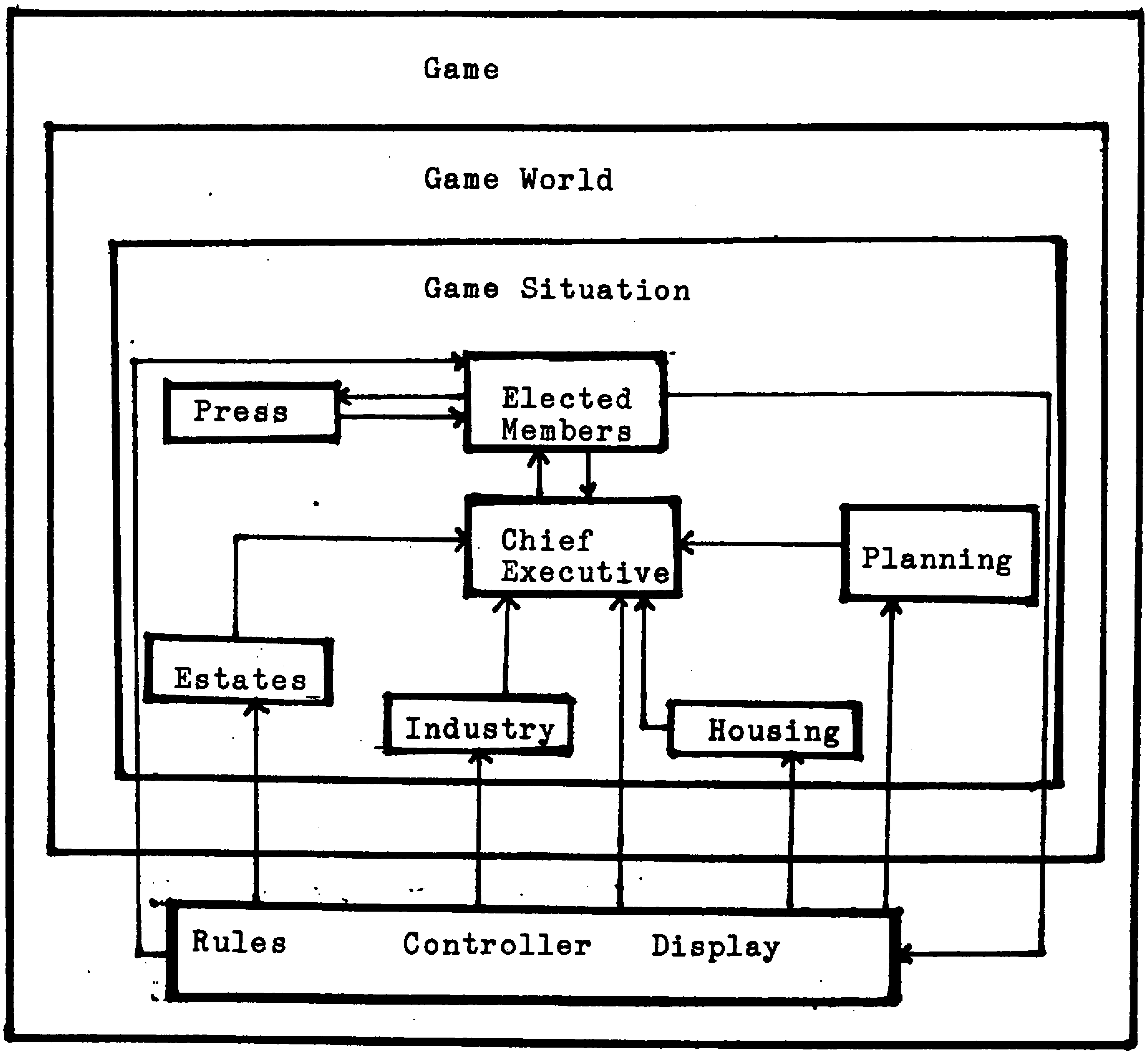


Figure 10 : A typical game model

Figure 10 shows the structure of the community Land Act game designed by D Mackie. The game situation (scenario) contains the representatives of the following department/agency as subsystems interacting with each other.

(i) Chief Executives

(ii) Housing

(iii) Planning

(iv) Industrial Development

(v) Estates

Also represented are the elected representatives and the press. The inter-relationship of the different role system is represented as in diagram by arrows. The rules, the external roles, i.e. the controller and the display (the game specific language) are outside the game situation but influence the subsystems in the game situation.

1.9.2. Persons Involved in the Model

Game Designer: The game designer must construct his game with some purpose in view, and this purpose as well as his own activity, must influence the final form of the game. The game designer and his purpose are therefore regarded as two components of a system external to the game model; only one of these, the game designer, is actively engaged in constructing the model - but since he acts as a member of a system containing the purpose of the model, this also must have its effect. The purpose may be dictated to the game designer by some other person or if he works on his own, may be of his own choice. The game designer is perhaps more likely to be free to determine the detailed purpose of his model than its general specifications; from his point of view, the detailed purpose may be seen as part of a policy for achieving the general and possibly imposed aim.

The game designer must both construct the game situation in its original state, and compose the rules which lay down how it develops, so he is eventually responsible for the whole inanimate part of the model. However, he does not create the experimenter or controller and the players but they are controlled partly by his rules.

It is the impossibility of reproducing the real decision-maker's activities adequately in an inanimate model which makes it necessary to include real people in a game. The first person who must be introduced are players. The players are involved in the capacity of playing the completed game to animate the modelled decision maker. It is assumed that their personal unpredictability can reasonably stand in for that of real decision makers (in practice, of course, a succession of different players would be used, to correspond to the variety of possible decision makers in the real world).

As soon as some real person enters the game, as a player, it becomes necessary to introduce another, the Controller or Experimenter in a kind of administrative role. He is needed broadly to communicate with the players and to respond to their unpredictabilities. His functions will include briefing the player passing information to them as required by playing of the game, and ensuring that they keep to the rules. He may also offer the cheapest way of keeping the Game-Situation up to date, although this activity may be well enough defined not actually to determine the attention of a real person.

The controller, like the player, is a part of the game, since it cannot be played without him, but he is not himself a part of the game situation, though he may adjust this from outside. He and the players are bound by the rules of the game, which should govern all communication required between them as well as the inanimate part of the model. In fact the rule should prescribe the controller's behaviour in all predictable situations so as to curb his own person like inconsistency, except when this is necessary to respond to that of the player. The controller, player and the rules together may be regarded as a motor system for the game linked together by their own system.

1.9.3. Element of Design and Construction

Due primarily to the problem-specific nature of games and broad range of game styles, few attempts have been made at drafting a "handbook" for game design. Most authors, in presenting a specific gaming technique, rely on the readers familiarity with an existing game. Though some game designers feel that game design is more an art form than a teachable skill, most agree that a familiarity with a wide variety of gaming techniques is a valuable prerequisite for a game design.

Feldt (1972), in an interesting informative review of the developments in the field of gaming in the United States, presents a general classification scheme for existing games which implies the emergence of some rather specific design principles and Duke (1974) highlights some specific techniques employed by contemporary game designers consistent with emerging design criteria. The following discussion will address the major elements of game design focussing primarily on the work of Duke (1974) and Armstrong (1975) unless otherwise stated.

1.9.3.1. Initiation

Prior to actual game design, a thorough review of the circumstances which prompted the consideration of gaming simulation as the most suitable mode for communication for adressing the issue at hand should be made. A clear definition of objectives is essential for rapid transition through the design and the construction phase and facilitates subsequent evaluation of the utility of the completed game.

Problem definition (initiation) involves a description of the client for whom the model is to be developed, the purpose to be served by the model through its development and use, the subject matter to be adressed by the model, the intended audience and the specific context within which the model is to be used. Other considerations include (but are not limited to) time constraints both in the development and use of the model, personnel and financial resources and any other further restraint imposed on the gaming simulation exercise. Only after a precise statement of objectives has been made should game design begin.

<u>1.9.3.2. Design</u>

The formal game design process consists of three distinct but contemporary stages: the description of a conceptual map; a consideration of existing gaming methods and design principles; and the development of a concept report. <u>Conceptual mapping and concept report:</u> Simply stated, the conceptual map is a model of perceived complex problem environment as supported by empirical data and appropriate theoretical evidence. It may be explicit; clearly (usually graphically) presenting the intended message of the game, Implicit; presenting the intended message subsequent to actual play (during a post game critique, for example); or integral; wherein players are directly exposed to the game message through actual play.

A thorough analysis of the conceptual map is necessary to ascertain the appropriate level of abstraction for optional game utility. Level of abstraction is defined by Duke (1974) as the degree of correlation between reality and the model employed in the game both in terms of the extent of structure and the level of detail. Exceptional games developed to address the wrong level with respect to established objectives will be of much less value than mediocre games design at the appropriate level. Modification of the game throughout its development should be reviewed for possible impact on the level of abstraction. Frequently, games consist of a series of subgames which successively introduce players to the rules and language and allow each group of participants to seek its own appropriate level.

The game design.process is actually an implementation of the conceptual map. Through the review of existing techniques together with artistic innovation by the game designer, a framework for the game evolves which can most adequately meet with objectives outlined in the conceptual map. The direct result of this effort is called the Concept Report which, when accepted by the client, becomes the "blueprint" used for game construction.

1.9.3.3. Design Principles

Though the range of techniques employed in contemporary gaming is understandably very large, Armstrong and Hobson (1975) have outlined four elements purported to exist in all applications of gaming:

(i) People playing roles not necessarily corresponding to those they assume in real life;

(ii) A scenario defining a problem area or a given "state of the system";

(iii) An accounting system designed to record such decisions and events together with their consequences, as are taken or occur during play;

(iv) Some algorith(s) (implicit or explicit) which dictate(s) operating procedures for playing and controlling the exercise.

Duke (1975) has identified another design element characteristic of games:

(v) The use of symbolic structure.

Since virtually all gaming effors incorporate (to varying degrees, of course) these elements, a brief description of each is in order.

Roles: Roles are characters assigned to players with prescribed patterns of behaviour. They are predicted on known real world counterparts. Participants may play a role similar to their own "realworld" role, but generally it is better to permit the player to experience the game problem system from a position unknown to him/her in reality. Roles are always limited in number to those most central to the problem being studied. There are basically three kinds of roles that can be included within the game design - pseudo, gamed, or simulated.

Pseudo roles: are invented frequently on the spot to serve some immediate function. (Examples include judges and technical experts). When the right situation arises, special participants with unique skills are employed on the spot. Pseudo roles remain unlinked to the basic role structure, nor are they processed formally through the game's accounting system.

Gamed roles: are built into the gaming situation framework and played by real players whose decisions are processed by the game's accounting system.

Simulated roles exist in the accounting system but not physically in the game room itself. Often they represent broad classes or categories of people (as in voting models and demographic models). It is often useful to have simulated roles in gaming simulation to generate output useful to the gamed or pseudo roles.

Regardless of the type(s) of roles employed by a particular game, the primary purpose of role designation is to delineate decision making concerns.

As important to the success of a game as the roles employed are the conventions which dictate the functions of those roles, including the manner in which the roles are allocated to participants. Feldt and Goodman (1975) report that the education and communication interest of a game are best served if, at every decision point, more than one person is involved. This facilitates the transfer of ideas and information and, in theory at least, enhances the quality of the decisions. Similarly, Duke (1974) employs a "rule of three" suggesting that whenever possible, three people be assigned to each role.

Beyond these guidelines the definition and allocation of roles is highly variable, role interpretation may be predetermined or player determined; role structure may be rigid or flexible, changing throughout the gaming exercise; roles may be solitary or interactive; roles to be assigned on the basis of participant background or interest or allocatedin some random fashion. The game designer must give careful thought and consideration to both the designation and allocation of roles together with a carefully established set of rules regulating their functions (Greenblast 1975).

Scenario: The scenario, according to Armstrong and Hobson (1974), is a statement of the initial conditions of the system under study and may relate to the past, present or future situation; thus an attempt to simulate the outbreak of World War I is situated in the past, the North East Corridor Transport Study in the present, and many weapons systems simulations some twenty years in the future. In addition a scenario set in the present may contain some information relating to the past, and also forecasts of the future. Generally the scenario is presented using some combination of texts, charts, maps, pictures, display models, statistical tabulations, financial statements, etc. As in the case with the use of roles, the extent and character of the scenario is dictated by the overall project objectives and requires thoughtful consideration during the design of the game.

Given the initial scenario, the dynamic element introduced by role playing (whatever the interpretation adopted by the players) may lead to changes in the form of content of the scenario. It is the function of the accounting system to monitor and process the activities of the roles and update the scenario.

<u>The Accounting System</u>: The accounting system is a set of fixed procedures incorporated directly into the game to deal consistently with player decisions. These decisions - outcomes of steps of play - are processed, acted upon, and forwarded to some other game component, feeding back either into an indicator, model, role, or some combination of the above. Thus the major function of the accounting system is the processing of information resultant from play of the game which normally serves to update the scenario. An accounting system is a model; a carefully abstracted representation for some realworld process. As such, it neither predicts, speculates but rather provides the basic framework within which predictions and speculations may be made. It contains the built-in assumptions

necessary to simulate its realworld counterpart; assumptions which may be subject to change through the development of the game and/or during the normal course of play of completed game as a deliberate objective.

The accounting system may be complex or simple, it may manoeuvre players' responses through models, simulations, or very simple algorithms, and it may or may not use computer. It will always be reported out to players through various indicators which will be displayed on forms, wall charts, playing boards. Whenever possible, it is desirable to have the players individually keep the accounting system. This gives them a better understanding of the problem being considered and saves a great deal of work for the operator.

Though the system being modelled by the game is gestalt in nature, the accounting system is inherently sequential. Hence the order of processing inputs through the system must be carefully designed to avoid any impairment to the gestalt character of the game.

Indicators are those aspects of the accounting system that the operator chooses to emphasize for the participants. They report on the game's progress - the interaction of player's decision as filtered through the accounting system and linked to the models.

Models on the other hand are devices from the accounting system to keep track of logical processes. They may be simple or complex. They may be expressed in mathematical terms or illustrated graphically. Examples might include the representation of economic process or demographic reality. There are basically three types pf models.

(i) The heuristic, or homologue, model is the least sophisticated and used most often,

(ii) Iconic models given the physical appearance of reality (they need not act like reality) board games serves as an example.

(iii) Analogue models parallel the realworld phenomena and corresponds to realworld counterparts they represent at least some level of abstraction. Sophisticated simulation models are an example of the latter.

<u>Operating Procedure</u>: Armstrong and Hobson (1975) suggested that operation procedures for gaming simulation are of three basic types: procedures for the conduct of the gaming simulation exercise; procedures for roles; and procedures for operation of the accounting system.

The first category -- procedures for conducting the game -- include the regulation of time and sequence of play. Most gaming simulation models are played through a number of time units (rounds of cycles) with each unit corresponding to some real-time phase (e.g. day, week, month, year, etc). During each cycle various player activities take place such as planning, decision making, accounting and/or assessment. The structuring of these activities within the time period varies from model to model in both style and flexibility.

Procedure must also be developed to define and allocate roles and to link roles to scenario and the accounting system. These procedures serve to direct (and frequently control) the flow of information through the exercise.

The procedure for operation of the accounting system must define what information is required as inputs and indicate the proper sequence for accounting to ensure the systematic use of the accounting mechanism. This frequently involves some kind of entry made on a report form or the manipulation of some piece of equipment which provides necessary feedback to participants as they progress through the exercise.

Care must be exercised both in the development of operation procedures and in introducing them to game participants so as to reduce player frustration involved in learning a new language. This concern has been expressed adequately by Duke (1975):

"There has been undue emphasis on rules in gaming simulation, perhaps as a result of the strong heritage on game-theoretic applications. A much more productive concept is 'procedure', intended as a more flexible term to cover all mechanics of play, including any essential structure. Because the game may be viewed as an 'environment for learning', it is essential that players be able to interact with the game, often in ways not initially perceived by the designer. In so doing, they feel it necessary to change the structure of the game. Because of game design considerations, certain conditions may be inviolable (e.g. the requirement of cycles as iterative experiences or calculations inherent to a particular model). These may well be called 'rules' implying a necessary finality or rigidity. On the contrary, if the players are permitted or encouraged to alter, amend or enrich procedures within the gaming structure (e.g. moving from a non-existent definition of acceptable player behaviour in the game through rudimentary and finally to an advanced articulation in successive cycles of play), we can maximise learning without the laboured and unnecessary specification of an elaborate rule structure".

The Use of Symbolic Structure: To the extent that games are actually a mode of communication, they employ unique symbol sets comprised of elements of other modes as well as symbols designed specifically for each model. The set of signs and symbols used in the game together with the conventions governing their use comprise what Duke (1974) refers to as the game-specific language. Clearly, the design of the game-specific language has a heavy bearing on the overall success of the game. Equally important, however, is the manner in which new symbols and novel use of conventional symbols are introduced to game participants. The incorporation of complex symbol structure into a game design must be thoroughly weighted against the potential problems which may arise in presenting symbolic meaning to players.

Construction: Ideally game construction is the identification, definition and naming of key components (boards, paraphernalia, models, etc) together with the iterative process of defining and re-defining the major linkages and relatively straightforward assemblage of parts. It further involves the gathering of required data and the synthesis of all components into an initial game form. Once completed, the game is ready for testing and modification.

Evaluation: The results of a game experience are important to the model designer as well as the players. Assessments can be made about the game session as well as the validity of the game model. For such an assessment, a final discussion among players is an important part of the game process. Sometimes the most important learning occurs at the end when some conscious effort is made to convert the experience into some knowledge or insight. One can evaluate primarily to determine whether the goals and objectives of the game operator were made. Where learning is involved there can be many different goals and the success of the game session is in the appropriateness of the model to the particular objective.

A useful approach to evaluation can be to understand what happened from the view point of all the participants and compare those views to the goals of the game controller or experimenter. What has been said so far applies mostly to educational games. When gaming and simulation is used in participation or problem solving a similar but less formal approach may serve.

2. REVIEW OF PLANNING GAMING SIMULATION MODELS

Several planning gaming simulation models have been developed. This section describes some of these models which are operational in the sense that they have successfully achieved their purpose.

2.1. AMERICAN PLANNING GAMING SIMULATION MODELS

The early planning gaming simulation models were developed in the United States of America. They are Meier and Duke's Metropolis, Allan Feldt's Community Land Use Game, and Peter House's City 1.

2.1.1. Metropolis Model

Metropolis was conceived by Richard L Meier and developed by Richard D Duke at Michigan State University. The initial phase of the work was begun in 1963 and continued through the early part of 1964. Metropolis is intended as a teaching aid for students and young professionals. Emphasis in Metropolis is on:

(i) The roles of the major players.

(ii) The importance of capital improvements on the physical development pattern.

(iii) The effects of various community issues.

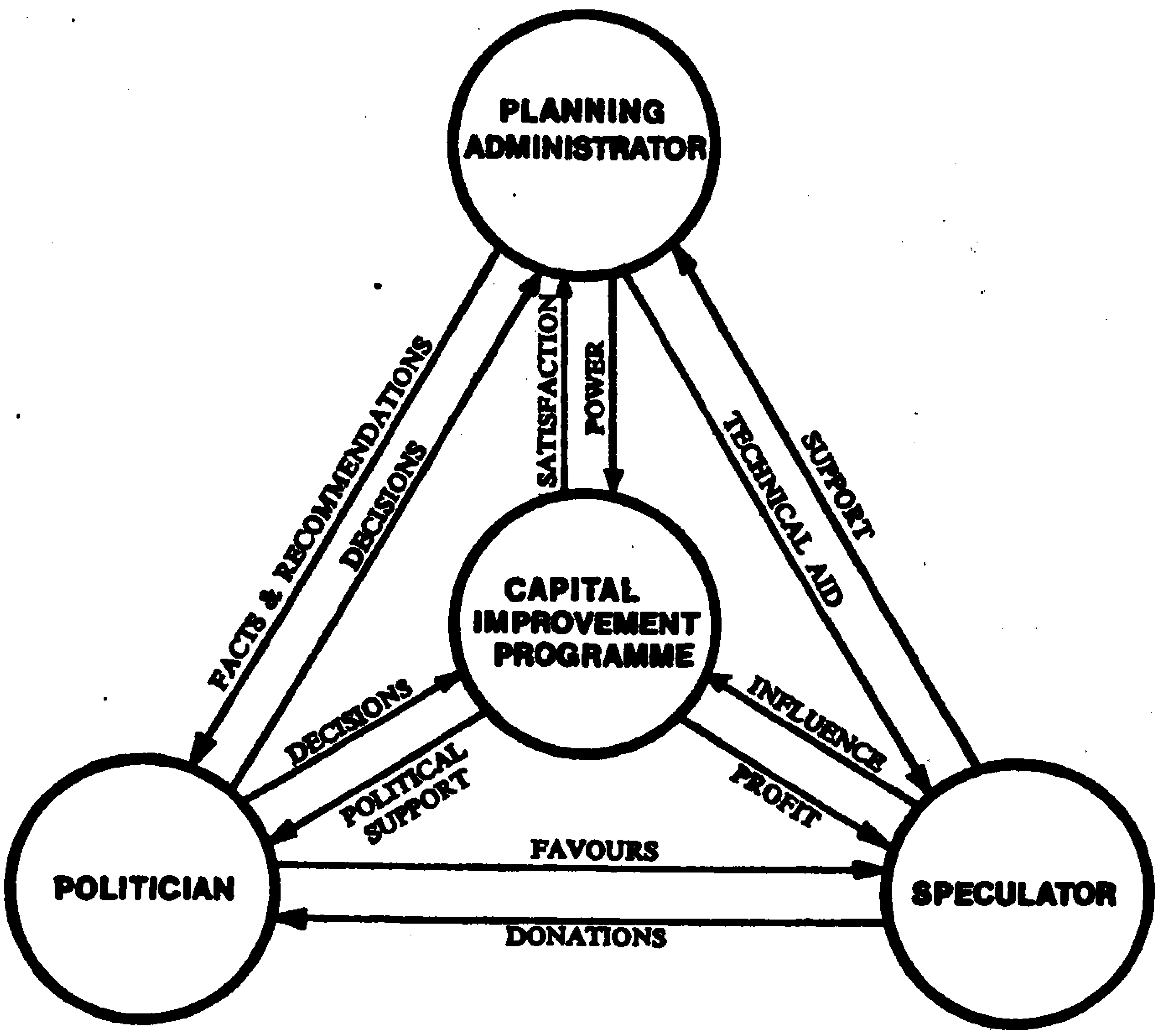
(iv) The linkages between the players, the capital improvements, and the issues.

There are four roles in Metropolis as originally conceived by Meier: Speculators, politicians, administrators, and educators. Duke did not use a computer in developing the first operational model of Metropolis. To keep computations manageable during play of the game, the role of the educator was eliminated,

(see Figure 11)

Although Metropolis is a hypothetical community, the City of Lansing, Michigan, served as a guide for structuring the game. Geographically, the city is divided into three wards. One ward represents the

Figure 11 METROPOLIS *static relationships*



Source: Duke (1964, p. 17).

central business district, another the blue collar and middle class areas, and a third the elite position of the city (see Figure 12).

Each player or group of players, plays his own sub-game within the context of the overall game. The administrator prepares the capital improvement programme which he submits to the politicians. The goal of the administrator is to increase his professional prestige with his colleagues. The three politicians (one for each ward) select the projects actually to be constructed during the year (one cycle of play). The

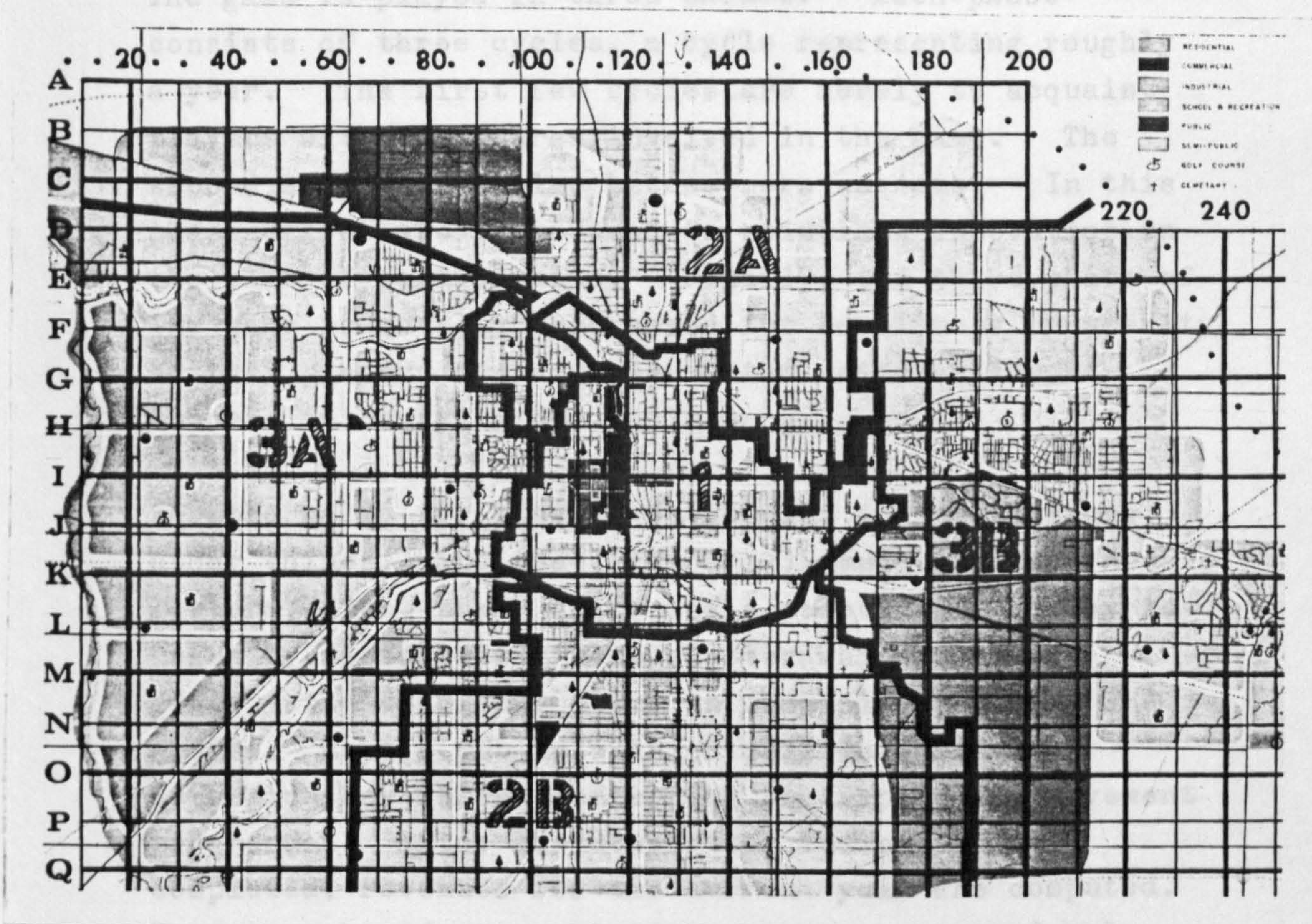


Figure 12 : Land Use Map of Metropolis

purpose of the politicians is to get re-elected. Speculators try to influence the location of development by making political contributions. The goal of the speculators is to maximise the return on their investment. This, of course, is enhanced by a concentration of public improvements near their real estate holdings.

A player makes two levels of decisions. The first level concerns his own personal gain. The second level of decision is made in the public interest. The decision concerns the capital improvement programme.

The game is played in three phases. Each phase consists of three cycles, a cycle representing roughly a year. The first few cycles are merely to acquaint players with procedures involved in the game. The second series of cycles become more serious. In this phase crises are introduced to stimulate innovation on the part of participants. Finally, the third phase of the game is usually programmed for continuous prosperity so that players may experience the satisfaction of success in carrying out their programmes.

Paraphernalia for playing Metropolis includes, among other things, maps (see Figure 12), budget forms, newsletters, dice, poker chips and a calculator. Play is begun by distributing a newsletter which contains state, city and local items on community projects and needs. Next a public opinion poll is taken to determine key issues concerning the capital improvement programme. After the newsletter and polls are completed, revenues for the current year are computed. These are based on population, average assessed value per person, the tax rate, non-tax revenue, school expenditures, and other discretionary funds which might become available. The task rates are set by the politicians, each for his own ward. The parameters are controlled by the operator of the game. These are the assessed value per person and the amount of funds drawn out of the budget for school expenditures.

Once revenues are determined, players make their decisions. The politicians decide which projects to spend available funds on. The speculators decide where and what kind of land use to invest in and also the amount of their politicial contributions. And, the administrator prepares the capital improvement programme for the coming year. After all decisions have been made, results are computed, recorded, and announced. Then, either a new cycle is begun, or an election is held depending upon the number of cycles completed.

Duke's success with the initial phase of Metropolis led to two additional efforts. One project resulted in a computerised version of the earlier game. In the computerised version, an IBM 1130 computer allows a greater number of relationships to be simulated. The increased complexity of the game enables participants to play more innovative roles. Also, in this version of the game, decision making is more policy orientated as opposed to the situation decisions dominant in the earlier version. The second project, called METRO was an attempt to expand the Metropolis model into an operational planning tool. Actual data were used in an effort to link mathematical simulation models with real world decisions. The objective of METRO was to evaluate alternative development programmes by comparing simulated land use patterns with planned land use patterns. A more sophisticated game has resulted.

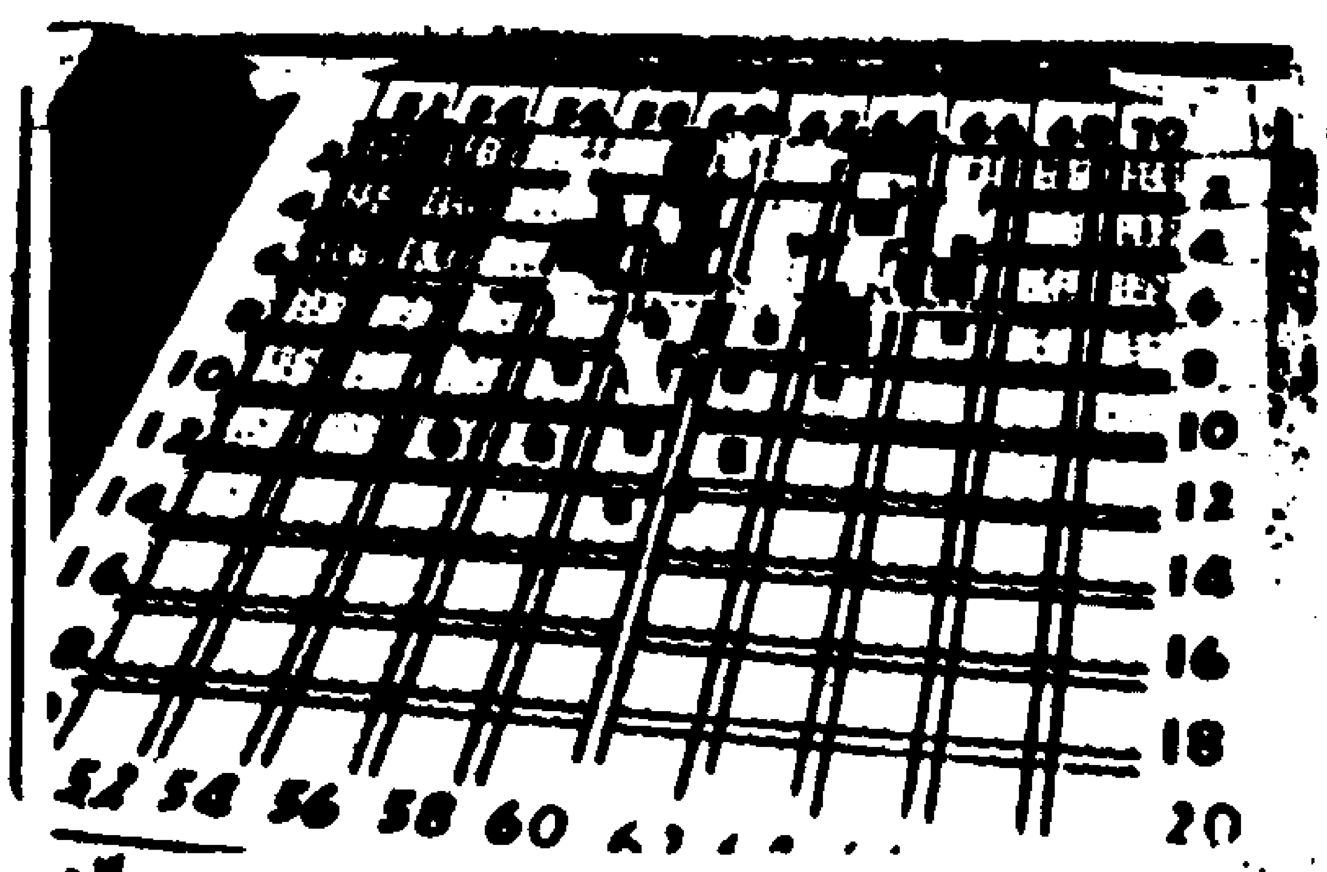
The recent offshoot from METRO is the APEX model which retains Lansing as a basis for its geographical layout. The game, however, has been expanded to include five roles compared with three in Metropolis. Apex includes politicians, planners, air pollution control officers, industrialists and land-developers. Approximately 40 mathematical models simulate the environment as the players cycle through their decision making process.

Comments: In Metropolis the planner wins if he accurately projects revenue and proposes a budget passed by legislature. Thus from such games players might learn that successful planning is that which is funded. Adaptive planning which reacts to funding opportunities, however may be inadequate in illuminating alternatives and assessing their social consequences. METRO, a computerised limits planning to administrators, politicians and land developers. Thus these early models for planners appear to reinforce the rigid style of professionals and political ellites making decisions for society. The real world simulation in the game means acceptance of status quo of all aspects of social life, not to be tampered with or criticised, otherwise this would spoil the rules of the game.

2.1.2. CLUG (Community Land Use Game)

The Community Land Use Game was developed by Allan Feldt beginning in the Autumn of 1963. The interesting aspect of CLUG is that it does not define specific roles for players. It establishes a set of definitions for the hypothetical urban system and allocates resources of the urban system to the players, who then become the decision makers.

In terms of structure it is a sophisticated hybrid of 'chess' and Monopoly'. This is because the strategy of the game is determined only by the rules of the game. The rules of the game for CLUG include a set of predetermined factors: (i) the location and efficiency of the highway network, (ii) the location of major points of access to urban systems.



CLUG. The grid dominates the layout of the city.

Figure 13

(iii) a structure of real property taxation to pay for the building and maintenance of needed community services, and (iv) a range of land use categories. Each player is given a fixed amount of capital with which he can buy land and construct buildings in order to get a return on his investment as well as to make profits from the operations of his investment (for example, he can spend part of his capital on advertising in order to bring customers to his shopping centre).

The purpose of CLUG is to teach students the fundamentals of Urban Ecology. Originally play of the game was started with a blank board, i.e. no land development at all. Play continued until all land was used, representing a population of approximately 100,000 people. To complete the game requires some 10 hours of continuous play.

The game is played on 14 by 14 square grid. The lines of the grid represent a secondary road network except for the two perpendicular lines that split the grid into four equal squares. These two lines for the primary highway system. Speed on highways is twice as fast as that on the secondary roads.

All land use is classified into four categories: industrial, trade, service and residential. Trade refers to centralised commercial activity and service applies to more dispersed functions.

CLUG has three players, or teams and three overseers; a banker, an accountant and a general referee. Players bid on land a square at a time. Each square purchased can be designated for any one of the four land uses allowed. If residential use is selected, one of three densities may be developed. To receive income, the land has to be improved. Next, the land must serve its intended function. That is, factories must have workers, houses must have residents (with jobs) and trade and services must have customers. When these conditions are met, the respective owners receive income or rent, as the case may be.

In addition to the capital cost of land and improvements, there are also operating costs for transportation and for maintaining structures. It is possible to defer maintenance costs, but then depreciation rates are faster. Other costs include payrolls, interest on loans, demolition costs if higher use of land is desired and various other penalties.

The interface between the community and the outside world is through one or more ports provided at the edge of the grid. Usually, industries gravitate toward these ports, while trade and services tend to locate with regard to internal markets. Workers, providing labour for these activities, try to minimise cost of travel by locating close to their work.

Special events, such as road closures, are introduced by drawing from a deck of chance or occurrence cards at the end of each cycle (about 90 minutes of play), Cards may be shuffled to generate a random effect or they may be sequenced to programme a series of hypothetical crises.

Feldt proposed several extensions to CLUG in his article. The game has been modified so that the playing board resembled the street system and structure of Syracuse N.Y. in 1960. Other proposed modifications included the following:

(i) The introduction of a variable marked for industrial goods which could result in occasional plant shutdowns.

(ii) The accumulation of inventories of manufactured goods, and competition among industrial players for sales in depressed markets - much in the manner of some of the presently existing business management games.

(iii) The introduction of a financial player who, with a limited amount of capital, will provide loans, mortgages, and other forms of financial assistance to the players in the game.

(iv) The introduction of zoning possibilities together with a zoning board of appeals and a few related government functions.

(v) The linking of this game with one or more other games already in existence.

Apparently many of these ideas have been incorporated into city games which are reviewed below. The physical model of CLUG is relatively crude. The board is at the scale of 1:10,000; it is divided into 100 squares representing one square mile each. These are the minimal planning units used in the game: for example, whenever a residence is constructed over one entire such square, representing in fact the construction of 10,000 units in the city. The buildings are symbolised by simple rectangular Lego blocks; the colour of the block represents ownership, their base represents building type (industrial, residential or commercial), and their height represents size. The blocks are void of any architectural quality and the layout of the entire city, governed by the 10 x 10 grid, is rigid and monotonous.

Bearing in mind these limitations, it is astonishing how effective the simulation becomes. Certain decisions are reached by majority vote: this creates the need for political cooperation among players or teams. Furthermore players must cooperate their strategies in order to keep a balance population and jobs - or to minimise total transportation costs. While players usually start in a competitive framework of mind, they soon encounter the need for cooperation and conflict between freedom and regulation that is typical of planning in democratic societies.

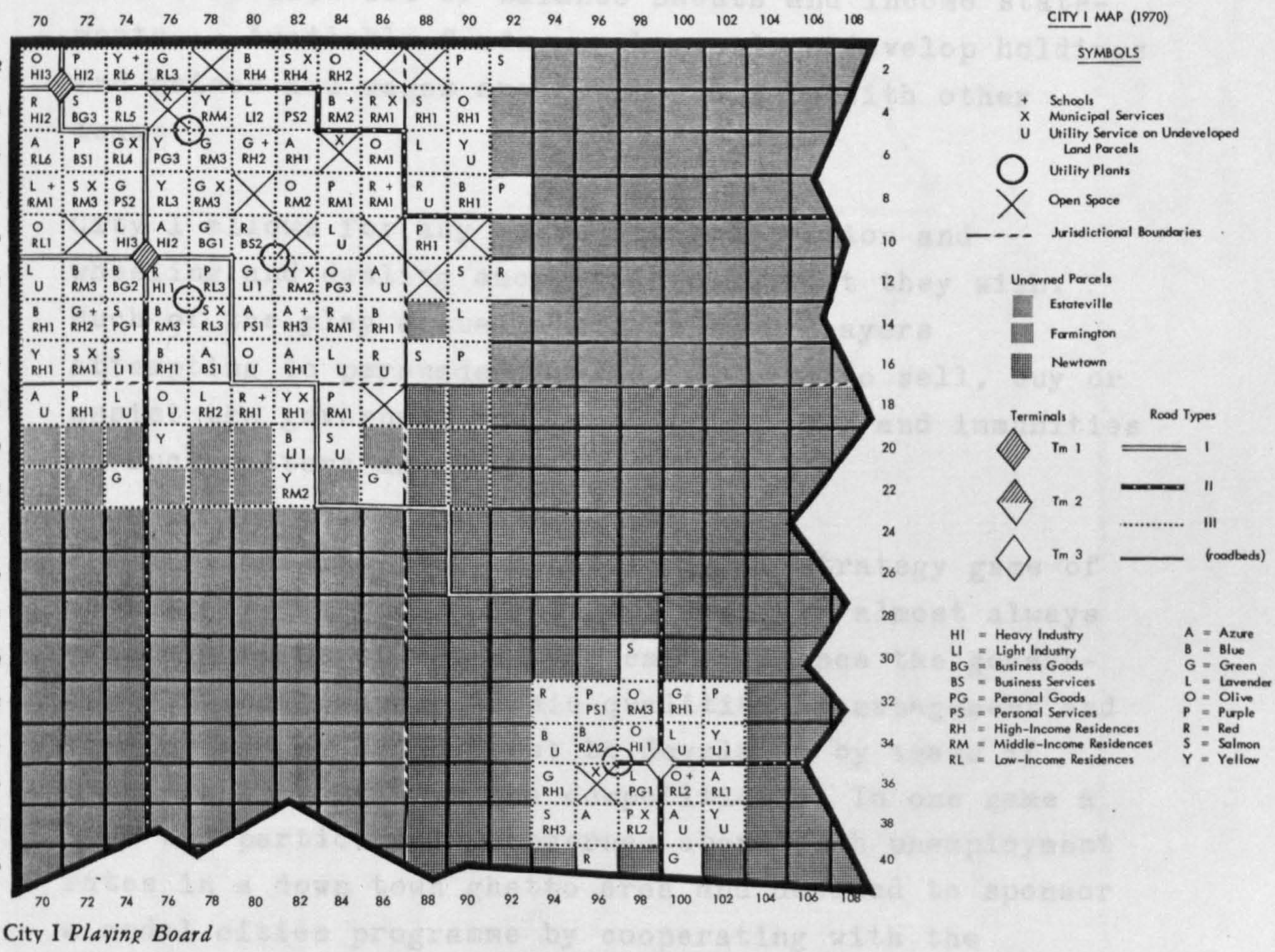
CLUG have no predictive or prescriptive value. It is not played to find out what will happen or what is the best possible course of action in a given situation, but to familiarise participants with the nature of the problem by letting them explore the interaction between its variables. A good post game discussion is necessary for the exercise to reach its full educational potential.

2.1.3. City Model

The next generation of models were the extensions of the first generation games to modelling, simulation and decision making for real urban systems. Development of City 1 began in 1967 under the direction of Peter House. Initial development took place at Washington Centre for Metropolitan Studies with financial support from both the United States Office of Education and the Ford Foundation.

City 1 used the CLUG game as a model for early development. The game is played on a board divided into 625 squares, representing parcels of land. The board includes both developed and undeveloped parcels. Developed parcels form one mature urban centre and another growing urban centre. Ownership of parcels is distributed among nine teams of players, the government, and outside interests. An electiveappointive governing body administers public affairs while the teams pursue their private enterprises. Play is in rounds.

The public administrative body operates much like any municipal government. Teams use their votes to elect a mayor. The mayor then appoints four cabinet members to head his department of highways, public works, schools and zoning, with no more than one cabinet member from a single team. Each department prepares its individual plan and budget. The tax base is than analysed and revenues estimated. A composite budget is then prepared which balances with estimated revenues.



City I *Playing Board*

The nine teams act as entrepreneurs. The parcels they own can be put to seven different uses provided the necessary improvements are made. Land uses include light or heavy industrial manufacturing of either business or personal goods, provision of either business or personal services, and residential uses. A market situation is achieved as teams set prices to attract shoppers and wages to attract workers. To operate a factory, a team must be able to attract an adequate labour force. Consumers purchase where the combined transportion cost and prices is lowest. The computer keeps track of all transactions and notes the status of all property. Teams begin each round with a revised set of balance sheets and income statements. Available funds may be used to develop holdings and prices and wages are set to compete with other teams.

City 1 allows for any degree of cooperation and wheeling and dealing among the teams that they wish. Much of the play actually consists of players attempting to persuade opposing players to sell, buy or assist the government to grant privileges and immunities in such matters as zoning.

The problem simulated in the infinite strategy game of City 1 are diverse. Political problems almost always arise in terms of which team can influence the government in legal ways. Basic qualities of management and finance are needed or must be developed by teams if they are to remain in the competition. In one game a team was particularly concerned about high unemployment rates in a down town ghetto area and decided to sponsor a model cities programme by cooperating with the government. After much simulated trouble over boundary lines, federal regulations, and politics, the team was able to attract business and industry to the model

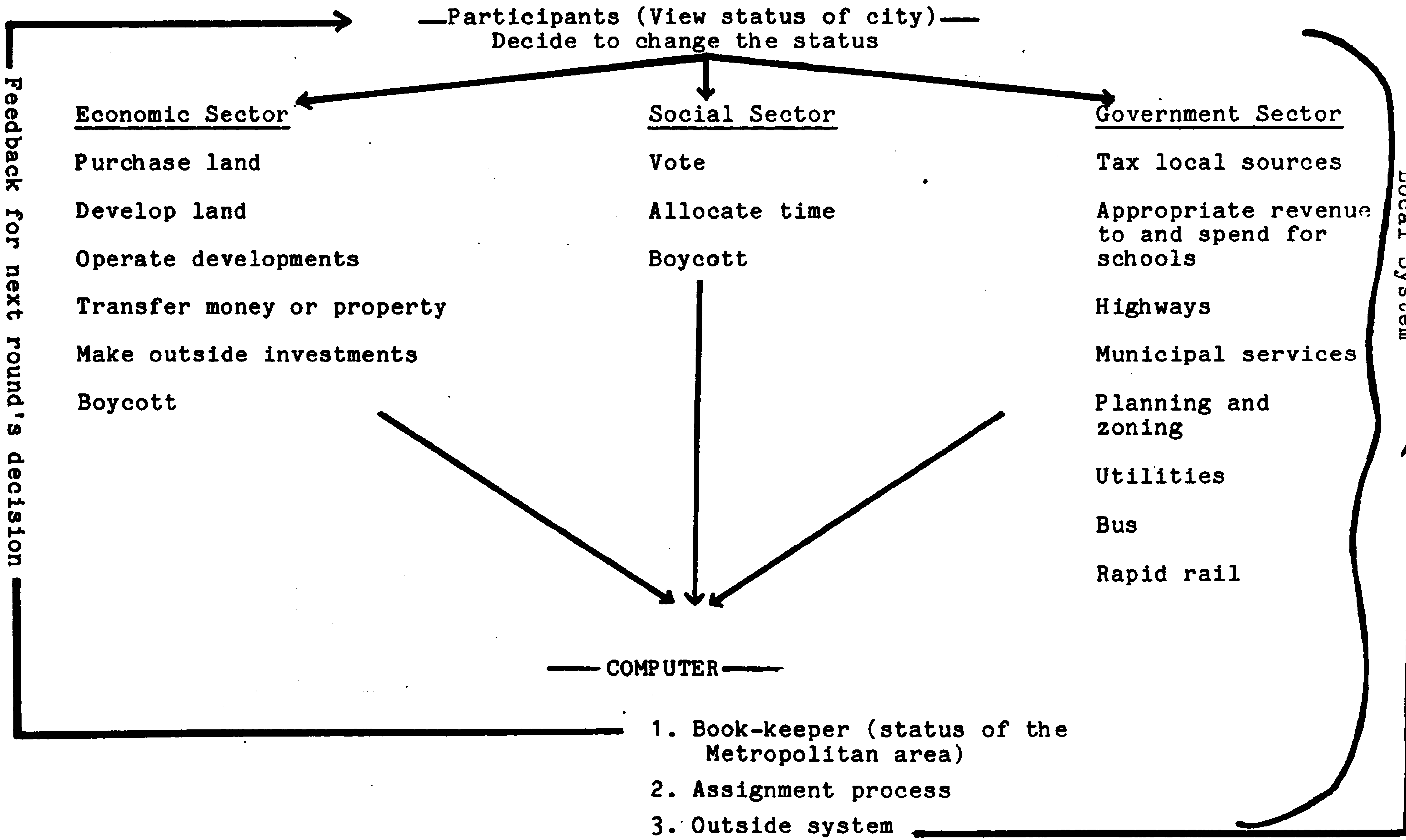


Figure 15. Interaction between players in City I

The City 1 game is complicated by a rather long playing time and large number of players - 30 to 100 players are needed for the average session, which lasts two and a half days. In order to overcome some of the drawbacks of City 1, several variations have been developed. Telecity is one version of City 1 which is played by remote terminals linked to a central computer which evaluates all players moves and strategies as well as keep records. Telecity allows 25 to 60 players to play four or five rounds in a few hours.

City II is an advanced version of City I. In City II migration is allowed to occur within the metropolitan area. The city proper competes with suburbs for industrial employees. Teams can select from three modes of transportation, bus, rail and auto. City II's expanded environment leads to a more realistic game. The game allows social and economic prejudices. Leisure hours are allocated among three social classes. The best jobs go to the best educated first, and it may be that some low income workers end up unemployed. This, of course, results in economically depressed neighbourhoods and out migration. In the City II version, the computer plays the role of national economy.

Leaders in the design of City II argue that City I, while quite successful for teaching had little policy implications for decision making in the real urban systems. City II thus expanded upon the economic and government sectors of City I in order to improve upon limited assumptions for strategies and to allow players to utilise strategies based upon social consciousness.

2.2. BRITISH PLANNING GAMING SIMULATION MODELS

Planning and land use gaming simulation models like CLUG - were imported from the United States of America and found their way in a few schools of planning and architecture in Britain in the late 1960's.

2.2.1. ILAG

The Institute of Local Government's Local Authority Game is a good example of gaming simulation research stemming from Feldt's work on CLUG at the University of Birmingham's local government post graduate training programme. It was developed by Armstrong (1968) and although acknowledging CLUG and Metropolis antecedents it is very much a product of local needs. The purpose is not to reproduce exactly what has happened or is happening in any given town development scheme. Rather the object is to produce an abstract environment in which the emphasis is placed upon the general nature of the forces at work in a developing town, the multiplicity of alternative lines of development (hence the need for some long-term strategical concepts) and the need for devising ways of assessing information and co-ordinating activities within a group responsible for decisions in a given sphere.

The models used in the game and the roles provide an environment into which the players project a number of things of their own making, namely: first, a system for co-ordinating and centralling their own activities as a group, which in turn involves them in devising some system for assessing the information available to them; second, a strategy for development of activities over time must be formulated to which the round-by-round tactics can be related, this process involving some attempt to "forecast" the future; third, there is the need to select techniques that will enable the group to judge the effectiveness of their activities in producing the results they are aiming for and to enable them when necessary to adjust their activities to bring them closer to the desired end, or even to allow for a change in strategy where ineffectiveness in action is seen to stem from an inappropriate strategy. Finally, there is the need for setting up some system for negotiation with other groups and monitoring their intentions and activities. Thus, within the environment of the game each group is in effect playing a subsidiary administrative game in which the criteria for success or failure will be of the group's own making.

Sixteen teams are actively engaged in the game. One as a local authority; two represents local residents and land owners and three act as development companies. In addition, two groups of controllers are required, one arbitrates in disputes and control development through the operation of various models; the others act as bankers with responsibility for controlling financial aspects of the game. Rounds or periods in the game simulate one year of real time and each round is divided into planning, negotiation, accounting and assessment stages. Each round is timed to take just under one hour to complete and ultimate or minimum length of time is not prescribed.

The area for development is represented by a board divided into 1 inch squares (2,436 squares), each one representing a plot of land. Every plot of land is represented by a grid reference denoting the sector of the board and its location within that sector, e.g. SE/64. Sector boundaries are established, a river (running from West to East) and a main railway line (running from West to East).

At the start of the game most plots of land are in the possession of the original land owners and used for mainly agricultural purposes. The town is assumed to have developed to 84,000 population before play starts. Development to date is outlined on the schematic map of the central area and the accompanying schedules.

Much of the value to be derived from the game came from the extent to which groups have an opportunity to plan beforehand, and in this particular aspect the game is very much orientated towards integrating the various aspects of the advanced course for senior Local Government Officers that are concerned with decision making techniques, into a coherent whole. However this does not mean that the game cannot be played or used by people with different objectives in mind.

2.2.2. Community Land Act Simulation

The Community Land Act Game was designed by Drew Mackie (1975) devised especially for Boisat Waters Cohen Partnership (BWCP), a firm of planning consultants, architects, development analysts and valuers who practice the multi discipline management approach that will be required by the act. The purpose of the game was firstly an understanding of the technicalities of the complex piece of legislation; secondly an awareness of the opportunities created, possible solutions to tricky problems and of the pitfalls that can lie in the way of successful implementaiton. The simulation models a small district council and its community land working party through a period of years starting with the preparation of the first rolling programme and land policy statement. It highlights the problem of communication between different departments, relates the complex procedures of the Land Act to those of the Planning Acts; it brings out the conflicts inherent in the land scheme between financial expedience and planning policy; it identifies the new working relationships between the local development industry and the authority and also shows up the career implications for officers implied in the scheme.

The simulation is based on a detailed planning model of a town Ilkinton, but different problems and pressures can be programmed into the basic scenario so that "players" can experiment with various situations. The players take on the roles of various members of the team which will be required to implement the Land Act; Chief Executive, Estates Officer, Housing Manager, Employment Officer, Planning Officer and elected member (see Figure 16).

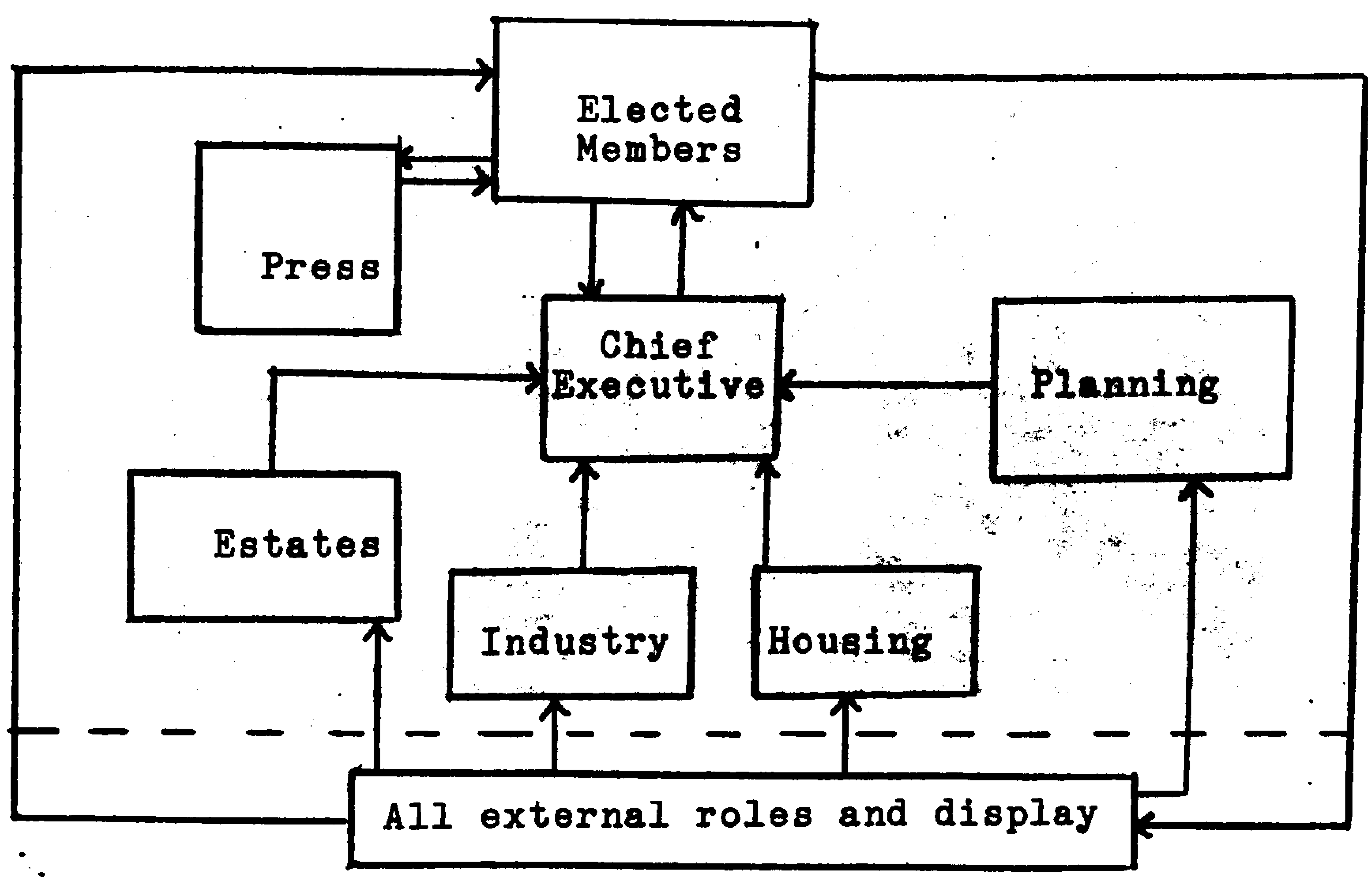
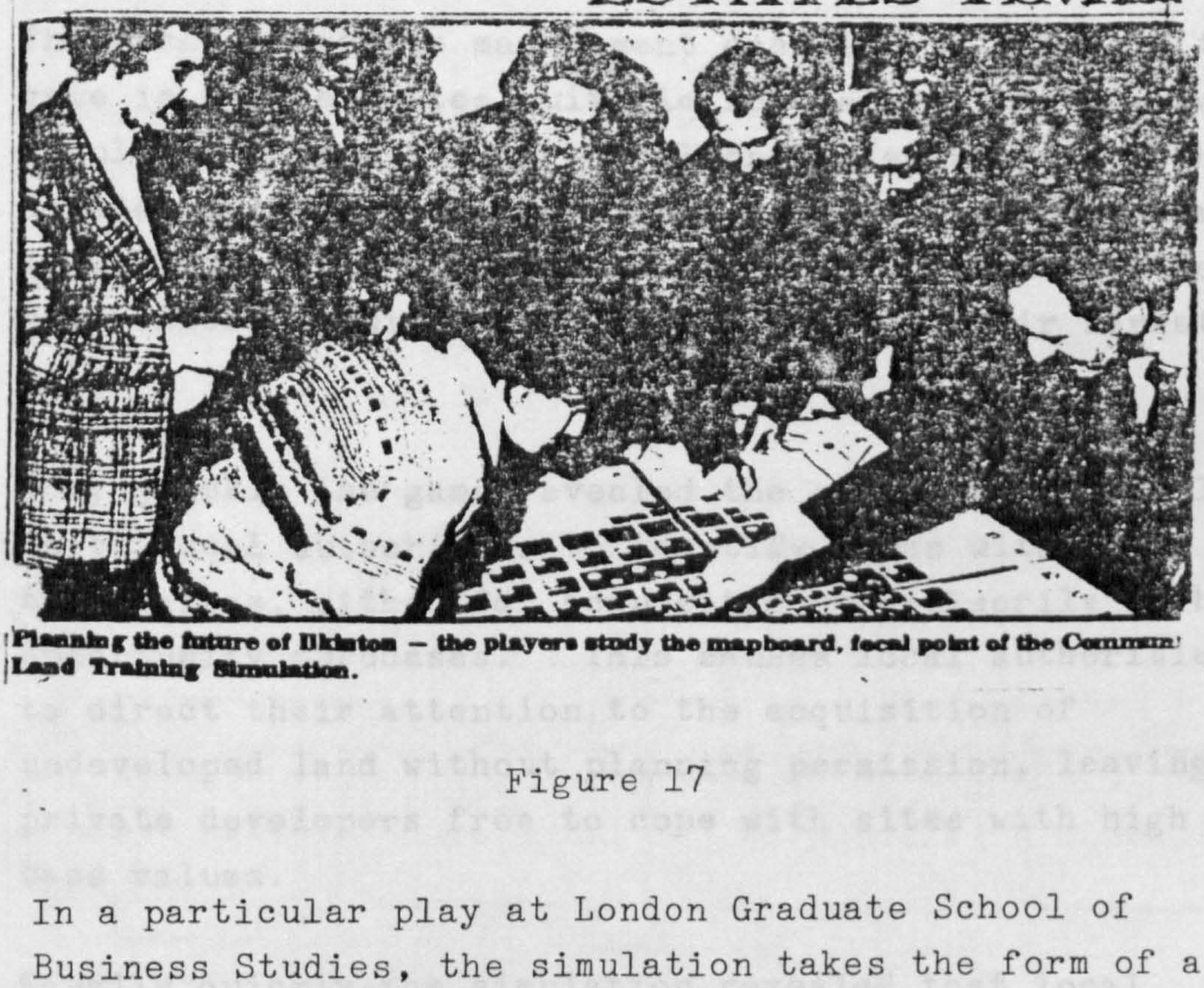


Figure 16: Structure of the Community Land Act Game

All other roles, such as builders, developers, county authority and Secretary of State are taken by "Control". The simulation is played in nine sessions, covering nine years from the present before the first appointed day dawns. Over this period the team has to carry out all those functions that would be required in real life, drawing up land policy statements and rolling programmes, getting Government loan sanctions, dealing with planning applications and even fending off scandalous allegations made by the South Ilkinton Times.

The mapboard, shown in the photograph, is the most vital part of the simulation. It consists of cards, representing sites, which bear all the necessary information such as land use, standard of visual amenity, ownership and valuation category.

ESTATES TIME



Planning the future of Ilkinton — the players study the mapboard, focal point of the Commun Land Training Simulation.

Figure 17

In a particular play at London Graduate School of Business Studies, the simulation takes the form of a business game in which participants represent the corporate management structure of Ilkinton. Following the recommendation in the first Community Land Act circular (DOE circular 121/75), the game began with a political decision that it was the council's intention to get the Land account into surplus as quickly as possible. This was to colour everything that happened afterwards, and the official exhortation that profit making programmes must be consistent with planning objectives soon seemed to get forgotten.

This may either be a fault of the game or an awful warning about the future. To restore the perspective it would be interesting to see a game played on the basis that it is not essential to make a profit on the Land account, since loss making authorities will eventually benefit from the redistributed surplus from profit making authorities.

The first corporate management decision to arise in the game is whether sites suitable for relevant development should be identified by the planning department or the estates department. The basic conflict revealed here is whether sites should be identified in terms of their environmental suitability or in terms of their market value.

Very quickly the game revealed the pressure that will be on local authorities to identify sites with low base values, either for acquisition compulsorily or by opportunity purchases. This causes local authorities to direct their attention to the acquisition of undeveloped land without planning permission, leaving private developers free to cope with sites with high base values.

Equally quickly the simulation revealed that local authorities are soon likely to be fully stretched, deciding targets for private and public housing and for industrial and commercial employment, dealing with (or delaying decision on) planning applications, attempting to identify sites for acquisition, and preparing their rolling programmes. It soon proved necessary in the game for the local authority to commission an outside firm of planning consultants to advise on land that might be released for new development.

2.2.3. SODIT (Scottish Oil Development Investigation Tool)

This simulation was designed by Drew as a conversation piece for a two day conference on the impact of oil development on coastal settlements held at the School of Architecture, Aberdeen, 1971. The purpose of the game was to lead to discussions of the oil industry between groups of people whose knowledge varied widely - oilmen who did not know the culture of the villagers, protest groups who know little of the structure or operation of oil industry, politicians who may have known nothing of either. The game is a representation of the present situation in which the exploration of North Sea oil is causing considerable pressures on the local authorities in the coastal region. The game uses very

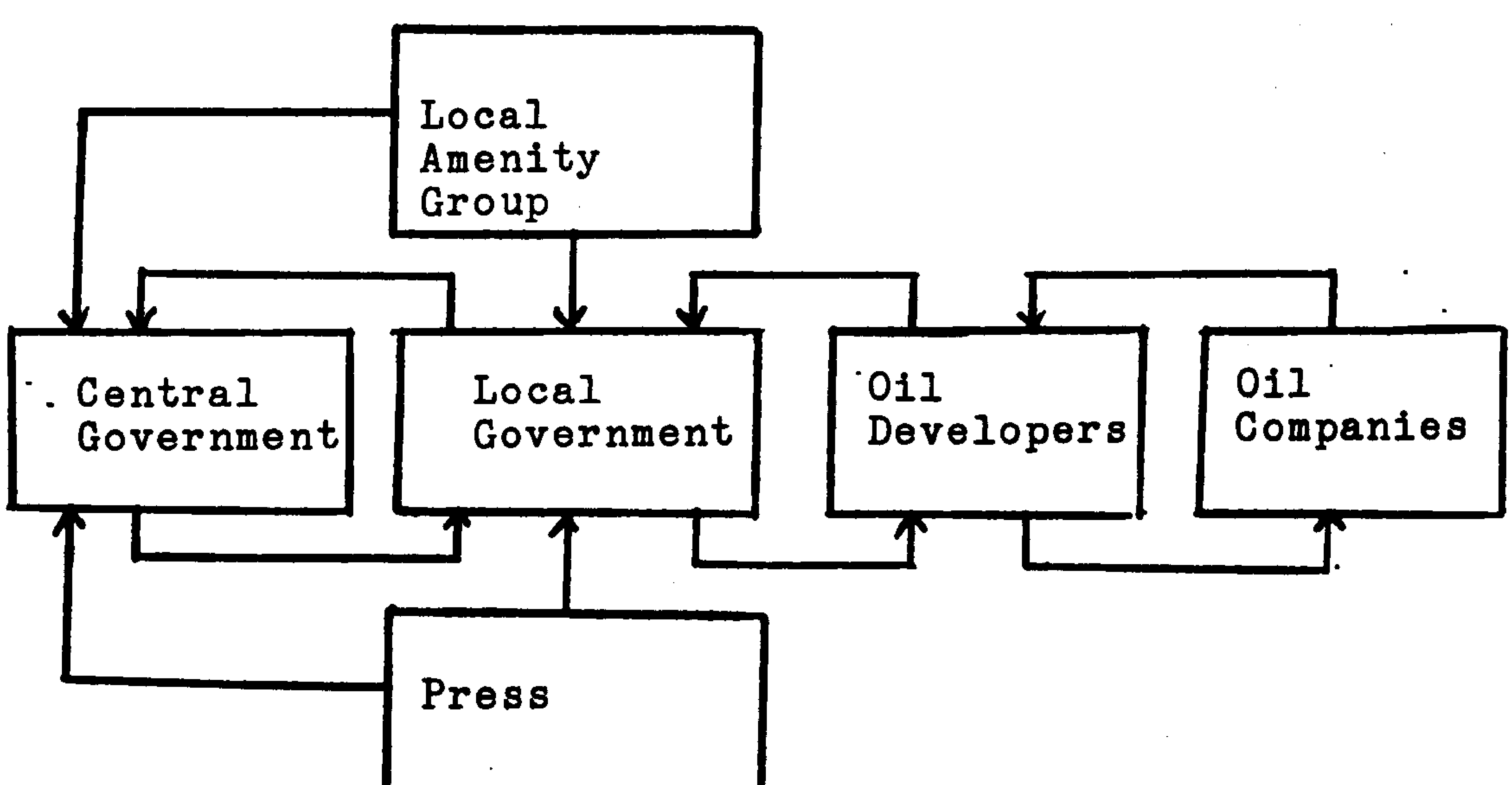


Figure 18: Role Relationship in SODIT

simple circles of exchange between the oil companies, their developers, the local authorities, the local social groups and the central government to simulate these pressures and enables players to test out strategies for the attainment of goals (economic or social) within this structure. The inter-relationship of the roles was represented thus: See Figure 18.

Each role is only given a minimum amount of information with which to construct and act out his role. Each player brings to the game a certain amount of knowledge gained from the real world situation. When his sector of the action appears to be moving in an unreal direction, he consciously acts to correct this. Thus the game as a whole corrects itself.

The remarkable thing was the game, although crude and prepared by students with relatively little knowledge of planning or oil industry, produced results which predicted many of the infrastructural and social problems which now affect the settlements of the coast and was predicted at a time when the opinion of experts ran in quite a contrary direction. So the idea gradually emerged that SODIT like games just might be of some use in real planning.

Unlike the other planning games this model is different in structure and it attempts to bring together the real decision makers - it is a free game with minimum rules. SODIT is not intended to substitute for experience, since as a model, it can only be a simplified representation of real complexities that characterise decision making. However SODIT offers several advantages over experience that may not be easy to achieve. The advantages are its conprehensiveness and its compactness in time.

2.3. SWEDISH PLANNING GAMING SIMULATION MODEL

Much has been said about American and British models but the documentation cannot be complete without a brief look at planning gaming simulation models in European countries. For this an example which focuses on local and regional planning problems in Sweden is described below.

As a result of Nordic co-operation a gaming model has been constructed for three communes in the Swedish county of Varmland by Olof Warneryd, 1973. In this game, commune No. 1 is expanding with a dominant centre and differentiated trade and industry. Commune No. 2 has a one-sided economy and is dominated by a single major enterprise. Commune No. 3 is based mainly on agriculture and is on the decline.

The purpose of the game is to attempt to reproduce a sequence of events based on given problems with roles comprising individuals, households, enterprises, commune administration as well as national and regional policy, and, to evaluate the effects of the decisions made on individuals, households, the commune and the enterprises.

The framework of the game is intended to include both the establishment of aims and means, the creation of alternative lines of action (as well as the collection of basic data), decision making, and evaluation of results achieved, Processes of a routine nature are disregarded in favour of more interesting decisions and measures affecting future development.

An essential element in the game is to reflect the influence of national and regional government policies in the three communes, specifically to analyse what happens at local level upon the introduction of new regulations, subsidies, etc.

The system of roles and the inter-relationship is shown in Figure 19. Figure 19 illustrates the different pressure groups included. Commues A, B and C are thus three different communes with certain characteristics. Commune stands for administrative and political authorities.

The population in the communes is represented by a box named households tied to each commune. The households can establish formal and informal pressure groups. This facilitates a certain flexibility, as the formation of groups can vary in time depending on the conflicts and questions arising during the course of the game.

Sections of the political and administrative bodies of the commune are represented in the game but the number varies in the different communes. Specified classifications cover the roles of commerce and industry in the game.

Apart from the roles previously mentioned there is also a journalist group to carry out the functions of the press. It is available both for the individuals and for the interests of the remaining groups. Other pressure groups, including interlying and controlling authorities, are included in a role system under the heading of the national and regional policy group.

The links between the different role systems show the possibilities of taking contacts. Thus, for example, industry has direct contact with the three communes. Decisions taken in the national and regional policy groups influence the household group in, for example, commune B. The household group A, B and C are

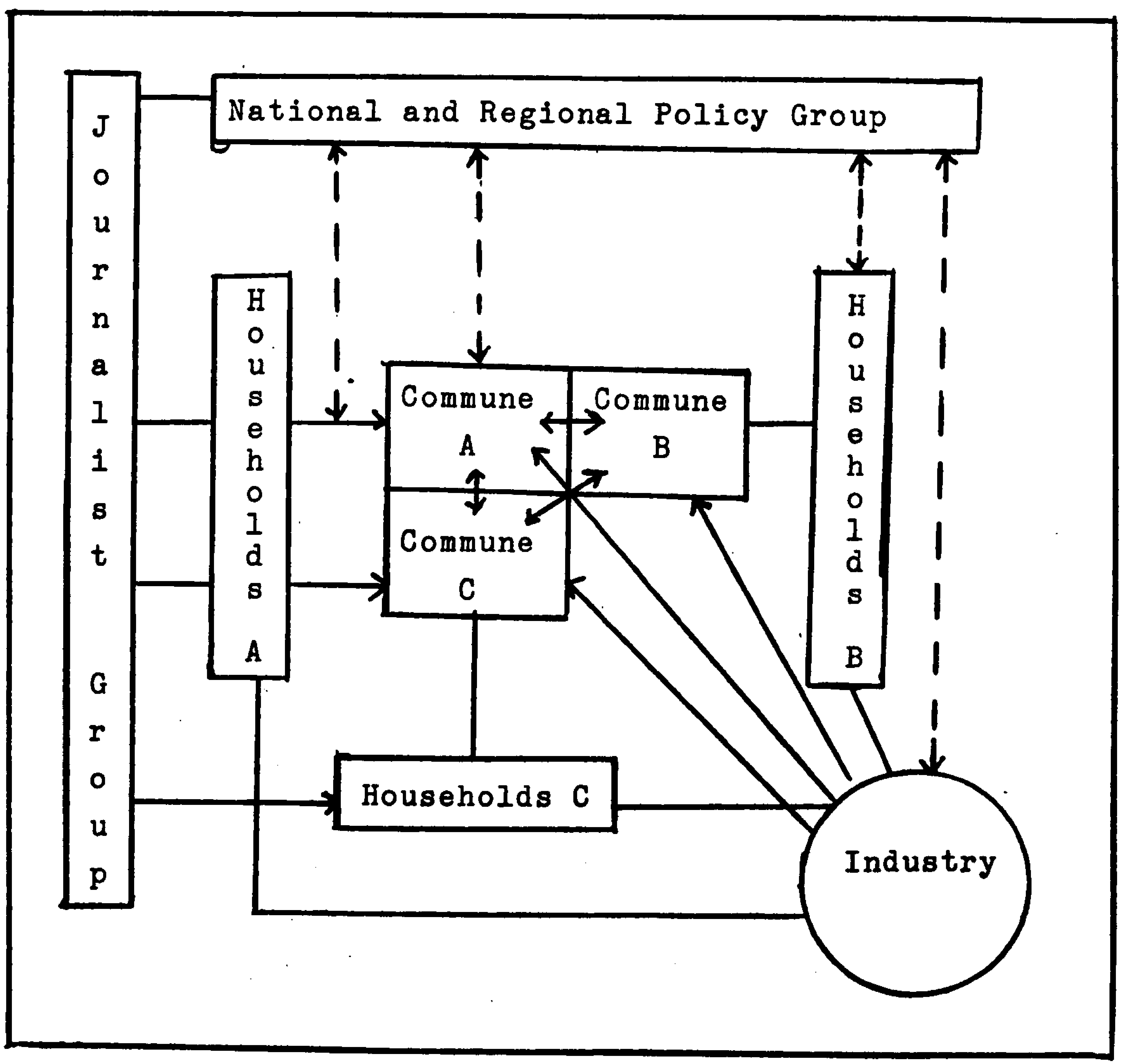


Figure 19: The role system and their inter-relationship.

employed in the industry and negotiate with the people. All combinations are not shown in the figure.

The basic difference between the various game groups consist of the existing conditions in the respective communes. As mentioned previously, three types of communes are represented: One is on the decline, one is stagnant, and one has slight expansive tendencies. Very little contact exists between the communes. Each game group is furnished with data concerning its own commune with regard to population, employment situation, etc.

The internal distribution of roles within each gaming session takes place as follows. The game is constructed along the lines of a triangle drama, where the components consist of state and commune, commerce and industry, and finally, individuals and households. The action in the game is mainly centred on state and commune as well as the business owner role, whereas the individual and household roles concentrate more on the evaluating the results of the measures taken. The latter roles can, of course, take the initiative to bring about changes, for instance, via the press.

The setting of the game is governed by a theme announced by the game executives when the gaming is to commence. The starting point is a particular problem which will thus direct the actual content of the game. After a gaming period of 4 - 6 hours, the game is interrupted as the result summarised.

The game serves as a means to analyse a given problem and then immediately forms the basis for a discussion with all participants. When the discussion has been concluded the game is played afresh with a new set of problems. Role changes can then also be made.

2.4. PLANNING GAMING SIMULATION MODELS IN DEVELOPING COUNTRIES

Not much is known about models which are related to planning problems in developing countries. However, it is interesting to note that professional designers like Richard Duke and Drew Mackie are now developing planning gaming simulation models that focus on problems in the developing countries. A brief review of two such models are discussed below.

2.4.1. SNUS - Simulated Nutrition System

This model was developed to serve as a communication improvement device to be used primarily in connection with seminars and workshops in nutrition planning in developing countries. Another use would be at Universities in course in nutrition policy and planning. In the seminar context, the participants would be government planners in medium to high positions, responsible for sector planning at the departmental level.

SNUS simulates the planning process in a hypothetical country, and the wisdom of the planning decisions made in cabinet meeting can be evaluated, since the decisions are also implemented in the game. This leads to another planning session with new decisions, followed by an implementation phase. Thus SNUS is run in cycles, with each cycle containing a number of steps of play: arbitration and allocation of national budget, production and distribution of both industrial and agricultural commodities, import and export of goods, calculation and assessment of food supply situation in the nation's different population-groups and development and implementation of intervention strategies.

The progress made by the participants in the sequence of the steps of play is monitored by the game controller. Most of the action takes place around a playing board which depicts a hypothetical developing country composed of three regions: urban, farm and coast.

In each of these the population is divided into two groups: rich and poor. This very coarse distinction can be taken as an example of how SNUS, as a model of reality, takes account of variables of importance but simplifies the handling of the variables down to a bare minimum. Within each population group, distinction is made among adults, school-age children and infants. In the context of the game sex differences in nutritional requirements would have a negligible impact and therefore they are not considered.

The production is simulated through a medium of production units. There is production of both agricultural and non-agricultural commodities: cereals, pulses, fruits/vegetables, meat, fish; cash crops, forestry, mining, industry.

Each of the production units has its input and output quantified, based on as assumed production function. In each unit, the production is carried out at a given level of technology: low,medium or high. The level of technology can be raised for any production unit, provided specified investments are made, such a change will be savings, and expected output will increase. The inputs to provide for the management of the production units are public works, education and tools as investments, and fertilizers or new materials, energy and labour as recurrent expenditure.

The first roles in SNUS are played by regional teams who are responsible for the management of the production units, first to purchase the required inputs and then to make the produce available to the market, with a minimum of transportion and other losses. Efficient management ensures that available resources are allocated so as to yield maximal output.

SNUS recognises the common duality in the economy of developing countries caused by the existence of a subsistence sector. This comes into play most significantly at the stage of purchase of inputs. Those agricultural production units applying a low level of technology are, in the context of SNUS, considered to be working for subsistence, which means that the only recurrent input they require is labour; they require neither fertilizer nor energy. Obviously, since these production units have no economic means, the produce belongs to the labour in lieu of wages.

The playing board has a market place which represents all the markets in the country. All produce meant to be sold must be brought to the market. In this process, transportation losses are incurred and their magnitude defined by the distance of the production unit from the market. At the market, the produce is either purchased by a buyer from within the country or it is exported, giving the country export earnings. In the game the complications which would be caused by changing prices are not considered; the prices are fixed at various levels represented (wholesale, retail, export and import).

The population of each region (rich and poor) have income from employment in the production units. This income is pooled and then used for purchasing food, which is the only commodity recognised as a consumption item. Even though their money is pooled, the difference between rich and poor is brought out at various stages.

First, employment opportunities go first to the rich; only when all rich are employed can the poor be considered. Second, the demand for food for the rich is always met; only when the rich have been fed can the poor use money from the pool to purchase food toward meeting their demand. Third, at the stage of food preparation the rich have less losses than the poor, since their facilities are much better than those of the poor.

After the steps comprising production and distribution of commodities according to demand are available resources are completed, there are three simultaneous activities carried out. A nutrition planning team prepared a report to the cabinet. The report is based on a nutritional assessment of the extent to which six population groups managed to satisfy their demand for food. The nutritional characteristics of their diets are simplified into energy, protein and Vitamin A. The value of diet is calculated and converted into per capita consumption, given in terms of energy, proteins and vitamin A. These figures will be divided by the estimated requirements and the figures thus obtained reflect the adequacy of the diet. As an example: if the consumption in terms of energy is equal to the requirements, the adequacy is said to be 100%. For those population groups with an intake substantially lower than 100% for any nutrient, SNUS has defined rules for the negative effects of such an event. Low energy intakes affects worker productivity, if it is very serious it causes migration; low protein intake causes increased health costs and low vitamin A has an effect on the cost of education.

These effects have to be taken into account for the next planning cycle. On the basis of this assessment, recommendations are prepared for consideration by the cabinet.

A national planning team collates the data describing the performance of the economy of the country and prepared recommendations to the cabinet on the basis of their analysis.

Three regional teams formulate projects aiming at improving the situation in their own region and prepare requests for their funding from the national budget to be decided by the cabinet. These projects can have objectives of increasing agricultural production in order to provide more food or more income to purchase food.

The roles in the cabinet includes five ministers: the Minister of Finance; Agriculture: Health and Social Welfare; Natural Resources; and Industry and Public Works. The cabinet meeting is the most important phase of SNUS as it provides the forum for discussion of issues pertinent to the solution of nutrition problems of the nation.

The performance of the economy of the country cannot be exactly predicted, even if all inputs are pre-occurred. There are random climatic effects on agricultural production, there are certain "human events" and there are "natural events". The climatic effects are determined by the result of a throw with two dice to adjust the size of harvest in positive or negative direction of up to 20% from normal. The human and natural events are given on a set of cards from which random draws are made. An example of the content of these cards are:

- strike by urban workers causes large production losses in city.
  Results: 20% loss in industrial production units.

After the cabinet has decided on the policies and programmes they will pursue, another event card is randomly selected. This gives a "natural event" similar to the following:

- infestion in farming region disrupts cereal production.

  Results: 10% less in all cereal production units operating at low level of technology.

Not all but the great majority of events have a negative effect. The reason for this is that - at variance with real life situations - mere luck should not save a cabinet from facing the results caused by a selection of policies and programmes.

2.4.2. Design a House Game

This is another example of a model which has proved successful in its use as a training tool and evaluating consumer preferences for house design in the developing countries is "The Design a House Game", experimented in Zambia. In Zambian cities, especially on the copper belt, housing has been provided by the major employers - usually the mining companies - and councils in large "townships" of detached two, three or four-roomed concrete bungalows of standard design on a fairly standard size of plot. The preponderance of a single type of housing provision has influenced the concept of a house which people have when building one for themselves. They are further constrained by building regulations which specify materials to be used, distances between houses and service provision.

A game designed by the National Housing Authority for the Lusaka Show in 1971 and 1972 was taken as a basic model and redesigned to simplify its use, concentrate on what were considered to be the most important aspects of house design in Zambia, and generate usuable data for analysis. The resulting game was used in Lusaka at the "Tiyende Pamodzi" Show in October 1974 and proved reasonably successful. As a result of experience there, modifications were made to the game board and it was used by Kitwe City Council at the copper belt Agricultural Show in Kitwe in May 1975.

Almost 100 people played the game in the three public days of the Show and 80 results were recorded to allow some analysis of preferences to be made.

The elements of the game are eight choice parameters: plot size, number of rooms in the house, wall construction, floor finishes, roof construction, power, washing and toilet facilities, and furniture. Each parameter is represented by a row of 'windows' showing alternative levels of facility, each of which can be selected by turning a switch to light up the relevant window. The cumulative cost of the selected level of facilities is registered on a dial mounted on the game board. In order to reflect the real life choice of the householder building the house himself, a self-help switch can reduce the cost of the rooms, walls, floor and roof by one third.

The game starts with a minimum level of facilities pre-selected and 'charged' on the cost meter. These represent a minimum plot size with a house containing a kitchen and one habitable room, built with unplastered mud brickwalls, a beaten earth floor, and a room of asbestos cement without ceilings. No electricity, furniture, or internal washing or toilet facilities are provided.

Each player is set a budget related to his monthly income (approximately three years' salary being the guideline from the choices available). In this way he can sort out his priorities, perhaps for the first time and give himself and policy makers information which would otherwise be unavailable. Players seemed to enjoy the game especially where the budget was low and several attempts had to be made to maximise preference without overspending.

This review of planning gaming simulation models have dealt only with what one considered to be the most significant and well known models, particularly to the researcher. In practice there is probably in existence or under development very large numbers of gaming simulation models dealing with all or some planning problems.

2.5. GENERAL CHARACTERISTICS OF PLANNING GAMING SIMULATION MODELS

Planning gaming simulation models as reviewed above vary widely in their details, however they all appear to share certain characteristics which are emphasised to different degrees from model to model. Taylor (1971) the following characteristics:

(i) They are principally used for learning how systems react under continually changing conditions.

(ii) They are in essence simple abstractions of reality.

(iii) They achieve their simplicity very largely through reducing complex operations into a series of simply expressed actions controlled by explicit rules.

(iv) They expose participants to certain pre-selected features under relatively controlled and risk free circumstances.

(v) They allow concerted use of physical models, mathematical representation and human behaviour.

(vi) They require participants to assume roles involving various degrees of co-operation, competition and conflist between players or teams to make decisions which reflect their understanding of key features of the model.

(vii) They produce certain decision 'payoffs' - reward or deprivation - determined by chance, by reference to human assessments or by use of predetermined rules or formulae.

(viii) They provide varied experience in controlling the course of events over time where the state of the simulated environment is continuously altering in response to the quality of an accumulated decision making.

(ix) They generally compress time, and as a result, are able to provide rapid feedback on the results and consequences of decisions.

(x) They progress in predetermined stages or periods and each period represents an allotted time span.

PART II : EXPERIMENTAL STUDIES

3. EXPERIMENT I - NATIONAL INVESTMENT DECISION GAME

3.1. INTRODUCTION

Studies of development can begin from any of a number of disciplinary issues, for example, as the relative weakness of interest groupings in the political systems, or the peculiar function of ideology. One may well assume that it is somewhat more refreshing to take such policy problems as a starting point in this area and then see what the disciplines can do about them. Thus, if one begins with the problems of policy making in developing societies, and then tries to work out what contributions planning can bring to bear, one will see at once at least three aspects which might be tackled.

The first can be organisational, policies emerge from somewhat peculiar decisional systems. What is called governmental decision-making organisations like cabinets, committees, departments or arbitral or reconciliating structures are peculiar enough decision-making situations in any case, with their characteristics of institutionalisation, of group behaviour and of imbalance toward incremental rather than innovative outcomes. These peculiarities are no less in societies requiring and seeking rapid change and having severe obstacles facing them.

Secondly, there is the notion of policy itself; that is to say a distinction, briefly between the idea of policy as a commitment of resources with certain possibilities of defending that commitment, from other notions of goals or aims on the one hand and ideologies, promises, wishes or dreams on the other hand. Once again, the distinction between the notions of policy and ideology is peculiarly important for the politics of developing countries.

Thirdly, there is the idea of outcomes: that is, the notion of distinguishing between decisions as the ending determination of processes of choice, and the actual consequences of those determinations once the play between the choices and the environment comes into play. The gap between design, selection and choice on the one hand, and the consequences on the other, is again particularly vivid in developmental experience, most familiarly, and perhaps importantly so, now, is the gap between plans or planning documents, seen as very elaborate statements of choice indeed, and the actual record of planning experience.

It is very worthwhile, then. seeing how one can further the study of these three aspects of public policy decision making (particularly as it happens, for some of us concerned with developing societies), and the relationship between them. One of the ways of doing so is evidently to abstract certain features of collective decision making, and negotiation which are present in these aspects and then analyse and to simulate them. Consequence this case is a simulated decision making system in Nigeria, designed to expose the difficulties of decision making through the mechanism of investment allocation to achieve national objectives and to reflect how the state government makes claims from national government through its physical resource. A post game delphi technique was used to develop components needed for planning.

The main area of research is to explore the potential of gaming simulation techniques as an effective means of learning and communication in the development planning process.

3.2. GENERAL CHARACTERISTIC OF THE MODEL

A description of the component parts of the game follows with the decisions taken in its design hopefully being made explicitly. It is worth mentioning at this juncture that the game was adopted from the model "Calagrande" designed by Drew Mackie.

Roles: The actual roles chosen for players followed certain constraints:

- practicability: in terms of the number of groups or individuals represented. It was envisaged that if the number of players exceeded 50, the game would be difficult to arrange and hard to manage. Equally (after listing potential roles) it was felt that a number of roles below 25 would act to close the system beyond an acceptable point.
- flexibility: with a possible variation of 25 - 50 in the number of roles and players, it was felt that certain roles should be capable of "doubling up" without obvious incompatibility in objectives.

The following roles were actually selected in the simulation:

The central government role; represented by a team of no less than three players and no more than five players. They include the president, the minister of works and housing, the minister of agriculture and natural resources, the ministry of health and education, etc. They act on behalf of the office of planning and co-ordination of the National Central Government.

The state government role; represented by no less than ten and no more than nineteen. They represent and act on behalf of the nineteen states in the country.

The entrepreneurs' role; represented by a team of no lessthan two players and no more than four. They act on behalf of and represent the interest of industrialist and foreign investment groups.

The political opposition role; represented by a team of no less than two and no more than four. They act on behalf of political parties of opposition who oppose the policies of central government.

The unions represented by a team of no less than two players and no more than four. They act on behalf of the workers.

The national press role represented by a single player whose function is to report all major issues in the game.

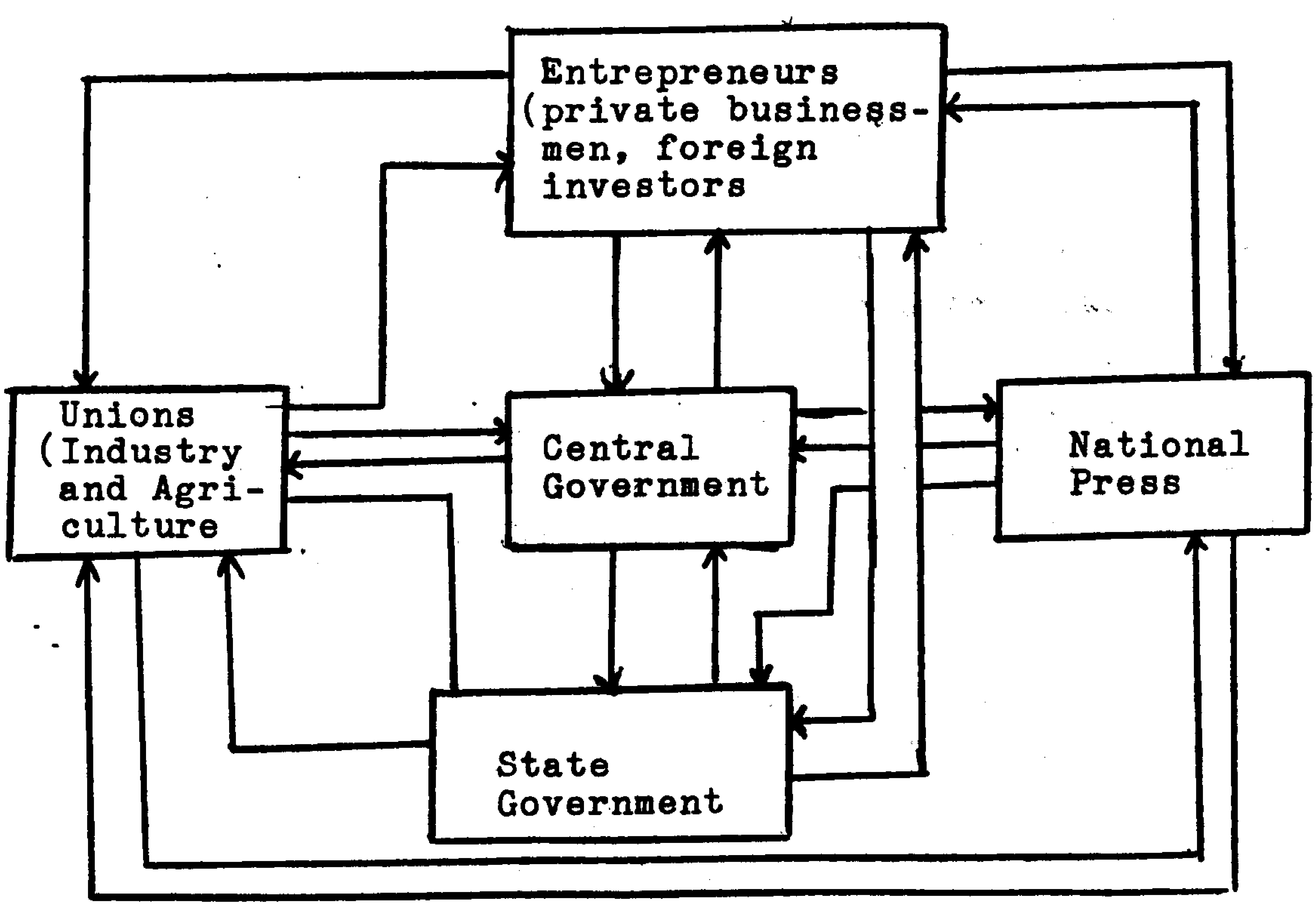


Figure 20: Role Interaction

A role definition matrix was outlined, so that information about how teams characterise themselves and one another could be included within the exercise as part of the reality which surrounds a particular role in the real life situation. Such role matrix contained information about every role in three basic subjects:

Political orientation of the role in question as seen by itself and by other roles.

Role's power as seen by the role in question itself and by other roles.

Definition of the general economic conditions of the country, states, etc, as defined by the role in question itself and as defined by the other roles in the exercise.

<u>The Model</u>: It was felt that the game should be played on and around a model of the country. This would be a model on which results of decisions would be recorded. It would act as an important identification element in simulating results, and a focus for contact between players.

But the immediate problem became that of scale. It was felt that any representation of the country upwards of 1:2,000,000 would not allow the model to serve any of its proposed purposes. An ideal scale was considered to be 1:800,000 for detail, but this proved impracticable in the case of Nigeria. The map would have been unmanageable at 5M minimum length.

A representation at 1:2,000,000 was decided upon and a base was made on a tracing paper on which was marked the main roads, railways, the relief and vegetation condition, the state capitals, the state boundaries, the agricultural and industrial units, the mineral resources, basing on the information presented earlier, the airports and seaports are also indicated.

A degree of detailed identification of the natural and mineral resources of the country was in fact possible at this scale although the model was by no means accurate, but major landmarks were carefully represented and in several cases labelled for identification.

<u>Time Consideration</u>: As in the case of Nigeria many of the investment projects are from the National Development Plan, and the strategies are designed to cover a time-span reaching 5 years. Thus it was proposed to build-in the time element by operating the simulation in rounds of two to three hours each representing 5 years.

<u>Political Elements</u>: To simulate reality more closely, when choosing the roles for inclusion in the simulation, it was decided that political elements would be simulated by the election of a president who will then appoint cabinet ministers to serve as the national planning office. Votes are allocated to state governors, the number based simplistically on the comparative size in population of each state. Elections occur at the end of each round for the post of the president. Any player may stand. Each candidate gives a short election address. Political alignments may be expressed. The distribution of votes to states is as follows:

Anambra state	4	Kwara state	2
Bauchi state	2	Lagos state	2
Bendel state	3	Niger state	1
Benue state	3	Ogun state	2
Born state	3	Onso state	3
Cross river state	4	Oyo state	4

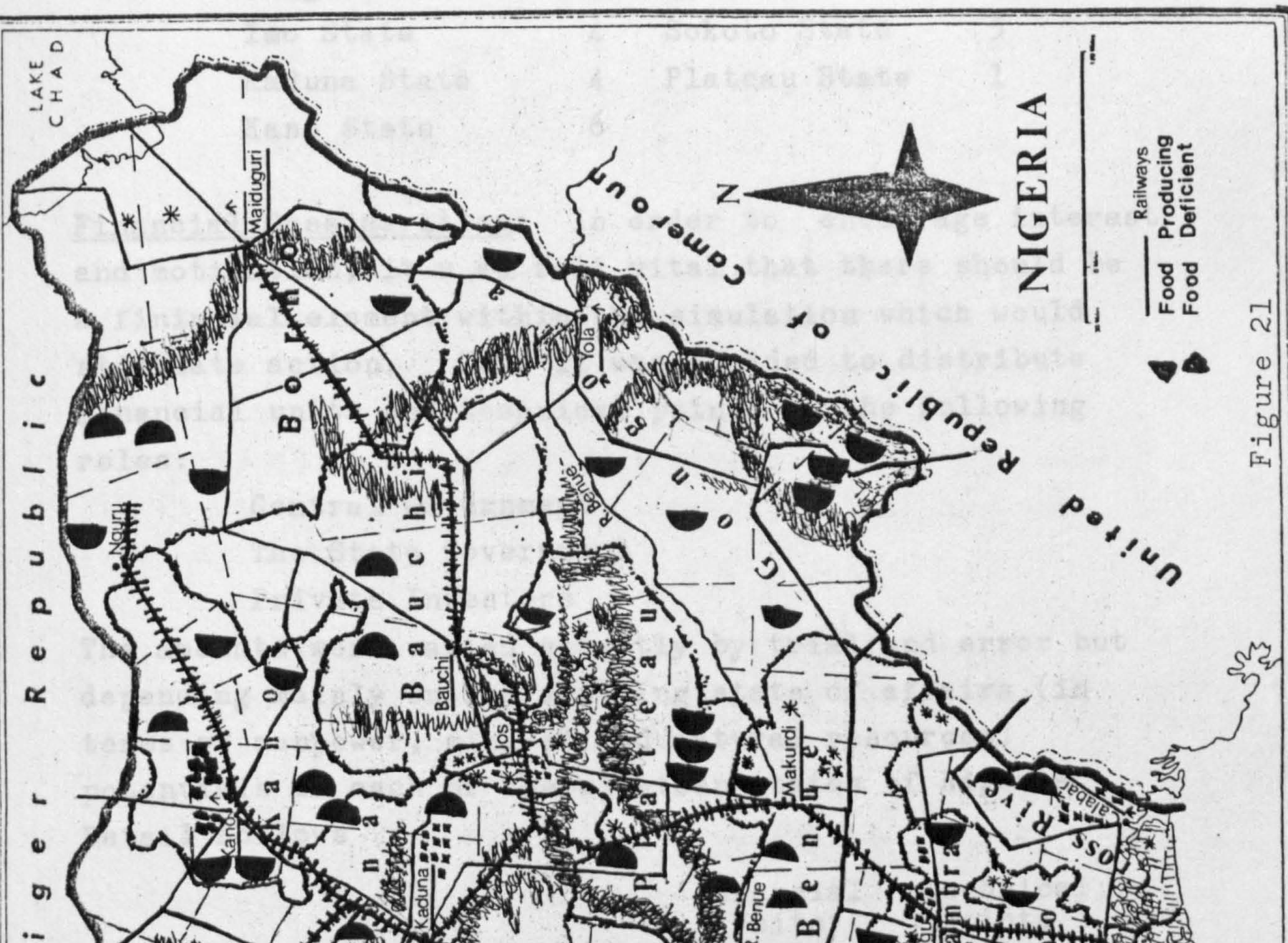

NIGERIA
N
Niger Republic
United Republic of Cameroun
Republic of Benin
GULF OF GUINEA
LAKE CHAD
R. Niger
R. Benue
Food Producing
Food Deficient
Railways
Sokoto
Kaura-Namoda
Kano
Nguru
Maiduguri
Yola
Bauchi
Jos
Kaduna
Zaria
Minna
Federal Capital Territory
Makurdi
Lokoja
Ilorin
Ibadan
Abeokuta
Ikeja
Lagos
Akure
Benin City
Enugu
Owerri
Port Harcourt
Calabar
Sokoto
Kaduna
Kano
Borno
Bauchi
Gongola
Plateau
Benue
Niger
Kwara
Oyo
Ogun
Ondo
Bendel
Anambra
Imo
Rivers
Cross River

Figure 21

Gongola State	3	Rivers State	2
Imo State	4	Sokoto State	5
Kaduna State	4	Plateau State	1
Kano State	6		

<u>Financial Consideration</u>: In order to encourage interest and motivation, it w as felt vital that there should be a finincial element within the simulation which would stimulate action. Thus it was decided to distribute financial units and technical points to the following roles:

Central Government
The State Government
Private Investors

The amounts were varied slightly by trial and error but depending mainly on the existing state of affairs (in terms of manpower, mineral and natural resources) potentials of each of the nineteen states of Nigeria. Detail follows

	Financial Units	Technical Points
Central Government	150	60
Anambra State	5	3
Bauchi State	3	2
Bendel State	5	6
Benue State	3	2
Bornu State	3	2
Cross River State	5	3
Gongola State	3	2
Imo State	5	3
Kaduna State	5	3
Kano State	5	4
Kwara State	3	2
Lagos State	5	4
Niger State	3	2
Ogun State	5	3
Ondo State	5	3

Oyo State	5	3
Plateau State	3	2
Rivers State	5	2
Sokoto State	5	2
Entrepreneurs	60	20

While attempting to retain a degree a reality some simplification was considered necessary in order to facilitate the operation of the simulation. There were doubts at this stage as to whether the somewhat arbitrary allocations would achieve a workable balance. But it was assumed that only subsequent testing would yield an answer.

The financial element it was thought, would not be interpreted as a "way of winning" but a means of clarifying the ways in which our system functions.

The price list for capital projects are as follows:

	Financial Units	Technical Points
Road Project	1	0
Rail Project	1	0
Port Development Project	2	2
Airport Development Project	2	2
Power Stations	1	1
New Industries	1	1
Oil Field Development	3	2
Military Unit	2	2
Health	1	1
Housing	1	0
Agriculture	1	1
Other Mineral Exploration	1	1
Education	1	1

Each industrial unit may produce 1 financial unit at the end of a five year period. Each agricultural unit may also produce 1 financial unit. The output of each of these can be doubled if a technical point is assigned. Technical points are not spent they are renewed each period. Entrepreneurs has a potential profit of 1 unit from each operating industrial unit. This may be increased by 1 unit for each technical point assigned to an industrial unit and may be reduced if the Entrepreneur player has had successful strikes against him or if he has given wage rises. Any oil-field development produces 10 financial units and 5 technical points at the end of a five year period.

<u>Sequence of Events</u>: The model simulates the national development planning process of Nigeria, and the wisdom of planning decisions made in Cabinet meeting can be evaluated, since the decisions are implemented in the simulation. This leads to another planning session with new decisions followed by implementation. Thus the model is run in cycles, with each circle containing a number of steps of play: establishment of investment objectives; negotiation; establishment of planning programme; computation of budget; election.

<u>Establishment of Objectives</u>: players develop their objectives after going through the scenario as is given to them and sets out strategies to achieve objectives.

<u>Negotiation:</u> after the formulation of objectives, players may start to negotiate with each other to achieve objectives. Players may wish to keep their negotiation secret or may wish to make public announcement during this phase. During the process the press may make public statements. Cabinet ministers at this stage receive project

requests prepared by each state.

Establishment of investment programme: the cabinet meets and discuss the investment programmes after hearing reports and recommendations from the states, the union and entrepreneur. The time factor is of importance to put pressure on the cabinet. The operator or controller decides on the time limit to impose. While the cabinet meeting is going on, other roles prepare their policies. Cabinet establish priority projects and allocate budget to them accordingly.

Policy Presentation: the cabinet announces its investment policies and investment programmes, state where capital investment projects are to be implemented on the map. The states announces their own policies, and where necessary conflict between these are resolved by the controlling team. Of particular value to meet the purpose of the simulation, that is, to increase the communication between participants from various disciplines, is the discussion of the various policy measures and their consequences. This is the phase which very clearly makes the participants aware not only of the multisectorial effects of investment policies but also that investment policies for national development can be tackled from many directions. The selection of priorities and the spatial location of capital investment projects normally leads to heated exchange of views, and the realisation that the budget cannot accommodate all projects brings out a wide array of argument for the selection of those with the highest benefit. Implementation follows by indicating projects accepted on the model.

Computation of Budget: after the policy presentation phase each participant updates his budget sheet which indicates the starting level for the next round. This also includes calculation of tax revenues.

Election: the round terminates with the election of a president. This is to show the public approval or disapproval of the investment policies and the package of investment projects.

3.3. TESTING THE SIMULATION

Thursday, May 29th 1980 was set as the date for the first testing of the game, a Thursday being the only practical time on which to expect students (post graduate planning students) and staffs to give up several hours of their time. Friends from other departments were also invited to spend the day from 9.30 a.m. onwards at a "party with a difference" where a policy decision game would be tested in between meeting others. In fact the whole event was made out to be a social occasion. Drew Mackie - a co-designer of the game, was invited to give a brief lecture on gaming simulation in public policy studies before testing the game.

In the event a degree of "hard sell" was necessary in order to induce a selection of people from different interests and disciplines to spend at least eight gardening hours in the last term in university huddled around a model of Nigeria. The subterfuge did not, as it turned out, offend in any way, those who attended. The friends who were asked had been, to a degree, selected because of their views, backgrounds and interest were felt to give a fair representation of the prople who it was hoped could ultimately derive the greatest benefit from a gaming simulation of this type. One factor must be noted, that the final year MSc II students as part of the course programme of the year had already undertaken a preliminary study of

National Development Planning and Regional initiatives in Nigeria.

Before the start of the game, players were asked to indicate their own assessment of their previous experience of gaming simulation, the Nigerian Development Planning system, and knowledge of Nigeria. The results of these three were as follows:

Previous experience of gaming simulation

None	20
Negligible	8
Some	3
Considerable	2

Previous experience of Nigerian Development planning system

None	10
Negligible	16
Some	2
Considerable	5

Knowledge of Nigeria

None	8
Negligible	5
Some	5
Considerable	15

The following facts are also considered pertinent

- 18 out of 32 were Nigerians
- 2 women took part and 30 men
- ages were distributed between 24 and 40 with average age to be 28 years.

While the role allocation was being planned, the players coffee in hand at this stage, appeared to be chatting happily around the model without the majority knowing anything about the game, the "model" had become a centre of conversation and interest. A "game" had already inadvertently started, that of identifying objects on the model.

"That's where the new federal capital is?"
"Isn't that where the uranium deposit is?"
"Oh, that's the main oil refinery".

The time had come to explain and brief. Players were told that the game was based on Nigeria, and involved the acting out of allocated roles that were instrumental in National development planning. An information sheet was handed out to players. This contained a description of the roles, the description of the National, and each of the states economic, social, political and cultural background. The state budget sheet was then distributed with price list and budget allocation.

Nigeria was then described verbally, accompanied by explanation of the game symbolic language. Views were identified on the model, and specific issues were stressed. Players were then allocated their roles and relevant labels of identification adopted. Discussion ensued concerning both Nigeria and the roles. Then the rules of the game were explained. As these are fairly few, their principles were made clear, but it was felt better not to delve into detail.

At this point, confusion was detected and a break was called. Questions were answered on individual basis by the two participants who had knowledge of the game. The informality of the procedure appeared to allay suspicions and fears as to what was to come.

It had been stressed that what would happen would be up to the players themselves and if they felt they

needed guidance, the game controller would help.
The ideal way to monitor the game would have been by video, but this not being possible other procedures were adopted. The interaction during the game was photographed. Participants were given a diary sheet to re record for each round, the events, alliance and transactions, and the cabinet and state planning programmes and policies in each was collected for analysis.

<u>The feel of the Play</u>: Some players adopted a policy of egoistic self interest. It works for some time. The constraints within the system made frustration inevitable. There were always those who try to "go it alone", seeking to manipulate the whole system on behalf of some personally favoured policy. This succeeds for a short period. Soon it becomes evident that one cannot avoid cooperating with others to achieve even a modest range of objectives. One player gains victory for his own ends in the first round only to find that, despite a temporary increase in his influence, it has increased his chances of defeat in subsequent play. Stalemate and deadlock between conflicting parties operates for several periods until it is finally broken up by compromises.

A typical example was when a group of southern states formed an alliance and threatened the Central Government to secess in round 1 because of its policy of uniform taxation. However compromise was evident in round 2 because of the appointment of one of the Governors of the seccessionist states as a cabinet minister.

The shrewd bargainer, meanwhile, is discovering the nature of the constraints which limit what he can achieve merely through adroit bargaining. Those with power (central government) discover that command is not of itself sufficient to get decisions implemented - that without the support of the states, the president is not as all powerful as he might believe himself to be.

PLATE 1: President pleading for support

Some players neglect long term considerations to capitalise on short term payoffs, but are brought up short when it runs out of resources and goodwill at a critical point of development in subsequent rounds. Another set of players fail to adopt flexibility to changes as they occur, so fixed in their concentration on longer term results. They soon learn how for present decisions constrain, limit, guide or dictate future decisions. At one point, participants were so locked into conflicts on behalf of regional and sectional interest that they begin to pull the country apart. See Plate 2 some southern states succeeding to form Delta republic.

PLATE 2 Players form alliance to break away from the rest of the country.

Genuine cooperation often develops after some time, those involved perhaps discovering that this is the only way in which change can be effected. Some players gradually gaining ground in respect of their own goals as a result of elaborate and systematic calculation and prediction of events, suddenly find all their painstaking work overturned by their political miscalculation. Yet others were still trying to decide what their objectives were.

As the game proceeds, players find themselves increasingly involved in the developing simulation. Arguments and discussions take on a very serious, real appearance, people are by turns angry and aggressive, thoughtful and reflective, perturbed, acquiescent, stubborn, sceptical, jubilant. By lunch-time, some players feel (and look as if) they have undergone a

PLATE 3 Players find themselves involved in the simulation

month's experience and learning. Some seem to suffer from decision making "fatigue". Some recognise their mistakes and try to correct them only to find they have over-reacted and must suffer the consequences. People begin to realise that they cannot get what they wanted simply by asking for it, nor merely by arguing for it persuasively.

During the first round of the game, players tended to be more inhibited in their ideas as to what could help them achieve their aims. But soon when some of the players were seen to break through the constraints of preconceived notions, others could be seen to accept the challenge of innovating within their roles. Players admitted to surprising themselves by their own capacity to act out roles.

PLATE 4.(Policy presentation in round 1

During the game players would not hesitate to enquire of the game controller when they encountered anything they did not know or understand, and again that players on learning from their discoveries, would frequently share information with any player, not just those with whom they were allied.

3.4. ASSESSING THE SIMULATION

At the end of the simulation exercise, the exhausted players were given a "feedback" questionnaire. Despite their condition, all filled it in without needing to be persuaded and with a surprising degree of enthusiasm.

It is noted that the results of questions and observations made during and after the two runs are in no way to be considered conclusive. Controlled experiments with controlled groups were not carried out - this would have been too costly, even if possible under the time constraint.

The questionnaire answers and the observations are presented below and assessed against the objectives expressed earlier, but no statistical validity is in any way claimed and no guarantee of future effectiveness is any way assumed.

The following two types of assessments were made:

1. The effectiveness of the technique of gaming simulation as an on-going learning and communication device that will increase an understanding of national investment planning.

11. The effectiveness of the model developed in this project.

3.4.1.1. General Reaction to the Simulation

The great majority of the players enjoy the simulation. Their comments show that the motivational effect of the setting was indeed at work. Some were no less than enthusiastic. They learned but they also had fun. They felt personally challenged, and they liked it; they would enjoy renewing the experience. A flavour of all these is provided by the statements players made after playing:
"What a simulation!"
"You really had to think and use your head seriously. It was a great simulation and fun too".
"The simulation was realistic, but it was a lot of fun".
"Terrifically stimulating! and useful. You are forced to evaluate yourself".
"Excellent valuable experience of thinking".

"I have learned a great deal from this. I hope you will bring it to Nigeria".
"I consider the simulation a great success in that I have learned the importance of politics in National development planning".
"I would enjoy being able to play the game again".
"Very good, I would like to take this back to Malayasia." "It would show people just what happens in the National development planning process. The complexity of the simulation was enjoyable in itself".

These comments were offered spontaneously in the answers to open ended questions or on the back of the questionnaires. As a rule, however, they are mixed with the answers to the following question.
Do you feel that by participating in this simulation you have learned something about the use of gaming simulation methodology for public policy decision making particularly National investment planning in Nigeria.
It is why I have coded this question according to two dimensions: intensity (enthusiasm) and specifity of learning. A seven point scale was thus adopted.
To illustrate the concrete content of the scale categories, the following is a sample of coded answers:

Question: Do you think that by playing this game you have learned ....see above).

Category 1

"Yes definitely! I realise the fact that there are competing priorities for limited resources; the need to put creative and constructive ideas into the form of policy. That National investment policies due to vagueness, and lack of political support exhibit failure in realising some of its set out objectives".

"Yes definitely! Too many regional and sectorial interest when there should be cooperation to achieve national objectives. The fact that policy programmes may have different impacts upon different social sectors".

Category 2

"Yes, the simulation illustrates the need to develop decision making skill in an environment which involves uncertainty and restraints (budget), the operationalisation of a modified PPBS system".

"Yes, the model provides an insight to the industrial, natural and mineral resources of each state and the country. I can now identify the poor and rich states. The simulation highlights conflict between equity and fairness. The role of planning should be to resolve equity and fairness".

Category 3

"Yes, the day is stimulating and I can now see how politics and economic power are influential in determining priorities for national investment decisions".

"It taught me the role of politics in planning, the importance of carrying out one's responsibilities, the importance of group decision making, and the need to think in terms of goals or objectives".

Category 4

"Yes I do. I found I didn't know anything!".

"Yes, it gives me an understanding about the relationship between my culture and the other cultures. I developed a higher consciousness of the role I played. During the game new interconnections and restraints kept coming up that I hadn't been aware of before".

The next category includes those respondents who, for one reason or another, did not learn very much by playing the game:

Category 5

"A little. In most cases policies taken in the game would not be applicable to my country. The game should be simplified to reflect physical planning".

"Very little because situations very much general".

Finally, categories 6 and 7 include the negative responses to the game experience, with category 7 representing an intensity of negative feeling which can only be compared with that (positive) category 1.

Category 6

"No, I do not".

"No, I feel this really did not serve a very useful purpose".

Category 7

"Directions not clear, people don't understand, symbols need more explaining".

"I think it was very poorly presented. I would not want to repeat it ever again".

Given this categorisation, the distribution of responses is as indicated below. Several things should be said about the bulk of the participants (over 80%) who feel that they have gained by participating in the simulation.

Category 1: Intensive specific learning	6.5%	
Category 2: Intensive general learning	12.9%	19.4%

Category 3:	Specific learning	25.8%	
Category 4:	General learning	38.7%	64.5%
Category 5:	Learned very little		6.5%
Category 6:	Negative response to the game	3.2%	
Category 7:	Very negative response to the game	3.2%	6.4%
	No answer		3.2%
			100.0
			N = 31

4.1.2. What has been Learned

The most pervasive single thing which is learned by the players is probably a general feel for the situation. It is a deep and fundamental dimension of learning. But to the same extent it is a difficult one to express. As a matter of fact, players are often aware of the imponderable nature of what they have learned; thus one respondent writes "I cannot think of anything definite I have learned, but in case I am involved in National planning I might do something that I would'nt have done if I hadn't played this game". Others, the majority, convey the same message by speaking of what they "feel" or realise as a consequence of playing the game: "This game led me to have a deeper understanding each of the states mineral, and natural resources. I had a chance to learn about playing politics by negotiating and communicating with others".

"I definitely feel that this has awakened me to some of the difficulties of cabinet decisions and co-operation during National development planning".

"After this experience, I can see better how to carry out plans with certain restrictions like budget problems". "I gained experience in a role which could be applied directly to real life if the situation ever came up".

"It helps a person realise the need to develop decision making skills in an environment which involves uncertainty and restraint".

"I did not realise the trouble that could be caused by lack of communication between central government, states and entrepreneurs. The game led me to have a deeper understanding of how to decide priorities in developing policies and evaluating project effectiveness".

This learning by experience is of course one of the major aims of games with simulated environments. Above all, abstract concepts such as cooperation, etc, get a concrete meaning. Furthermore, one is supposed to learn by experience because one is able to make mistakes. It is interesting to see how strikingly such an assumption is borne out.

"Role changes character, what I fail to appreciate as a cabinet minister, I came to appreciate and fought for it as a state governor".

"I learnt a lot about how to play safe. I think we made as many mistakes as possible, but I also think that this could prevent us from making the same mistakes in a real experience with National planning".

"I was under the impression that massive Nationalisation would be of great help but I see that in case of real investment planning they would be of little or no help".

"It surely showed me that I had some mistaken ideas about what would be the best policy to adopt to play safe".

Thus the players didn't only learn superficially a set of facts, but they were eventually to use them to reconsider their outlook on national investment planning. Moreover, whatever shortcomings they discovered in their previous knowledge, rather than inducing discouragement, led some of them to face the necessity of further learning:

"I have learned that there are many things that I don't know about in my country which I should know for effective operation of National planning in Nigeria".

"I think that I have learned something and I am going to try and learn more if I can".

4.1.3. The Realism of the System Simulated

Given the impact of the game it is important to inquire whether the knowledge which was inculcated in the players is valid. Usually, the only way to do this is to ascertain to what extent the model which is simulated fits the actual decision making process.

First, the players were asked whether they thought that the game was realistic. Their reaction is quite revealing:

"The politics, voting pattern, seccessionist tendency seemed very real. The realism of people not co-operating or challenging central government policies seemed very much present, too".

"It did allow the occurrence of many policy decisions that I am sure would prevail".

Second, players were asked whether they had ever been involved in any form of National planning. This question allowed me to determine who were the subjects who had previous first-hand knowledge on the matter. Table 3 shows how these respondents perceived the game and how much they learned by playing it.

TABLE 3

Perception of the Game				
	N	Very Realistic	Realistic	Not Realistic
Proportion of players with:				
Previous knowledge of National investment planning	7	57.1	14.3	28.6
No previous knowledge	(24)	29.2	45.8	25.0
	(31)			

TABLE 4

Learning by Playing the Game				
	N	Learned Very Much	Learned	Did Not Learn
Proportion of players with:				
Previous knowledge of National investment planning	7	14.3	57.1	28.6
No previous knowledge	(24)	25.0	54.2	20.8

Players' knowledge of National planning and the perception of:

1. The realism of the game
2. How much they learned by playing it.

As is apparent from this table, players with previous knowledge on National planning tend much more than the others to find the game very realistic. Inversely they tend to learn less by playing it. Put together these two findings make indeed sense. Insofar as the game is realistic it is exactly what one should expect to happen. Quite naturally, in the light of their previous experience, people with a good knowledge of National development planning should be better able to recognise the basic validity of the complex political, social and economic situations, as they should have less to learn by being once more involved in it. That this interpretation is not arbitrary is clearly shown by the following comment of a player researching on National planning in Egypt:

"I thought it was very true to National investment planning in that what we have done in this game was basically similar to what was done in the Suez plan after the Middle East war", though in terms of learning he adds the general comment that the game only clarified and made many things much clearer to him.

One should not overlook, however, that the statistical test used fails short of significance for each of these findings. A close inspection of the data shows that this outlook should not surprise us too much - for there are relatively few cases of subjects with previous good knowledge of National planning in developing countries especially Nigeria.

4.1.4. Communication

The alliances and transactions that took place during both rounds were recorded by each player. They are indicated in Figure 22. It was evident in both rounds that central government acting on behalf of the office of planning and coordination and public roles

	Fed Govt	Anambra	Bauchi	Bendel	Benue	Borno	Cross River	Gongola	Imo	Kaduna	Kano	Kwara	Lagos	Niger	Ogun	Ondo	Oyo	Plateau	Entrepreneur	Rivers	Soko
Fed Govt		○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Anambra	○			○	○		○		●	○			○			○		●	○	○	
Bauchi	○				●	●		●		○	○	○		○					○		○
Bendel	○	○					●		○			○	●		●	●	●		○	●	
Benue	○	○	●			○	○	●		○		○						○	○		
Borno	○		●		○			●	○	○								○	○		○
Cross River	○	○		●	○				○	●	○								○	●	○
Gongola	○		●		●	●				○	○	○						○	○		○
Imo	○	●		○	○		○			○								●	○	●	
Kaduna	○	○	○	○	○	○	●	○	○		●	●		●				●	○	●	●
Kano	○	○	○		○		○	○		●				●				○	○	○	●
Kwara	○		○	○	○	○		○		●								○	○		○
Lagos	○	○		●			○		○						●	●	●		○		
Niger	○		○			○		○		●	●							○	○		●
Ogun	○			●									●			●	●		○		
Ondo	○			●			○		○				●		●		●		○		
Oyo	○			●									●		●	●			○		
Plateau	○	●			○	○		○	●	●									○	○	○
Entrepreneur	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		○	○
River	○	○		●			●		●	●	○							○	○		○
Sokoto	○		○			○	○	○		●	●	○		●				○	○	○	

● ALLIANCE ○ NEGOTIATION

Figure 22

communicated with each other. However, this cannot be taken as having any value for the purpose of the mooted final game.

Interstate communication was also evident. Negotiation and alliance formation was more common among tribally, geographically and politically related states. The pattern is quite similar to the trend in present day Nigeria. The communication pattern also reflects the voting pattern. Apart from tribal sentiment controlling the pattern of negotiation, most mineral rich states tend to cooperate and form alliances to fight for one course. This was evident in round 1 when the oil rich states in the south attempted to break away from the country because they felt they had been exploited for the poorer states. Also a close examination of the pattern shows that there was cooperation and coalition among the food deficient states and food surplus states.

4.2. ASSESSMENT OF THE SIMULATION DEVELOPED IN THE PROJECT

A reference must be made here to issues identified. It was felt from the events and subsequent end state of both rounds that the simulation had been effective in providing some insight to some of the problems of National development planning. and equity policy in Nigeria. This was to an extent borne out by the participants response to the questions after game play. But in the absence of "real life players" - people directly concerned with policy making in Nigeria, It is not considered of value to assess each issue specifically. Nevertheless, the observations that are made are not totally removed from the context of Nigeria. The model is assessed and where necessary alterations are suggested below under the following component parts:

Roles Represented: The roles represented seems adequate but in a country with nineteen states, it became difficult to monitor the activities of each of the nineteen states - during the simulation. A fewer number of states (3 - 5) could have allowed each of the states to present their regional policies and conflict with central government resolved. The over simplification of roles also removed the resultant procedure too far away from reality.

The Model: The scale of the model served the function of providing orientation identifying and recording developments that occurred. But it proved too small to illustrate refinements of environmental changes in detail. It can be argued that this is unimportant as there are other gains to be had sufficient in themselves; and that the concern is at National and state level not in local and particular development control level. Nevertheless an expansion of the policy testing value of the simulation could possibly be achieved by increasing the scale of the model. The disadvantage then lies in the functional aspects of its size, scope and construction.

Time Consideration: Five years in two-three hours proved too great a compression, in that processes involved became over-simplified, and perhaps too superficial. This is a personal view. None of the participants commented on the time scale being unsatisfactory. In fact in the final round the fact of 5 years plus from the present appeared to encourage "stretching of the imagination" but nonetheless in a pragmatic way.

An adjustment could and, it is felt, should be made for using the simulation with government officials from Nigeria. But bearing in mind that the National development plan becomes a legal document for 5 years, perhaps the simulation should be retained.

Political Elements: In the simulation participants with voting power took advantage of this by forming alliance with promised votes and of course standing as the president themselves. The absence of additional public roles was felt to have limited permutations and in the second round upset the balance of power. An election at the end of the final round should have taken place.

Financial Consideration: The economic element with in the simulation, it is felt, requires reconsideration. The arrangements were over-simplified and thus not effective enough. Discontent with the return on investment has been mentioned by some of the participants. The rules as employed here did not match the degree of reality simulation as achieved elsewhere in the simulation. They facilitate the playing of the simulation but tunning here is felt necessary for future improvement.

Finally, the very small number of rounds of the simulation undoubtedly affected the validity and reliability of the study. Two rounds of the simulation gave a very restricted amount of evidence on which to base judgements of the feasibility of the model. However, it could be considered as a starting point to what can be called public policy decision making simulation. The use of testing questionnaires becomes another item that may have influenced the results. It has one main difficulty and this is "subjectivity". People when filling out such questionnaires tend to be ambiguous; and if they are asked to comment, then they tend to be emotional in their comments. However, such difficulties can be avoided by playing the game several times, and also having different players in each occasion.

3.5. DEVELOPING PRIORITIES NEEDED FOR NATIONAL INVESTMENT PLANNING

A specially modified Delphi exercise was designed after the simulation to satisfy two study objectives, (i) to develop components for satisfaction indicators of the Nigerian society, (ii) to determine the importance and alterability of components of dissatisfaction experienced by the participants. The study of both importance and alterability of components of dissatisfaction leads to priorities for application of resources in both improving existing conditions and in developing plans for future investment.

A "satisfaction indicator" is an explicated component of the quality of life. It is sometimes developed by studying those things that dissatisfy individuals. To phrase it positively to satisfy an individual with respect to the satisfaction indicator for housing, for example, conditions with respect to that component must improve. Thus the expression of dissatisfaction precipitates the articulation of a goal to improve the housing conditions. Indicators of satisfaction may serve to develop performance criteria. Variations in measures relative to the performance criteria may serve as a barometer of the nation's overall health.

The importance and alterability of components of dissatisfaction are sometimes referred to as dynamic importance. Dynamic importance refers to the operational consideration of which indices should be given the most attention in terms of government effort that ought to be expended on them in order to hold the line or achieve improvements over their levels.

<u>The Delphi Exercise - First Round</u>: An open ended questionnaire was conducted amongst the participants. The open-ended question read as follows: <u>What are</u>

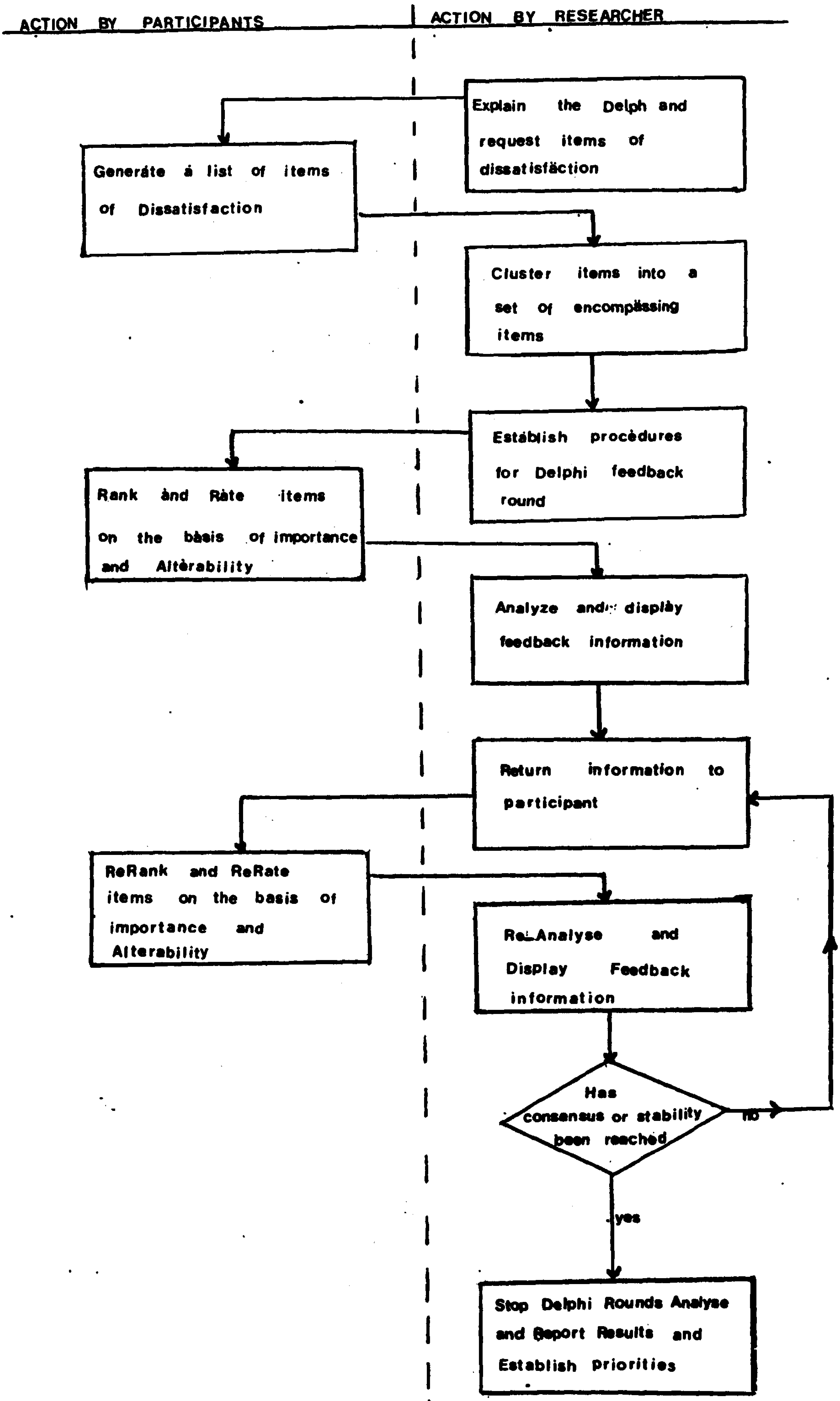


Fig 23 Procedures used in Delphi Exercise

<u>those components of the quality of life in Nigeria which most disturbed you, and is needed to take care of in National investment planning.</u>

This resulted in over 120 phrases describing those items of dissatisfaction. Each of these phrases were transcribed to cards and clustered by a three judge group. The items were first grouped on the basis of all two-judge categorisations. That is if two of three judges placed a given card in a group, that group became a candidate for final group. There were some items which were grouped similarly by all three judges. Most of the items were grouped on the basis of these two- and three judge agreement. In the case of the two-judge grouping, we checked whether the odd judge disagreed with the grouping imposed by the others. Differences were negotiated by all three judges.

This clustering process resulted finally in 19 clusters which were then labelled as simply as possible. These became the components of dissatisfaction. The second round, the panel was presented a list of 19 components of dissatisfaction and the listing of all the phrases that were grouped under each component.

<u>Subsequent Rounds:</u> Three more rounds were conducted. For these feedback rounds the following questions were asked:

(i) What is the relative importance of each of the following to satisfaction with respect to overall quality of life in Nigeria?

(ii) How important is each of the following to satisfaction with respect to overall quality of life.

(iii) In terms of National investment planning to what extent can each of the following be altered in a positive way (by allocating more resources to it).

In each case the list of items of dissatisfaction followed the question with a simple format for responding. It was found that the relative ranking i.e. ranking each from 1 to 19 is difficult to do, especially when statistical feedback is included. This question was dropped after round three. A nine point scale was used to rate each item individually both on the question of importance and alterability. This statistical feedback was accomplished through use of a 'tent' over the scale for each item, which indicated the median, and the 25th and 75th percentiles. Statistical measures indicated a good degree of consensus (reduction in variance on subsequent rounds) and thus the delphi was concluded afterthe fourth round.

Results: The first result was the 19 items of dissatisfaction. These are the result of the clustering of over 120 items offered by the participants. They are presented here in no particular order: (a) housing, (b) cost considerations, (c) health care, (d) agriculture, (e) inequality, (f) education, (g) transportation (h) energy, (i) rural-urban migration, (j) organised tribal system, (k) information, (l) political instability, (m) communication, (n) government responsiveness, (o) labour unrest, (p) industrial development, (q) pollution, (r) water supply, sewerage, (s) natural resource exploration.

The participants could refer to a table of phrases from which these labels were derived. For example, 'housing' served to label the following (a) lack of adequate housing; (b) urban blight; (c) inadequate housing, (d) poor housing, (e) slums, (f) unsound and unsanitary conditions.

Cost consideration included (a) cost of living,

(b) inflation, (c) high cost of housing, (d) high taxes for fewer services.

'Agriculture' included (a) nutritional deficiency, (b) inadequate income, (c) suboptimal use of income, (d) suboptimal use of food, (e) poverty.

The mean rating after round four was used to rank order 19 items on the basis of importance and alterability. This was a better discriminator of the rank ordering than the median, since several items can have the same median score.

Table 5 shows the rank order of the items based on importance. Table 6 shows the rank order based on alterability. Figure 24 depicts the alterability of the item relative to the importance of the item. By way of explanation the 19 items are arranged in decreasing importance based on the result of the last delphi round of importance ratings. The mean rating was used to rank the items. The bars show the mean rating on alterability obtained from the final Delphi round.

Table 5 Rank Order of Importance Based on Mean Rating

Item	Mean Rating *
Agriculture	8.44
Housing	8.32
Health care and sanitation	8.16
Education	7.84
Organised tribal system	7.52
Water supply/sewerage	7.40
Transportation	7.00
Industrial development/commerce	6.76
Inequality	6.40

Table 5 continued

	6.04
Communication	6.00
Cost consideration	5.68
Energy (power supply)	5.56
Mineral resource development	5.04
Pollution	4.76
Rural-urban migration	4.32
Political instability	3.72
Labour unrest	1.84
Information (mass media)	1.40

* These means are based on nine point scale.

Table 6 Rank Order of Alterability Based on Mean Rating

Item	Mean Rating *
Agriculture	8.36
Health care and sanitation	8.32
Housing	8.32
Industrial development	7.84
Water supply/sewerage	7.68
Transportation	7.68
Education	7.64
Energy (power supply)	7.40
Communication	7.20
Natural resource exploration	7.00
Rural-urban migration	6.92
Government responsiveness	6.44
Cost considerations	5.84
Mass media (information)	5.52
Inequality	5.48
Pollution	5.36

Table 6 continued

Labour unrest	5.20
Political instability	4.92
Organised tribal system	3.64

* These means are based on a nine point scale.

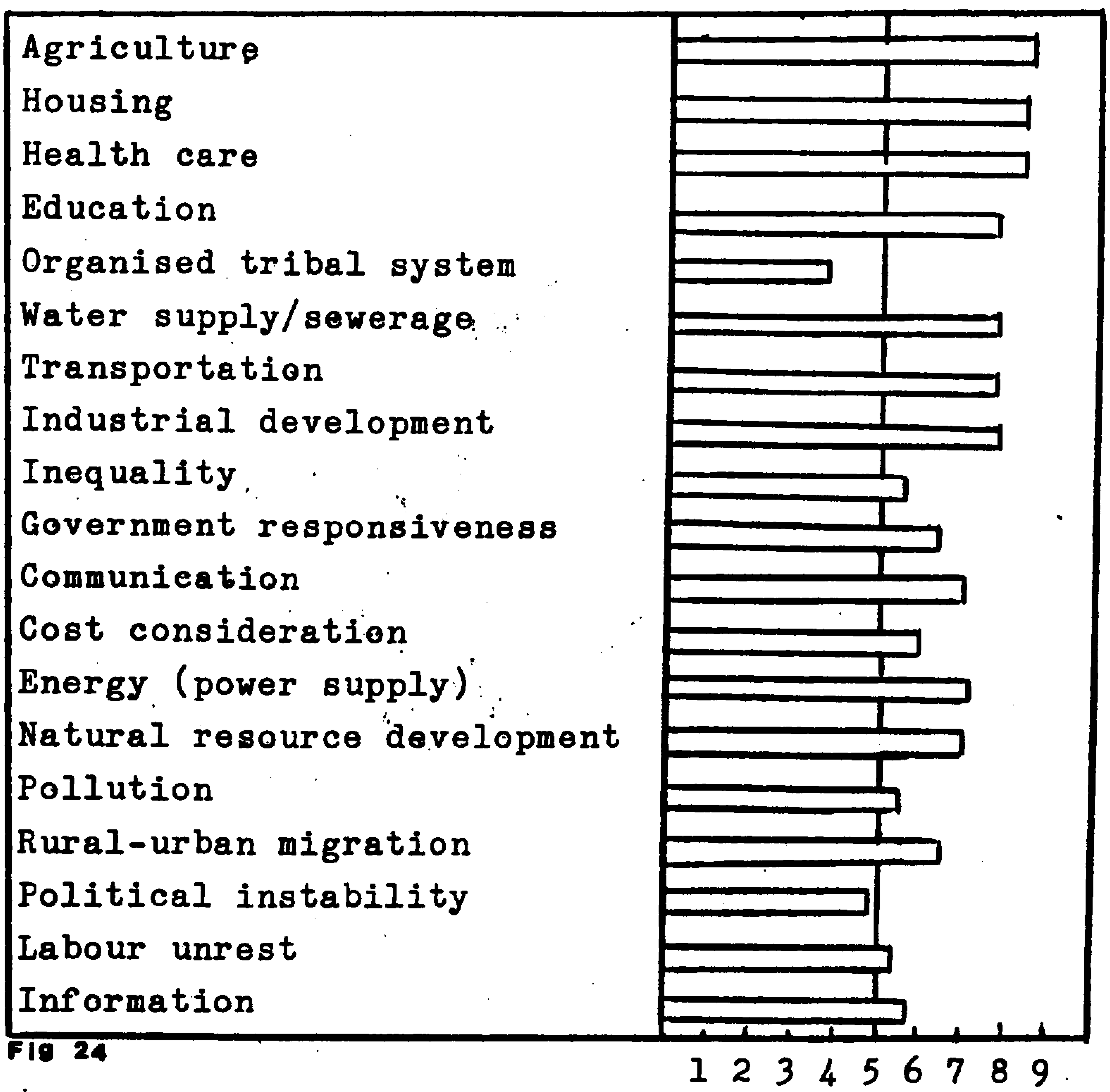


FIG 24

There is no reason to expect any kind of correspondence between importance and alterability, and the depiction shows this to be true. However, several observations are possible from analysis of Figure 24.

(i) Agriculture, housing, health care and sanitation and education are ranked very high on importance and are judged to be very highly alterable to positive direction by the use of more resources.

(ii) Water supply/sewerage, industrial development, transportation are ranked quite high on importance and are judged to be highly alterable by the use of resources.

(iii) The remaining items that are considered highly alterable (seven above) are energy, communication and natural resource exploration.

(iv) There is one item that is ranked highly important but is not amenable to change - organised tribal system.

(v) Only the items deemed most amenable to be altered through the application of resources are agriculture, health, housing, industries, water supply/sewerage.

These results, although general, should be useful to the planners. In setting priorities, the planner should be cognizant of what people think arethe areas of most importance to dissatisfaction with the quality of life. In this case, the following items are ranked high in importance - agriculture, health care, housing, education water supply/sewerage, transportation and industrial development. These are also ranked high on the basis of alterability meaning that dissatisfactions could be lessened through application of resources in National investment planning. Obviously, the Delphi may be used to set priorities. These priorities are based on two measuring scales - importance and alterability. These two perspectives are a necessity in the planning sense. Obviously, there may be an item of dissatisfaction that is considered very important but is not amenable to positive improvement through application of resources. In this case 'organised tribal system', 'inequality' are two such items. The planner must be made aware of these kinds of generalisations if he is to allocate resources in the proper way.

On the other hand, there may be some items that are considered fairly alterable but not very important. In this case information (mass media). The participants must have indicated that these are items that could be quite easily improved through applications of resources but there are other items that are much more important.

The next step was on concentrate more specifically on the item of dissatisfaction deemed more important and alterable and suggesting ways of solving it. For this, agriculture was chosen and the following measures were recommended to promote agricultural production.

- provision of rural infrastructure (feeder roads, storage and processing facilities, drinking water, mass education of rural population and other amenities;
- establishment at national levels of agricultural mechanical centres for the production of tools, equipment and other relevant and appropriate machines inclusive of servicing;
- encouragement of the creation of national agro-service centres aimed at bringing agricultural inputs (seeds, fertilizer, credit or skills) within the easy reach of farmers;
- encouragement of multi-purpose river basin development, irrigration - water resource exploration and evaluation, production and supply of irrigation equipment;
- improvement of the distribution, marketing and pricing mechanisms;
- provision of basic governmental service (training,

extension, vetinary services, hydrology, training and research to generate (large scale) massive adaptive technology for accelerated agricultural development

- increasing output by direct action (focussing on specific food or cash crops, on the one hand, or on the other hand, on the supply and quality of land in specific locations or a particular character);
- increased investment through national budgets and foreign assistance;
- increased participation of local farmers in the planning process.

3.6 Discussion and Conclusion: While the use of gaming simulation as a means of learning and communication spreads, little as yet is known about their impact. The preliminary research reported in this study attempted to tackle this problem. In general it can be said that the results clarify what can be expected from a simulation as well as they highlight the limitations of the procedure.

The data on the whole support the claim that simulations are a powerful motivational device. Over 80 percent of the participants enjoyed the game, and gained knowledge and insight into the subject that it purported to teach. In particular, the "feel", the experience that the players gained by being able to participate actively and make mistakes in a simulated environment is striking.

A policy decision game, is not in any sense real. At best its realism can only be abstract. The majority of participants were aware of this. Some sharp comments made the point very clearly. This remark, coupled with the fact that a minority of the players appear not to enjoy the simulation, points to the fact that simulations should probably not be a substitute for other modes of learning and communication. As a means of communication, on the other hand, simulations seem likely to be a very valuable aid for involving the participants in a variety of topics for preparing them for active participation in discussions on the subject simulated. At any rate, this is the limited purpose for which the present simulation was designed, and for this purpose it seems to be largely successful.

The game raises a series of questions about the mechanism by which National investment policies are formulated. The lessons learnt about the way central government run their affairs are regarded either as too obvious to need stating or as so contentious that they are shocking. What may be called national investment planning and equity policy by central government is the thing that has been called into question on almost every policy presentation phase in the game. The cabinet has attempted to draw up a fairly comprehensive national investment programme but the results have not been satisfactory from the states' point of view.

Any one of the following or a combination of the following seem to bedevil the attempts to put the policy into operation and has resulted in change of government.

(i) The weakness of political support for comprehensive national investment planning policies. During the game session strong political support for national investment policies by the states had been negligible. The shallowness of support is reflected in opposition by the states of plans suggesting fundamental changes in economic structure.

(ii) Deficiencies in the content of policy plans and difficulties of relating national policies to investment decisions. Cabinet policies themselves lack substance to guide decision making. Most of the cabinet objectives were stated in vague and amorphous language calculated to gain widespread consensus without specifying implementation strategies that might generate conflict and opposition.

(iii) The central government was able to stop those things that is considers undesirable, but seems unable to obtain the things it wants, resulting in non-fulfilment of the goals of the investment policies.

Another lesson that emerged is that national investment decisions have always been, and will continue to be, political decisions. "Optimality" as a technical goal is always re-interpreted in terms of political cost and benefits. Neither optimality nor consistency are values highly priced in political interaction, nor are they really preconditions for resource allocation and investment.

The game highlights the need for providing essential, financial and service support as preconditions for expanded public and provate investment in economically lagging states in Nigeria. Among the most important functions of central governments in such a society are: providing social overhad capital and physical infrastructure without which the cost of productive investment by private organisation becomes prohibitive; ensuring that at least minimum levels of health, education and social services are available to a majority of local people and ensuring through legal means equitable access to resources and factors of production.

The game highlights the need for increasing the physical linkages among lagging states and more developed sections of the country. The evaluation of a well integrated spatial system in which production, exchange and distribution among all major areas of the country is assured, can lead to greater opportunities for investment and larger internal markets for goods and services.

A very powerful result (output) of the simulation was of course the split of certain states from the country. This.also connects to the proposition that national policies should be formulated in the light of local implications. This lead us to the next experiment, Experiment II, which shows how national planning schemes are perceived from the view points of the traditional and modern sectors.

Finally, it was found that the delphi experiment after the game helped solidify players thinking about both descriptive and normative scenarios for new national investment decision. An extra benefit was that it helped to synthesize the thoughts of thirty participants who had been working on a highly complex, ill-defined problem. It helped to integrate the knowledge of professionals with varying disciplinary backgrounds.

The experience in using the simulation in testing policies suggests that more rigorous experimental research might cast light on many hypotheses and claims about the worth of simulation in public policy studies. One problem impeding such research is that a simulation of the kind here described causes participants to evaluate themselves, and the effects of this self-evaluation are themselves feedback into the game. This complicates the task of evaluating the result of the simulation because the highly self-aware participants are learning rapidly and may be rapidly transforming the whole system as it is being observed. Before and after research into attitudes and effects may help to overcome this problem and this concept is considered in experiment II.

4. EXPERIMENT II - AFRICAN VILLAGE SIMULATION

4.1. INTRODUCTION

This experiment deals with the planner's style in the developing nations and shows how national planning schemes are perceived from the viewpoints of the traditional and modern sectors.

National development is a complex problem. The best example of development in terms of growth rate may be the worst example in terms of social justice. In 1971, the Society for International Development (SID) addressed this problem in a conference on jobs and justice. Felipe Herrera, then president of SID, succintly stated the issue

> paraphrasing Madame Roland's cry in the French Revolution, "Oh Liberty, what crimes are committed in thy name!", there are sectors in Latin America which will seem to echo "Oh Development, what distortions are perpetuated in thy name!"..... No one can deny the enormous progress achieved in respect of economic growth....But can the same be said of collective participation in many of the benefits obtained?

Hence it is recognised that development measured in terms of single objectives such as GNP, is no longer acceptable. But even with a comprehensive set of social objectives, unintended side effects may dominate development attempts. For example, "green revolution" ..... a scientific breakthrough to avert massive starvation ..... relies on increased use of pesticides and monocropping patterns, both of which raise the risk of large scale crop destruction and possible disruption of established social patterns. Also in addition to these risks, complexities of economic markets may keep food prices high and thereby thwart the basic objective. Unforseen consequences from complex inter-relationships can subvert attempts to achieve even the best set of development goals, and it is imperative that planning of a much broader scope form the basis of development activities.

Recognition of multiple objectives for development and awareness of complex inter-relationships and unintended higher order consequences that may result from development programs indicates that development can no longer be based on incremental decision making of independent bodies, e.g. the ministries of economic development. A mechanism is needed to better integrate decision making information and access development programmes, the mechanism is planning - planning in a new dimension.

The new dimension is strongly associated with public policy and requires of the planner increasing abilities in the areas of multiple objective planning. These emerging requirements demand not only sophisticated technical expertise from the planner, but also awareness of the planning process. The planning process can be characterised by a variety of planning styles. The orientation and attitude associated with considerations of whose values are included in arriving at the public interest, who participates in public decision making, and who benefits from public plans. From this concept, the overall public interest can be assessed in terms of the planning style with which the public programmes are developed. Planning style is conceived to operate in a dimension ranging from rigid to flexible.

A rigid planning style is characteristic of one which performs with narrow bounds of goals alternative assessments. It is generally characterised by plans with:

(i) goals that are distant from or without recognition of the cultural values of the full range of interest affected,

(ii) alternatives that are generated on a narrow goal set, usually generated by professional planners or political elite, and

(iii) Assessment that narrowly defines the beneficiaries, and consequently is unaware of the maldistribution of benefits and costs.

Flexible planning style implies planning within the diverse values of the community, allowing participation in decision making, assessing the benefits for collective good.

The game is designed to provide the opportunity for negative experiences stemming from interaction with a model of rigid planning style. The planning students as players would experience the difference between tribal life and one imposed by a colonial administration. These experiences should enable students to better "feel" what an established social organisation might "feel" as recipients of projects already formulated by expert planners of different cultural orientation.

This research will attempt to measure attitudes indicative of a flexible planning style. An instrument given before and after playing the game will be a test of the simulation's ability to modify attitudes. The scope of the research is therefore to show that planning styles do exist, and that they can be manipulated in the direction of flexibility in a semilaboratory setting through gaming simulation in planning education and practice.

A policy capturing device is used based on a multiple regression analysis method to indicate the implicit weightings assigned to socio-economic variables on twenty one proposals for development in Fulaniland. The relative values assigned to these socio-economic variables are assumed to reflect planning style to some degree.

4.2. General Characteristic of the Model

Fulaniland is a simulation game of a tribe called the Fulanis, who live in northern Nigeria. They are nomadic herdsmen who migrate to the highland pastures to reach the grasslands which are flooded; for six months there is no rain and the Fulanis must migrate to the marshlands in the flood plain of the upper Niger. During the dry season this is the only area with sufficient moisture for portable green grasses.

In the game Fulaniland participants assume the role of Fulani tribesmen in four different villages; their local chief (peace maker in Fulani society); some statistician from the local area; and a board controller. The villages are related, that is their clan come from the same lineage. Related villages are in closer proximity on the board. The most distant villages are not related. Villagers from Thiang and Yol are related; villagers from Rang and Cany are related.

Diagram 25 shows the segmented lineage system. Yol and Thiang are on one segment of the lineage, Rang and Cany are another segment. Fulani tribal society has many conflicts. Conflict resolution is determined by the lineage system in that related villages will coalesce in a conflict with a village not related. For example, Yol and Thiang would join together in a feud against a village not related to them.

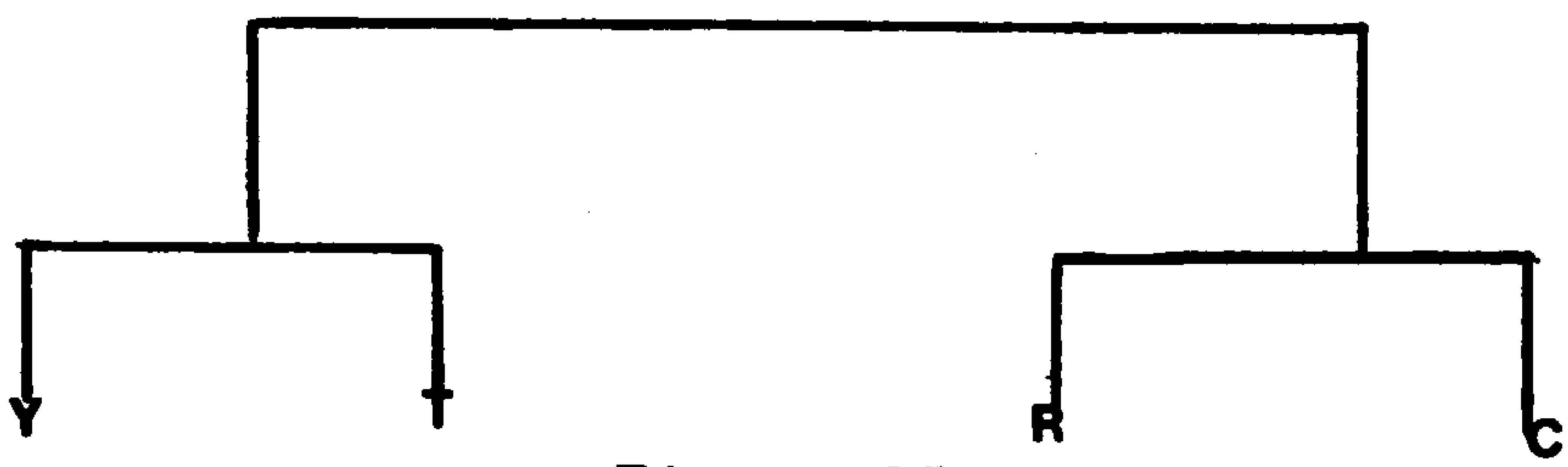


Figure 25

4.2.1. Board and Pieces

To represent migration with cattle, a board has been constructed. The board has squares numbered 1-15

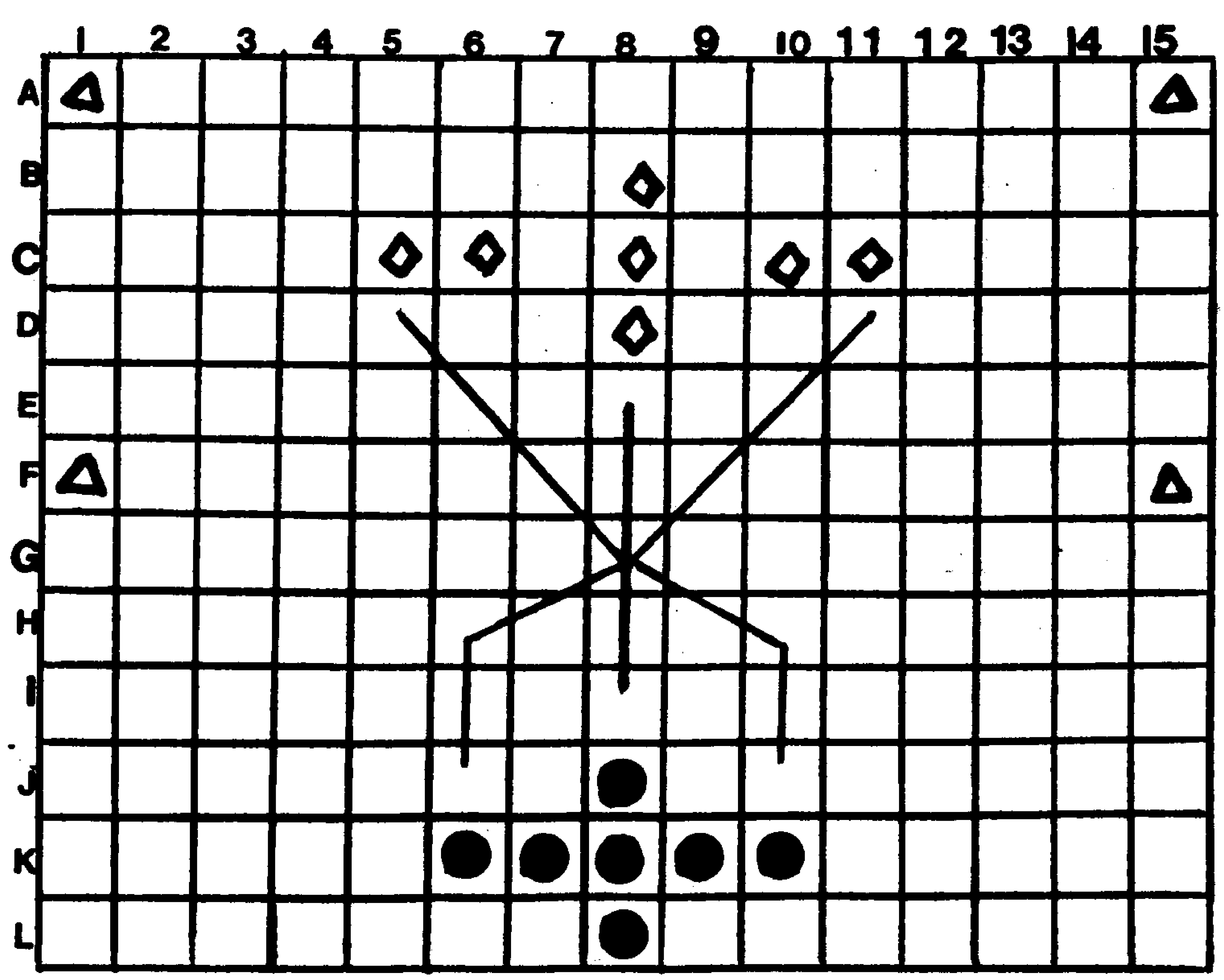


Figure 26 Game Board and Pieces

across and lettered A to L down. Each light green square represents average grazing land and can hold one cow. Very good grazing squares represented by dark green diamonds in diagram 25 can sustain life of three cattle. The game begins in the wet season, with tribesmen migrating from their villages to dark green diamond lands. Other physical features of the board include villages (Yol, Thiang, Rang and Cany), represented by triangles, roads represented by black lines and marsh lands represented by blue discs. During the dry season, tribesmen migrate to the marshlands, which also holds three cattle, and is in an area of breeding. At the end of each season, tribesmen on good grazing land or marshlands can increase their cattle through breeding. Roads may be used to migrate to the marshlands, and also hold three cattle.

Each villager receives a transparency which replicates the main board, and a grease pencil (the same colour as his village) for planning moves on the transparency. The pieces that move on the board are symbols for men and cattle. Brown barrels symbolise cattle, different coloured pieces represent men from various villages. Pieces fit on top of each other for convenience in moving. To begin migration cattle and men are placed near the village in the square shown in diagram 27.

4.2.2. Sequence of Operation for Tribesmen and Intermediary Roles

1. Tribesmen write moves on their transparency.
    - (a) Board controller puts transparency on overlap projector
    - (b) Tribesmen move pieces on the main board
    - (c) Board controller checks that moves made on board coincides with written plan.

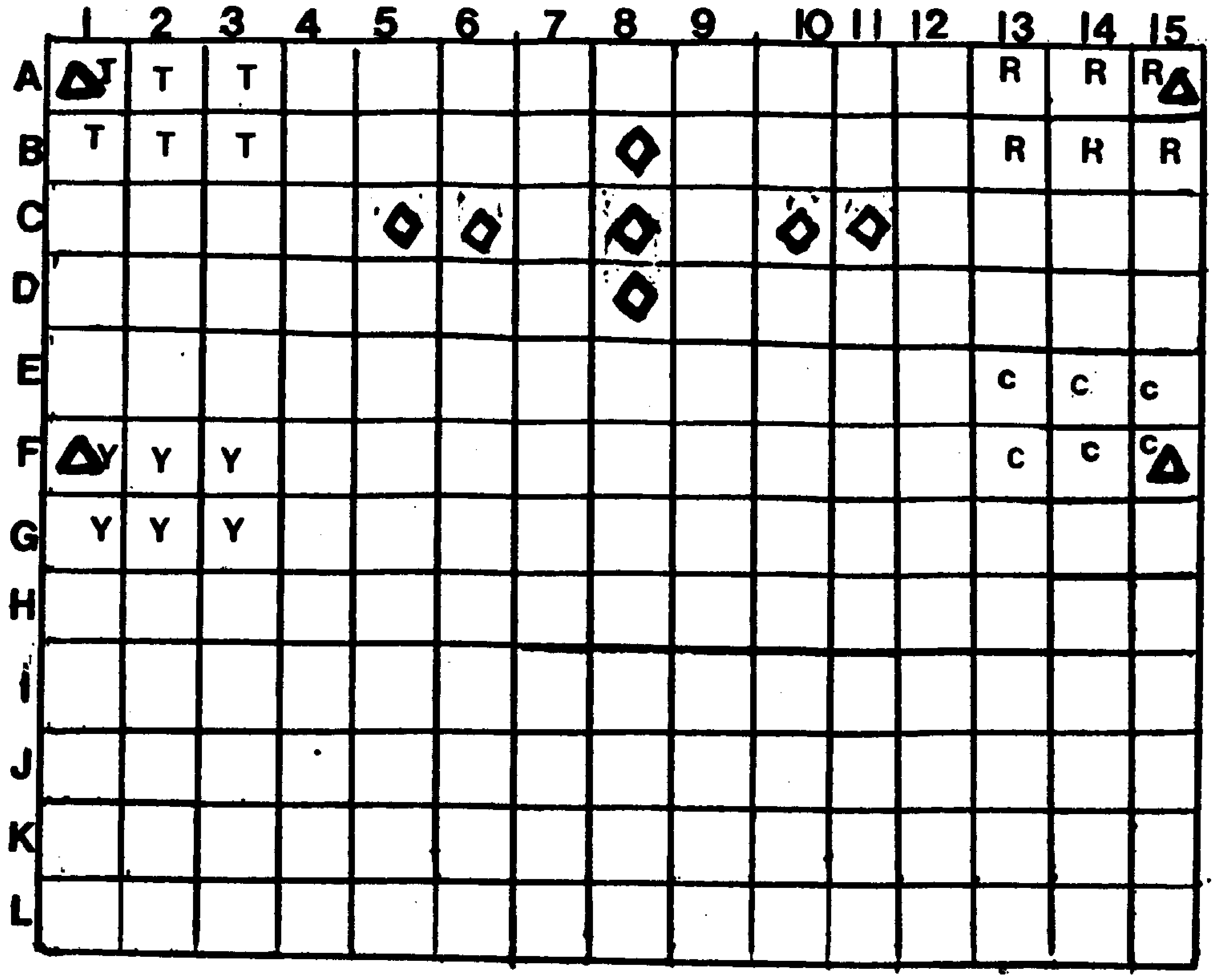


Figure 27

2. Tribesmen draws Incident Card
   (a) Statistician records an incident of raids, rituals and size of cattle herd.
   (b) Statistician summarises data for planners.
3. Tribesmen records gains or losses in life satisfaction points.
4. Local chief informs villages of feud and conflict
5. Change of seasons: after six moves gain cattle by breeding and migrate to marshland.
6. Use roads.

1. Tribesmen writes move on their transparency: Every period of a season, each village will initial squares on the transparency where their cattle will be moved. Each cow and man pair (six for each village can move one space each period, including diagonally). After initialling squares, villagers give transparencies to board controller, who will overlap them on the overlap projector. When transparencies are past back, tribesmen move

cattle and men to positions on the main board according to the written plan, on the transparency. After planning the second move, tribesmen erase move from the last round so that board controller receives only the migration plan.

2. Incident Cards: A set of incident cards of events reflecting nomadic life allow the tribesmen to gain or lose life satisfaction points. Tribesmen picks incident card after each move. After reading it aloud, they replace it at the bottom of the cards. Statisticians records incident of raids, rituals, rinderpest and the size of cattle herds by listening to the cards read aloud.

Incidence can give an automatic gain or loss of life satisfaction points or tribesmen can roll die for number of satisfaction points.

Even number	=	three points
Odd number	=	one point

Some incidents indicate ritual ceremonies, the local chief receives a ring from the tribesmen for presiding over their celebrations.

3. Scoring: Scores are recorded after each period for gains or losses in life satisfaction points. Life satisfaction score is made up of

(1) Cattle (one point for each cow)

(2) Others

(a) points gained from the incidents
points gained from conflicts and feuds.

Points gained for incidents, conflicts and feuds can be an automatic 2, or players can role the die

Even number = three points
Odd number = one point

Each village begins the game with six cattle on the board and different numbers of cattle in reserve. If a villager loses a cow, he subtracts one from his reserve. A villager will not lose cattle from the board until he uses up his reserve cattle, for example, if Yol loses a cow with three in reserve

Yol life satisfaction point will be

Cattle	Other
9	
-1	
8 (two are in reserve six are on the board)	

Cattle are gained by breeding. At the end of the wet season, sixth move, tribesmen add one cow for every two cattle on the good grazing land. At the end of the wet season, tribesmen add one cow for every two cattle on the marshlands. Cattle are gained by winning conflicts (1) feuds (2) and through some incidents. Life satisfaction points are gained through some incidents and by participating in conflicts and feuds.

4. Resolving Conflicts and Feuds: If two related villages land on the same square there is conflict. Since the main advocation of the Fulani tribesmen are conflicts, conflicts increase life satisfaction points. For every victorious one in a conflict, two points are gained or players can roll the die for one or three points.

The board controller will circle the conflicts when transparencies are overlapped. When related villages have a conflict it ends quickly by the stronger gaining one cow from the weaker. The local chief will determine how strong villagers are by counting each village's men in the conflict square and in squares adjacent to the conflict. The local chief will inform villages of conflict and its resolution.

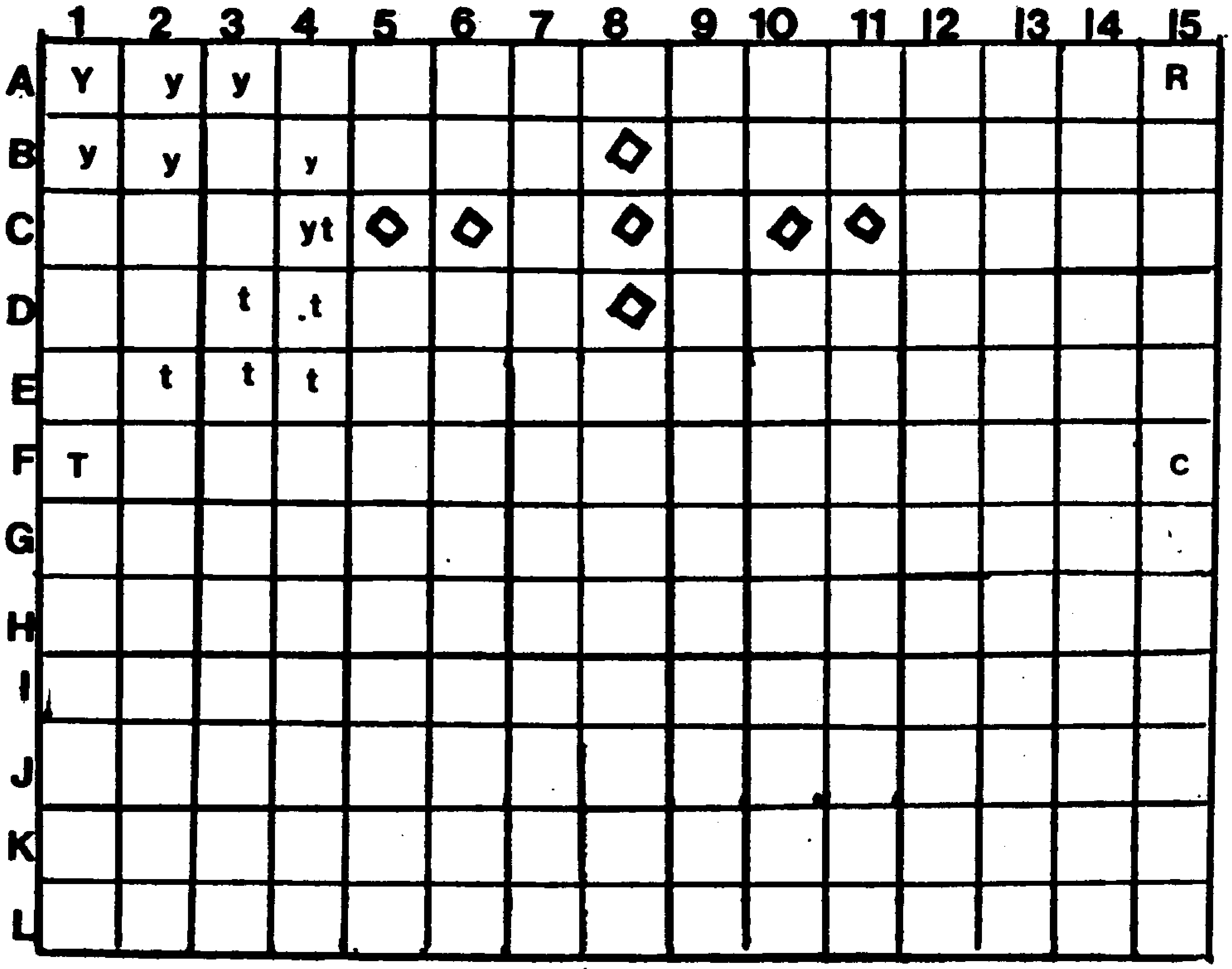


Figure 28. Showing Conflict

As the conflict diagram (Figure 28) above shows men from Yol and Thiang come to the same square C4, and had a conflict. Thiang has two villagers in adjacent square D3 and D4 so with the strength of the three he wins the conflict. Yol gives Thiang a cow and retreats to the nearest unoccupied square. If related villagers have equal strength, they roll the die to see who gets the highest number. When two villagers who are not related land on the same square, there is some serious conflict which causes feud. The diagram on page 181 shows Yol, Thiang, Rang, Cany all arrive at C8, a square that can hold three cattle. In a feud related villages support each other. Yol and Thiang will coalesce. Rang and Cany will unite against the villages that are not related to them. Rang and Cany have three related tribesmen in adjacent squares, Cany in C9 and Rang and Cany in D8. Feuds result in the stronger winning the cattle from the weaker, and the weaker retreating to the nearest unoccupied square. Yol and Thiang will give a cow to Rang and Cany.

The weaker village can attempt to negotiate for less cattle payment if all villagers in feud agree to go to the local chief and ask his advice on settling the feud. A village gives a ring to

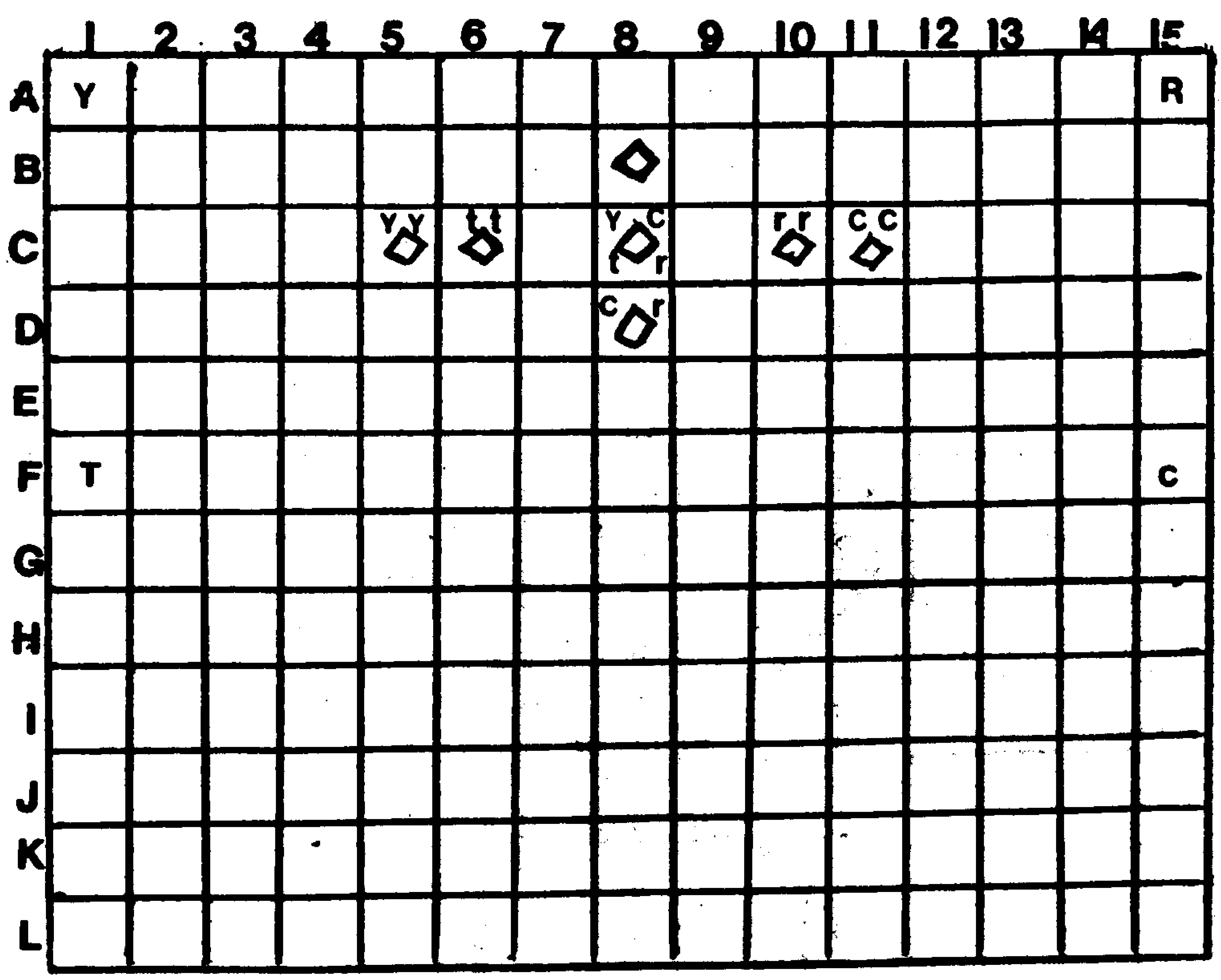


Figure 29

the local chief if he negotiates a feud settlement for that village. If there is both feud and conflict in the same round, players settle the feud first then the conflict. If there are several feuds, the feuds in the square with the lowest number, for example D8 before D10 will be settled first.

5. Change of Season: Each season lasts six rounds. Additional cattle are gained from breeding only once, at the end of each season. At the end of each season cattle are counted for life satisfaction points. When the dry season begins, men and cattle move down the board to the marshlands. Any cattle remaining in the grazing land area (A-E) after move four of dry season will die.

6. Use of Roads: Roads may be used to speed up travel. Villagers can get on the road at any point that is anywhere along the road. Each

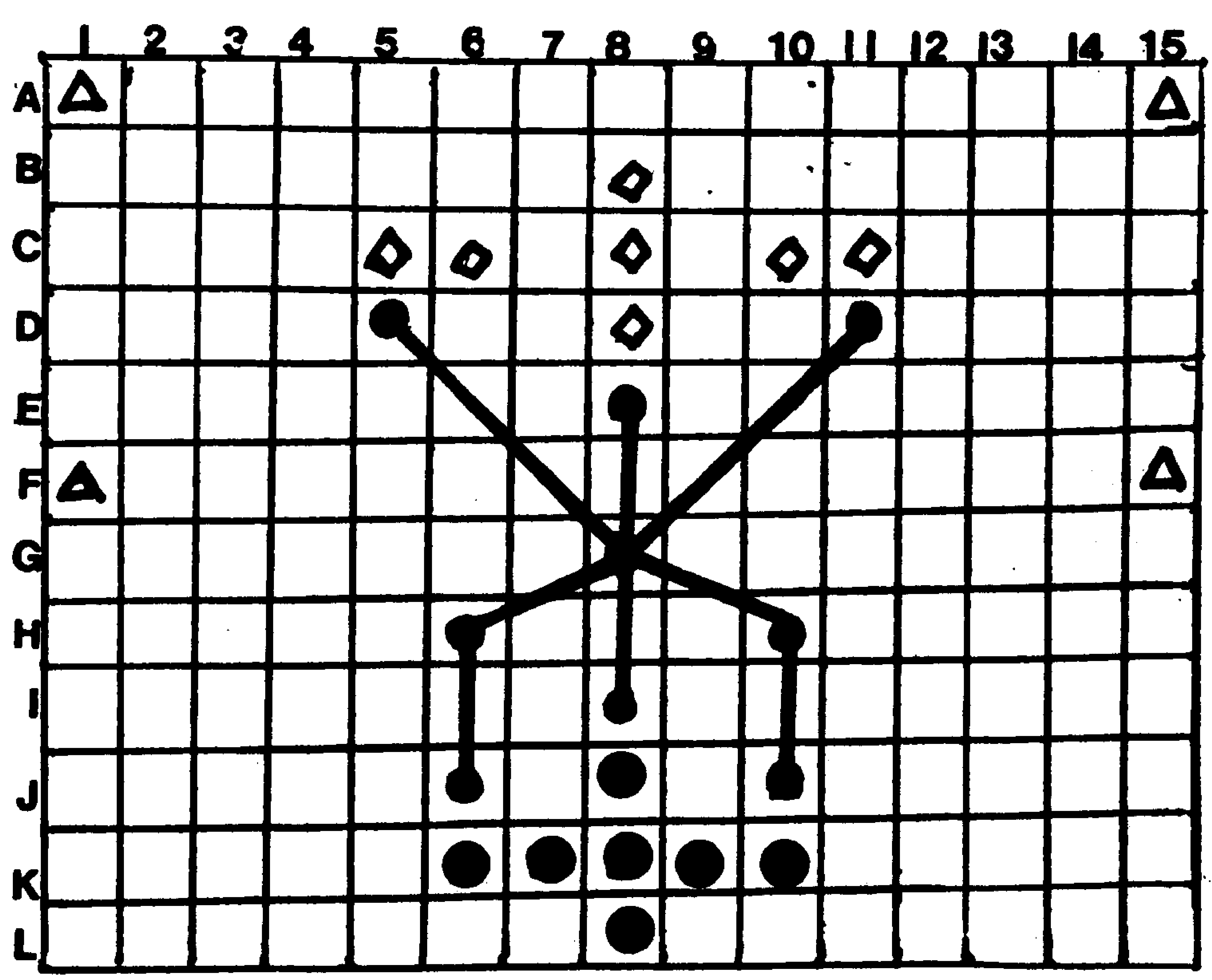


Figure 30

square on the road can hold three men and their cattle. After arriving at the road, the next move can be as fast as the next junction in the road. The possible distance travelled at any one move is indicated by dots in the diagram.

4.2.3. Background for Planners

The Fulanis are a Nilotitic tribe of people occupying the savannah and marshlands of northern Nigeria. Like many traditional people throughout the world, they are on the verge of modernisation. These nomadic herdsmen migrate with their cattle according to the wet and dry season of northern Nigeria. For six months of the year it rains and the tribesmen migrate to the highland pastures to reach the grasslands which are not flooded. The diamond rings on the upper part of the board represents these sandy elevated spots which are the flood refuge for the tribesmen.

If the herds do not reach the sandy highlands their cattle contract diseases of the hoof for standing in water for long periods. For six months of the year there is no rain, and the tribesmen must bring their cattle to the marshlands in the flood plain of the upper Niger, represented on the lower half of the board by circles. The herdsmen migrate on the average of sixty miles during the dry season to reach the rivers and marshes, but the water is scanty and foul and their cattle are dying of rinderpest. Rinderpest is an infectious disease of cattle marked by diptheritic inflammation of the mucous membranes, especially of the intestines. Epidemics of this disease prevent the accumulation of cattle. The traditional sector has a low productivity, so that rise in income must come from the transfer of traditional people to the modern sector.

To restore the herds after ravages of rinderpest and to supplement their food supply, the tribesmen raid other nomadic people. The extreme climatic changes and harsh conditions along with neglect of government services extended to these nomadic people have arrested development of the nilolitic cultures of the interior.

As a government planner to carry out development progrmmes for the social emergence of these people into the national life of Nigeria the following programmes have been considered.

(i) Rinderpest Control: Vetinarian services extended to the tribesmen to reduce incidence of diseases in their livestock

(ii) Irrigated Rangelands: For adequate water supply and medical inspection of cattle, government rangelands would be established

(iii) Cash Crop: For the economic stability of the tribesmen, a crop with high comparative advantage would be introduced.

(iv) Legal System: Law would be used as a tool for development through the decrease in the tribesmen preoccupation with violence, the prevention of intertribal feuding and cattle raids.

Many specialists were called upon in developing these programme alternatives. The major area of consideration in developing these alternatives are: (i) the potential for changing social structure and life style. The legal system would outlaw social patterns of tribal interaction and incorporate people into modern nation. Rinderpest control will change the mortality of cattle and migration so that more permanent village life could be established. The cash crop would also tend to shift the herdsmen from migratory to sedentary life and to raise the economic standard of living. Irrigated rangelands will develop marketing of livestock and bring more people into the monetary sector. (ii) the conservation of natural resources: impacts on the ecosystem could result in human or animal disease as well as impact on vegetation.

Careful consideration has been given to maintaining tribal structure. For example, resettlement will be carried out through their local chiefs, and money will not be introduced too quickly as a distributive force in traditional society. Further, the commercial aspects of cotton plantation will be in conformity with the aims of the social emergence of the people and their eventual self sufficiency. Careful study will assure that the most fertile land and natural water supplies will be utilised while conserving the natural resources.

4.2.4. Sequence of Operation for Planners - First Season

1. Select Development Programmes
    (a) Rank proposal
    (b) Give weight to local chief/planners
    (c) Local chief ranks cards.
2. Gather statistics on Conflicts.
3. Receive data from Statisticians.

1. Select Development Programmes

Assignment	Planners Profiles Purpose
Vetinarian Disease Specialist	Decrease the mortality of cattle from rinderpest and other infectious diseases; you will attempt to implement a health programme
Economic Planner	Raise the standard of living among herdsmen; you will attempt to introduce cash economy
Land Use Planner	Increase the production of cattle; you will attempt to introduce irrigated rangelands where livestock may be left unattended.
District Commissioner	Decrease tribal conflicts and inter-tribal feuding; you will try to implement a legal system prohibiting intertribal warfare.

As managers of one of these programmes in the simulation game you will be charged to take into account the over-all development of this region and to select certain periodic development projects. As a group rank development proposals with various budget allocations and choose the most preferred card. The planners will decide the degree of participation of the local chief, in introducing programmes. Determine the weight the local chief ranking will have .... %

Determine the weight the planners ranking will have .... %

TOTAL 100 %

The local chief will rank cards and choose the most preferred card. Multiply the rank times weight for the planner and the local chief. Combined rank is equal to the sum of both products.

	Planner		Local Chief		
Development Programme					
	Rank	Weight	Rank	Weight	Combined weight Rank
A					
B					
C					
D					
E					
F					

2. Gather Statistics: Gather statistics on conflicts which occur in Fulani society and where they occur on the board. The board controller will show a transparency of the board on the overhead projector. The board controller will circle any squares that have a conflict. Each planner records conflicts on attached sheet for three months.

Local government statisticians who are living near the Fulanis will gather data for you on the incidence of diseases and the pattern of their occurrence, the average size of each herd of cattle, and any loss of cattle from ritual slaughtering or raiding parties. Every three months you will get the data from the statisticians.

3. Receive Data from Statisticians: With statistics on raids, number of cattle and diseases, and your own information on areas of conflict, determine where you will implement your development projects. After six months you will have to put dots on the main board indicating where a development project will be established, based on your budget allocation for this period.

Practice your budget allocation with a transparency of the board.

a)	Vetinarian - (disease specialist)	Put black dots on a transparency where you would like cattle health zones.
b)	Land Use Planner	Put green dots on a transparency where you would like rangeland zones.
c)	Economic Planner	Put blue dots on a transparency whereyou would like cotton plantations. (four contiguous squares for one plantation).
d)	District Commissioner	Put red dots on a transparency where you will like conflict management zones.

Grazing zones must be protected with health programmes and conflict management. Place black and red dots on grazing (rangeland zones).

Second Season - Brief Steps

(i) Put dots on main board
(ii) Observe outcome
(iii) Re-rank cards

1. Put Dots on Main Board: A similar placement of dots will be made on the main board to replicate the planners transparencies. New incident cards will be introduced in the game to carry out development projects.

2. Observe Results: Observe the results of each development project and calculate the actual progress in each area to be able to contrast it with expected results shown on the development card.

a)	Vetinarian - (Disease Specialist)	Put black dots on the main board, calculate the decrease of rinderpest in

		this phase of the game (you will receive a record of cattle in health zones)
b)	Land Use Planner	Put green dots on the main board, calculate increase in cattle and the number of cattle left unattended so that the herdsman may work on cotton plantations (you will receive records of villagers on plantations)
c)	District Commissioner	Put red dots on the main board. Calculate the decrease in violence from conflict management zones.
d)	Economic planner	Put blue dots on the main board. Calculate the rise in GNP from the transfer of people from inefficient rural economy to monetary sector. (You will receive records of villagers on plantation).

3. Re-Rank Cards: After observing the results of your budget allocation for six months, a new programme can be introduced. Re-rank the cards for the next budget allocated. Again determine the weight that the local chief will have. The local chief re-ranks the development programmes.

	Planner		Local Chief		
	Rank	Weight	Rank	Weight	Combined Rank
A					
B					
C					
D					
E					
F					

Third Session

1. Put dots on the board indicating budget allocation for this period.
2. Observe results
3. Calculate progress in each area as in session one.

PLANNERS DEVELOPMENT PROGRAMMES

Development Programme A

The following projects are funded for implementation:

1 cotton plantation
5 grazing zones
30 cattle health zones

You may locate these areas on any board location (1 square to each zone and four contiguous squares for a plantation). Expected results:

GNP increase	5-8%
Rinderpest reduced	50%
Social conflict reduced	33%
Non-migratory population	10%

Development Programme B

The following projects are funded for implementation:

2 cotton plantations
5 grazing zones
12 cattle health zones
24 "conflict management zones"

You may locate these areas on any board location (1 square to each zone, all four contiguous squares for a plantation). Expected results:

GNP increase	10-13%
Rinderpest reduced	20%
Social conflict reduced	40%
Non-migratory population	10%

Development Programme C

The following projects are funded for implementation:

1 cotton plantation
10 grazing zones
10 cattle health zones
27 "conflict management zones"

You may locate these areas on any board location (1 square to each zone, and four contiguous squares for a plantation). Expected results:

GNP increase	5-11%
Rinderpest reduced	17%
Social conflict reduced	38%
Non-migratory population	20%

Development Programme D

The following projects are funded for implementation:

2 cotton plantations
13 grazing zones
28 cattle health zones
18 "conflict management zones"

You may locate these areas on any board location (1 square to each zone, and four contiguous squares for a plantation). Expected results:

GNP increase	5-10%
Rinderpest reduced	40%
Social conflict reduced	40%
Non-migratory population	20%

Development Programme E

The following projects are funded for implementation:

2 cotton plantations
5 grazing zones
42 cattle health zones
10 "conflict management zones"

You may locate these areas on any board location (1 square to eaxh zone, and four contiguous squares for a plantation). Expected results:

GNP increase	10-15%
Rinderpest reduced	70%
Social conflict reduced	15%
Non-migratory population	10%

Development Programme F

The following projects are funded for implementation:

2 cotton plantations

12 grazing zones

28 cattle health zones

18 "cotton management zones"

You may locate these areas on any board location (1 square to each zone, and four contiguous squares for a plantation). Expected results:

GNP increase	10-17%
Rinderpest reduced	47%
Social conflict reduced	30%
Non-migratory population	24%

4.3. TESTING THE SIMULATION

The game was tested at Glasgow College of Technology with post-graduate students of Public Administration - Developing Countries. A total of twenty-one students from different nations in the developing countries took part in the two day exercise.

Before and after playing the game, participants were asked to evaluate twenty-one scenarios for development in Fulaniland. The alternative scenarios are composed of combinations of variables relating to participation in planning, incidence of disease and changes in income and lify style that would occur if the proposal is implemented. These variables identified as X1 through X4 were chosen to link preferences for alternative proposals with elements of planning style. Two representative proposals are given below.

A. This proposal was generated by a planning organisation composed of three central government planners. They were assisted by one local chief and three semi-professional staff (i.e. high school background).

The majority of the budget has been allocated toward social programmes such as malaria control for nomadic tribesmen and the prevention of rinderpest in their herds. About one third of the budget has been allocated to cotton production facilities but the per capita GNP has remained 100.

The character of the society is markedly different from its original conditions, with about 70% of the herdsmen engaged in cotton production and cotton processing occupations, and with sparse occurrence of tribal rituals celebrated by the nomadic villagers. Malaria and rinderpest outbreaks still occur, but because of adopted health programmes the incidence of these diseases is about 5% (i.e. about 1 out of 20 villages and cattle may be expected to be stricken during any malaria/rinderpest season).

SUMMARY (10 YEARS FROM TODAY)

Planning Ministry	Malaria/ Rinderpest	GNP/ Capita	Nomadic Lifestyle
3 Government professionals	5%	100	30%
3 Semi-professional locals			
1 Local chief			

L. This proposal was generated by a planning organisation composed of one central government planner. He was assisted by four villagers and two semi-professional staff (i.e. high school background).

About half of the budget has been allocated to cotton production facilities and as a result the per capita GNP has risen to 200. The balance of the budget has gone into social projects such as malaria control for nomadic tribesmen and the prevention of rinderpest in their herds.

The character of the society has changed consistently from its original conditions, with about 40% of the village population engaged in cotton production and cotton processing occupations and with frequent occurrence of tribal rituals. Malaria and rinderpest still occur, but because of adopted health programmes the incidence of these diseases is about 15% (i.e. 3 out of 20 villages).

SUMMARY (10 YEARS FROM TODAY)

Planning Ministry	Malaria/ Rinderpest	GNP/ Capita	Nomadic Lifestyle
1 Government professional 2 Semi-professional locals 4 Villagers	15%	200	60%

Procedure for Ranking and Scaling 21 Scenarios

The alternatives are description of outcome of certain programmes that might be implemented to develop Fulaniland. Legal, medical, enconomic and social. You are to evaluate the outcomes. The twenty-one alternatives deal with the variables of:

(a) Planning ministry: who will constitute the planning ministry.

(b) Percentage of malaria/rinderpest: the level of health in terms of reduction of diseases.

(c) GNP per capita: the level of per capita income to be aimed for.

(d) Percentage of nomadic lifestyle: what percentage of tribesmen will continue a nomadic lifestyle of migrating with their herds.

These four variables appear with different combinations on the twenty-one cards.

Read the twenty-one proposals. Spread the cards on the table as you read them so that you can refer to previously read cards. Arrange the cards according to your likes and dislikes. Pick up the most favoured card and subsequent favourable cards in descending order of preference. On the attached sheet, fill in the letter which appears in the left hand corner of the proposal, next to this corresponding number from 1 to 21.

For the purpose of this exercise, the following data is considered representative of conditions in Fulaniland today.

GNP = N100. Malaria/Rinderpest = 25% Nomadic life-style = 95%

Participants were then asked to estimate the preference of each proposal. Proposal L have arbitrary assigned as standard. Every other proposal is evaluated in relation to the standard value. For example, if a particular proposal seems ten times as preferred as proposal L, write a value of 1,000. If a particular proposal seems half as preferred as the standard, write a value of 50. If a particular proposal seems only 1/20th as good, write in a value of 5.

Procedure for the Analysis of Data

The method of analysis utilised is based on a multiple regression technique. The scaling procedure follows that utilised by Sellin and Wolfgang (1964) and is one method for deriving a ratio scale (Garner and Creelman, 1970) for preferences. The scale values were then normalised and used as the dependent variable in a multiple regression analysis utilising normalised variable values in each of the scenarios for independent variables. The multiple regression analysis solves for coefficients that indicate the relative weights for each of the independent variables that best "explain" or predict the scaled preference values for the scenarios. These coefficients may be interpreted as the relative importance that a subject implicitly assigns to each of the factors of the scenario. The model utilised in the policy capturing technique is of the form:

$$Y_j \quad a_{0i} + a_{1i}X_1 + a_{2i}X_2 + a_{3i}X_3 + a_{4i}X_4 + e$$

Where Y_j = score assigned by each subject (i) to the alternative

the X's = variables of the scenario as described in Table

the a's = the relative weight a subject has implicitly assigned to each variable

and e = an error term representing unaccounted for variation. If the numerical values can be assigned to the X's and the Y's the a's can be calculated by the use of multiple linear regression. Thus the subject's policy is "captured" mathematically by calculating the relative importance given to each of the variables.

Table 7 Range Values Chosen for Each of the Variables

Scenario	X_1 Planning Ministry	X_2 Malarial Rinderpest	X_3 GNP/ Capita	X_4 Nomadic Lifestyle
A	.14	5	100	30
B	11	10	200	50
C	4	0	300	80
D	.14	15	400	45
E	11	10	500	50
F	4	10	100	60
G	.14	5	200	70
H	11	10	300	70
I	4	20	400	40
J	.14	20	500	80
K	11	20	100	80
L	4	15	200	60
M	.14	5	300	70
N	11	15	400	50
O	4	0	500	30
P	11	0	100	75
Q	4	5	200	50
R	.14	5	300	40
S	11	5	400	40
T	.14	15	500	60
U	4	0	200	40

The number which appear under planning ministry are ratio of villagers to central government planners.

A stepwise regression analysis was conducted using each of the subject's (players) scores as a dependent variable and the standardised independent variables (the regression coefficients for each subject are tabulated in the Table 8).

TABLE 8

	Subject	Before Playing	R^2	After Playing
1	Villager	$0.01X_1$	.75	$0.13X_1$
		$-0.42X_2$		$-0.06X_2$
		$0.82X_3$		$0.44X_3$
		$0.04X_4$		$0.35X_4$
2	✓	$0.74X_1$	.86	$0.06X_1$
		$-0.11X_2$		$-0.08X_2$
		$-0.18X_3$		$0.07X_3$
		$0.09X_4$		$0.47X_4$
3	✓	$-0.02X_1$	.70	$-0.09X_1$
		$-0.10X_2$		$-0.29X_2$
		$0.09X_3$		$-0.11X_3$
		$1.01X_4$		$0.94X_4$
4	✓	$0.20X_1$	.96	$-0.03X_1$
		$-0.88X_2$		$-0.92X_2$
		$0.50X_3$		$0.42X_3$
		$-0.40X_4$		$0.10X_4$
5	✓	$-0.04X_1$	.88	$0.21X_1$
		$0.22X_2$		$-0.51X_2$
		$0.28X_3$		$0.22X_3$
		$-0.27X_4$		$0.52X_4$
6	✓	$-0.16X_1$		$0.04X_1$
		$-0.65X_2$		$-0.27X_2$
		$0.29X_3$		$0.42X_3$
		$0.06X_4$		$0.14X_4$
7	Villager	$-0.12X_1$	.72	$0.05X_1$
		$-0.68X_2$		$-0.45X_2$
		$0.75X_3$		$0.58X_3$
		$-0.18X_4$		$0.12X_4$

	Subject	Before Playing	R^2	After Playing
8	✓	$0.07X_1$	.68	$0.03X_1$
		$-0.70X_2$		$-0.55X_2$
		$0.25X_3$		$0.12X_3$
		$0.05X_4$		$0.16X_4$
9	Local Chief	$0.11X_1$	.78	$0.26X_1$
		$-0.02X_2$		$-0.42X_2$
		$0.07X_3$		$0.77X_3$
		$-0.96X_4$		$-0.30X_4$
10	✓	$-0.07X_1$	.91	$0.08X_1$
		$-0.10X_2$		$-0.30X_2$
		$0.05X_3$		$-0.65X_3$
		$0.62X_4$		$0.86X_4$
11	Int Role	$0.23X_1$	.85	$0.28X_1$
		$-0.46X_2$		$-0.31X_2$
		$0.58X_3$		$0.67X_3$
		$0.50X_4$		$0.54X_4$
12	✓	$0.36X_1$	.87	$0.07X_1$
		$-0.50X_2$		$-0.28X_2$
		$0.38X_3$		$0.46X_3$
		$-0.31X_4$		$-0.62X_4$
13	Int Role	$-0.34X_1$	.67	$0.07X_1$
		$-0.36X_2$		$-0.70X_2$
		$0.09X_3$		$-0.65X_3$
		$-0.04X_4$		$0.50X_4$
14	Planner	$-0.05X_1$	.78	$0.13X_1$
		$-0.87X_2$		$-0.87X_2$
		$0.17X_3$		$0.31X_3$
		$0.09X_4$		$0.40X_4$

	Subject	Before Playing	R^2	After Playing
15	✓	$0.01X_1$	.92	$-0.01X_1$
		$-0.84X_2$		$-0.84X_2$
		$0.03X_3$		$0.04X_3$
		$-0.06X_4$		$0.04X_4$
16	✓	$0.16X_1$	.84	$0.08X_1$
		$-0.96X_2$		$-0.98X_2$
		$0.16X_3$		$0.01X_3$
		$0.01X_4$		$0.06X_4$
17	✓	$-0.01X_1$	.65	$0.09X_1$
		$-0.08X_2$		$-0.47X_2$
		$0.21X_3$		$0.17X_3$
		$0.66X_4$		$0.85X_4$
18	Planner	$0.18X_1$	.69	$0.27X_1$
		$-0.78X_2$		$0.09X_2$
		$-0.04X_3$		$0.01X_3$
		$0.17X_4$		$0.72X_4$
19	✓	$-0.22X_1$	.91	$-0.50X_1$
		$-0.35X_2$		$-0.17X_2$
		$0.95X_3$		$0.20X_3$
		$0.02X_4$		$0.08X_4$
20	✓	$-0.06X_1$	.97	$-0.02X_1$
		$-0.20X_2$		$-0.52X_2$
		$1.15X_3$		$0.30X_3$
		$0.04X_4$		$0.12X_4$
21	✓	$-0.002X_1$	.65	$-0.008X_1$
		$-0.40X_2$		$-0.48X_2$
		$1.05X_3$		$0.40X_3$
		$0.05X_4$		$0.13X_4$

The R^2 which appears after the regression coefficients for each individual score is the multiple index of determination. It is a measure of how well the regression surface fits the data. A value of zero indicates no linear relationship between Y and X's. A value of 1.0 indicates perfect agreement.

4.4. ASSESSING THE SIMULATION

The researcher conducted brief post game discussion with the experimental group. In these discussions, game participants verbalised their subjective impression of the planning style which is simulated by the game. This self reporting on change from the game coincided with the changed preferences measured by the weighting instrument.

In the post game discussion for example, a participant questioned the social cost of development. Although the questions reveal an elitist approach to changing o other cultures, he did show the awareness of various value orientation.

> "Life satisfaction is relative. I have different life satisfaction than this tribe would have. How should we approach this relative position? Do we move fast? What will be the reaction of the tribe member to changing his lifestyle? How important is lifestyle or life satisfaction to this individual? As a planner looking at it, how should I rate it? Should I rate it higher or lower than some of the programmes we wanted to introduce?
>
> If we instituted these programmes over a long period of time, his lifestyle would be changed to something else and his life satisfaction would be based on other criteria. Now, is it

> good or bad to change the criteria for measuring the way life satisfaction is measured. Are we measuring it the way he experiences it now or are we going to measure what it could be or are we going to measure it as what I consider life satisfaction?".

Post game discussion of the participatory planning aspect of flexible style showed awareness of the importance of this variable. Discussion of this issue usually centred around the participation the Fulani tribesmen were allowed by the planners. Briefly the game provides a situation in which planners can practice local participation in designing and implementing plans. The planner and the local chief have the task of ranking six development cards which specify alternative budget allocations. Planners can determine the "weight" they will give their own preference, and the weight they will allow for the local chief's preference. In the two runs of the game, planners typically assign themselves more influence than the local representative. When this rejection of participation in planning was brought up in the post game discussion, a planner who had given a weight of 10% to the local chief and a weight of 90% to the planners commented

> "We gave the local chief less influence because he was only interested in cattle grazing. He chose no cotton plantations whatsoever, despite the fact that there were plenty of areas in the north still available for cattle grazing".

Subjects who had roles as planners often justified their development schemes on the basis that they did not know what consequences would occur from their development proposals. When asked: would you have chosen differently if you had known?", one planner answered:

> "If we had other information we definitely would have chosen differently".

The information on what the tribesmen wanted, however, was available from the local chief. One player who took this role lamented the small amount of influence he had with the planners.

> "I think I was the only one who could help the planners because I was there with the herdsmen (villagers) and then I came here (to the planners), when they asked me to line up the cards. I wanted to avoid the mistakes they fell into in the end, especially with their cotton plantations. I know what was going to happen and they did not know. I was able to know everything that was going on, but they did not allow me much communication. They cut me out at just the wrong moment".

This discussion revealed the ability to assess the consequences of development schemes on more than economic criteria. When asked: "What do you think the game teaches?", one game player stated:

> "It teaches how to impose western plans on them (the herdsmen). We think health is good, so we expect the tribesmen to appreciate getting innoculated and being sedentary to reduce epidemics; that health programmes took away everything in their culture - seasonal migration, tribal rituals, settling their own conflicts. Their tribes were divided all over the rangelands. We destroy their lineage system and tribal loyalties".

Individual Analysis of Role Taken in the Simulation

The participants in two runs of the simulation were divided into four groups depending on the role they played in the simulation, i.e. (i) villagers or herdsmen, (ii) local chief, (iii) intermediary roles, i.e. statistician and board controller, (iv) planners. The change in the weightings was noted for each role on each variable (X1 through X4) of the policy capturing instrument.

X1 - Participation in Planning

The following coefficients on X_1 show that there were differences in the mean change on this variable depending on the role played in the simulation.

	Before Playing	After Playing	Mean Change
Villagers (herdsmen)	0.09	0.05	0.04
Local chief	-0.09	0.17	0.26
Intermediary role	0.05	0.14	0.09
Planners	0.001	0.004	0.003

The local chief and intermediary role are more aware of the need for participation in planning from their experiences in the game than the other roles. This increased preference for participation shown on the policy capturing instrument is confirmed by their remarks in post game discussions. The previous section contains the comment by one local chief,

> " I was the only one who could help the planners ....but they cut me off at just the wrong moment".

The statisticians also gained a keen awareness of the need for participation from their position in the game. In the discussion a statistician commented:

> "The planners had no idea they were decreasing life satisfaction, because there was no communication between the herdsmen and planners.
>
> The planners have a different value structure and they don't even seek information different from their own. They solved problems that they saw, but never got together with the people to see what they thought were problems. Was that the objective of the game? to show them (the planners) that they can plan without information from the people."

The post game discussion and the weighting revealed more awareness of the need for participation on the part of the tribesmen and the planners than is shown in their preference for participation before the game. Many statements were made by the tribesmen such as:

> "The planning was made without any knowledge of lifestyle. There should have been more communication".

The planners also discussed the need for participation:

> "Except for the statisticians we were basically ignorant of what we were planning. Then we saw what was happening, but by that time it was too late".

X_2 - Concern for Health

The following coefficient on X_2 also show there were differences in the mean change on this variable depending on the role played in the simulation.

	Before Playing	After Playing	Mean Change
Villagers (herdsmen)	-0.47	-0.39	-0.08
Local chief	-0.51	-0.36	-0.15
Intermediary role	-0.44	-0.43	-0.01
Planners	-0.56	-0.53	-0.03

The villagers (herdsmen) and the local chief changed the most in their decreased concern for the health programme adopted in the game. The health programmes for the herdsmen have meant sedentary lifestyle and the abandonment of many rituals concerned with migratory life. The local chief, who previously presided over rituals, also feels a loss from government health programmes as adopted in the simulation. One local chief commented:

> "I would have liked to revert back to the old ways and taken my chances. Even though you know there was disease, you could count on the birth of cattle at the end of six months".

X_3 - Concern for GNP per Capita

The following coefficient on X_3 shows every role decreased their concern for GNP/Capita. Whereas the initial policy capturing instrument shows this variable as the main one in determining preferences for alternative development proposals.

	Before Playing	After Playing	Mean Change
Villagers (herdsmen)	0.35	0.27	-0.08
Local chief	0.06	0.06	0.00
Intermediary roles	0.35	0.16	-0.19
Plannerz	0.46	0.18	-0.28

The mean change on the coefficients show that planners changed the most in attitude after participation in the simulation. This change may have come from the planners observation of the herdsmen responding to the development schemes, and the general resentment of development that was so disruptive of traditional lifestyle. One planner noted:

> "As an observer, it became apparent that western civilisation or western social patterns override those that were supposed to be of nomadic tribes. We had a choice of six programmes. In each of these programmes there were one or two cotton plantations that we could have chosen from. In the first and second ranking we chose two cotton plantations. If we had really understood the results that would have occurred, I don't think we would have chosen any. But we didn't have that choice".

X_4 Concern for Nomadic Lifestyle

The following coefficient on X_4 showed that every role increased their concern for maintaining traditional lifestyle after the simulation.

	Before Playing	After Playing	Mean Change
Villagers (herdsmen)	0.05	0.35	0.30
Local chief	-0.17	0.28	0.45
Intermediary role	0.26	0.39	0.13
Planners	0.12	0.30	0.18

The herdsmen (villagers) followed by the local chief, are the most conscious of the need to maintain traditional lifestyles. Most of the post game discussion revolved around the herdsmen's resentment with sedentary lifestyles. One herdsman commented:

> "When the government introduced the rangelands, I jumped into it because I thought it would improve my cattle and my life satisfaction. Then all of a sudden everything deteriorated rapidly, my life satisfaction plummeted way below the zero point. The cattle score remained the same, but the sacrifices that were made, I don't think were worth it. I was ready to revolt".

When then can be concluded from this research on simulation games as sociodrama? The sociodrama does not change most the persons most oppressed by hierarchy, but rather changes most those aware of their oppression from hierarchies. Those who gain insight on the inappropriate behaviour of hierarchies change the most in the direction of flexibility. This is the view of Azima (1969) in "the case for insight" as the change mechanism in sociodrama. Keen discernment or understanding of a pattern of behaviour allows commencement of changes in attitudes.

The tribesmen are also excluded from planning but there is no activity in the game by which they state their own planning preferences and are subsequently aware that their views are being ignored by the professional planner. The local chief interaction with both planner and planned for gives them awareness of hierarchies to a degree not experienced by other roles. His subsequent planning behaviour is to prefer increased public participation.

The planner and the tribesmen did not increase their preference for public participation in planning as the other roles, but rigid planning model in the simulation did not make them prefer more rigidity. The simulation does not teach people to prefer the rigid planning style modelled in the simulation, but appears to move them in the direction for flexibility. This is important to note since it was considered a rival hypothesis that putting planners through a rigid planning experience could result in modelling this behaviour and amplifying their rigidity.

4.5. DISCUSSION AND CONCLUSION

The simulation on Fulaniland was designed to show the ineffectiveness of planning schemes which did not consider the goals of the community. Fulaniland, which began as a model of the Fulanis political structure.......segmented lineage system.....evolved to a simulation of rigid style colonial development schemes on this traditional community. The simulation presents a "Technology Assessment" of several development schemes which were introduced in Fulaniland and allows participants to assess the accomplishment or more precisely four social indicators of development - participation, health, GNP/Capita, traditional lifestyle. Too often social indicators are considered only from the production side. For example, participants with planners roles in the simulation usually assess the efficacy of their plans by observing the increase in level of GNP and cattle production, and the reduction of conflict and disease. But these are prototype indicators and seriously overlook the consumption side of the developing system.

However, as the simulation develops, it is believed to foster the consideration of these social indicators from the consumption side of the recipients, revealing the social cost of resettlement compulsory labour, sedentary lifestyle, cost of traditional customs and traditional laws, ecological costs of irrigated plantations, such as loss of marshlands. This research has shown that planning style does exist, and that they can be influenced to some extent through gaming simulation.

Planners who are now engaged in development may have been trained for rigid planning style, and be unable to access social consequences with their present planning skills and orientations (Marayam 1973 and Grabow 1973) showed the most prevalent model of planning is the rational comprehensive model establishing objectively defined goals of the dominant group, generating alternatives with the planner set apart from the world he is to "plan" and assessing the effects of alternatives by eliminating all but programmed social change.

Planner education should therefore include devices for enhancing this flexible planning style. Many planning curriculars include courses to develop technical competence of management skills. For example, operation and research techniques are thought for the purpose of efficiently achieving goals in planning. Virtually none of these curricula, however, deals with the cognitive aspects of planning and little attention has been directed toward those aspects of planning which have to do with consideration of the goals themselves, or social requirements of the various clients who will ultimately have to live with the consequence of plans.

As modern society and expanding technology interact, the role of the planner takes on new dimensions. These new dimensions are strongly associated with public policy and require of the planner not only sophisticated expertise, but also awareness of the planning style. The "Guidelines" written by American Institute of Planners (AIP 1973) on social responsibility of the planner, advocate a flexible planning style.

To make good decisions, it is not enough for planners to know that some social change is likely to occur, such as improved health of cattle herds from an immunisation programme. The planner, analyst, or decision make must also have a cognitive appreciation for the consequences that will accompany this change. The simulation is extremely useful in identifying not only the direct consequences of such change (i.e. an increase in cattle herds), but also the higher consequences (i.e. the over-grazing of land from larger herds and the sedentary lifestyle that is required in establishing health zones). While this attribute of the simulation has often been cited as one of its most elegant strengths, there is an even more profound attribute of the simulation. This is the characteristic of allowing participants to experience in "compressed time" many of the effective perceptions of social changes. Here the value of more sedentary lifestyle.....a higher order consequence of cattle ranching.....may be "felt" and assessed from different points of view.

Over twenty years ago, Reiner and Davidoff pointed out this affective dimension of assessing consequences in their "choice theory" of planning. "Facts by themselves will not suggest what would be good or what would be preferred. Therefore, when considering the broader 'public interest' of programmes, the affective considerations may be very crucial to programme formulation".

How to arrive at public interest has long been debated in political philosophy. Plato's republic posited a separate guardian class who will maintain a just state by limiting the wants of society. Samuel T Coleridge, the eighteenth century conservative English Tory, argued eloquently that an elite could more capably determine the long term needs and goals of man, and envisioned the "cleriсу" of national Church of England as the proper planning authority, Jeremy Bentham, a contemporary of Coleridge, argued with equal eloquence that given the corruption of government, the majority must determine the public interest. Karl Mannheim (1936) synthesised these two seemingly opposing views of elitist versus consensus means of arriving at the public interest. In his epistomology of knowledge, Mannheim points out that different paradigms, or structures of reasoning exist not only across cultures and classes, but also across specialisation and professions, and that these different ways of knowing, generate unique perceptions of the public interest. To discover the goals of all various interest groups, planners must be capable of communication among these various groups and logics. The simulatien provides one means of gaining personal experience with the "feel" of these different paradigms.

Although each individual has some unique construct (private culture), there are many shared constructs among people living in proximity (public culture). For communication to occur between development planner and community, there must be some shared constructs, When the planner has incorporated the constructs, (that is, understands the local values and customs and respect their utility for the community's perception of the world) he can then reveal his own constructs or ideas of development. In a trusting relationship the individuals in the community can add some of the planner's construct to their idioverse (the unique way of seeing the universe of the individual). This increase of mental constructs occurs for the community only if the planner increases his mental construct also. A planner totally aloof from the local customs, attitudes, and values, cannot expect a transfer of his ideas to the community (as was evident in the game), regardless of his technical expertise as a professional development planner.

Jan Sperling's "Human Dimension of Technical Assistance" (1969) analyses the rigid style of the largest technical assistance programme ever carried out in the developing nations, the $500 million steel indsutry for Rourkel, India. This technical assistance of the Federal Republic of Germany was jeopardised through a lack of knowledge of the culture of the Indian society. The German attitude towards work and performance, committed to order and punctuality and a genuine desire to collaborate in development clashed with the Indian social system, which was threatened by the growth of industrialisation. While the Germans lacked patience and tolerance and felt superior to their Indian counterparts, the Indians distrusted aid as implying political dependence. The German sociologist Max Weber analysed the Indian resistance: "After inviting modern construction workers to exploit their skills, the Hindus set up ritual barriers against them because they considered them as tainted by magic".

The simulation shows that diffusion of innovations occurs most rapidly when change agents can operate within the cultural values of the community (i.e. planners should understand the community so that a programme of change can be made to fit the cultural values and past experiences of the community). The agent of change should help organize those activities for which the community already has a felt need. The game has shown that acceptance and satisfaction with decision is positively related to the degree of participation of members of the social system in the decision.

The game emphasises that the beneficiaries of plans should be those who live under the plans, for a community to accept a plan, there must be a trust that the beneficiaries will be the people, and that the professional planners' skills will be applied to the benefit of the client. There is a substantial empirical support that the relative advantage of a new idea, as perceived by members of a social system, is positively related to its adoption. (Alero-Montalo, 1957).

Tentative findings from an attitude survey of economic planners in various developing countries show that they view traditional values as impediments to be eradicated (illchman 1968). They place high value on modernisation and industrialisation and exhibit a poor conception of the social costs of these phenomena. Far from eliciting traditional values for their inclusion in national policy, they reject traditional sector and its values as impediments to development. There is a call for a change to flexible style of planning which requires affective dimension on the part of the planner. These effective dimensions includes the planners' oritentation or attitudes towards the public, such as awareness of subcultural values, acceptance of citizen participation and evaluating social consequence of alternative proposals. The simulations have been demonstrated to provide a convenient pedagogy for increased flexibility in planning style.

Inplication for Future Research

Those aspects of planning style which were modified in the direction of flexibility from one session with the simulation (Fulaniland) might be tested in an expanded game. New phases added to the game modelling flexible style could allow players to practice participatory planning. A longer game could have allowed participants to change roles to see development from several perspectives. For example, a participant might change from one role of a National government ruler with certain objectives to a Fulani tribesman, with traditional goals, and then to a regional planner who tries to illuminate alternatives which synthesis goals of various interest groups in society.

5. EXPERIMENT III - BASIC URBAN GAME (BUG)

5.1. INTRODUCTION

Today, functions of education and urban planning are still separated by sharply delineated institutions, tasks and roles. It is not an unusual practice for city planning offices to produce "comprehensive plans" without evolving the board of education, and vice versa. Usually, those involved have developed neither channels of communication nor awareness of class interrelatedness of the problems both agencies are dealing with. If there are any contacts at all, they are mostly on an ad hoc, informal, personal effort basis, at a technical level which cannot lead to very significant results as long as both struggle daily with a paramount in house crisis. Since education today can be defined as an on-going process involving every body between the ages of 3 and 75, and the entire city with all its human potentialities, institutional, commercial, industrial, and recreational uses must be defined as resource, the institutional and functional separation of planning and education becomes obsolete, or worse, it becomes a barrier to urgently needed change. To bring about this magnitude of change, both agencies will soon search for an instrument which will allow them to coordinate and integrate their effort to make the city a more viable place to live and to mobilise existing resources.

Gaming simulation can become such an instrument, for several reasons. It can provide an on-going learning and communication process, which will increase an understanding of the fundamental needs of citizens, private and public agencies in the city; it could provide a practical vehicle for citizen participation in the planning and decision making process; and a dynamic model which represents the growing complexity of our social and economic structure more adequately than traditional models still in use. It is in this context that the model BUG (Basic Urban Game) is adopted in this study.

BUG was designed by Drew Mackie to provide some insight into the manner in which planning and the urban development process operate. It is frankly an entry and not an exhaustive study. If such a study can lead to the elimination or lowering of barriers so that the architect/the planner understands the influence of the financial structure on the physical structure, so that the banker understands the relationship of his financial decisions to the quality of living in his community, so that the building speculator sees the long lasting effect of short term decisions and the politicians understands the effect of their policies to the quality of living in the community - then their attention might turn to innovative ways to attain a higher quality of living for all. I proceed from a naive belief that all the "actors" in the environmental development process would genuinely wish to work to improve the quality of life if they were able to break out of their narrow interest constraining cells by understanding their vital roles in attaining a better life. Consequently the objective of this study can be expressed as follows:

> To provide a mechanism which will permit urban community groups as well as planning institutions and non-community groups, to test the effect and consequences of particular strategies of action when facing social, economic or political conflicts.

To explore the use of gaming simulation in the field of perception especially perception of urban development process.

To allow maximum expression of value position by participants; to gather information..... on the functioning of the town....from participants and lay groundwork for eventual development of a policy making tool.

Areas of Research

There were a number of areas which is thought should be researched so that a comprehensive assessment could be given about the feasibility of using gaming simulation techniques. These areas of research can be described as follows:

(a) Would it be possible to use planning gaming simulation (PGS) as a tool for identifying social conflicts in the process of urban development?

(b) Would it be possible to use (PGS) for identifying the relationships that can exist between public bodies and private enterprise in the process of urban development?

(c) Is it possible to use (PGS) models for identifying the interaction that can exist between politician, social, economic pressures in the process of urban development?

(d) Would it be possible to use (PGS) models for identifying the key decision making elements in the process of urban development?

(e) Is it possible to use (PGS) models for teaching and training community groups and leaders to become aware of the potential use of the technique for self planning of urban communities?

5.2. GENERAL CHARACTERISTIC OF THE MODEL

5.2.1. Roles

The following roles are represented in BUG:

Title	No. of Players	Aims
Central Government	Game Controller 1	To feed into the game possible external policy decisions with the chance decisions dictated by dice. To help participants realise the scope of their roles.
The Bank	1	The accounting system. To distribute initial financial resources; interest payments, etc, and handle all accountings as occurs.
Land Owners	2+	To act as owners of all sites and properties until purchase.
Developers	2+	To develop sites and buildings for a profit within the established constraints of the planning/development system.
Industrialist	1+	To protect and further the interests of the industrial element within the town.
Media	1	To monitor what is happening and keep the public informed.

Title	No. of Players	Aims
Planning Officers	3+	To prepare and implement any strategies/policies for this area answerable to planning committee. To control development within the area and make relevant policy decisions subject to approval of planning committee.
Housing Officer	1+	To prepare and implement any strategies/policies on housing for the town. To make relevant policy decisions on housing subject to approval of planning committee.
Councillors	3+	To represent the interests of the community under study, and in so doing to stay in power. To act as the planning committee.
Amenity Society	2+	To monitor proposals and exert pressure in order to safeguard the heritage and environment of the town.
Chamber of Commerce/ Entrepreneur	1+	To protect and further the interests of the business element with the town.
Public (workers housewives, youths, pensioners, tenants)	4+	To protect and push for the interest the faction belongs to.

Roles may be added or subtracted from the list above depending on which aspects the researcher wishes to examine during the simulation.

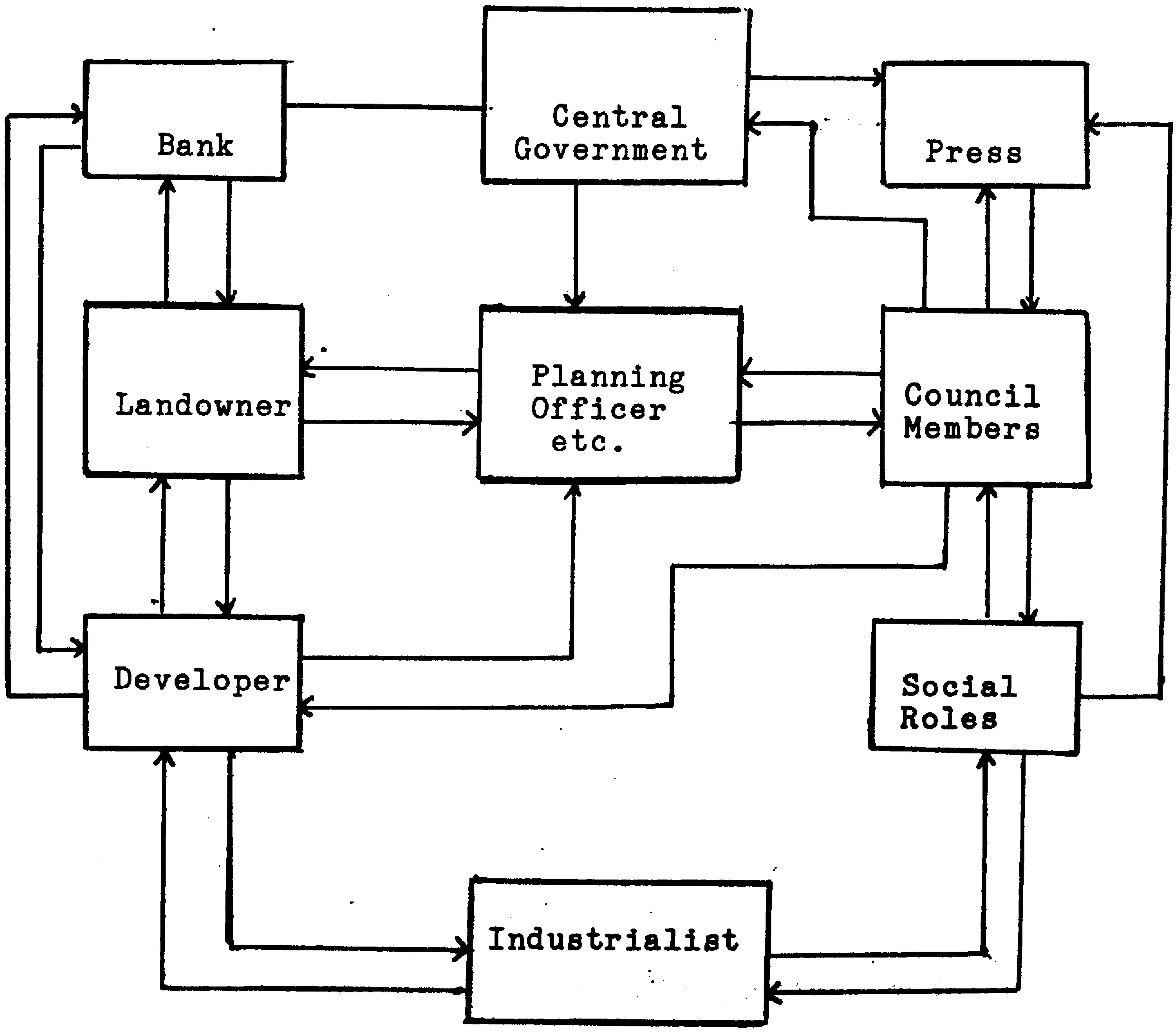


Figure 31 Shows the Role Relationship for BUG

5.2.2. Scenario

BUG can be designed to reflect three possible scenarios, a town centre, a small town expansion and a small declining town. For the purpose of this exercise a small declining town was adopted with the following characteristics:

(i) River north-south of the town,

(ii) Major road on east-west line.

(iii) Intersection is only bridge for 5 miles.

(iv) Town lies 20 miles from major industrial city

(v) No commercial pressure on town.

(vi) Existing industry (on periphery) is in decline

(vii) High male and female unemployment

(viii) No population imbalance (total population about 15,000).

(ix) Nearby town (20 miles away) is capturing most new development.

(x) Screen tree planting along the periphery of the town.

Figure 32 (page 223) indicates where building finance markers are placed. (A) markers indicate high quality buildings, while (D) markers means lowest quality of existing development.

5.2.3. The physical Model

The game is played on and around a physical model of the town simulated. This is a board on which the results of decisions are recorded. It acts as an important identification element in simulating results and as a focus for contact between the participants.

A representation at 1/500 was used and a base was made on which was marked the main roads, and the river. Buildings were formed on the base out of a series of specially made timber building blocks. A degree of detailed identification of buildings was in fact possible at this scale, major landmarks were more carefully represented and in several cases labelled for

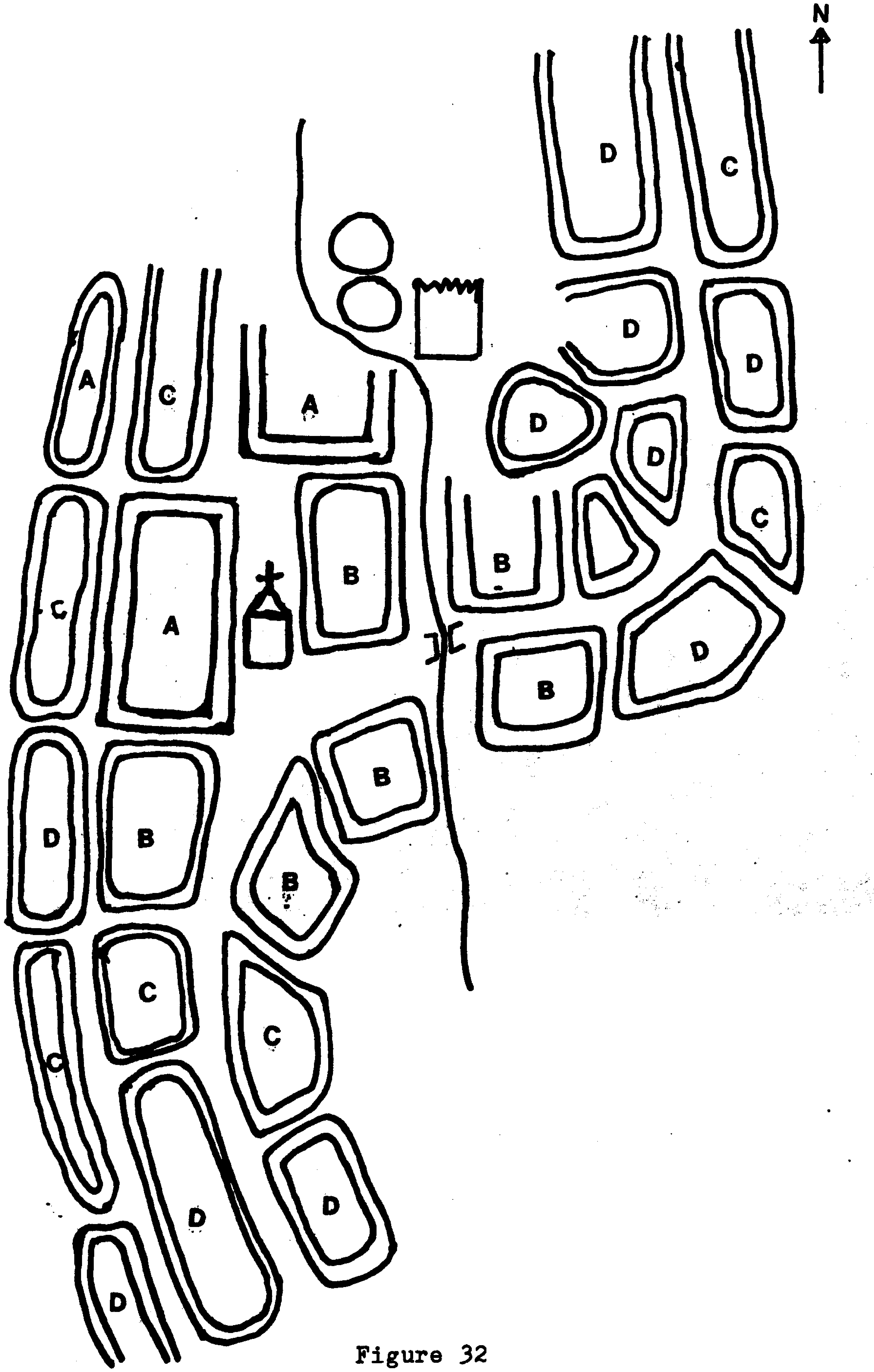


Figure 32

identification. Prior to the operation, developable sites will be indicated on the model and buildings in poor conditions will also be identified. This process is repeated before the beginning of each round. If properties remain in poor condition without action for a whole round, they will be removed from the model and the site assumed derelict. New buildings are denoted in Lego blocks purchased from the bank.

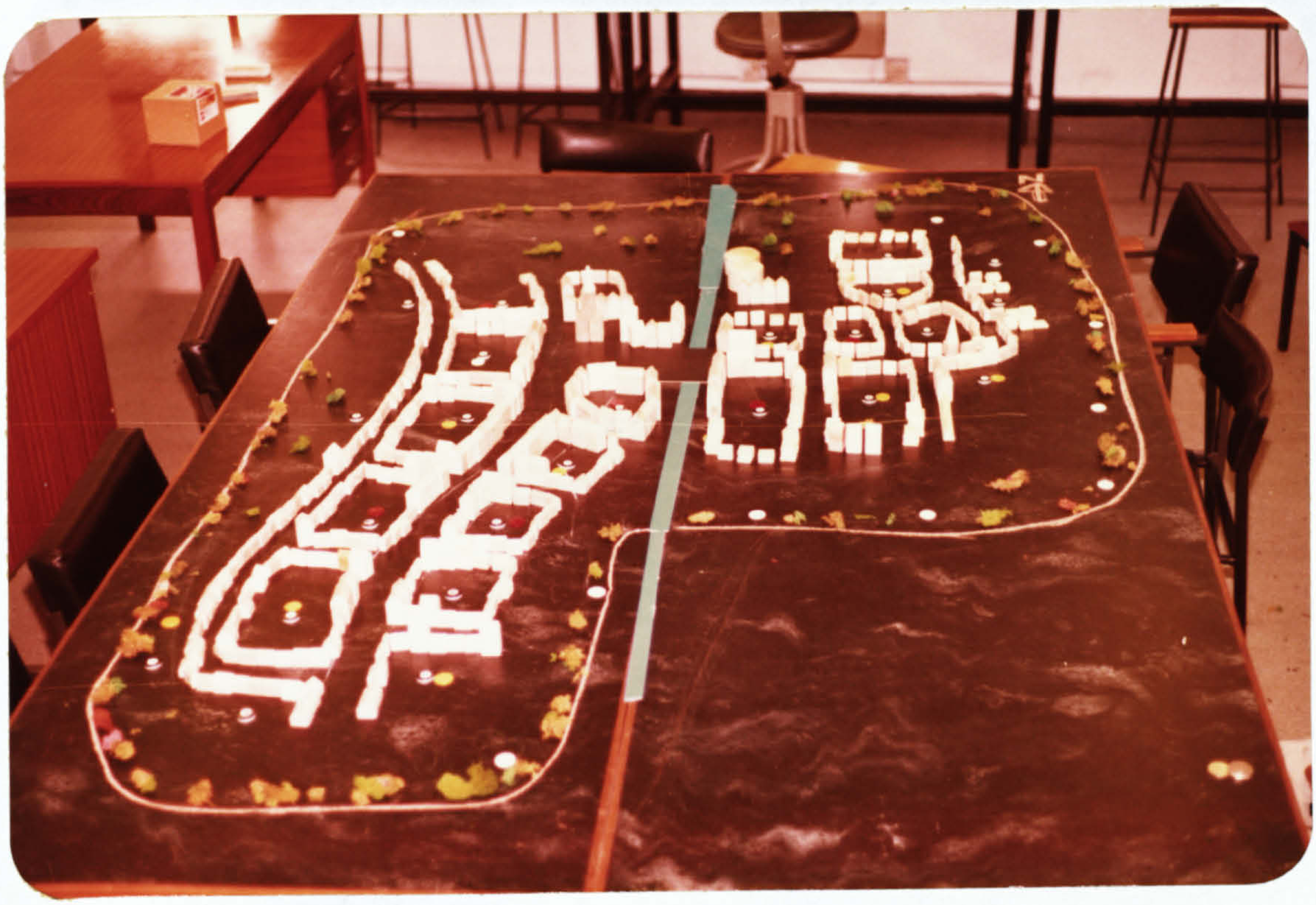


plate 5

5.2.4. Procedures

BUG is played in rounds with each round of two hours simulating one year of real time. The first session of the game (the first game year) is played over slowly so that participants may learn the mechanics of their roles. Subsequent game years will take less time to play through.

The sequence of play is as follows:

(i) Dealing and Negotiation - each player may make as many "deals" as benefit his role.

(ii) Election - existing councillors stand for re-election. New candidates present themselves (see election procedure).

(iii) Accounting - players provide the Bank with information to adjust yearly accounts.

Dealing and negotiation occupy the majority of the game year. Election may take about a quarter of an hour to hold. Accounting takes a similar length of time. If possible these are run concurrently.

<u>Election</u>: Elections occur at the end of each round for the post of councillors. Any player can stand. Each candidate is given the opportunity to make a short election speech and answers questions from the electorate at the end of the "Dealing and Negotiation" phase. Participants vote using the number of votes allocated to them, see below. The controller conducts the election. Councillors hold power in direct proportion to the votes cast. Political alignments may be expressed. The distribution of votes is as follows:

Bank	1
Landowners	2
Councillors	1 each
Planning Officer	1
Amenity Society	2
Housing Officer	1
Media	1
Chamber of Commerce	2
Social Role	8

<u>Accounting (Money Transactions)</u>:

(i) At the beginning of the game the bank makes the following payment

District Council	£140 x 10^3
Developers A	50 x 10^3

Developers B £ 75 x 10^3
Developers C 100 x 10^3

(ii) Prior to the start of each round the game controller allocates a unit value to developable sites indicated on the physical model. Bidding can occur for any of these sites.

(iii) Development unit (one "dot" of Lego) may be purchased from the bank at a cost of £1,000.

(iv) Rates are payable to the district council at: 25% of building cost and is collected by the bank at the end of each round in conjunction with the accounting of rate of return payments.

(v) Rates of return on investment is issued by the bank in accordance with the result of a throw of the dice or fixed as in this experiment. No return will be on undeveloped land.

(vi) Where conversions are carried out to existing property, the cost will be deemed to be half that of new work and the developer will pay the bank on the basis of the number of Lego bricks that constitute the existing property. volume.

(vii) It is the bank's discretion as to when and how much a developer may borrow and on what security. The above is a set of rules, perhaps too many, perhaps too few.

5.3. TESTING AND EXPERIENCE

BUG has been exercised regularly, although not frequently since its development I survives! It has been run for graduate and undergraduate groups for practicing professionals, educators and for local communities. The results have been educational for the researcher and even for the participants.

However, in any one play, it is almost impossible to predict the learnings that will occur. The possibilities are as endless as there are combinations of people and roles. The best that can be said is that the opportunity is present and one had better keep his eyes and ears open. In order to demonstrate the dynamics of BUG attempts is made to discuss a particular experience.

The game was administered with postgraduate planning students of the "Department of Urban and Regional Planning", University of Strathclyde (10th and 11th January 1981). Before the start of the game participants were asked to indicate their previous experience of gaming simulation and the British Development planning system. The results of these questions were as follows:

Previous experience of gaming simulation	
None	12
Negligible	4
Some	4
Considerable	0

Previous experience of British Development Planning System	
None	8
Negligible	6
Some	4
Considerable	2

This was followed by a short lecture on the origin - development and potential of gaming simulation and a review of some gaming models in planning. Participants were then introduced to a game called "New

Society". The aim of which is to acquaint the participants to gaming simulation before the actual play of BUG. From the above information and experience the allocation of roles was planned. While this was going on, the players, coffee in hand, appeared to be chatting happily around the model. Without the majority knowing anything about the game, the "board" had become a centre of conversation and interest. A "game" had already inadvertently started, that of identifying objects and places on the model.

The time had come to explain the brief, participants were told that game simulates a historic declining town, and involved the acting out of allocated roles, that were instrumental in the shaping of change in the town. A role definition matrix sheet outlined earlier was handed out to players. The town was then described verbally by the game controller. Views were identified on the model, and present specific issues were stressed, players were then allocated their roles and relevant labels.of identification were issued. Discussion ensued concerning both the model and the roles.

Then the rules of the game were explained. As these are fairly few, their principles were made clear, but it was felt better not to delve into detail.

At this point, confusion was detected and a coffee break was called. Questions were then answered on an individual basis by the two participants who had previous knowledge of the game. The informality of the procedure appeared to allay suspicions and fears as to what was to come.

It had been stressed that what would happen would be up to the players themselves and if they felt they needed guidance, the controller would help. It was now 3 o'clock. The players were asked if they would like to adjourn at this stage or play one round first. Enthusiasism appeared unexpectedly high - even amongst those from whom motiviation was least expected - and the group unanimously voted to begin immediately.

The ideal way to monitor the game would have been to video, but this not being possible two simpler approaches were adopted. The model was photographed before the game began (see plate s) and at the end of each round, in order to record physical changes ~~and~~ each player was given a "diary sheet" on which to record for each round, the events, alliances and transactions.

It is not possible or relevant here to describe all the events of the game in full detail. A summary of significant events is given below.

Round I

Present conservative government accepted as the outcome of National Election with working majority.

Land owners decides to let land find its own price level by accepting tenders for developable sites. Notofies all developers of current highest bids for sites which they express interest. Bottleneck with landowners ensues, landowners then accepts only one tender per site per developer.

Developer A buys without competition, site adjacent to cathedral. Claims to have obtained permission for supermarket. Builds four-storey block. Brought to task by Amenity Society and inquiry called for. Set for end of round.

Developer B in competition with Developer C for block of land S W of the major road. Developer C bids for package purchase and is awarded plot plus adventure playground. Developer B not aware of this then turns attention to adventure playground and persuaded the District Council to sell to him. On discovery of sale to Developer C, declares intention to sue District Council for breach of contract: hearing scheduled for end of round.

Housing subsidy of 50% on all units declared by central government. District council shows no interest. Workers lobby them.

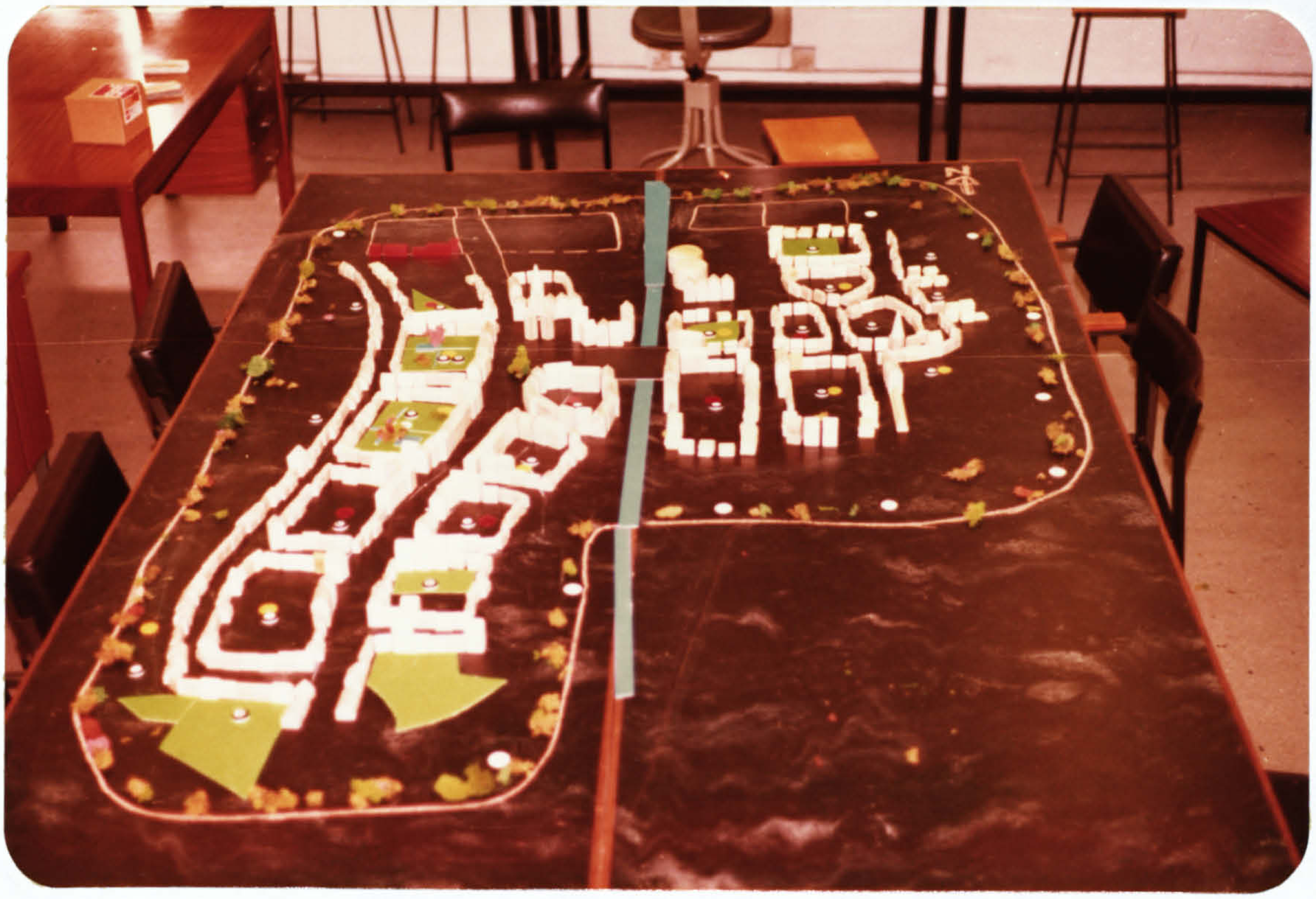
Developer B concentrates on upgrading of block of flats S W of the major road under District Council contracts.

Developer A discovered to be making secret deal with Chambers of Commerce. Cash payment involved. Detail remains unknown. Also approaches bank regularly with a variety of proposals on which to raise loans. All refused on discretion of bank.

Throughout the round, youth lobbies District Council for facilities. Allies with workers over job creation. Worker lobby for more jobs and approach Developer B, who agrees to build more factories. Workers, Amenity Society call through the press for Community Centre, sports facilities, more supermarkets and late shopping.

Inquiry held: transpires that Developer A had been given planning permission by District Council without knowledge of District planner, permission upheld.

Breach of contract hearing: it was decided that the landowner (yellow) had rightly sold the site for adventure playground, being the owner, and that the District Council did not have the right to claim ownership and promise sale. District Council to pay compensation to Developer B.



The following rates, rents and repairs values were fixed and was accepted to remain fixed throughout the game. (All in pounds).

	Rates	Rents	Repairs
A	20,000	50,000	00
B	15,000	30,000	5,000
C	10,000	20,000	7,000
D	5,000	10,000	10,000

Finances accounted by the bank.

District Council election result: Labour elected with working majority.

Round II

Before actual play started participants felt it wise to prepare a local plan to guide future development in the town. The first round has revealed to the participants some key issues and they are now ready to tackle it through some policy recommendations for the next five year period.

A local plan was quickly prepared and contains the following objectives:

(i) the provision of suitable accommodation in terms of size, tenure, cost, environmental, amenity and support facilities to house the projected population to 1985.

(ii) the provision of employment opportunities to meet the demand of the town's anticipated pool of labour and to solve present unemployment.

(iii) the maintenance and enhancement of the town's architectural, historical and landscape heritage

The following policies were therefore recommended for adoption:

(a) Housing

(i) That additional housing be made available to rent in the public sector. (About 5,000 people to be housed).

(ii) That rehabilitation (upgrading) rather than demolition be accepted as the general principle in dealing with areas of substandard housing. However, demolition should take place in certain cases.

(iii) That housing associations and private developers be encouraged to invest in development, re-development and rehabilitation and that new development on greenfield sites be restricted to areas presently allocated for housing purposes (N W).

(b) Employment

(i) That every encouragement be given to new and existing firms which will provide additional employment opportunities for male and manual workers.

(ii) That the growth of employment in the service sector be encouraged as far as it is consistent with the reservation of prime industrial sites for industrial purposes - and the policy regarding the growth of offices in the central area (i.e. restraint in the central area).

(c) Industry

(i) That priority be given to the identification, acquisition and servicing of additional land for industrial and commercial development and to the rehabilitation of vacant and derelict sites in the town.

(ii) That small scale industries of local concern, e.g. electronics, soft drinks, be encouraged and located away from town centre.. Priority on the provision of training and retraining opportunities.

(iii) Enable change of use of residential property for industries/service/commercial use. Vacant properties in the town centre be used for the development of a community shop, flatted factory accommodation, etc.

(d) Recreation/Leisure

(i) That the provision of sports complex and playground be given priority.

(ii) Provision of allotments on vacant land to enable families to produce their own food.

(iii) Improve existing recreational grounds by providing seating area and hard surface access.

(iv) Provision of seating areas throughout the town. This would have to be combined with tree planing to provide shelter especially for the elderly people in the town.

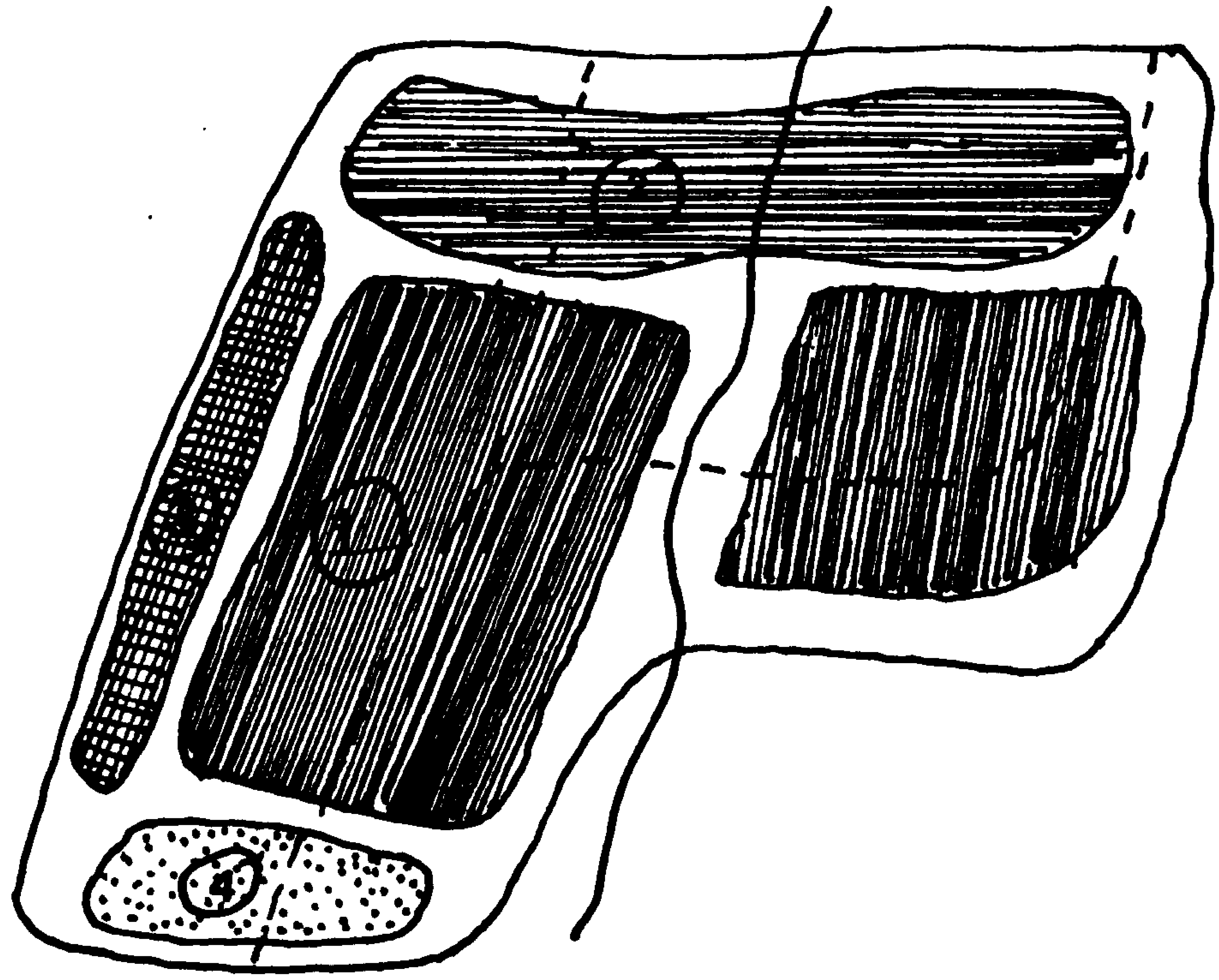
(v) Provision of screen tree planting and the development of a forest on the hill area around the periphery of the town. Screen planting will reduce wind exposure, while development of forest would have the advantages of shelter, wildlife and recreational and amenity potential and an economic crop when the trees reach maturity. This policy is already in existence in the town.

(e) Conservation

(i) That every encouragement be given to privately financed development proposal involving significant conservation and social gains.

(ii) That the District Council actively pursue the conservation of areas of special architectural or historical interest and designation of conservation areas.

On page 235 is a sketch of the spatial strategy proposed.



(1) Existing residential area, including open space including garden, sitting areas, kickabout pitches, school for all ages; industries compatible with housing, i.e. book binder, watch maker, etc.

(2) Land zoned for new residential areas with properties as in (1).

(3) Industries meeting specific criteria. Examples includes electronics, soft drinks, petro-chemical, etc; spaces for parking.

(4) Major recreational open space, i.e. district sports complex, district park, etc.

Public inquiry was held with central government (game controller) standing as arbitrator. Issues involved conflict over redevelopment proposals. The proposals to demolish were necessary in zone (1) was attacked by amenity group and pressure was exercised on the District Council to delete the clause. The Council responded almost immediately by deleting this minor proposal for demolition and redevelopment since they had no material effect on the main principle underlying the plan.

Local plan was finally accepted and other activities commenced with immediate effect.

Derelict areas declared. Returning District Council asked for loan from bank to be able to implement policies in the local plan. Loan was granted.

Developer C purchases three sites adjacent to south of the river and a row of cottages for upgrading.

Developer B continues to buy land at the western area of the town. Obtains planning permission, builds small industrial units, and redevelops some existing sites.

Developer C, it transpires, has entered into an agreement with Chambers of Commerce whereby she has agreed to allow him 10 percent commission on her profits at the end of the round. He then proceeds to lobby heavily on her behalf.

Chamber of Commerce acting as agent for Developer C negotiates for the construction of a community/leisure centre on a site near town centre. Supported by all members of the community. Financial gain to Developer C vague.

District planner under pressure of work is criticised by central government for poor quality of development taking place (amenity society previously lobbied).

Council constructs several houses on land purchased from landowner (blue) on N W corner of town. It was claimed it is all for the public and allocation will soon be made.

Central government announces the development of new office complex at centre of town. Developers bid for contract for the development. Developer A wins contract.

Youth allies with Amenity society and workers form pressure group for building recreational facilities. Through press, note is made of the growing waiting list for housing. Press runs campaign for more residential development and traffic noise, accident and congestion along the main road running through the town. Population has now increased to 17,000.

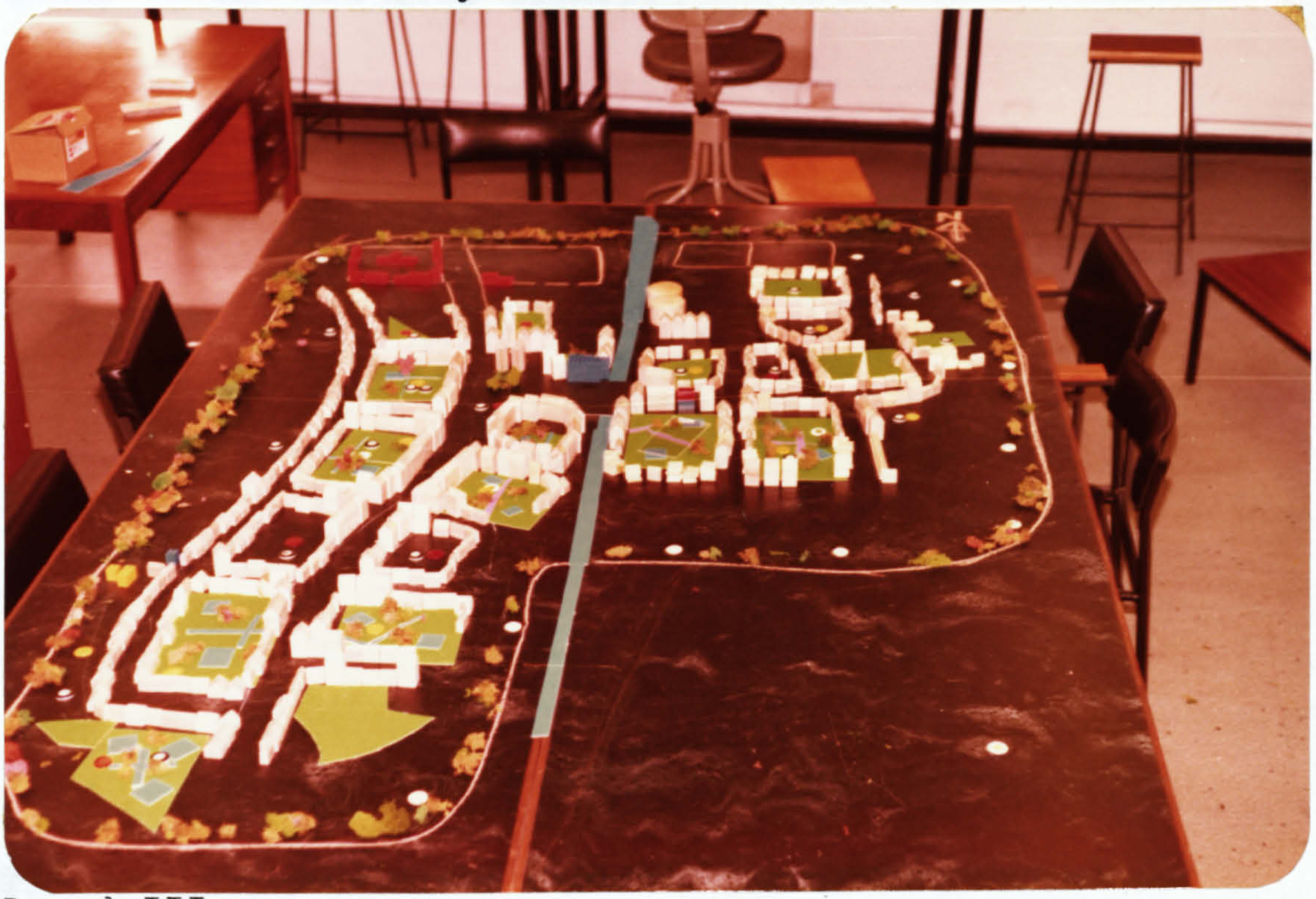
Central government proposed to develop a bypass - feasibility study was commissioned. District council welcomes the idea but local shop owners along main road lobby politicians and District planners to adopt traffic management solutions to alleviate traffic problem rather than bypass - that bypass will reduce trade.

Industrialist prepares a list of industries he wants to locate in the town and negotiates with District Council. Industries mainly of local significance, such as textiles, electronics, soft drinks, soap and carpet were allowed to be located along main road N W and S W of the town. Industries compatible with housing areas on factors such as noise, such as watch maker, bookbinder, battery manufacturer, printers, etc, allowed within residential areas.

Central government issues circular which stresses the importance of efficiency, urgency and relevance in the handling of planning applications. Development control must avoid placing unjustified obstacles in the way of any development, especially if it is for industry, commerce, housing or any other purpose relevant to economic regeneration of the town it says. It is, and should be seen to be part of the process of making things happen in the right place at the right time

District Council election result: Labour elected with working majority. Retiring District Councillor opts to become Developer C.

Finances accounted by bank.



Round III

Appropriate adjustment made to sites and properties.

Central government announces the route of bypass and call for objectors to make their cases. Objection from landowners N W of town and shop owners along major road. Public inquiry was called.

Council make known their intention to gain maximum autonomy from central government. Announces intention to sack physical planner. Workers go on strike. No effect. Return to work. Central government pressurises landowners to N W of town to sell some of its land. Industrialist proposes a major industrial complex (Electronix) on west of the town between proposed bypass and the row of houses on the west of town.

District Council builds sports complex and completed adventure playground S E of town.

Central government commission an environmental impact study on the proposed bypass.

Developer A received planning permission to redevelop housing in S W. Developer C sells off part of land holding and obtained planning permission for more shopping units, with residential units over it along the north of major road.

Developer B gets planning permission and builds 150 houses N W of town. Other developers proceed to build.

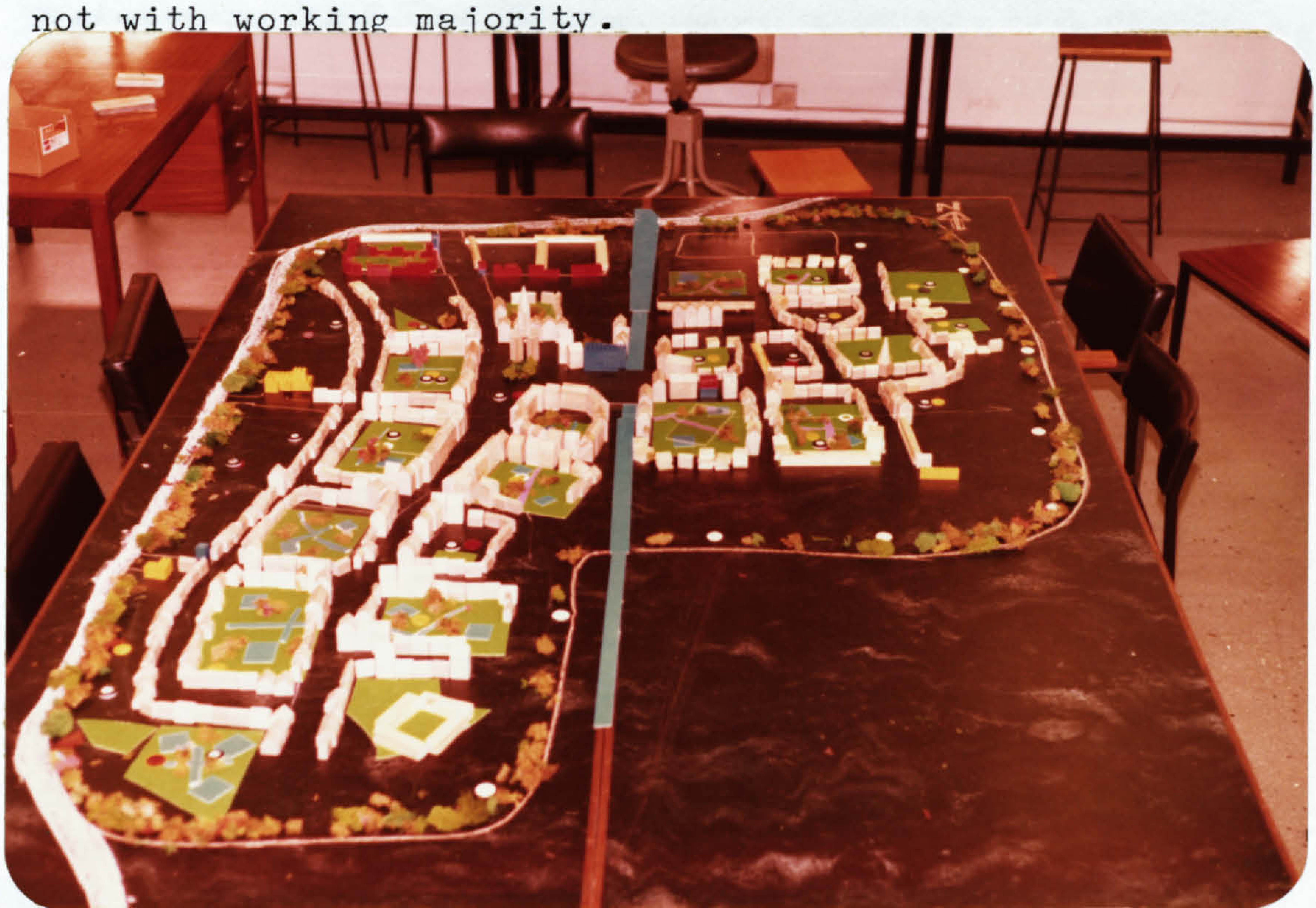
Public inquiry on proposed bypass was held. Central government - the proposer made its case by pointing that according to an environmental impact study it was found that the bypass will be beneficial to the town, it will facilitate easy flow of traffic. Traffic noise in the town will also be reduced. The accident rate which is claimed to be high at the moment will also be reduced. Shop owners on the other hand objected to the proposed bypass on the grounds that they will lose their tourist trade. Landowners made their case by pointing out that it will reduce their land value and agricultural land and accused the central government for producing only one alternative route for the bypass. Central government was eventually given the go ahead with the bypass but was instructed to pay adequate compensation to landowners involved.

Developer C gets planning permission to clear gas works N of the town behind textile industry and builds a row of cottage industries for central government development agencies.

Developer A gets planning permission to demolish residential units near town centre. Local group opposed to demolition pressurise District Council but lost. Demolition was successfully carried out and new residential buildings were developed. Campaigning takes place for elections.

Finances accounted by bank.

District Council election result: Liberal elected but not with working majority.



Round IV

District Council plan comprehensive school, cottage hospital annexe. Capture full support of all community, except Conservative councillor.

District Council negotiates with Developer B who agrees to build more residential units N E of town.

Electronic industry on the west of town completed. Employs 400 workers. Central government gives grant to declining textile industry north of town.

Developer B obtains planning permission to redevelop sites on the N E. Developer C breaks agreement with Chambers of Commerce.

Central government announces cut in transport, education and social services. But confirmed its commitment to the completion of the bypass. As a result District Council suspends all proposed development on schools, and recreational facilities like leisure centre, sports complex, etc.

District Council urge for increase in rates but was immediately opposed by social roles and developers.

Developer A was refused planning permission to convert residential blocks to office and commercial use around the town centre. Inquiry called for set; for end of round.

District Council adopt policy of hurrying decision through planning committee.

Workers interest flags after unheard call for better public transport.

Inquiry held: transpires that proposals for change of use of residential property be granted only if special circumstances justify this course, and that such proposals will also be considered in the light of specific policies regarding offices in the central area (i.e. the present policy of restraint in the central area be maintained). That Developer A application conflict with local plan policy on office development. Permission upheld.

Round halted at 5 p.m.

The somewhat exhausted players were asked to fill in a final short questionnaire designed to record their reactions to the game. This was followed by a post game discussion. Answers to the questions and post game discussion will be dealt with in the next section.

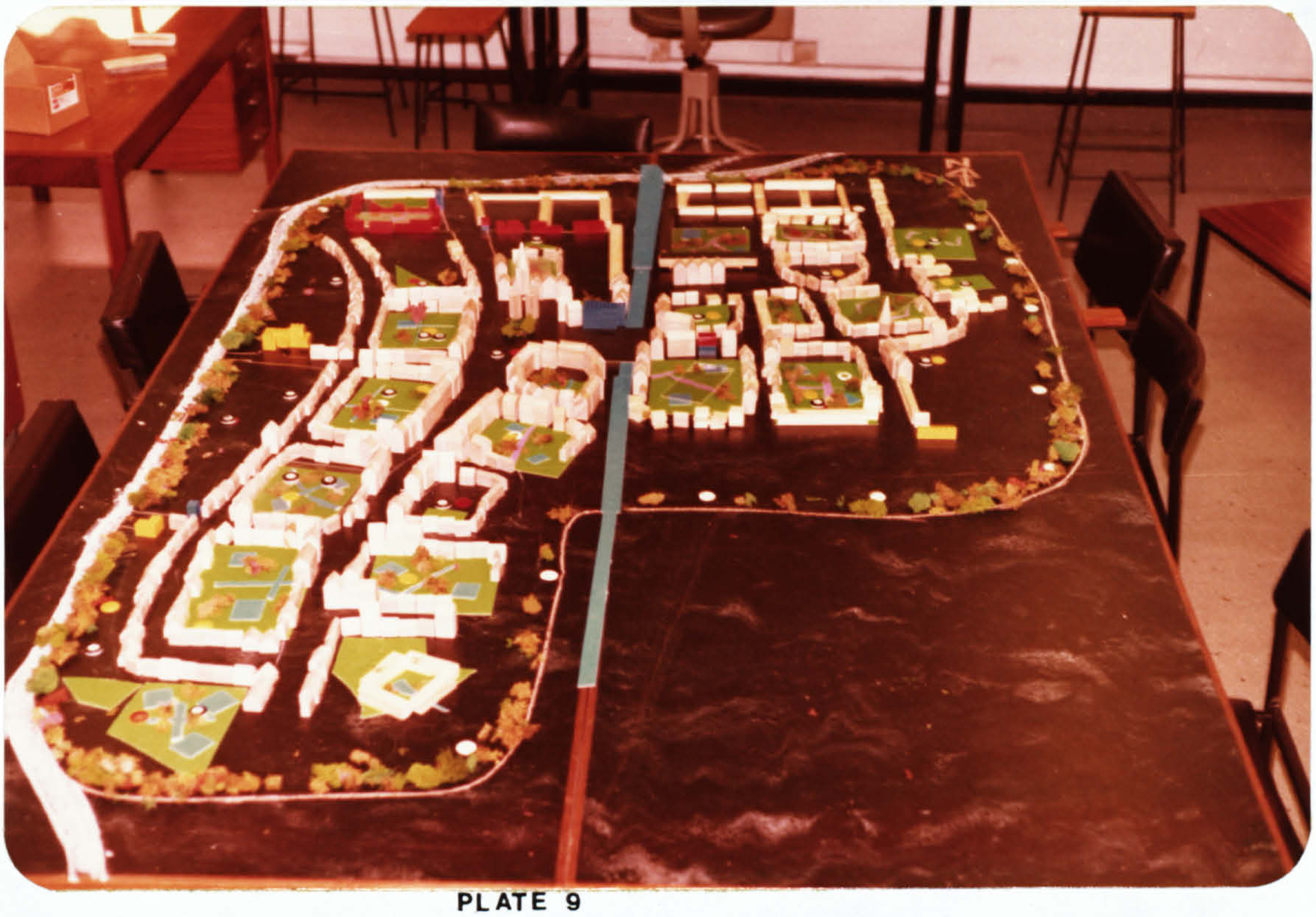


PLATE 9

5.4. ASSESSING THE SIMULATION

It must be made clear before attempting to examine the results from the game that a great amount of data available has not been examined because it is really outside the immediate purpose of this study. Most of the results also are not quantitative (with the exception of opinion rating questionnaires which were presented to the players after the session), but qualitative and based on observations and involvement. All the results will be examined from two points of view: (i) results from observations

(ii) results from opinions of players

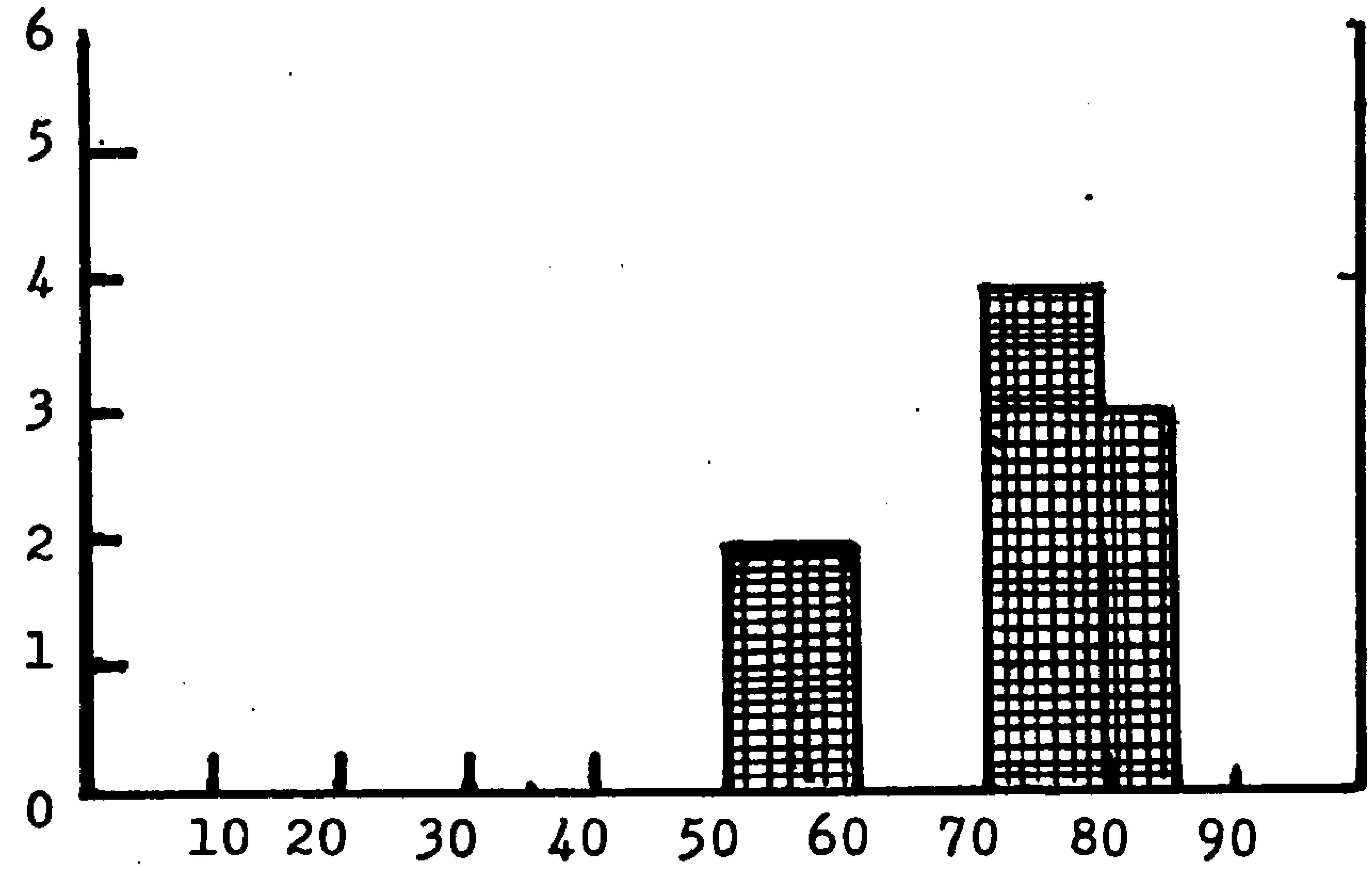
The results will be examined in relation to several aspects in which one is interested.

1. On the replication of the simulation: The simulation from observations seemed to behave quite well in terms of replication, and apart from some minor mistakes and problems in relation with general structure, replication is achieved to a satisfactory degree. Of course this opinion is based only on the results and observation.

The basic statistical values which were chosen to be used in this study are very simple and describes only the mean values, the range (difference between the higher and lower value) and the interquartile range (difference between the upper quartile and the lower quartile value). All of these are measures of dispersion and or central tendency and all indicative of the average ratings to each question of all players of the group and of the scatter of the answers which could in turn be interpreted as the agreement between the players in relation with the answer to a certain question. The values have been approximated to the next whole number to avoid presenting decimals as symbols of precision and exactitude which this research doesn't possess. Meanwhile let us see how the players reacted to the following question:

How real was the simulation in which you participated?

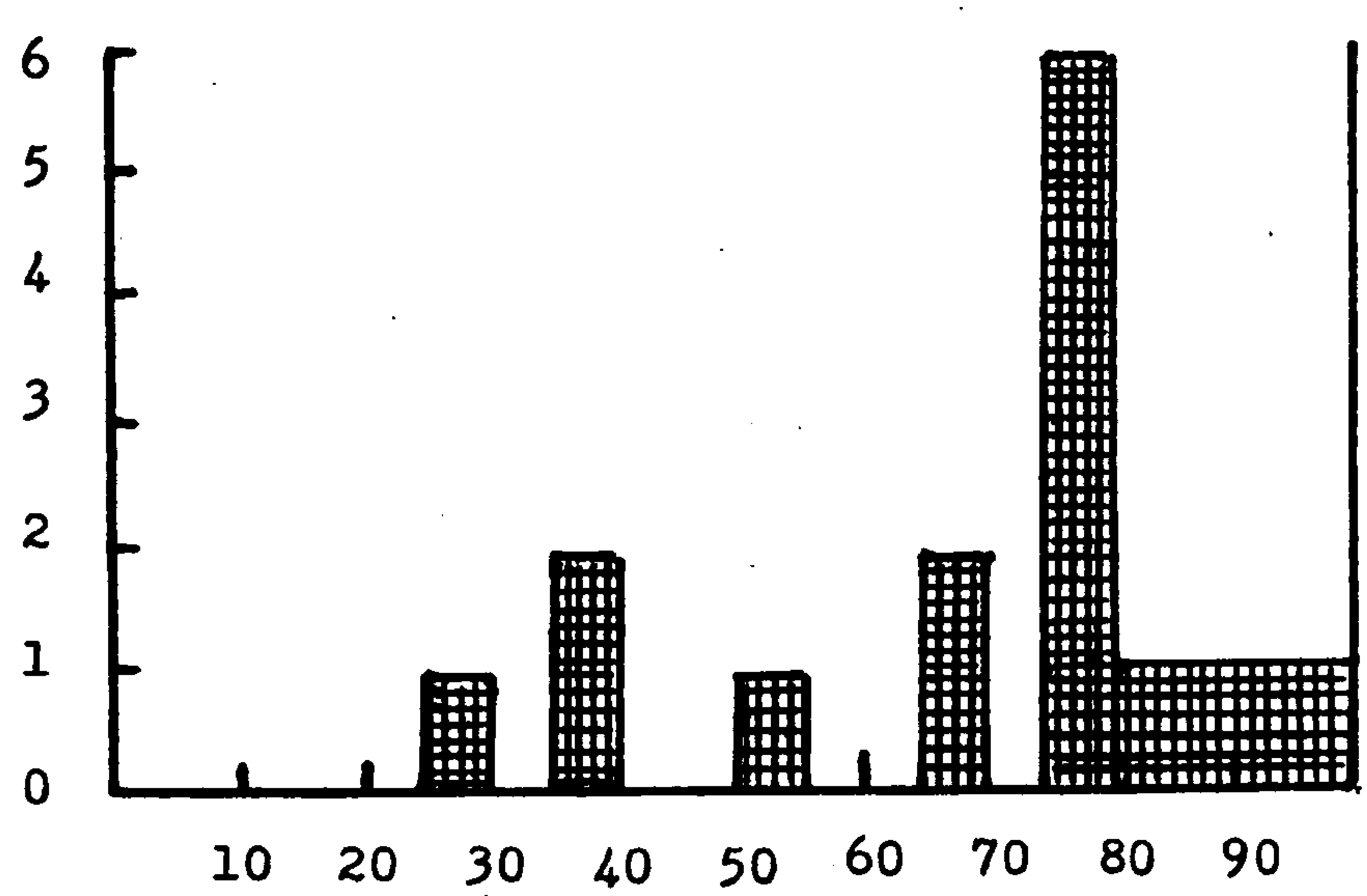
According to the results obtained (see Figures 33 and 34) in the simulation it can be said that a considerable degree of similarity to reality was achieved. The model, in fact, resembles the real life situation of conflict in a community. The representatives of the model can best be seen when comparing the results of activities that went on during the exercise with the real life situation of conflict. Participants gave some mean values of over 68 percent along the scale of reality to the simulation and there was quite a good amount of agreement on this. These are some of their answers:



Ratings

Mean = 68.66 Range = 30.00
Lower Quartile = 71.31
Upper Quartile = 80.62
Inter Quartile Range = 9.31

Figure 33. How Real was the Simulation in which you Participated?



Ratings

Mean = 67.0 Range = 75.0
Lower Quartile = 69.12
Upper Quartile = 84.50
Inter Quartile Range = 15.38

Figure 34. How Dynamic was the Structure of Events?

"All participants involved in the game took their positions quite seriously". ".....reasonable, so as in real life, the influence and power aspect of the game contribute considerably to make the game real". "Allowing for a certain amount of philanthropic attitude by the council, I think a real life council would probably do as the simulated council did taking into account the efforts of the resident's community". ".....progress seemed typical of real world similar problems".

In general the game provides an effective structure in which events and activities take place at different times with a dynamic involvement of participants. Some players felt that what made the simulation dynamic were two things: first, the negotiation period, because of the form in which the players were confronted with each other; second, the political and power factor of the game permitted them to actually take over other players' positions, and see how the game structure could be changed.

These types of comments by the players are clearly confirmed by the results of the questionnaire itself, (see Figure 34) and by tracing the events that took place together with the recording transcriptions of the negotiations or newspaper print out during the game. From the results one can see that participants gave a rating of 67% on the dynamism of the structure of events in the simulation although the degree of agreement was less (15.38) than on the degree of agreement on realism (9.31). The following are some of their answers to the questionnaire: "The second round of the game was very dynamic, because players had more confidence in themselves. They knew more about the total situation and the dynamic mechanism of the game". "The game is quite dynamic in terms of time; the existence of a stepping process to carry out the activities contributes considerably to make it dynamic". "The whole situation of the game is dynamic. It was actually a real situation...." "The negotiation period is very dynamic as different players are confronted with each other". "All players tried to make the situation real and therefore dynamic". The dynamism of the simulation lies in the urgent solution put forward in the development programme.

The fact that participants did not share the same information about the total situation of conflict of the community and therefore they had different "interpretation and perception of the reality" of the simulation, made the gaming exercise resemble the real life situation of urban communities. The concept of differing interpretation and perceptions of a reality as a new game, produced in the players a high degree of uncertainty about the total environmental situation of the simulation. The uncertainty corresponds in a real life situation to the difficulties and uncertainty faced by the agencies involved in the planning process when trying to understand the social behaviour of those members of the social structure of the community they are trying to plan for. It also corresponds to the difficulties faced by these agencies when trying to identify the images of reality that other institutions of planning agencies carry, and which ultimately made them adopt certain kinds of typical behaviour during the planning process. With regard to this aspect players' answers were: "Information about reality of the situation in the scenario was misleading and ambiguous. I think my information about the situation was different to those of the other players". "There was some lack of information about the right role of the entrepreneur. At times I did not really know what he wanted". "My information about the general conditions of the community was different to the information of other players. It was misleading". "Also I didn't know why any player loses its power, although I think that power was highly related to the wealth of each player". "I felt very uncertain because different people had different interpretation of the game".

With regard to the planning aspect and according to the results of the exercise, BUG has a number of potential outcomes which can prove to be of great help for those agencies involvedin urban redevelopment process in any urban community. It is thought that the game helps to identify planning strategies of action. It was possible, through the game, to explore and identify the key decision making elements in urban redevelopment process. Players' opinions about the implications of gaming exercise for urban planning policy was tested; the type of answers obtained is of the sort: "It helps the planning policy makers to be aware of the probable reactions of those agencies involved in the planning process, and, therefore, to be more cautious about their decisions as well as to begin to study social problems that might arise as a consequence of a particular planning policy". "It would serve as a guiding device for planners and the outcome of the gaming exercise could possibly be one of the solutions to the particular urban problem under study, although not necessarily the best or more practicable solution". ".....it explores the number of probable solutions that might be given to urban redevelopment problems". "You can get an idea of how such urban renewal and redevelopment problems can be solved".

The alliance and transactions that took place was record by each player (see Figure 35).

	Central Government	Industrialist	District Council	Housing Officer	District Planner	Amenity Society	Chambers of Commerce	Landowner A	Landowner B	Developer A	Developer B	Developer C	Bank	Media	Workers	Youths
Central Government		x	o		o	o	o	o	o	o	o	o	o	o	o	o
Industrialist	x		o		o	o	x	o	o	o	o	o	o	o		
District Council	o	x		x	[illegible]	o	o	o	o	o	o	o	o	o	o	o
Housing Officer			x		o	o				o	o	o				o
District Planner	o	o	[illegible]			o	o			o	o	o			[illegible]	
Amenity Society	o		o	o	o		o							o	x	x
Chamber of Commerce	o	X	o		o	o				o	o	x	o			
Landowner A	o	o	o				o		x	o	o	o	o			
Landowner B	o	o	o					x		o	o	o	o			
Developer A	o	o		o	o			o	o				o			
Developer B	o	o	o	o	o		o	o	o				o			
Developer C	o	o	o	o	o		x	o	o	o	o		o			
Bank	o	o	o				o	o	o	o	o	o				
Media	o	o	o			o									o	o
Workers	o	o	o			x								o		x
Youths	o	o	o	o	o	x	o				o		o	o	x	

X ALLIANCE O NEGOTIATION

Figure 35

Attitudes of the Players: The attitudes of the players to the simulation exercise will be examined from the following points of view: learing, involvement, enjoyment, and usefulness. These aspects as I have said before are also examined from two points of view, my observations and the opinions of the participants.

Learning: From the talks with some of the players outside the simulation sessions I have been able to learn that they strongly considered that the simulation shows them mainly how to understand and be aware of the difficulties involved in solving those types of conflicts similar to the ones simulated. Some aspects which they think they learnt are; "I learned that people with problems are very stubborn in their views". "People can become all to irrational in certain situations". "Roles are very important, i.e. similar people in different roles behave unlike each other". "Lack of alternative solutions proposed by District Council and central government". "It is very difficult for ordinary people to convince the council of their ideas and try to compromise with them". "I learned what it is really like to try and put your own view forward to the council". ".....different strategies.." "...the dynamic structure of our complex society".

This as one can see, can be divided into the following sets:

(i) Learning due to the outcome of particular strategies

(ii) Learning in relation to the internal behaviour of some roles involved in the simulation.

(iii) Learning in relation with the relationships between the conflicting roles involved in the simulation.

(iv) Learning about the simulation itself, i.e. learning.

To try to identify the amount of knowledge that participants "felt" they learned from the simulation, the following question was put to them after the sessions were over:

<u>How much do you think you learned from this simulation?</u>

A graphic scale was used for ratings at which extremes were <u>nothing</u> and <u>quite a lot</u>.

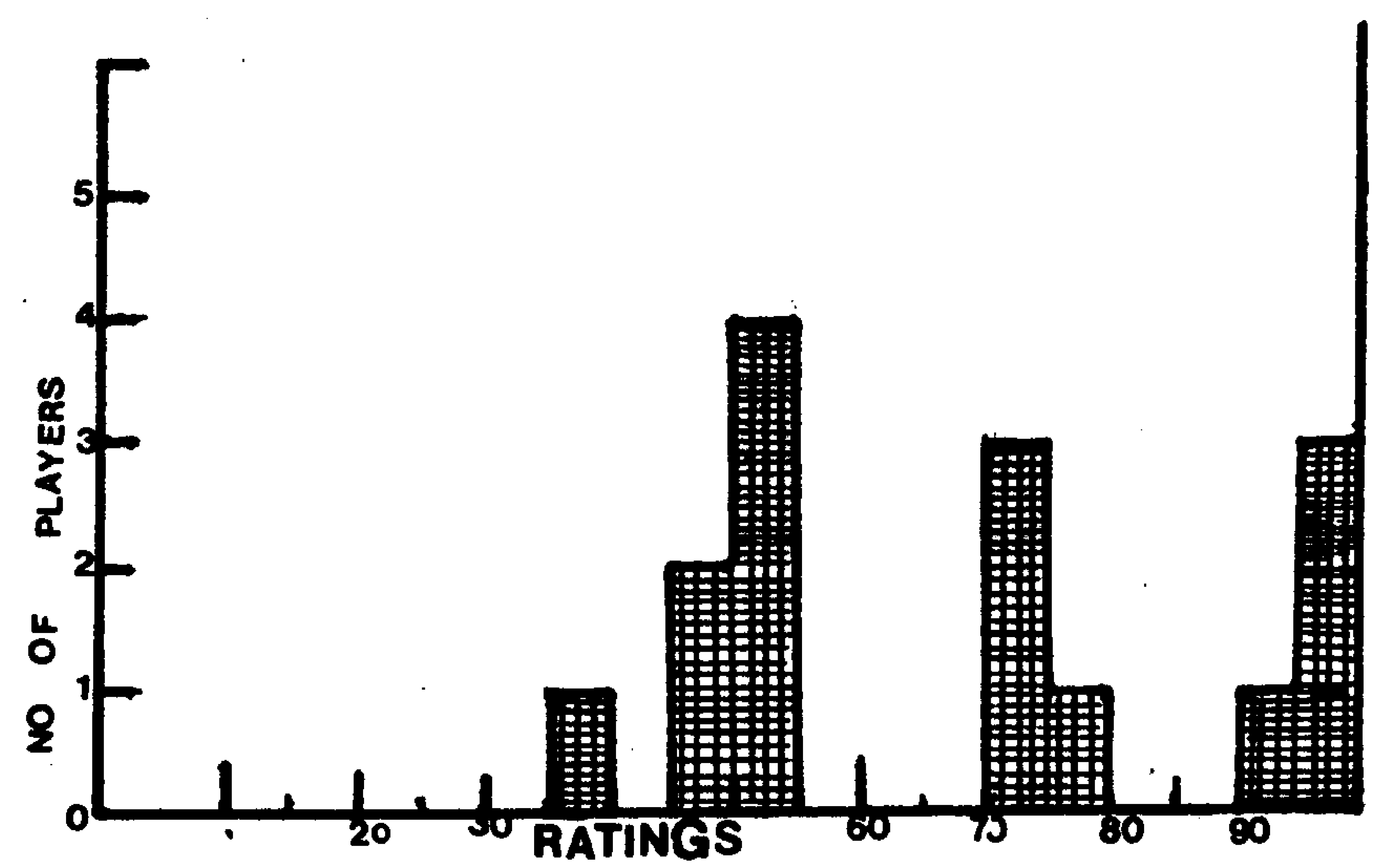


Figure 36

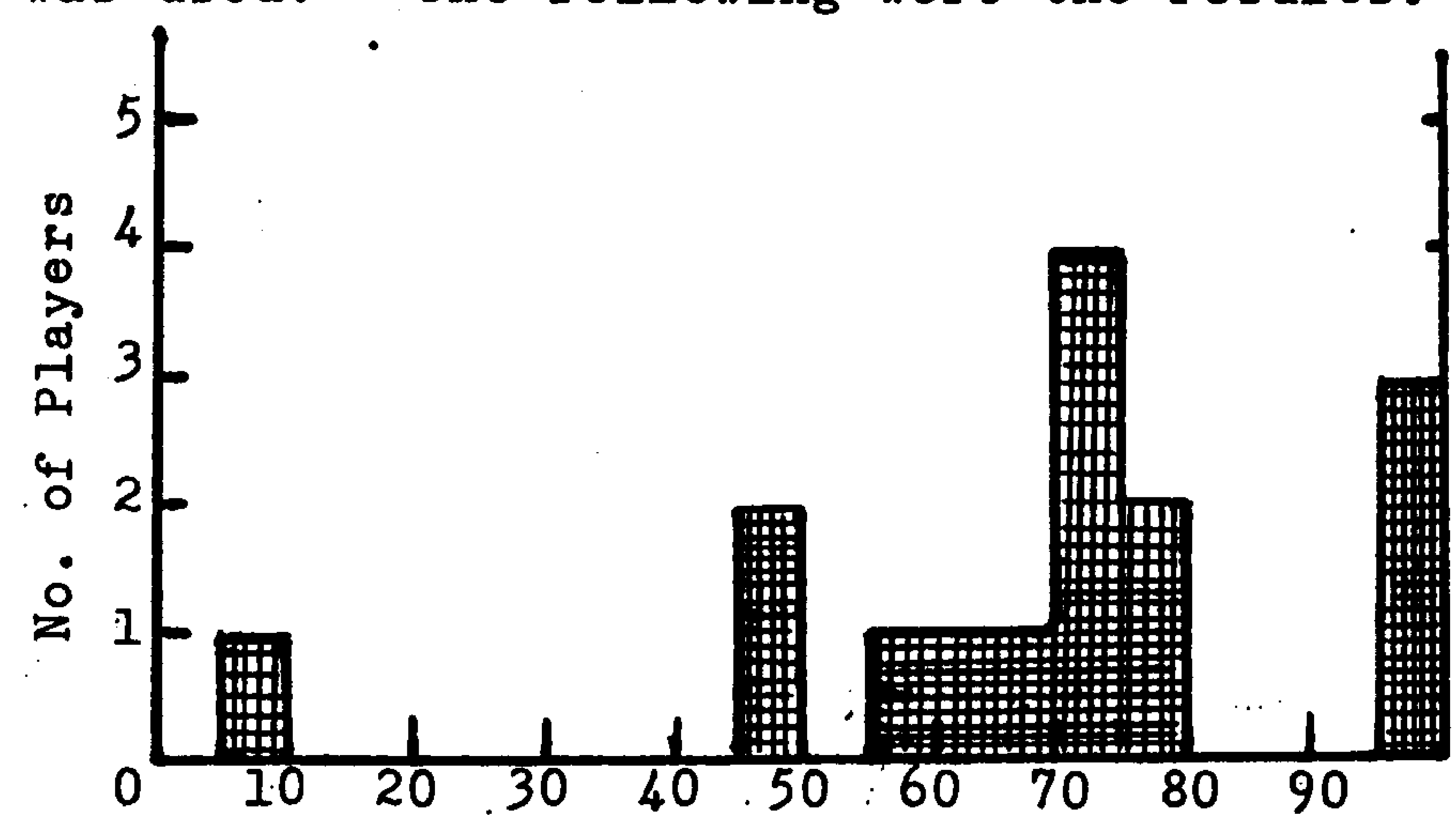
Mean	=	70.80
Range	=	60.00
LQ	=	52.56
UQ	=	94.50
IQR	=	41.94

From these results one could see that participants rated a 70.80% of learning. However, one must consider very carefully this result, because IQR as high as 41.94 is an indication of a great scatter in data.

Enjoyment: Enjoyment of this kind of exercise is a basic factor of success. If players don't feel attracted to play or run a simulation session, their involvement would be certainly inferior than if they strongly enjoy what they are doing. The enjoyment of the sessions was measured by the answers to the question:

How much did you enjoy the session?

A graphic scale at which extremes were did not and very much was used. The following were the results.



RATINGS

Figure 37

Mean	=	71.00
Range	=	90.00
LQ	=	62.25
UQ	=	80.25
IRQ	=	18.00

Participants on the average rated the questions of enjoyment over 70% in a scale of one hundred. With the exception of three players, all others rated over 60% the enjoyment of the sessions and three of them rated over 90%. This implies that on average most people enjoyed the sessions in a considerable degree although very few did it 'very much'. The reasons behind this enjoyment varied a lot and ranged from: "It is nice to try to think problems out in a new situation". "The unpredictability of certain elements provides stimulation". "Because it brings the problems of other people to light. I can now understand what they must be thinking and how frustrated they must be". "Gave me a challenge.....". ".....They present real situations and give one the chance to participate in making decisions which may benefit other individuals". "Like trying to stir up trouble.....". "It makes you feel as if you have helped a real community". Some others thought that it was: "Boredom, not enough action, no alternatives, feeling of unreality and irrelevance....." "Sometimes frustrating". "..... rather boring when no action from other roles".

My observation confirm the fact that there were some periods of confusion for one reason or another, and during these periods people seemed to get bored. However, I think one could say with all truth that in general the sessions were enjoyable.

Involvement: The involvement of players in the situation was one, that one could argue, quite high. To find out how difficult it is for players to get involved in the sessions and take roles which are not normally theirs, the following questions were asked:

<u>Was it difficult for you to put yourself in the position of others and understand their problems?</u>

For the ranking a graphic scale at which extremes were <u>very difficult</u> and <u>very easy</u> were used

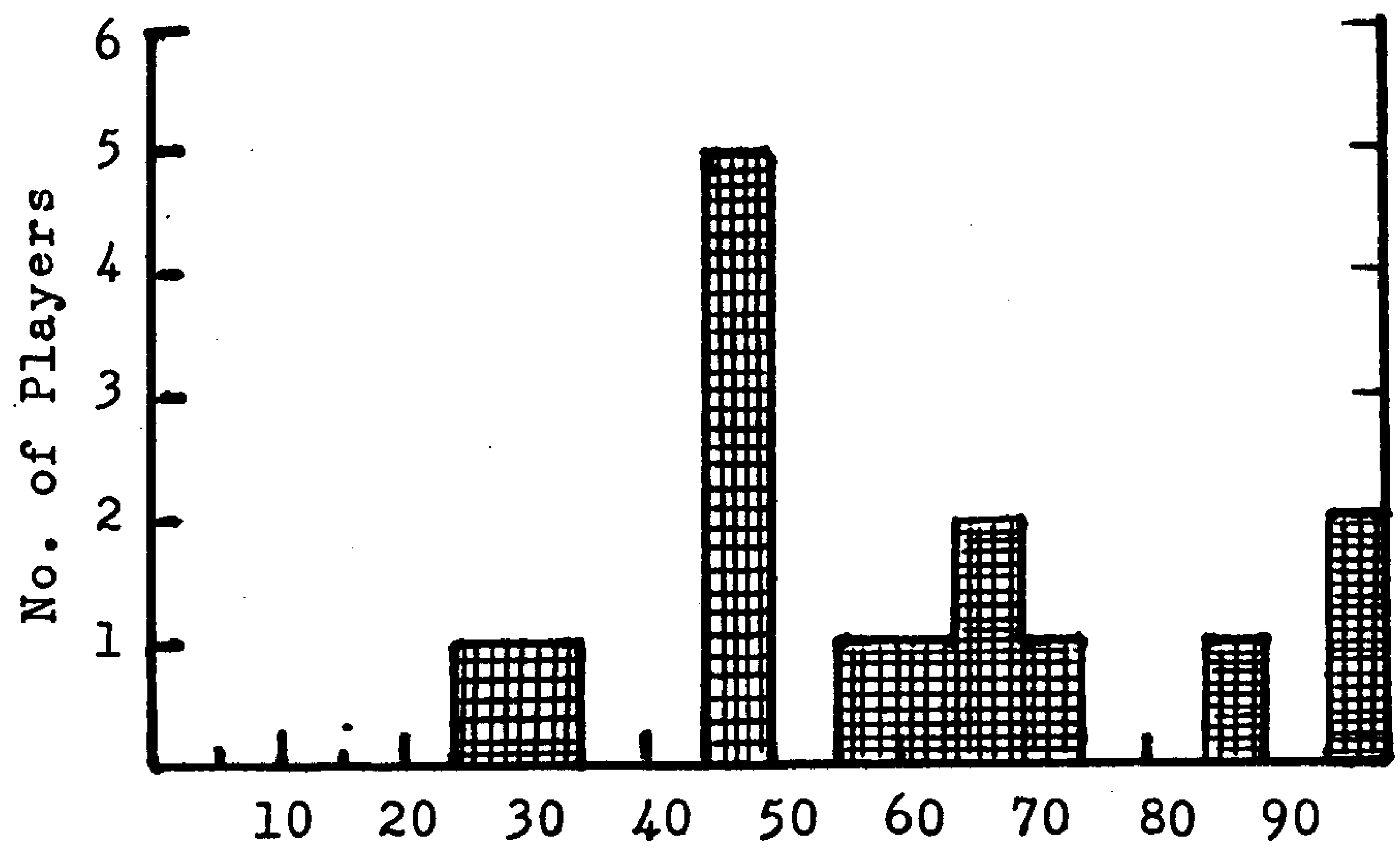


Figure 38 RATINGS

Mean	=	63.00
Range	=	70.00
LQ	=	48.12
UQ	=	74.50
IQR	=	26.38

The data as one can see is well gathered around the centre of the graph (above) between 45 and 75%. Only two players consider it rather more difficult than easy (30%) and only three players "easy" and "very easy". The rating according to Figure 38 is fairly concentrated. This suggests that most players considered it neither difficult nor easy to put themselves in the position of others.

Usefulness: The opinions regarding the usefulness of simulations have been made clear, I hope, throughout this study. However, it seems relevant to investigate what the opinions of the players were. To do this participants were asked to select three areas, in a list given. The question was as follows:

In which of the following areas do you think this kind of simulation might be of use?

1.	Teaching planning students in urban renewal and development	24.5
2.	In the education of communities in relation with their own problems	21.1
3.	Identifying the social conflicts caused by urban development or renewal problems	12.1
4.	Urban policy testing in local authority	10.0
5.	Self planning urban communities	10.0
6.	For laying out strategies toward citizen participation in urban development or renewal process	12.2
7.	As a tool for politicians in the understanding of the problems of communities	10.0

From the results one can draw the conclusion that players consider that simulations of the kind carried out can be useful, mainly in the education of students in urban development/design, they also considered that it could have a place in the education of communities in relation with their own problems; they also considered that it could be a tool for participation and identifying the social conflicts caused in urban renewal or development. These results however, could be influenced by the fact that the majority of the subjects were student planners and they could have assumed that the objective of this study was educational and reflecting this in their selections.

Assessment of the Model: The game is assessed and where necessary alterations are suggested below:

The Physical Model: The scale of the model served the function of providing orientation,identifying and

and recording developments that occur. But it proved too small at 1:500 to illustrate refinements of environmental or aesthetic detail. It can be argued that this is unimportant as there are other gains to be had sufficient in themselves; and that the concern is for participation at local plan level, not in specific development control. Nevertheless, an expansion of the instructional value of the game could possibly be achieved by increasing the scale of the model. The disadvantages then lie in the functional aspects of its size, scope and construction.

<u>The Roles Represented:</u> The public roles also came in for scrutiny. It was felt that in order for them to have felt more involved they should have had more influence on the course of events. If the public are to benefit from this game, then an adjustment along this line must be made to the balance within the roles.

The doubling up of roles attempted in the second day of the game was unsatisfactory, as such player put his or herself mainly into one role at the expense of the other.

<u>Resource Allocation</u>: The economic element within the simulation, it is felt, requires reconsideration. The arrangements were over-simplified and thus not effective enough. Discontent with the return on investment was one of the criticisms of the game. The rules as employed here did not match the degree of reality the simulation achieved elsewhere in the game. They facilitated for playing of the game but tunning here is felt necessary for future improvement. Many would like the game to use a better accounting system like the computer. This point is discussed later.

5.6. DISCUSSION AND CONCLUSION

The events and actions which took place during the game, suggest the basic social problems of the community in question were clearly defined through the urban development process simulation in the game.

It is clear from the results, that the agencies involved in the gaming simulation exercise did actually establish clearly their strategies of action. The game also allowed players to assess the effects of their strategies on the general condition of the community; they could actually see the effectiveness of their strategy. However, players activities during the game and the outcome of the exercise constitute strong and considerable evidence to say that planning gaming simulation and indeed BUG could prove to have very successful results, if used as a tool to lay out strategies of action by all agencies involved in the planning process of urban communities.

For example, from the results of the open discussion which went on after playing, it is clearly seen that a number of important issues were raised, e.g. citizen participation, the role of the entrepreneurs in the planning process, economic problems of Britain, the responsibility of local government in front of such problems, etc. Therefore, we believe that the game does in fact help to identify the basic relationships that can exist between public bodies and private enterprise in the redevelopment process of declining urban communities.

The outcome and actions during the game suggest that planning gaming simulation models is highly useful in the exploration and identification of the key decision making elements in urban development process.

Players did certainly get involved in the situation. This can be observed by the type of discussion which was held during the negotiation period. The fact that negotiating with other players implied that players could in fact get the support of others, and therefore become stronger in political and economic terms, meant that players would feel more motivated to look for group action. All this seems to suggest that it would appear to be possible to use planning gaming simulation models for teaching agencies involved in the planning process particularly groups, to find out the outcome and impact that group action would have on the decision making cycle. On the other hand, players' opinions after the rounds of the game seems to reinforce this optimism, since over 80 percent of them saw a significant use of this model to actually teach the community the advantages of group action.

One of the field in which this kind of gaming simulation exercise would have a relevant use and which will open a new dimension in planning is in the area of self planning communities. The results of the game suggest that it is possible to discuss and lay out urban development programmes. The game provides the necessary structure to bring out the important planning issues of a given community, and the necessary framework where these issues can be discussed.

I recall one occasion when BUG was used to stimulate a case that was making headlines: Fishermen in a Scottish village were fighting developers who wanted to promote tourism, threatening their traditional environment and lifestyles. The board reflected the existing conditions and players represented the various interest groups involved. After a couple of hours participants were clearly leaning toward one of the alternatives available.

An interesting point well portrayed is that planning deals with time as well as with space. An ideal scheme for the town may be agreed upon, but if the chain of stages leading from the existing conditions to the desired ones is not laid out carefully, and if each of the intermediate stages is not reasonable too, the ideal scheme will never be implemented.

Now, let's return to the objectives stated earlier and see how BUG scores. One of the objectives was to allow maximum expression of value positions.
This has occurred with every game play, and at least in this objective, BUG is highly successful. However, the question has arisen as to whether the price of one or two days of 20 people's time is worth this result; and whether similar results could have been achieved more efficiently by other means. This may be true! It is possible to arrive at the same results by other means. What the person or group must determine is whether BUG as well as other methods will work with this group here and now and of the methods that will work, what are the respective costs and benefits and which device is most effective. In defence, one can only say BUG works.

Another objective was to "heuristically gather information.....from participants". Again, one can rate BUG as successful in that the researcher has learned much through the use and the development of BUG. Specifically, it is possible to learn about urban systems by writing a game such as BUG, and learn about groups and group decision making through the play of a game such as BUG. Both types of learning are there for the researcher. Therefore, if one wants to learn about a system, a good device is to design a game of it. Gaming allows the possibility of learning about gaming, the particular system and about the groups that play and compose that system simultaneously.

It should also be pointed out that the players also learn from one another in the play of the game. Again, the learning is two-fold - the nature of an urban system as seen through the eyes of the game developer, and about people and role expectations.

Through the game, participants are exposed to classical principles of urban economy - and they usually conclude from it that planning and control are difficult but necessary processes, if urban development is to be rational and humane.

The third objective "to provide community participants with access to expertise.....and to expose professionals to community values," has been partially achieved. We have learned something about community values, including the fact that community values are people's personal values. Community participants have had access to expertise to the extent that BUG has been played with community residents and representatives; however, there seems to be no felt need in the community for the particular expertise "available".

It is evident from this project that if gaming simulation is effectively employed, it will increase the power of citizens, making them more knowledgeably effective in public affairs and less dependent on the actions of either their appointed, elected or hired representatives or decision makers of urban communities. Also if gaming simulation is effectively employed to increase communication among elected/appointed/hired decision makers at least the quality of decisions on individual issues would be improved, the impact of individual decisions on future time would be less destructive and the inevitable conflict between departments would be minimised or at least rationalised.

As with any tool, BUG can and should be refined; it should be corrected in some areas. However, it is basically a useful tool, filling a need in the vast array of urban simulation games.

It has been suggested that the use of a computer would make things much easier for accounting. However, this suggestion could be resisted on the following grounds:

(a) The computer programme required would be extremely complex and involve many man hours of work to achieve what might be only a marginal improvement when viewed overall.

(b) The cost of computer time for playing would be high and would restrict the number of opportunities for playing the game

(c) The need to have a computer "on line" would also impose restrictions regarding locations in which the game could be played.

A further reason for resisting the use of a computer at this stage has been an uneasy suspicion that the fascination of having fast computing facilities available might lead to concentrating on producing an ever increasing degree of sophistication into the controlling models at the expense of other factors, notably development of more realistic face-to-face situations involving bargaining, agreement, persuasion and decision. The fear is that of developing a game where what becomes important is what is in the " "black box" and not the interaction between interest groups. If this viewpoint is regarded sympathetically, even if not accepted, it leads to consideration of what may be termed the "operational gaming paradox". Stated in simple terms the paradox is that given a situation simulation becomes more difficult (presents more problems) the further one moves away from reality.

Finally, one is led to the conclusion that the game is a quick introduction to a perception of current land use planning which raises all sorts of questions for the design of other games. The game does not treat urban transportation - and this aspect is taken up in Experiment IV. Although a number of inquiries were held during the play of the game - the procedures were not treated adequately - and this aspect is taken up in Experiment V. An interesting output of the game was that public planners had no time to prepare, or formulate policies in advance with the participation of public representatives. There should be a new direction, that which attempts to narrow the bridge between the planner and planned -that which facilitates "grassroots" involvement and understanding of priorities - that which gives public feedback on consequences of their alternative development proposals. These aspects are taken up in Experiments VI and Vii.

6.0 GUTS: A GAME ON URBAN TRANSPORT SIMULATION

6.1. INTRODUCTION

One of the problems in transport management and planning is how to develop a general comprehension of a transport system rather than just an accumulation of detailed information about its parts. What's needed is a simplified version of the system emphasising the way in which its parts inter-relate and change with time even if the level of detail has to be sacrified.

Gaming simulation is a technique which has shown promise in this field. What follows is a description of GUTS, an urban transport policy game whose artificial environment environment is supported by a computer model of the transport system of an idealised city. Some comments are also made about the experience of using this type of technique in Leeds and of possible future developments. In particular, it is felt that GUTS could be appropriately used to bridge the gap between technical advisers and political decision makers in the urban transport field.

Objectives of the Simulation: The purpose of the exercise is to allow the user of the model to experiment his/her decision making and learning skills on an artificial environment provided by a computer program. The computer program has built into it the representation of an ideal city, "GUTS" giving particular emphasis to its transport system. The user or player of GUTS is to take the role of decision maker with approximately all the powers associated with a local authority, and in fact, some more. The user can take decisions within a whole range of alternatives as they affect the traffic management of GUTS, its public transport system and investments in roads, buses, multi-storey car parks and area traffic control. The decisions are input into the computer interactively. Each run of the program represents one year of operation and for a typical day it considers two basic periods, peak and off-peak. The program simulates the effect of the decisions taken by players and of the secular growth (population, car ownership) in GUTS. These effects concern travel times, changes in distribution, modal split and link. flows and their consequences on the public transport system and user's welfare.

The program produces a number of performance measures for the transport system in GUTS and prints them out at the end of each run. The player should then use his/her own judgement and this information, to learn more about the system and take better decisions during future runs of the game. All players start with the same initial conditions, but after some runs they will end up with different states of GUTS, depending on their abilities as decision makers.

Realism in GUTS: The city in GUTS has a number of idealised features particularly in its geometry, distribution of employment and residential density, and public transport and road networks. Otherwise, the model is fairly sophisticated, very much like an advanced aggregate transportation planning package. The purpose of the simplification is two-fold:

- they allow a very short run time of the program, e.g. less than thirty seconds for a full trip - generation, distribution, modal split, assignment and evaluation cycle for two journey purposes in an ICL 1906A machine.
- they simplify the task of decision making, permitting a faster and more productive learning process. What would take years in real life is

here compressed into hours and kept simple to facilitate learning "how to learn" from a real system.

There has been no intention to "calibrate" GUTS to represent any particular city. Although most of its features are thought to be simplified but realistic, the purpose of the model is not to teach any specific lesson. For example, if a player finds that a supplementary licence scheme is very helpful in dealing with congestion and equity problems, this is a lesson applicable only to the city being simulated. A different set of initial conditions might have taught a different lesson and besides, players will never have to confront angry and influential motorists or public transport voters in GUTS.

6.2. CHARACTERISTICS OF THE GAME

Description of the City: GUTS is a city with perfect symmetry around its centre. Its configuration and strategic network are depicted in Figure 39. The city has 10 radial routes of approximately the same characteristics. For the purpose of this exercise, 10 bands or areas with a ring shape is used to allocate population, employment and other characteristics to GUTS. All bands are 500 metres wide, with the exception of the central zone, which is a circumference with a 500 metres diameter.

Each radial road is made up of 9 links, each link being approximately 500 metres long. The nodes in this network can be deemed to represent signalised intersections and they are placed in the middle of the corresponding band. There are two ring roads in GUTS. The inner ring road runs through the middle of band 4 and the outer ring road runs through the middle of band 8. All links are two way links.

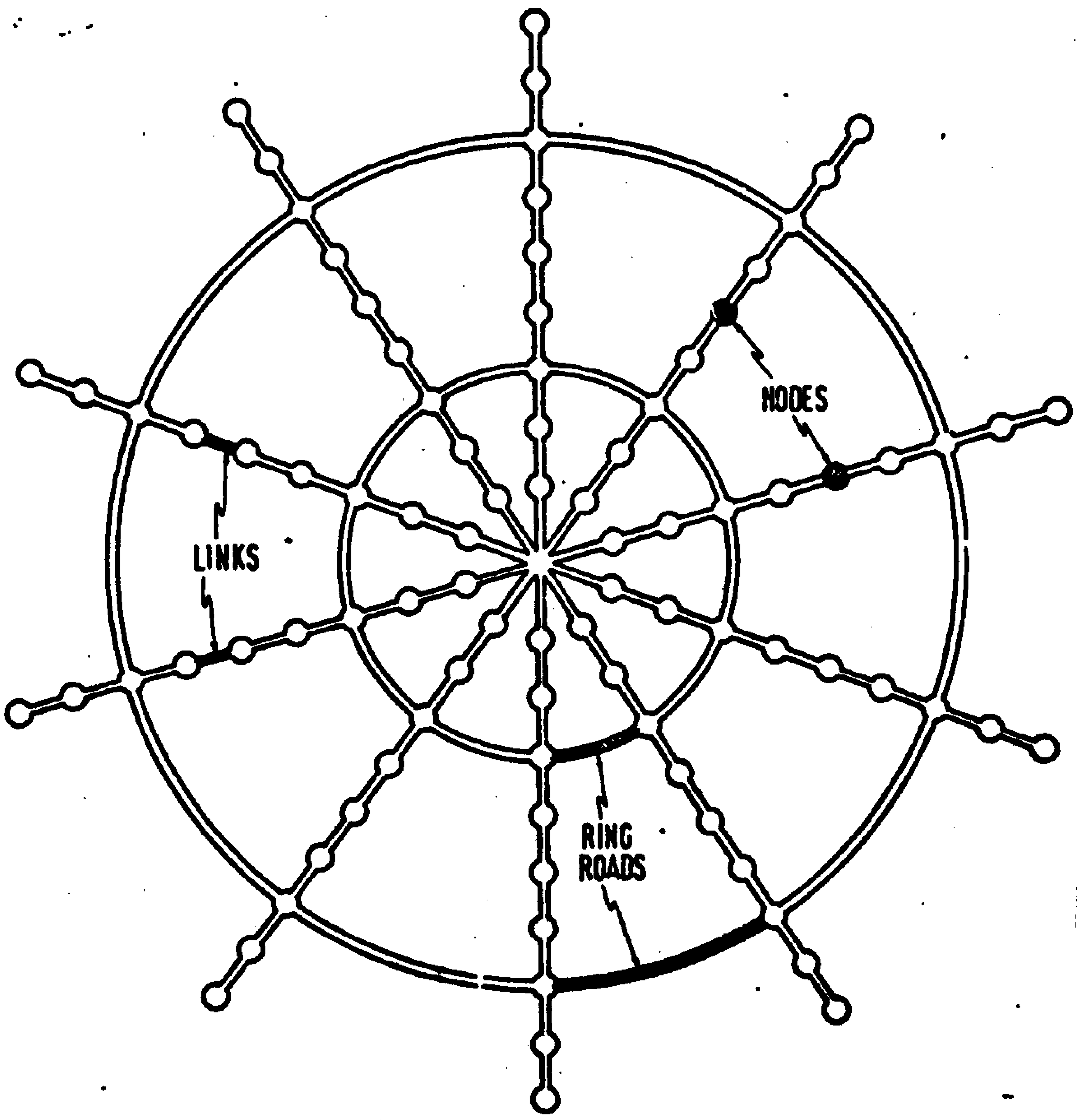
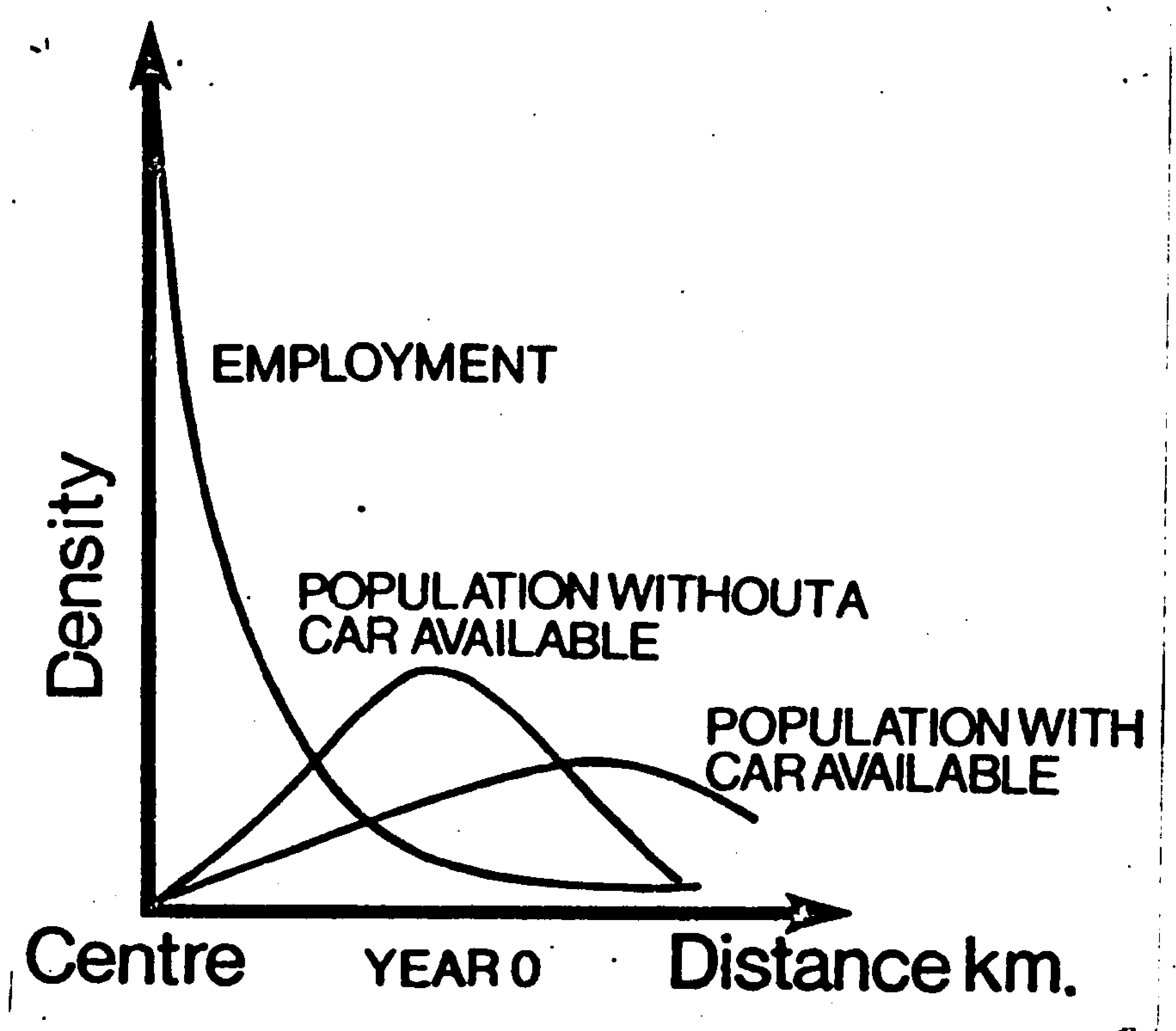


Figure 39

The secondary network is not described in detail but under certain conditions some trips use it, for example, interzonal trips. Each link is characterised by its length, its uncongested speed and its capacity. Its length is measured in kilometres from stop line to stop line. The uncongested speed is the average speed for moving from the previous stop line (at the moment of clearing the intersection) to the next stop line and accordingly includes time spent queueing before reaching a stop line.

The capacity of a link is mainly determined by the capacity of its downstream intersection and is measured in terms of PCU per hour. An average of about 900 pcu per hour per lane is considered acceptable in GUTS.



'e 2a Initial Demographic Characteristics

Figure 40

Population - Employment: Employment in GUTS is quite concentrated in the centre which, on the other hand, does not house anybody. The distribution of population follows a different pattern and peaks somewhere in the middle of the city (see Figure 40).

Car ownership tends to increase towards the city outskirts. This means that residents with a car available tend to concentrate in the outer suburbs of the city, and those without a car tend to concentrate near the centre. These two person types also have different characteristics regarding trip generation rates, value of time and so on. Population, employment and car ownership grow every year at a certain rate and the shape of their distributions may also change with time depending on the condition of play. See Figure 41.

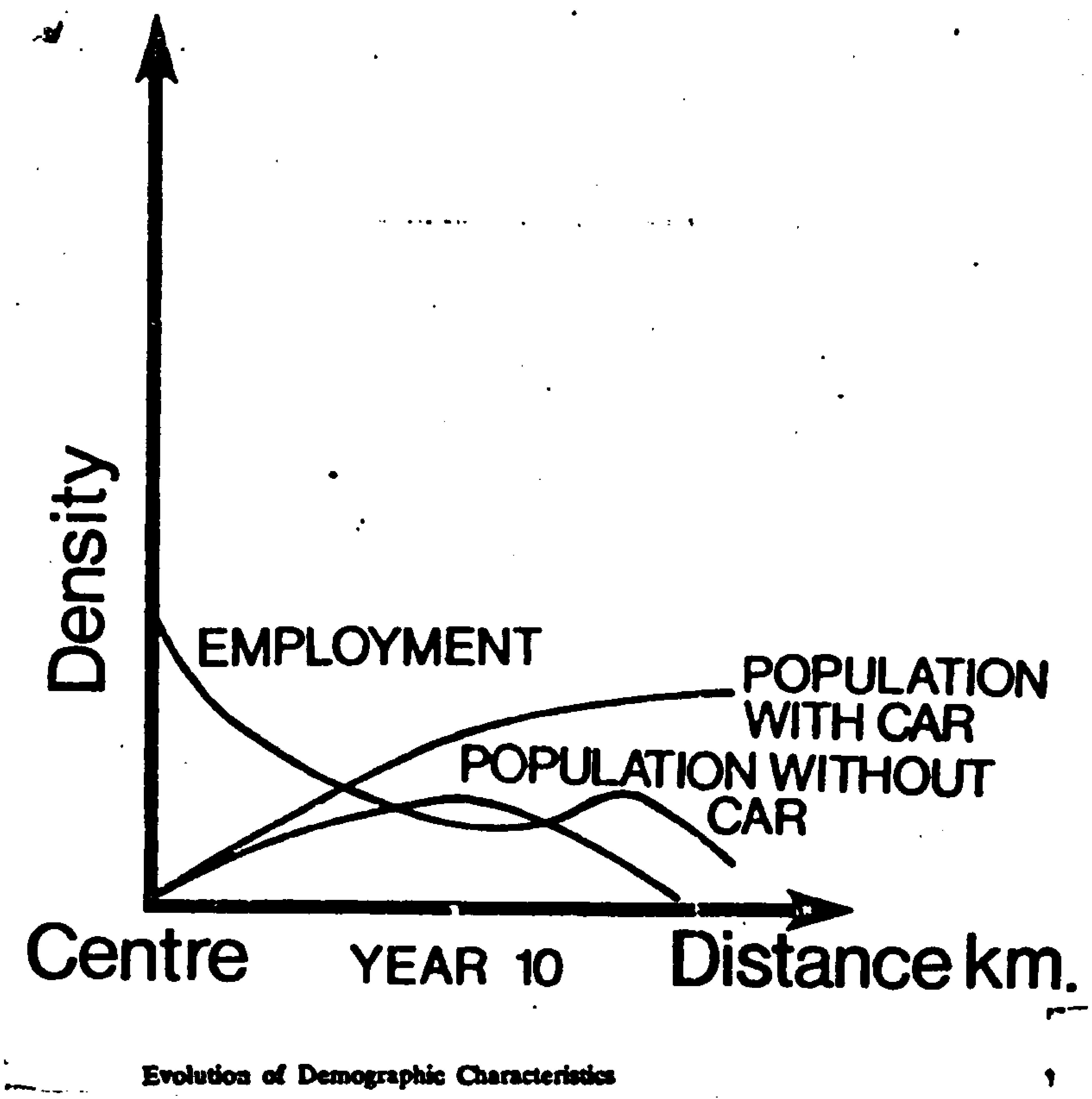


Figure 41

Modes of Transport: There are two modes of transport in GUTS, private car and public transport buses. Average car occupancy is about 1.3 persons per car, and average bus occupancy around 35 passengers per bus. Bus services are not described in detail but they are assumed to match demand perfectly. The player cannot influence the pattern of bus services except by controlling the number of buses and thus the service frequency.

Flow of Time in GUTS: The decisions taken by players affect one year of operation of the city. The simulation of this time span includes 300 days containing off-peak periods and 250 days containing peak periods.

This financial year is used to estimate the global impact of the player's policies.

An average day in GUTS is made up of two peak hours and ten off-peak hours, half of them the mirror image of the other half. In general each journey is made up of two trips and there are two basic journey purposes; to work (mostly during the peak) and other (mostly during off peak hours).

In some cases, the development of managerial skills to react to unexpected changes in the economic climate is a desirable policy objective. An option in the program allows up to three crises, that is unusual changes in some of the parameters of the model, to be introduced during a complete set of runs (only one is possible in any given run). There are two possible types:

- those which take place at the beginning of a run and are totally unexpected by players, i.e. they cannot modify their decisions beforehand, e.g. petrol prices rise by 50 percent;
- those which are announced to take place in the next run, therefore giving players time to adjust to the new situation, e.g. an increase in construction costs.

In both cases a message is printed at the end of the run. Usually players start with common initial conditions, and after agreeing to a set of objectives, run the game for a number of years, typically 8 to 10. Their success as decision makers can be assessed by comparing and discussing their performance as reported by the model.

<u>Structure of the Model</u>: The basic structure of the model in GUTS is depicted in Figure 42. The first step

is to read the players decisions and a history file containing the characteristics of the city and providing a link between one run and the next. The second step

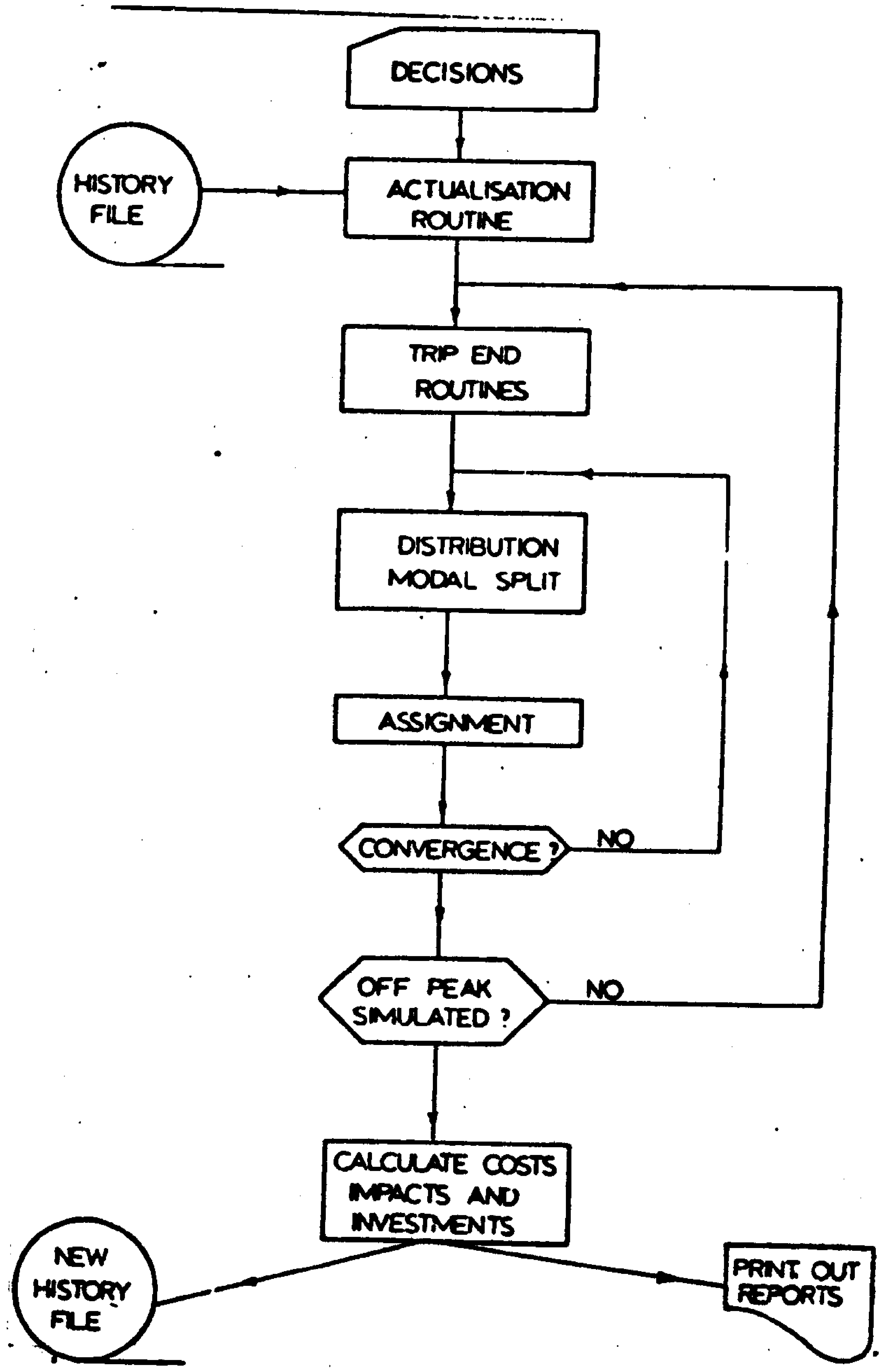


Figure 42 Structure of the Model

involves the use of an actualisation routine performing two main roles. Firstly, it replicates secular growth in the city and modifies the distributions of population, employment and car ownership accordingly. Its second function is to translate player's decisions into changes in the system, mainly network and transport supply modifications. These two roles are not completely independent; for instance, the application of a consistent parking restraint policy in the central area will tend to reduce car ownership growth. Furthermore, not all player's decisions produce immediate results, i.e. the accumulative effect of policies, realistic time lags and reasonable resistances to change are built into this routine.

The next stage involves the translation of this new system's parameters into trip patterns in the city. Simple trip-end models produce trip generations and attractions for two journey purposes, "to work" and "other purposes", and for the two persons type in GUTS. Trips are then distributed and allocated to the modes by means of a joint destination/mode choice multinominal logit model, using generalised costs of travel of the SELNEC type (Wilson et al 1969). This stage also includes a segment for calculating shadow prices for parking, in order to simulate the effects of parking charges and of restrictions to the total number of spaces available.

Supply-demand equilibration is achieved by the use of simple but realistic demand dependent speed flow curves in an all-or-nothing route choice model coupled iteratively to the distribution-modal split model. The cycle distribution - assignment is repeated until equilibrium is attained. The same process is carried out for off-peak conditions subsequently. After simulating both periods, several performance indicators are calculated and printed out. At the end of each run a new "history file" is produced which records the new state of the city. As this file is used to run the next period, each player develops a particular series of history files which corresponds to a particular evolution of the city.

The symmetric nature of the city in GUTS considerably reduces the computer requirements of the model. This has made possible the introduction of sophisticated features seldom available in commercial packages For example, the consistent treatment of the impact of parking restraints, bus lanes, cell systems and road pricing schemes, and possibility of introducing bus subsidies are not normally available in any single model. The presence of these featues in GUTS enhances its didactic capabilities..

<u>Decisions in GUTS</u>: The following groups of decisions are open to players.

(a) <u>Public Transport Management</u>

(i) Fares: The fare structure can be specified in terms of a fixed part, and a variable part dependent on the distance travelled. Flat fares and even free fares can also be specified in this way, for each run (Figure 43). Dramatic fare increases, however, are not allowed and the program will smooth them down to politically feasible levels. An off-peak discount is also specifiable and it works out as a percent reduction on the corresponding peak fare, affecting both fares components by the same proportion. The combination of fares, demand and costs will determine the level of subsidies to the bus undertaking, if any.

(ii) Services: Bus services run matching demand perfectly, but players have some control on their quality through the total number of buses. Peak periods are run with all the

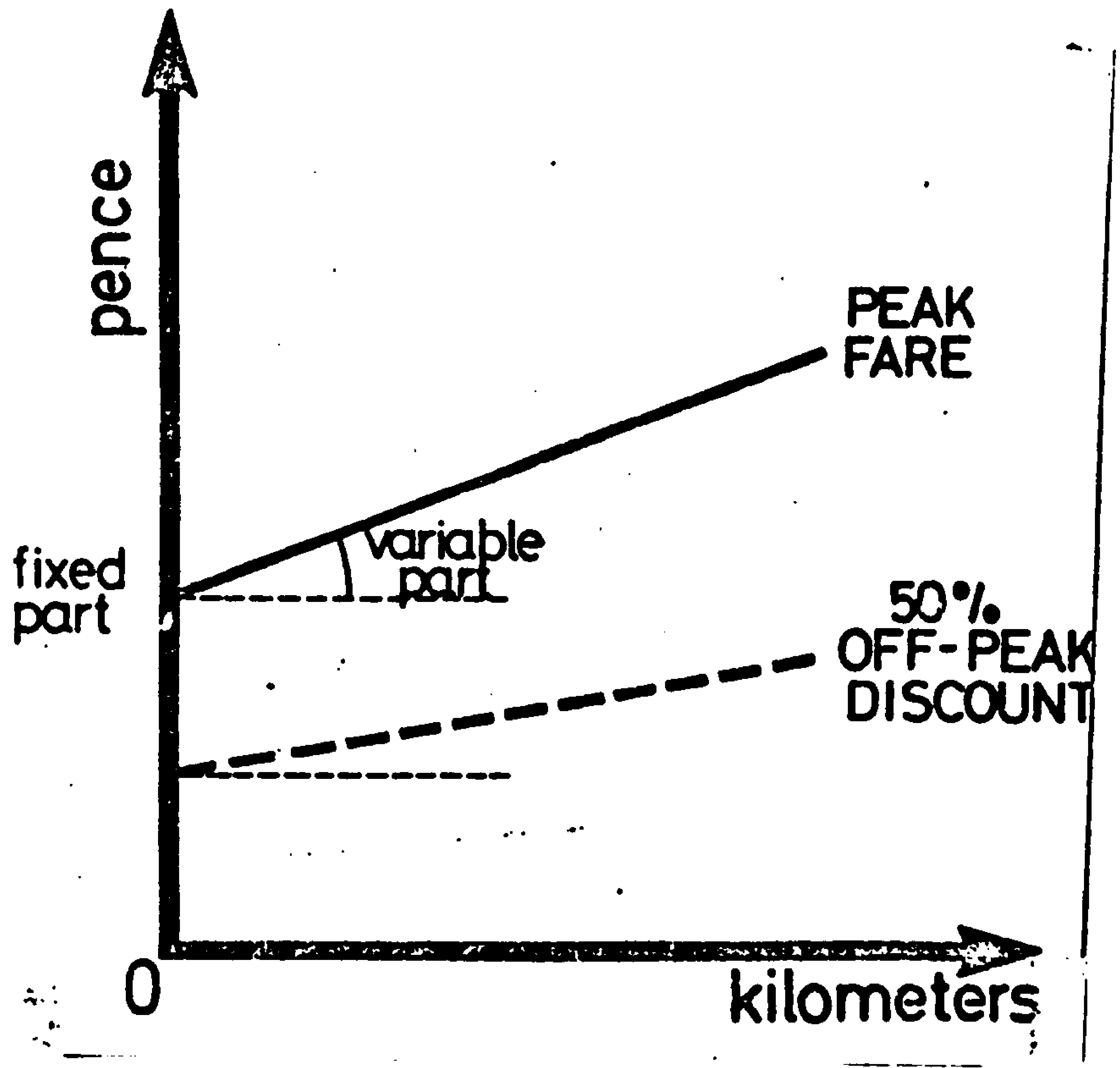


Figure 43

operational buses available. Off-peak frequencies, on the other hand, are determined so that a 'standard' service is provided. This frequency can be increased to provide a better service by introducing an off-peak frequency bonus. Each year about 10% of the buses must be scrapped. In order to maintain the services, new buses must be bought. Traffic management schemes may also affect the amount and quality of service that can be offered with a given number of buses.

(b) <u>Traffic Management</u>

(i) Bus Lanes: Can be established in all links and they may be peak only or all day bus lanes. When a bus lane is introduced in one link, it is actually implemented in all similar links in the city because of the symmetry considerations.

(ii) Parking Control: It is possible to control all parking in the six innermost areas. There are two types of parking spaces, for long stay and short stay parking. The parking charges at each band and for each type of space can be fixed and the revenue, less an administrative cost, is accrued by the local authority. If more drivers want to park in a zone than the number of spaces available, they are diverted to other modes or zones, and their excess time increased. Because of the seasonal and daily variations, only up to 90% of the parking spaces are occupied on average.

(iii) Supplementary Licence Scheme: It is possible to set up a road pricing scheme as the one implemented in Singapore. A boundary is created around the city centre and all cars crossing it towards the centre during the morning peak must pay a fee. Both the boundary of the scheme and the fee have to be chosen. (Figure 44).

(iv) Cell System: This is a scheme similar to the one implemented in Gothenburg. The central area, that is the area inside the inner ring road, is divided into cells whose boundaries can only be crossed by public transport. Of course, the greater the number of cells, the more restrictive the scheme is. (See Figure 45).

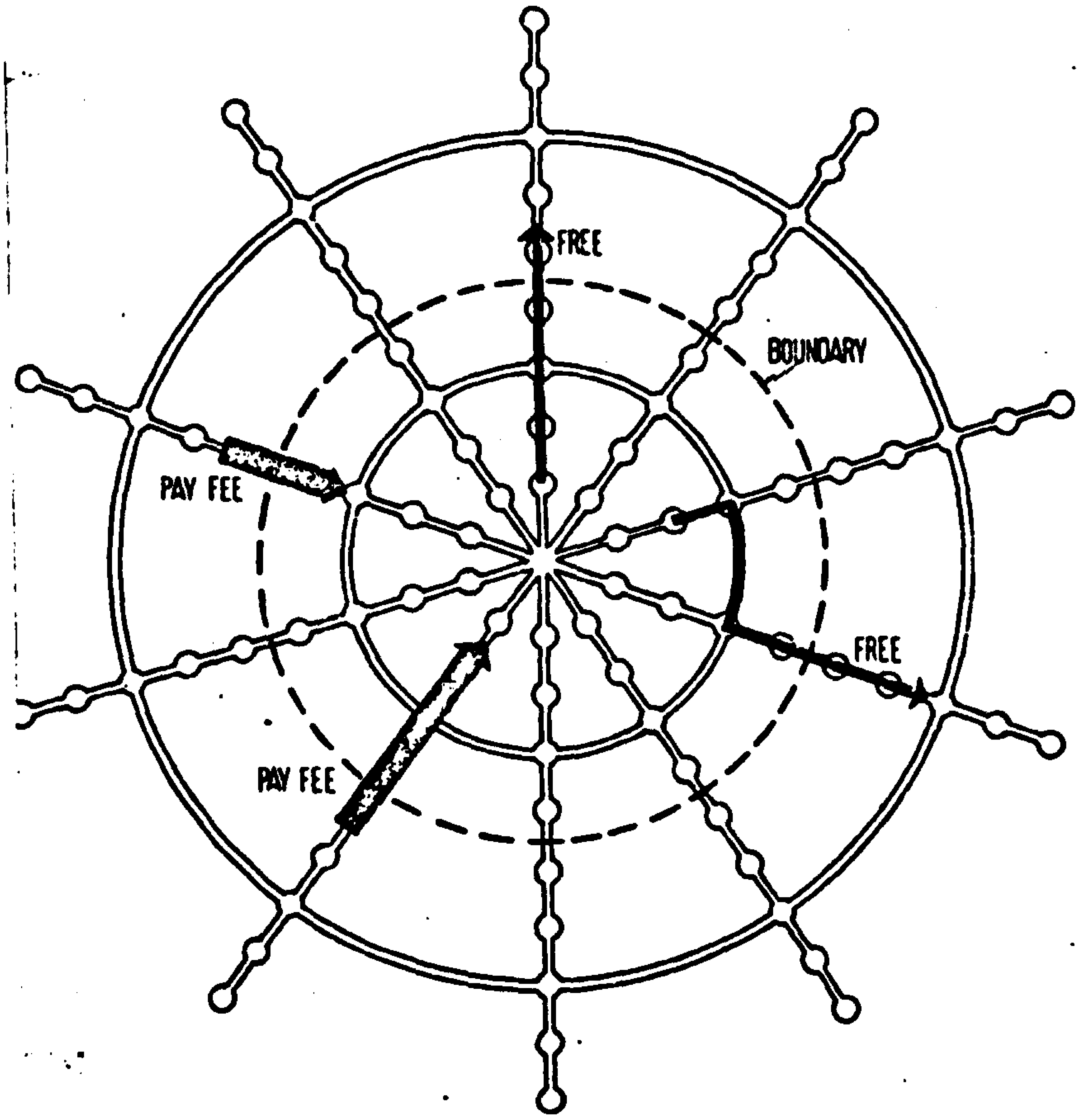


Figure 44

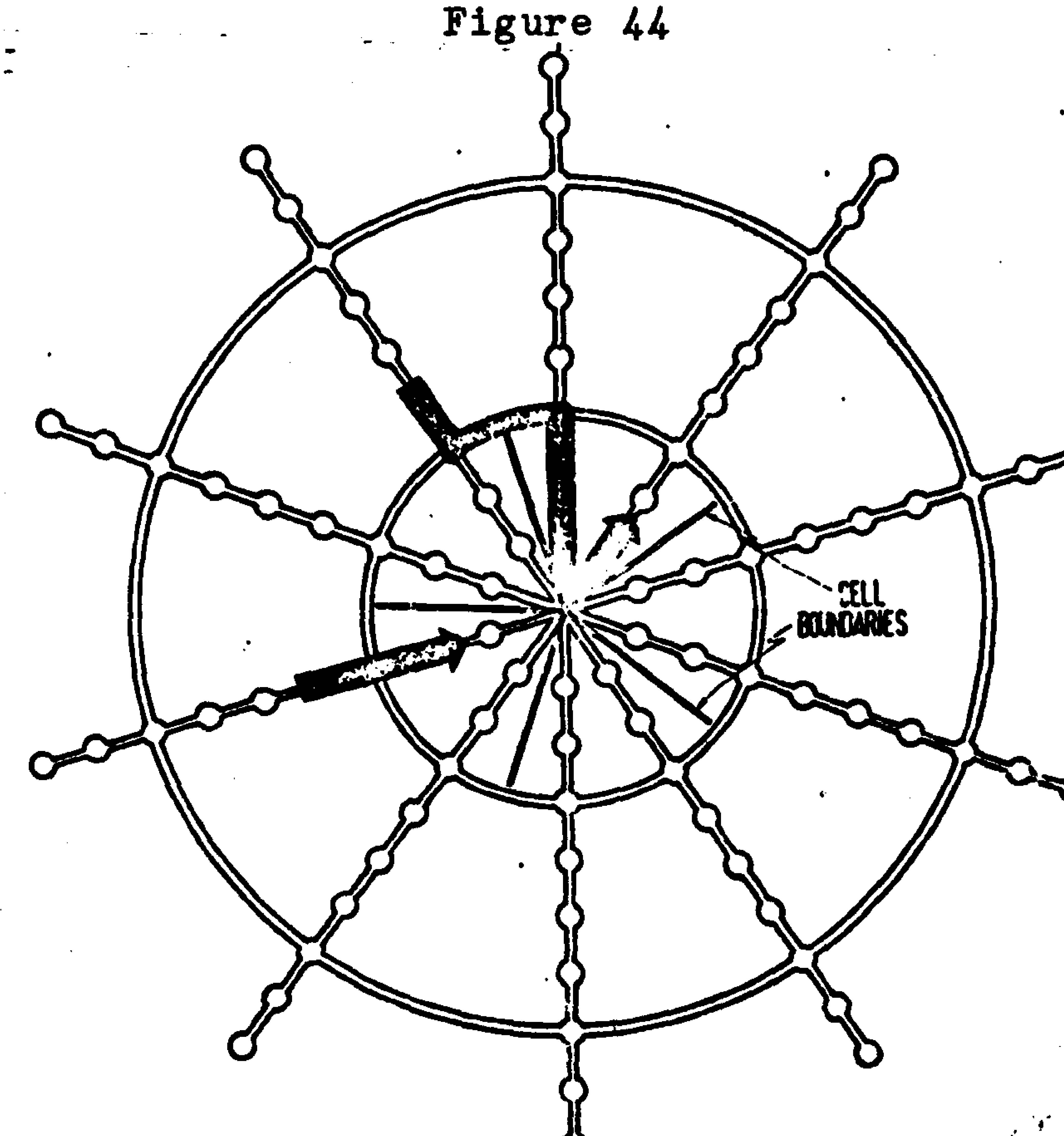


Figure 45

(c) Investment Decisions

(i) Engineering Projects: It is possible to invest money in up to 15 projects. These usually include

- multistorey car parks,
- road improvement, and
- urban traffic control systems.

In general, only up to one third of the total cost of a project can be invested in any one year.

(ii) Research and Development: If more information about the system is required, special studies can be contracted to provide data about

- speeds,
- modal splits,
- travel cost, and
- accessibility indices.

(iii) Financial Decisions: It is also possible to borrow money from the open market at a high rate of interest, but there is a limit to the total amount that can be borrowed. The funds which are not spent during the yeear remain in the bank as deposits, perceiving an interest below that of the aforementioned loans.

The main sources of funds for operations in GUTS are

- a central government which grows with population,
- part of the local rates which is allocated to transport,
- profit from the bus operations, if any,
- revenue from parking and supplementary licence scheme, less the administrative

costs
- interest on deposits, and
- balance in the bank from the previous run, if any.

The main destination of funds are
- subsidies to bus operations, if necessary,
- acquisition of new buses,
- studies
- road maintenance which depends on traffic levels
- minor works, like painting bus lanes, changing parking meters, etc.
- interest on debts,
- major capital expenditures. Expenditure in this category is only permitted if the player is within his credit limit at the end of the previous year. If the player was within his credit limit there is no restriction on the amount of capital expenditure he chooses to make.

(d) Credit Limit
The player is reminded of his credit limit at the end of each year and he is advised to make sure he remains within it.

(e) Bankruptcy
The player is reminded of the absolute maximum debt he may incur at the end of each run. If this limit is exceeded the player must apply to the game controller for advice.

Description of the Output

There are up to 9 groups of output. They are:

(a) Decisions this run: This is just a print out of the decisions the player has taken for the current run and interpreted as read by the program.

(b) Census Data: This appears only on runs 0, 5, 10 and so on. It appears for both peak and off-peak periods, in that order in contains for each zone

- car ownership level, cars per inhabitant,
- area of whole zone, in square kilometres,
- number of inhabitants in the zone with a car available to them,
- ditto, but without a car available to them,
- employment, or more specifically, journey to work attractions during the morning.

For the off-peak period the first two indices are the same but the next three are

- number of trips generated during the off-peak period for people with a car available to them. Car availability is different during peak and off-peak periods,
- ditto, but for people without car available to them,
- trip attractions for off-peak journeys.

(c) Traffic information on link capacities, average speeds and flow levels.

(d) Travel characteristics: These include the number of vehicles parked in each zone, parking revenue and qualitative indicator of the excess demand for parking spaces. If suitable studies have been ordered, modal split, cost, time and distance travelled by type of user are also printed out. It is also possible to obtain accessibility indices for different journey purposes and zones in the city.

(e) Financial report reflecting the year of operations and made up of the following three parts:

(i) a bus operation report which consigns costs and revenues and calculates the number of buses required to maintain a certain level of service and the subsidy levels,

(ii) a revenue and expenditure report which contains all the sources and destinations of funds for that year - these include loan payments and bank balances, and

(iii) an investment report giving the amount of money invested so far in each of the possible investment projects - their impacts (in terms of improved networks, for example) only accrue when project has been completed.

6.3. EXPERIENCE WITH GUTS

Graduate students at Leeds University and local authority officials have extensively used GUTS requiring little supervision and no previous experience in the use of a computer.

Running the game requires a preparation stage which involves reproducing the instructions for the players and preparing the information which is specific to the city to be simulated. This information includes

- output from one or two previous runs so that players can have some idea of the history of the city,
- specification of an 'investment' file which characterises projects in terms of their likely impacts (new speeds, capacities, and so on).
- preparation of a 'crisis' file containing up to three unexpected changes to occur in future runs of the game.

During the first session with players seven groups of four members each with different backgrounds were set up to run the game. A general explanation of the game followed. Leeds University has prepared a tape-slide

READ FROM THE OUTPUT OF RUN ZERO

P.-INFORMATION ABOUT THE ENGINEERING PROJECTS AVAILABLE TO YOU

PROJECT 1 INCREASES THE CAPACITY OF LINK 1 TO 3000 PCU
AND THE AVERAGE FREE FLOW SPEED UP TO 32 KM/HR FOR CARS.

PROJECT 2 INCREASES THE CAPACITY OF LINK 2 UP TO 2900 PCU/HR
AND THE AVERAGE FREE FLOW SPEED UP TO 32 KM/HR FORCARS

PROJECT 3 INCREASES THE CAPACITY OF LINK 3 TO 3000 PCU/HR AND A SIMILAR
INCREASE IN SPEEDS IS EXPECTED.

PROJECT 4 INCREASES THE CAPACITY OF LINK 4 TO 2400 PCU/HR

PROJECT 5 INCREASES THE CAPACITY OF LINK 4 TO 3200 PCU/HR AND A LARGER
INCREASE IN NON-CONGESTION SPEED IS EXPECTED (36 KM/HR).

PROJECT 6 INCREASES THE CAPACITY OF LINK 5 TO 3000 PCU/HR
AND SPEEDS UP TO 40 KM/HR.

PROJECT 7 INCREASES THE CAPACITY OF LINK 6 TO 3000 PCU/HR AND SPEEDS
UP TO 36 KM/HR.

PROJECT 8 INCREASES THE CAPACITY OF THE INNER RING ROAD TO 3000 PCU/HR
AND SPEEDS UP TO 35 KM/HR.

PROJECT 9 INCREASES THE CAPACITY OF THE OUTER RING ROAD TO 3000 PCU/HR AND
SPEEDS UP TO 40 KM/HR.

PROJECT 10 IMPROVES CONSIDERABLY INTERCHANGES IN THE INNER RING ROAD
PROVIDING SOME DEGREE OF GRADE SEPARATION. CAPACITY IS IMPROVED
TO 3600 PCU/HR AND SPEEDS MAY INCREASE UP TO 45 KM/HR.

PROJECT 11 INCREASES THE NUMBER OF PARKING SPACES IN AREA 1 BY 1000.
ONLY FOR LONG STAY PARKING SPACES.

PROJECT 12 DITTO FOR BAND 2, IN 1000 EXTRA PARKING SPACES.

PROJECT 13 DITTO FOR BAND 3, 1000 SPACES.

PROJECT 14 DITTO FOR BAND 4, 1000 SPACES

PROJECT 15 INTRODUCES AREA TRAFFIC CONTROL IN GUTS. THIS IS EXPECTED
TO REDUCE IN-VEHICLE TRAVEL TIMES BETWEEN 15 AND 16% DURING
THE PEAK PERIOD.

THE PROJECT COSTS AND DURATIONS APPEAR IN THE RESULTS OF RUN ZERO. THE
PROJECTS ARE INDEPENDENT FROM EACH OTHER.

Q.-OUTPUT FROM RUN NUMBER ZERO.

```
        WHAT FOLLOWS IS THE OUTPUT FROM RUN NUMBER ZERO, THAT IS THE ONE
        JUST BEFORE YOUR RUN NUMBER ONE . IT IS THE BASIS FOR YOUR
        DECISIONS FOR THE NEXT RUN. IT ALSO CONTAINS CENSUS INFORMATION
        WHICH WILL GIVE YOU SOME IDEA OF THE POPULATION DENSITIES  AND
        CAR OWNERSHIP LEVELS. ALL PLAYERS START WITH THE SAME INITIAL
        CONDITIONS, GOOD LUCK ! .

DECISIONS THIS RUN

1

 DECISIONS THIS RUN

 RUN  TITLE

1

 DECISIONS THIS RUN

 RUN  TITLE
   0   INHERITED CITY


0      *PUBLIC TRANSPORT FARES DECISIONS*
    CARD  FIX.P  VAR.P  OFF-P  OFF-P
    TYPE   FARE   FARE  DISC.  P.BON
       6      5      9      0      0
0      *STUDIES*
    CARD   ROAD  MODAL   COST  ACCES
    TYPE   USE   SPLIT   DATA   DATA
       7      1      1      1      1
0      *NEW BUSES AND ENGINEERING PROJECTS*
    CARD    NEW  PROJ.  INVES
    TYPE  BUSES  NUMBR  TMENT
       8     90      1   3334
       8     90      8   5001
0      *RATES AND ROAD MAINTAINANCE DECISIONS*
 RATE AND ROAD MAINTAINANCE =         20       8500
0



 INFORMATION PER ZONE   1      2      3      4      5      6      7      8      9     10
0CAR OWNERSHIP        0.26   0.26   0.36   0.36   0.42   0.42   0.42   0.47   0.50   0.50
0AREA (SQUARE KM)     0.20   1.57   3.14   4.71   6.28   7.85   9.42  11.00  12.57  14.14
0RESIDENTS W/CAR        0.   1098. 11255. 25090. 33144. 43233. 45799. 43697. 36403. 25701.
0RESIDENTS NO CAR       0.   2148. 12528. 29041. 35645. 40967. 38899. 28156. 19727. 14469.
0CITY  ATTRACTIONS  11523. 41883. 39057. 25936. 15712.  8923.  4865.  2579.  1339.   534.
1REPORT RUN =  0          INHERITED CITY        POPULATION = 505000.          3  ITERATIONS          MRN.PEAK HOUR


0
```

```
ROAD CAPACITIES (PCU/HR)

*LINK*   ** **  ** **  ** **  ** **  ** **  ** **  ** **  ** **  ** **  **RR**  **RR**
+          1      2      3      4      5      5      7      8      9
ALL TRAF 2500   2300   2200   2200   2500   2500   2900   3000   2400   2400   2600
BUS LANE    0      0      0      0      0      0      0      0      0      0      0
0AVERAGE SPEEDS (KM/HR)

     CENTRE BOUND
CARS       14     12      9      7     11     15     21     26     29     20     28
BUSES       9      8      6      4      7      9     14     17     20     12     13
*LINK*   ** **  ** **  ** **  ** **  ** **  ** **  ** **  ** **  ** **  **RR**  **RR**
+          1      2      3      4      5      6      7      8      9
BUSES      10     14     16     16     18     18     19     19     20     12     18
CARS       15     21     25     25     29     29     29     29     29     20     23
      OUT  BOUND
0

FLOWS (VEH/HR)

     CENTRE BOUND
CARS     1434   1712   2071   2622   2317   1993   1485    872    373   1364    493
BUSES      91    107    128    145    119     89     61     34     14     56      9
*LINK*   ** **  ** **  ** **  ** **  ** **  ** **  ** **  ** **  ** **  **RR**  **RR**
+          1      2      3      4      5      5      7      8      9
BUSES      74     53     64     72     59     44     30     17      7     56      9
CARS     1196    552    177    430    193    118    165     59     20   1364    493
      OUT  BOUND
0

TOTAL NUMBER OF TRIPS=  121209  TRIPS VIA SEC. NETWORK=    4967   DURING MRN.PEAK HOUR
0TRIP ANALYSIS BY TYPE OF USES AND DESTINATION ZONES        PER WORKING DAY

          JOURNEY PURPOSE: TO WORK.

                                                                                          TOTAL
+          1      2      3      4      5      5      7      8      9     10
0MODSPLIT 0.65   0.61   0.61   0.62   0.56   0.56   0.55   0.55   0.53   0.52
+                                                                                          0.60
PARKING  2973  11759  10735   7658   5880   3409
P.SPACES 4000  13000  14000  13000   8500   5000
CHG $/HR 0.07   0.05   0.05   0.05    0.0    0.0
REV $/DY 2229   5879   5367   3829      0      0
+                                                                                         17304
SEARCH T
0

 INDICATORS        AV.TR TIME     AV.EX TIME    AV. DIST.    AV. G. COST    N.OF TRIPS    T. PAX-KM    T. G. COST
```

CAR USER	14.2 MINS	2.4 MINS	3.48 KMS	30.8 GMIN	119919	417633.	61635.GHRS
BUS USER	20.0 MINS	11.1 MINS	2.94 KMS	61.4 GMIN	183106	538938.	187382.GHRS

0

ACCESSIBILITY INDEX PER ZONE NUMBER	1	2	3	4	5	6	7	8	9	10
CAR OWNERS	1.11	1.02	0.97	0.89	0.77	0.70	0.64	0.61	0.58	0.55
NON CAR OWNERS	0.43	0.39	0.36	0.31	0.25	0.21	0.18	0.17	0.15	0.13

0

INFORMATION PER ZONE	1	2	3	4	5	6	7	8	9	10
0CAR OWNERSHIP	0.26	0.26	0.36	0.36	0.42	0.42	0.42	0.47	0.50	0.50
0AREA (SQUARE KM)	0.20	1.57	3.14	4.71	6.28	7.85	9.42	11.00	12.57	14.14
0GENERATIONS W/CAR	0.	823.	8441.	19568.	32353.	35175.	34349.	32773.	27302.	20025.
0GENERATIONS NO CAR	0.	967.	5637.	13069.	15490.	18435.	17565.	12670.	8877.	6511.
00-PK ATTRACTIONS	17285.	63798.	64221.	55444.	47504.	40144.	32706.	25424.	18847.	13373.

1REPORT RUN = 0 INHERITED CITY POPULATION = 505000. 4 ITERATIONS OFF-PEAK HOUR

0

ROAD CAPACITIES (PCU/HR)

LINK	1	2	3	4	5	5	7	8	9	**RR**	**RR**
ALL TRAF	2500	2300	2200	2200	2500	2500	2900	3000	2400	2400	2500
BUS LANE	0	0	0	0	0	0	0	0	0	0	0

0AVERAGE SPEEDS (KM/HR)

CENTRE BOUND

CARS	20	21	20	16	21	23	26	28	29	21	23
BUSES	13	14	13	10	13	15	17	18	20	13	17
LINK	1	2	3	4	5	5	7	8	9	**RR**	**RR**
BUSES	14	15	16	16	18	18	19	19	20	13	17
CARS	20	23	25	25	29	29	29	29	29	21	28

OUT BOUND

0

FLOWS (VEH/HR)

CENTRE BOUND

CARS	591	693	957	1569	1338	1113	942	628	271	1341	531
BUSES	17	21	26	38	31	24	17	10	4	25	5
LINK	1	2	3	4	5	6	7	8	9	**RR**	**RR**
BUSES	14	10	13	19	15	12	8	5	2	26	6

CARS	500	263	194	589.	387	304	320	232	96	1341	501
OUT BOUND											

0

TOTAL NUMBER OF TRIPS= 62395 TRIPS VIA SEC. NETWORK= 4383 DURING OFF-PEAK HOUR
0TRIP ANALYSIS BY TYPE OF USER AND DESTINATION ZONES PER WORKING DAY

JOURNEY PURPOSE: 'OTHER'.

+	1	2	3	4	5	6	7	8	9	10	TOTAL
0MODSPLIT	0.52	0.47	0.43	0.43	0.43	0.44	0.41	0.41	0.39	0.36	0.43
PARKING	4547	17557	21868	22136	18542	15707					
P.SPACES	9000	9000	10000	11000	15000	11000					
CHG $/HR	0.20	0.15	0.05	0.0	0.0	0.0					
REV $/DY	1364	4039	1532	0	0	0					6934

SEARCH T

0

INDICATORS	AV.TR TIME	AV.EX TIME	AV. DIST.	AV. G. COST	N.OF TRIPS	T. PAX-KM	T. G. COST
CAR USER	9.4 MINS	1.2 MINS	3.63 KMS	27.0 GMIN	353022	1279918.	158676.GHRS
BUS USER	10.5 MINS	10.5 MINS	2.55 KMS	73.8 GMIN	270934	690117.	333139.GHRS

0

ACCESSIBILITY INDEX PER ZONE NUMBER	1	2	3	4	5	6	7	8	9	10
CAR OWNERS	0.97	0.89	0.85	0.80	0.70	0.64	0.59	0.57	0.53	0.50
NON CAR OWNERS	0.26	0.23	0.21	0.17	0.14	0.11	0.09	0.08	0.07	0.05

REGMA= 7917.98

1

STATUS OF ENGINEERING PROJECTS

PROJ NO	DURATION	CURRENT INVEST	ACC. INVEST.	REQ. INVEST.
1	3	3334	4334	10000
2	3	0	0	10000
3	3	0	0	15000
4	2	0	0	10000
5	3	0	0	15000
6	3	0	1000	8000
7	3	0	0	2000
8	3	5001	5001	15000
9	3	0	0	12000
10	3	0	0	22000
11	1	0	0	2000
12	1	0	0	1500

13	1	0	0	1200
14	1	0	0	1000
15	2	0	100	5000

1

BUS SERVICES REPORT (THOUSANDS)

	PEAK		OFF-PEAK
BUSES IN OPERATION	773		203
REVENUE FROM FARES	14872		23509
OPERATING COSTS	29365		11854
COST OF NEW BUSES BOUGHT		2250	

SUBSIDY REQ. 5098

FARE = 6 + 9*KM OFF-PEAK DISCOUNT 0 % OFF-PEAK FREQ. BONUS 0 %

TOTAL NUMBER OF BUSES 927 NEW BUSES REQUIRED 39

FINANCIAL REPORT (THOUSANDS)

INHERITED BALANCE	10000
INCOME	
INTEREST ON DEPOSITS	399
PRODUCT OF AV PER CAP RATE OF 20 PENCE IS	10099
CENTRAL GOVT GRANT	4544
PARKING REVENUE (NET OF ADMIN)	5765
TOTAL INCOME	20408
EXPENDITURE	
CAPITAL EXPENDITURE ON ENGINEERING PROJECTS	8335
EXPENDITURE ON ROAD MAINTAINANCE	8500
EXPENDITURE ON MINOR WORKS	36
COST OF SPECIAL STUDIES	255
SUBSIDY TO BUS OPERATIONS	5099
TOTAL EXPENDITURE	22224
BALANCE IN ACCOUNTS TO CARRY FORWARD	8184

slide show to this end which is quite effective.

Each group then sets up its policy objectives to be pursued during the first say four runs and discusses the best way of achieving the strategy. As all groups start with the same initial conditions it was possible to determine, after run 4, who has performed well in this sense. Players took between 20 and 80 minutes to take one set of decisions and run GUTS.

The performance of different groups were compared and strategies discussed after run 4, by this stage many players found their original policy too simplistic, and argued in favour of a more elaborate one. Many found objectives confused by methods of achieving them, while others found themselves unpopular with the public and so changes policy objectives.

In the light of the experience in the first four runs and mid-game discussion, players were advised by the game controller to prepare a comprehensive urban transport management plan for the next series of runs. Below is a description of the main elements of the plan adopted by one group and the results after 5 runs.

A transport policy was adopted that aimed at maintaining the functions and the importance of the city centre. To achieve this, the group agreed that through traffic had to be eliminated, the access routes reorganised and public transport to be improved in an integrated manner.

The main elements of the plan were:

(i) division of the city centre into four traffic cells;

(ii) increase the capacity of the inner ringroad for through traffic;

(iii) parking restrictions in the six innermost areas

(iv) establishment of bus lanes using new and more comfortable buses.

This integrated traffic management plan achieved a dramatic fifty percent increase in bus partonage. At the same time, through traffic in the city centre was reduced by more than forty percent. Traffic journey speeds improved for all routes with destinations at the centre. Bus journey times improved by an average of about twenty percent through the peak hour. The total cost of the management plan was about £300,000.

6.4. ASSESSING THE SIMULATION

At the end of 8 to 10 runs of the game, the twenty-six participants were given a feedback questionnaire (see pages 287-288). The questionnaire answers and observations are presented below and assessed against the following objectives:

(i) the effectiveness of gaming simulation techniques to problem exploration and decision making

(ii) the effectiveness of the GUTS model in policy testing.

It is interesting to notice that 90 percent of the players considered that computer aided simulation is an effective educational technique in the field of decision making. Only about 8 percent of the players would agree that the understanding of complex systems can best be achieved by formal teaching techniques, e.g. lectures, tutorials, etc, while as many as 76 percent of the players would agree that simulation aids

Hereunder is a list of some statements concerning GUTS.

In each case circle the number adjacent to each statement which best reflects your views given that,

5 - Agree very strongly

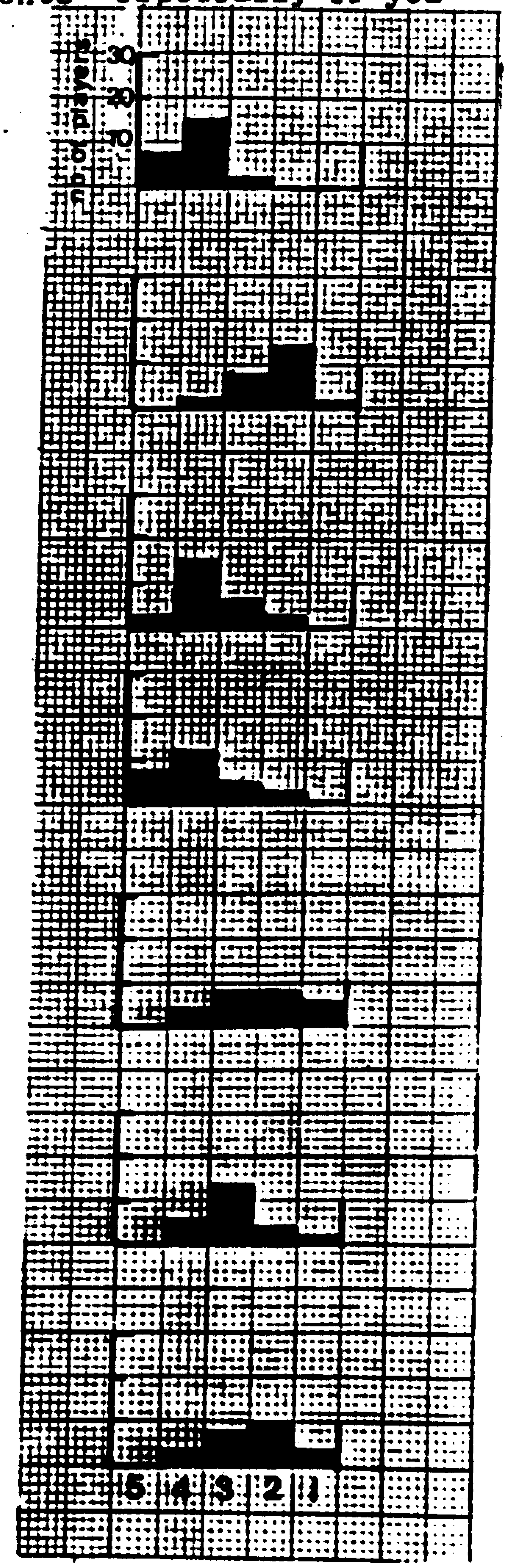
4 - Agree

3 - No strong views

2 - Disagree

1 - Disagree very strongly

If you wish to comment further on any item please feel free to do so on the right-hand side of the page under comments especially if you circle either 5 or 1.



1. Computer-aided simulation is an effective educational technique in the field of decision-making. 5 4 3 2 1

2. The understanding of complex systems can best be achieved by formal teaching techniques eg. lectures, tutorials etc. 5 4 3 2 1

3. The information on GUTS provided at the outset of the game was sufficient for my understanding of the simulation. 5 4 3 2 1

4. The short runtime of GUTS program allows a fast and productive learning process. 5 4 3 2 1

5. The complexity of the GUTS model inhibits my ability to draw conclusions from the results of my decision-making. 5 4 3 2 1

6. The GUTS model has sufficient realism to make me feel that I am dealing with a real-world situation. 5 4 3 2 1

7. The GUTS model provides decision-makers with all the powers necessary to influence transport planning. 5 4 3 2 1

8. The GUTS computer model causes confusion by providing too many indicators of performance. 5 4 3 2 1

9. The performance of a real transport system needs to be monitored at regular intervals eg. when new census data become available. 5 4 3 2 1

10. Relevant socio-political factors are adequately represented in the GUTS model. 5 4 3 2 1

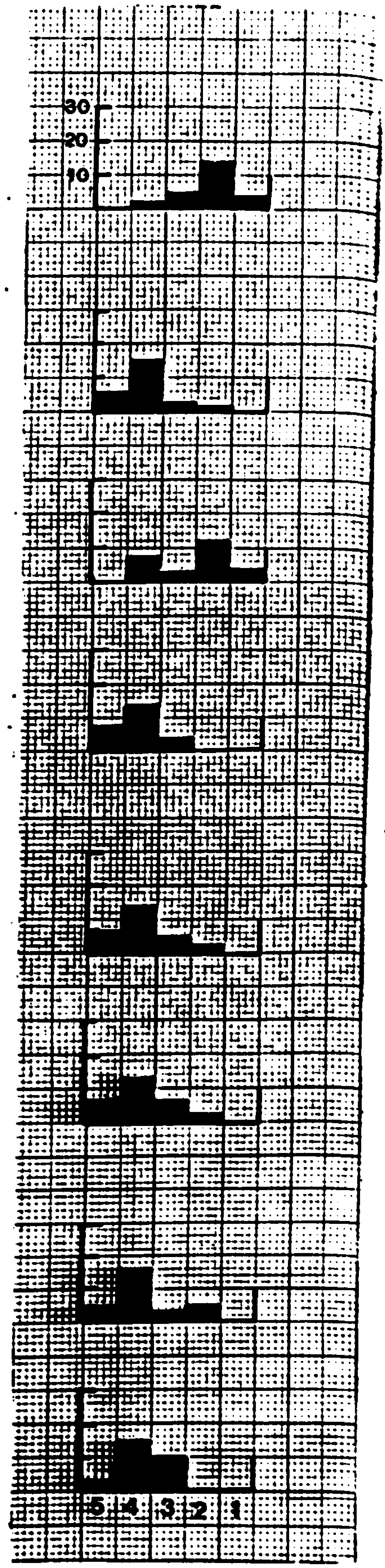
11. A real urban transport system is always subject to change and evolution. 5 4 3 2 1

12. Simulation aids rational decision-making by providing a comprehensive overview of complex systems. 5 4 3 2 1

13. My conceptual model of a real urban transport system has been enriched at this stage of the game. 5 4 3 2 1

14. I am able to identify those elements in the transport system which are most relevant to my objective. 5 4 3 2 1

15. Some of the results of my decision-making in GUTS have been counter-intuitive. 5 4 3 2 1



rational decision making by providing a comprehensive overview of complex systems. This is confirmed by the comment of one of the players, "....the game provides an opportunity for linking together several policy issues raised in different courses, thus enabling an overall systematic view of transport management".

With regards to the GUTS model some 65 percent of the players consider the information on GUTS provided at the outset of the game as sufficient for the understanding of the simulation. Over 76 percent of the players would agree that the short run time of GUTS program allows a fast and productive learning process. With regard to the complexity of the model, only about 15 percent would consider that the complexity of the GUTS model inhibits their ability to draw conclusions from the results of their decision making. However, only 23 percent of the players considered that the GUTS model has sufficient realism to make them feel they are dealing with a real world situation and less than 20 percent would consider that the GUTS model provides decision makers with all the powers necessary to influence transport planning. However, players consider the GUTS model as simple and easy to understand. Only about 8 percent would agree that the GUTS model causes confusion by providing too many indicators of performance.

With regard to transport planning it is interesting to notice that 80 percent of the players considered that the performance of a real transport system needs to be monitored at regular intervals, e.g. when new census data became available - and about 84 percent would agree that a real urban transport system is always subject to change and evolution.

The types of comments by players are clearly confirmed by the results of the questionnaire. In fact, 58 percent of the players thought that the relevant socio-political factors are not adequately represented in the GUTS model. The following is the comment made by one player, "some features of the game lack realism, for instance certain politically unfeasible or highly unrealistic policies can be pursued; but even then, the subsequent discussions of objectives and political constraints, help to clarify the links between modelling, planning and the political process".

Over 70 percent of the participants would agree that their conceptual model of a real urban transport system has been enriched by the experience in GUTS. This is confirmed by the comment by one player, "during the learning process preconceived ideas on how a transport system works and how it should be managed and tested and useful reappraisal of them takes place". This is also supported by about 68 percent who would agree that they are able to identify those elements in the transport system which are most relevant to their objectives. However, about 60 percent would agree that some of the results of their decision making in GUTS have been counter intuitive. This is confirmed by the comment made by one of the players, "the game also helps to discover new links between decisions and consequences, especially when counter intuitive results are found. These force an adjustment of the conceptual model of the transport system and in turn leads to a better understanding of it".

Generally, the players find the use of GUTS simple, challenging and enjoyable. Some have carried on using it to '..... improve on poor performances'. It provides a unique instrument for communicating a systematic view of the transport sector of a city.

As one of the players commented, GUTS apparently provides ".....a useful introduction to the types of trade-offs involved in transportation planning..... whilst at the same time emphasising to the more experienced transport planner the need to keep an open mind about the best solutions to the problem".

6.5. DISCUSSION AND CONCLUSION

The result of this research indicates that it is possible to represent the essential elements of urban transport planning systems in a game framework that will be motivational to the play group. While conclusive findings cannot be based upon limited observations, the application of this learning game as a policy testing tool is most encouraging.

It has recently been argued that the promotion of innovative planning tools or procedures has not, in itself, led to more rational or objective transportation decision making, particularly at the local level. There appear to be at least two reasons for this failure. Firstly, strategic transport decisions tend to be formulated in the political arena with relatively little input from detailed technical analysis. Secondly, local transport planners have often failed to answer specific policy questions in ways which are reasonable and comprehensible to the non-technical decision makers. The latter reason has led to the serious consideration of simplified sketch planning tools.

Models like GUTS may help to solve some of these problems. Firstly, they can be used in their normal 'policy testing tool' capabilities, to educate new recruits to local authorities and to achieve a common 'language' throughout the office, as they can

Hereunder is a list of some statements concerning GUTS.

In each case circle the number adjacent to each statement which best reflects your views given that,

5 - Agree very strongly

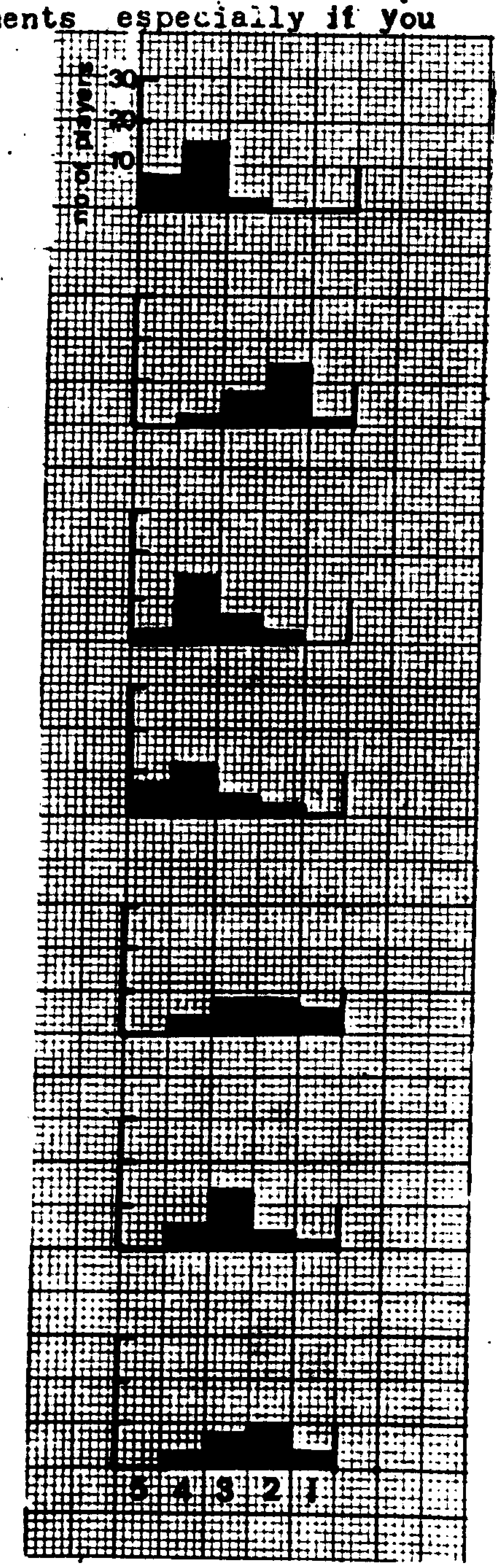
4 - Agree

3 - No strong views

2 - Disagree

1 - Disagree very strongly

If you wish to comment further on any item please feel free to do so on the right-hand side of the page under comments especially if you circle either 5 or 1.



1. Computer-aided simulation is an effective educational technique in the field of decision-making. 5 4 3 2 1

2. The understanding of complex systems can best be achieved by formal teaching techniques eg. lectures, tutorials etc. 5 4 3 2 1

3. The information on GUTS provided at the outset of the game was sufficient for my understanding of the simulation. 5 4 3 2 1

4. The short runtime of GUTS program allows a fast and productive learning process. 5 4 3 2 1

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9. The performance of a real transport system needs to be monitored at regular intervals eg. when new census data become available. 5 4 3 2 1

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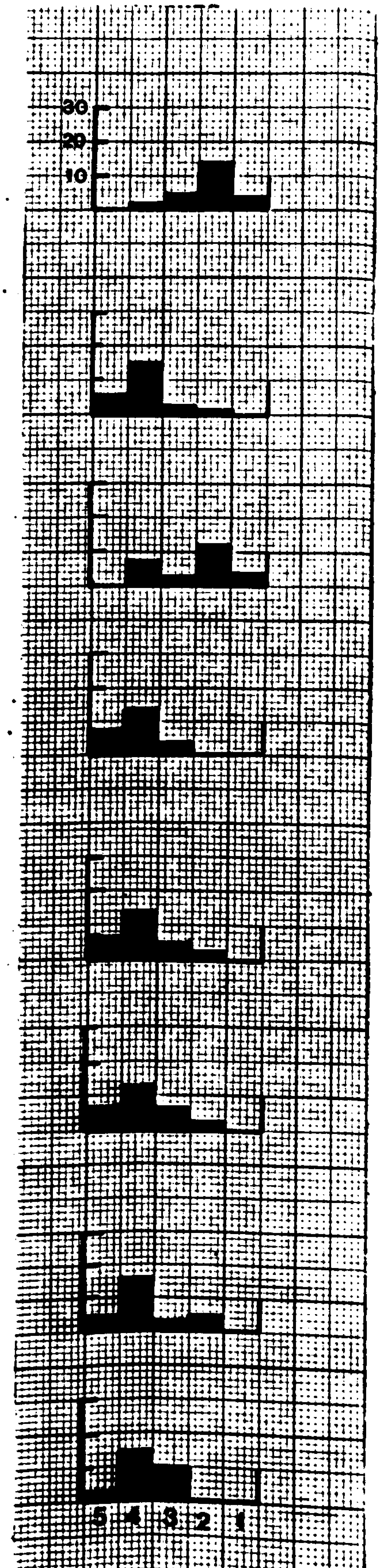


offer a reference point helpful in defining a common vocabulary. For example, it is not easy to provide a better means of explaining what is meant by "managing transport in a city as a system and not each mode in isolation". Secondly, a model like the one in GUTS, because of its simple and fast input/output, can be used advantageously to test and discuss broad strategies and particular conceptions of decision makers. This again leads to a better understanding among participants and about the transport system itself. GUTS is no substitute for more sophisticated models in dealing with specific projects and detailed analyses, but it can help to bridge the gap between broad policy proposals and specific modelling studies.

A third use of models like GUTS is in demonstrating the advantages and weaknesses of mathematical models. Maturity has not yet been reached in the design and use of transport models and the extremes of total rejection or blind acceptance of them are still present in our political, planning and academic quarters. The obviously simplified character of GUTS coupled with its capacity to depict interactions between modes and decisions provides a good example, albeit exaggerated, of what the modelling approach can offer. The use and subsequent critique of the game by politicians and planners would help them to understand each other's activities and interests better. There is much scope for developing further research in these areas.

7.0 EXPERIMENT V - EDINBURGH AIRPORT SIMULATION

7.1. INTRODUCTION

This experiment was conducted to illustrate the use of gaming simulation in reaching decisions about technological projects with social and environment consequences. Gaming simulation is employed in order to first explore the Law (the British Public Inquiry System) and its implications; second to highlight the complexity of consideration in airport planning and to discover techniques for resolving different views and interests.

The approach adopted in this exercise requires the participants to investigate and understand the power characteristics, the constraints and the pressures associated with each role, the diversified planning considerations, and the broader physical, political, economic, and social environment within which planning decisions take place.

For the development of the simulation a case was selected through a carefully deviced procedure, its major personalities and participants groups were identified, and the several corresponding roles were assigned to groups of students. After an investigation of the issues and forces shaping the individual points of view, a decision making session was held in which participants performed their roles and a decision was reached. At stake at each time were the interests of population segments of the community concerned, the political power base of individuals, and the future development patterns of the community.

7.2. GENERAL CHARACTERISTICS OF THE SIMULATION

The Scenario: Despite the obvious historical origin of this simulation, its major issues remain remarkably contemporary. Recent government pronouncement on London's third airport make it clear that within another decade planners are highly likely to be engaged on just such an exercise as this. The activities of Edinburgh Airport Planning Inquiry presented the opportunity to develop the simulation. The problem in the simulation concerned the decision on whether or not to allow the proposals by the British Airport Authority for Turnhouse to provide an alternative runway and also to develop it as a major international airport. When the plan for the new runway - was made public, the response of the residents was negative.

There already existed a runway and the development of a new runway was considered a threat to the residents and the environment mainly in terms of noise and air pollution. The volume of protests succeeded in obtaining a Public Inquiry. This presents the scenario on which to base the model. Some research was then carried out by the design team to compile information on the case history and current status of the issue. Out of this research, a brief description of the case and its principal roles was prepared, which contained a historical summary of the issue, with all important events, many economic and planning facts, and the action of key persons, and organisations. It was followed by a delineation of the simulation in which the set up was defined in addition, the simulation rôles were described and the decision making body identified.

The Simulation Tasks: In the simulation, participants were confronted with the question of whether the

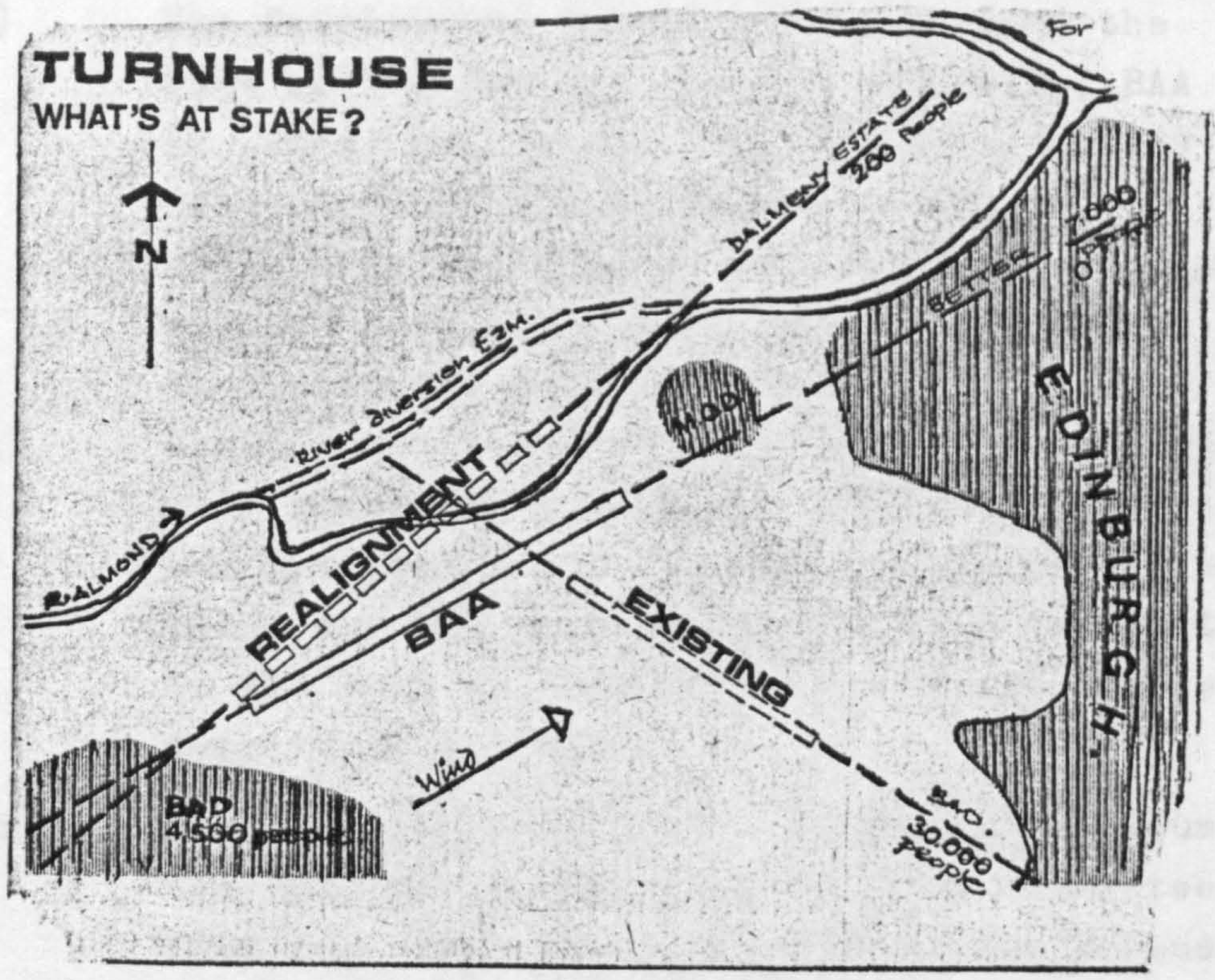


Figure 46

development of the new runway should be approved or not. In reaching a decision, the participants in the simulation must analyse and act within the real political environment of each actor, and the constraints with which each role is confronted. In other words, the participants assume completely a particular role, and are not allowed to make decisions that are in disagreement with the interests, political beliefs, and the philosophy of the constituencies of the actors, even if they personally disagree with them.

Roles Identified: All the major actors, both individuals and groups were retained for the purpose of the simulation. The size of the participants involved allowed distribution of the complete set of relevant roles, but certain decisions were made as to the size of the decision making body as discussed below. The set included:

(i) The Developers: participants assumed the role of the British Airport Authority, BAA (a public authority), but did not identify with particular individuals within it. While this would have been possible, it was decided that not enough information was available for accurate delineation of the developers' responsibilities. The developers were placed in a delicate position. They had invested a lot in planning and acquiring land, and had based their decision to locate in the area on comprehensive studies and were determined to build.

(ii) The Planning Authority: participants assume the role of the District Planning Committee. This role was introduced only in the second round. It is expected to provide its opinion on the issue after a careful examination of the various costs and benefits directly or indirectly derived from the proposed development.

(iii) The Community Representatives: participants assume the role of the community representatives. They are against the proposed development mainly on the grounds of noise, they are also worried about the possible effects on value of houses. They were given a minimum of information as in the real case.

(iv) The Decision Making Body: is represented in the simulation by three players, two of which act as the reporters or inspectors. They represent the accounting system of the simulation, recording all evidence given by the other roles, analysing the various points raised and then reporting to the Secretary of State - the third player (who for the purpose of this exercise was not allowed to be present in the hearing). The Secretary of State takes the final decision. He is allowed the flexibility as in real life to over-rule the decisions.

<u>Sequence of Operation</u>: The simulation was initially presented in class and the subject, objective and main issue of the simulation task discussed. Participants then chose the roles outlined above. Once the participants had acquired an understanding of the issues evolving around his/her role, the pressures and the characteristics associated with it, the simulated case proceeds. There were three separate but inter-related rounds played in which different rules were explored for the same problem. For the sake of convenience in this presentation, the sequence presented below has been adopted (Figure 47).

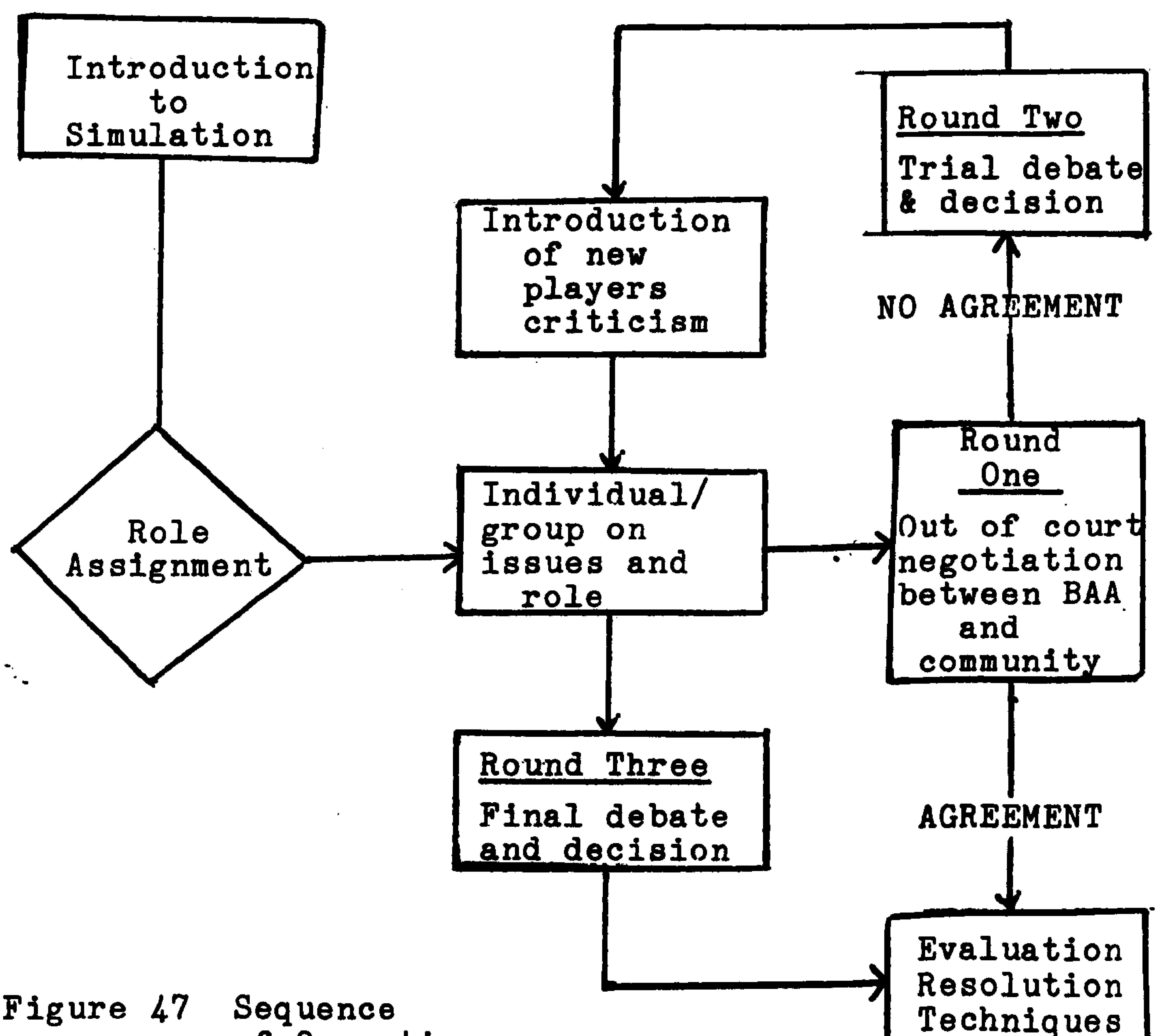


Figure 47 Sequence of Operation

Round One: Involves negotiation activities between the developer and the community representatives. Only the two roles are involved and the rules of Public Inquiry were not involved. Some useful techniques of resolution were also explored.

Public Inquiry Interlude: Before going to discuss the conduct of the Public Inquiry in round two and three I would introduce the reader to a brief description of the British Public Inquiry System.

When plans are published for any proposed development, the planning authority publishes details and requests comments by a certain date. If there are any objections to the proposed scheme, the planning authority first tries to resolve these by direct negotiation (as in round one). If the objections cannot be resolved in this way, a public inquiry is called.

There are basic differences between public inquiry system in England and Scotland. In England a departmental minister appoints an inspector to the inquiry. This inspector is himself a senior civil servant. In Scotland, only the Secretary of State is responsible, and he appoints a reporter who is usually a senior Q.C. The reporter hears and considers materials presented to him according to the laws of evidence. The reporter may be considered to be impartial as he is not associated with any government departments.

Parties of the inquiry can be represented by counsel, a solicitor or by an agent. In addition, private parties can give their own evidence. (To simplify the operation of our simulation, the majority of the witnesses act as private parties without any representation).

The reporter usually hears the evidence of the proposal first. This is presented by a Q.C. who calls expert witnesses. Most evidence is taken under oath, and any of the objectors has a right to cross-examine. As objectors usually cannot afford to employ expert witnesses of their own, they make full use of the proposers' expert witness in their cross examination. The expert witness can, however, decline to answer the questions on the grounds that it will be covered later in the inquiry by another witness. This allows time to prepare an answer to awkward questions. The proposing counsel has a right to re-examine the witness after cross-examination.

Other parties supporting the proposal are heard next. A witness can choose to make a statement to the inquiry without taking the oath. In this case no cross-examination is allowed. However, little weight is attatched to unsworn evidence and, for the purpose of the simulation, it will be assumed that all witness have taken the oath and may therefore be cross-examined.

The opponents of the proposal then present their case in a similar manner. Objectors represented by counsel are normally heard first, followed by those represented by solicitors. Private objectors are heard last.

Counsel for the proposers may obtject to evidence presented by objectors on many grounds, one being that the evidence was not put to the expert witness. The reporter must decide whether to allow the point to continue. At any time during the proceedings, the reporter may interrupt to ask his own questions. The entire proceedings are recorded verbatim by a team of shorthand writers.

After the inquiry, the reporter is left to study the evidence. He presents his findings in two parts. Part I is called "Findings in Facts" and list all the facts established at the inquiry. After this has been accepted, the reporter prepared part two, in which he presents his conclusions and the recommendations to the Secretary of State.

For the purpose of this simulation, the reporter will only give his conclusions and recommendations.

<u>Round Two</u>: The conduct of round two reflect the procedures of the British Public Inquiry System as described above with relaxation of some of the rules. The developers were given 15 minutes to present their case. No interruption was allowed during this presentation. The various supporters were then called, followed by the objectors (community) who were given equal time as the developers to present their case. After each witness has given his evidence, the reporters were allowed by the rule of the simulation to ask questions they considered necessary. Witness from each side were then called to make further statements or to dispute a point (or points) with the proposers or objectors but firm constrol was maintained over any such discussion. At all times, speakers were made to keep to the point.

Once all the listed witness have given evidence, the remaining time was devoted to an open forum in which any other relevant points were aired. At the end of the open forum the reporters were given time to analyse the points made and give their conclusions and the recommendations to the Secretary of State, The Secretary of State then gave his final decision on the issue and explanation of why his decision has been adopted.

Round Three: Unlike round two the conduct of round three was much more like the real life procedure described earlier. More players were introduced; witnesses were subject in the normal way to examination in chief cross examination and re-examination. An attempt was made to obey all the rules as described earlier of the British Public Inquiry System.

7.3. TESTING OF THE SIMULATION

The ideal way to monitor the simulation would have been by video, but this not being possible major activities were recorded as the simulation proceeds. It is not possible or relevant here to describe the events of the simulation in full, a summary of significant events is given below.

Round One - Negotiation: The developers made their case by first pointing out to the community the alleged benefits of the proposed runway. The community on the other hand disagreed with alleged benefits. A summary of claims and counter claims is shown below.

Alleged Benefits by Developers	Community Observation and Claim
1. Improve passenger handling	Agreed. But this does not relate to a runway decision.
2. Proximity to city.	Yes. But at an unacceptable cost to the local environment.
3. Fewer diversions due to cross winds.	Yes. One in a hundred.
4. Creation of work.	For any one job produced inside airport boundary two are produced outside.
5. Plans already drawn up.	Not significant.
6. Flight direct to Europe.	Airlines not interested.
7. Noise will not sig-	Noise will make people nervous

nificantly increase.	mentally stressed and even distraught.

Both sides however agreed to work out an environmental impact matrix to further highlight the different groups affected by the proposed development. The community was subdivided by distance (as a measure of noise) from the source though original assumption was that all members of the community were equally affected. The impact of each problem is considered using the scale:

A = make things much worse

B = make things a little worse

C = no effect

D = make things a little better

E = make things much better

Noise was identified to be the most important problem. Ways of solving this problem were discussed (i.e. compensation to residents - noise insulation for private houses, schools and churches, etc; improvement of aircraft operation system, adjustment of number of flights, etc, realignment of runway). The judgement was not clear for the developer was not willing to compensate every claim financially. Different possibilities for lessening the different impacts and for changing the attitudes of population were also revealed (the set of acceptance). Should the majority who benefit recompense those who lose and how should this be done?

The advantage of this apprach is that it is a good means of displaying information for ready communication to policy makers and the public and if properly done could be a comprehensive , wide ranging screening technique for impacts. The disadvantages being that the approach is a poor vehicle for considering

	Noise Pollution	Air Pollution	Loss of Agric. Land	Accident	Land Value	Business	Employment	Tourism	Accessibility	Traffic Congestion
Community A 5 Km	A	B	B	B	B	D	D	C	D	B
Community B 5 - 10Km	B	B	C	B	B	D	D	D	C	B
Community C 10 Km	C	C	C	B	C	C	D	D	C	C
Airport Authority	C	C	C	C	C	E	D	C	C	E
Planning Authority	C	C	C	C	C	D	E	D	C	C
Central Government	C	C	C	C	C	D	D	E	D	C
Businessmen	C	C	C	C	C	C	C	C	D	D
British Rail & Road Dept	C	C	C	C	C	B	C	C	C	C
Landowners	C	C	B	C	A	C	C	C	C	C
Schools - Churches	B	B	C	B	C	C	C	C	C	C

impacts dimensions of concentration, deviation and geographical scale and the many associated with subjective ranking. In retrospect this approach raises many interesting questions of technique and judgement which will be taken up under discussion later.

<u>Round Two - Public Inquiry</u>: The developers (BAA) concentrated in their opening statements on attempting to answer possible community objections rather than

stating the case for airport development and aiming it at the Secretary of State (e.g. on grounds of employment generation, business investment, tourisms, etc). This as they led, made them vulnerable to community cross questioning and into contradictions with regards to types of planes and operations (e.g. fewer but smaller sized planes and no increase in noise) with regards to predicted demand and scheduled and unscheduled flights, etc.

<u>Community</u>: Made their case with respect to noise and mental stress and the effects of different activities - education, TV viewing, farming, houses, etc. (they also referred to airpollution and safety). The developer in cross questioning mainly attempted to repeat previous statements, (e.g. that there was no case to answer - no increase in noise).

<u>Decision</u>: The judgement as recommended by the reporter and adopted by the Secretary of State was in favour of the community. This could be because (a) in this simulation - the statement of cases were not previously circulated allowing for further preparation in cross questioning (should the questioning also be circulated?) this will put the second speaker at an advantage, (b) there are only two parties involved in this round and the poor immagination of the developers of their role. It may be that the developers considered the Secretary of State to be neutral and did not appeal to his view and interest as a player as well as arbiter. Equally they did not appear to visualize their role and their responsibility to the British tax-payer, (in other words they played away game - on the communities pitch), (c) the present economic situation of the country (recession) must have been taken into consideration.

Round Three - Public Inquiry Final Debate: Here participants were allowed to search for more information and the real Inquiry procedure was adopted. An additional player - the district planning authority was introduced. The question being would more knowledge of the game and the introduction of another player make any difference?

Developer
The developers made a much more positive case - stressing the advantage of the proposed development to the nation, the district and the community - however the strength of the case was lessened by their apparent willingness to compensate the community.

Community
The community representative tended to include in his statement points from the trial debate cross questioning and emphasised the recession strongly attacked (in cross questioning); the basis of the prediction of increased traffic (i.e. attacked the foundation of the airport authority case for expansion).

Planning Authority (the district of which the community is a part)
Recommended the proposed development, but conditioning (e.g. with regard to flight operations, but also with regard to compensation which it had no power to do?!)

Decision Making Body (Secretary of State)
A very good summary of the cases as presented followed by judgement against airport development at this time principally on the basis of economic recession and the need for cuts in public spending.

There was considerable argument from the players as to whether this meant no development or development subject to review at some future date. It was clear that some amplification of roles and assumptions was necessary (e.g. the airport authority already had money allocated - and the Secretary of State as a representative of a province in Britain would be a recipient - if he refuses the finance allocated - some other province might gain).

A general point might be made - that role playing can be an educational device exercise in immagination - it cannot help us to understand or replicate behaviour in particular situations. We should involve real players in real situations and then what they do, the interpretation of why they do it is a matter of opinion as are the above statements.

Comparison with the Real Case: In the real case the recommendations of the reporter (a representative of the Secretary of State and a paid civil servant) against the development were over-ruled by the Secretary of State. The community reacted by a demonstration of civil disobedience (which antagonised what had been a sympathetic press) and then put the case to the ombudsman as a last resort.

The ombudsman reaffirmed the judgement as he was bound to do (his terms of reference being to consider cases of maladministration) - the planning inquiry had been carried out according to the law.

It should be noted that the community in this case could afford to hire legal representatives and planning consultants and had itself a resevoir of skills. The representatives of the community were surprised at the result - should they have been - they (mistakenly?) believed that justice and the law were the same thing.

The legal rules which granted them priviledges and protected these priviledges must be right - that was the way the game was played and lost.

7.4. ASSESSING THE SIMULATION

Major emphasis was placed in receiving the views and opinions of the students taking the course and experiencing its simulation using technique. A number of criteria regarding the quality of their reports were devised, such as comprehensiveness, perception of the issues, and development of appropriate arguments for a particular role. A report evaluation form was devised incorporating these criteria, and is shown in Figure 48.

Grading Factors	Strong	Adequate	Weak
ISSUE			
General understanding			
Critical characteristic identification			
Planning process understanding (planning inquiry)			
ROLE			
Description			
Relation to case study			
Point of view advocated			
Viewpoint justification			
Completeness of arguments			
SIMULATION			
Completeness of description			
Critical evaluation of process			
Critical evaluation of decision			
Accuracy of statements presented			

Figure 48

Of the total number of responses, approximately 4% indicated dissatisfaction with the simulation, either because of lack of interest on the part of the participants or whole process was just considered "a game", without potential for any real impacts. A full 15% of the participants indicated dissatisfaction with the real decision making process and the politics involved in it - a success of the simulation, since understanding the political environment of planning decisions was one of the objectives of gaming simulation techniques. Finally a total of 81% of the response showed satisfaction with the simulation as an idea and a process, with minor complaints regarding the amount of information provided.

From the evaluation of the participants response, it can be concluded that the simulation constituted a very significant innovation in the teaching methods used by the course. The students were given the opportunity to participate personally. This exposure allows them to learn by participating and to absorb a tremendous amount of information within a short period. It also gave students a feeling of understanding of the real world, as it relates to critical planning concerns. Concepts such as social justice, market economy, conflict resolution and political trade off were made far more meaningful to these students than would be the case if reliance were placed solely on lectures. It takes personal involvement to comprehend such complex concepts, and there are no planning laboratories readily available to planners for day-to-day experimentation and learning through experience. This direct experience was acquired through the simulation and has proven invaluable to the participants.

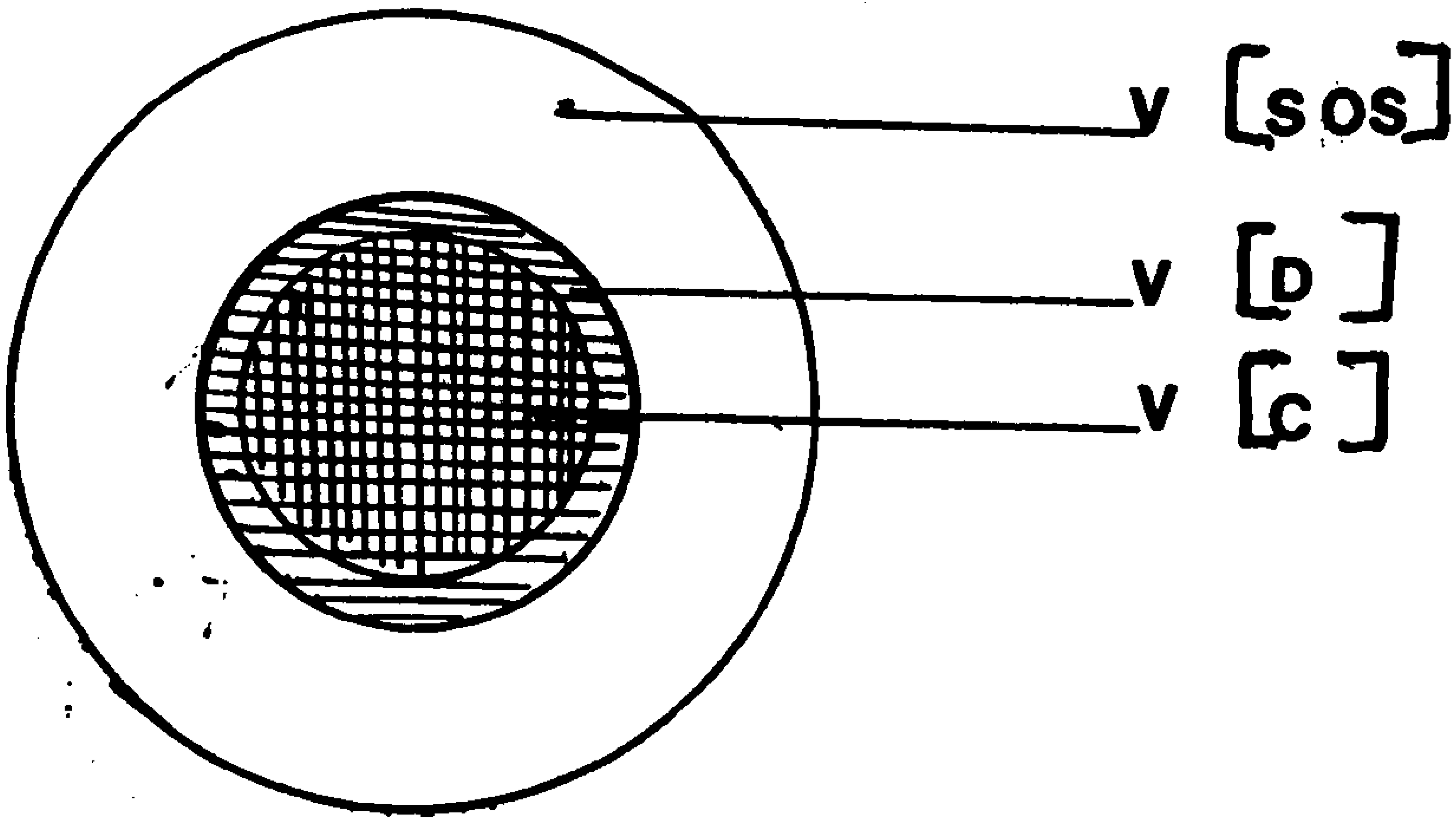
The participants in the simulation spent some time preparing for the debates. There was always much anticipation of the arguments and the final decision. There were intense discussions and questions and answer periods during each debate, which usually continued several hours after the session was over. The large majority of the participants showed tremendous interest, sound judgement in the development of the case, maturity in dealing with issues and personalities and satisfaction with the opportunity to personally handle such critical issues. During the simulation several groups of students came up with good ideas and techniques of presentation.

Finally, the participants satisfaction with the experiment was reflected in their response. Their comments and evaluations have indicated that planning simulations are a powerful tool which can dramatically alter the results of traditionally conducted lecture room education and suggest that such simulations should become an integral part of planning courses. They have also shown that, perhaps for the first time in similar courses, the participants had fun as they followed the sequence of planned events, and attempted to resolve major planning problems. It can be said, therefore, that the experimental simulation that was used to communicate sensitive planning issues to post graduate planning students with no prior experience of and maybe even no concern about certain planning issues, could be a very promising teaching device for similar courses in the future.

6.5. DISCUSSION AND CONCLUSION

The results of the 'real' game which took place over a long period of time were in favour of the developer.

The logic of this judgement was that the community and the Secretary of State were concerned with different views - that is with different spatial perspectives (or universe) and within these are different populations with different interests.

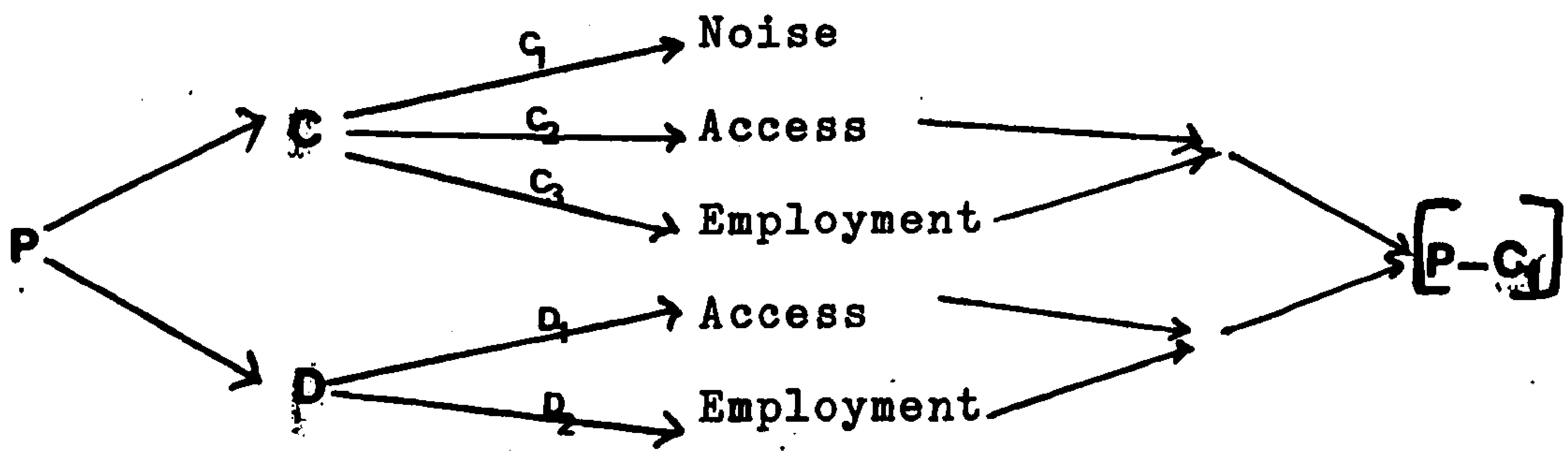


We can relate people to the possible effects of the proposal in a matrix.

	Noise	Access	Employment
5,000 community	-	+	+
500,000 district	+	+	+
5 million Secretary of State	+	+	+

where - represents a perceived disadvantage
and + represents no disadvantage or possible advantage

If we weigh these by the number of people in each view clearly whether SOS is regarded as outside or in the game, the majority would favour the airport and governments are concerned with the number of votes (in this case those who feel they may lose something if the development does not take place). This is one way of resolving conflicts to assert the dominance of the majority. We cannot only change the view (extend the universe) but we can also subset the interests - the properties defining populations and recombine within each view and between views and the developer: and SOS could well play these ways to over-



rule minority objections. Having identified the problem and the minority defined by it, alternative solutions can be explored - as in Figure 49.

These policies can be combined in relation to types of proposals and can be evaluated in terms of factors of environmental performance, cost, flexibility and implementation and then relation considered.

In the real case the community proposed (i) realignment of the runway, and (ii) relocation of runway and there was a later proposal on the result of the inquiry: to withhold rates - but this was not carried out. However, reduced night flights was a condition agreed by the developer, proposed by the Secretary of State (no night flights after 12.00 p.m.) but in practice this has not been vigorously implemented.

Clearly many of the policy instruments would not be within the current powers of the developer to implement Also there are other activities and users affected in the community area (e.g. education, military, administration, etc) and other activities pursued by residents outside the home.

The case can be as complete as we wish (and we could as

- Counter measures against aircraft noise
  - Measures to reduce noise at source
    - Improvement of aircraft
      - Improvement of engines (development of new models of less noisy engines and improvement of conventional models).
      - Use of bigger-size aircraft
    - Adjustment of number of flights
      - Prohibition of flights during specified times.
    - Improvement of aircraft operation system
      - Noise reduction operation systems (regulation on noise.volume, the cut-back system, preferential runway, etc)
  - Counter measures against noises around airports
    - Land use
      - Building restriction
      - Land use planning (buffer zones, re-development)
    - Compensation
      - Removal (removal of residences, procurement of lands).
      - Noise insulation for private houses, schools, churches, etc
      - Compensation for business losses.
      - Other (compensation for hindrance to TV viewing).
    - Other (noise intercepting plantations, noise cut walls.
  - Realignment of runway or relocate

Figure 49. Possible policies towards aircraft noise.

in the case of London Airport spend much time and money on expert advice - yet still the judgement is contrary). Here we have simply taken what the objectors said was the problem, provided an explanation of why the judgement was given, and suggested some ways of dealing with it or making it acceptable to residents for further considerations. But why did the community not only lose - but deserved to lose! Because of its narrow view (V)!

The remaining peaceful possibilities open to the community was to challenge the rule of the game (or lack of rules) - of public inquiries or to eliminate the need for such games - and this could only be done by thinking of others.

(a) With respect to the former - if it is true that richer (in skill and money) have an unfair advantage - then the community might in practice have filibusted - ignored the array of experts on the side of the developer and continued to line up individuals in the community and hold the floor to attract national attention (the attention of all those who would be subject to the rules and in the future).

(b) With respect to the latter to call for national standards (subject to periodic review and medical advice) with respect to noise whether generated by aircraft or anything else and for full compensation at existing land use values, etc) to be taken into account in all development or change of use proposals (the majority should compensate the minority wherever industrial health rights is concerned).

    There is a case to be made that when minorities are affected at different times and places they may eventually become the new majorities who have somehow adopted (why shouldn't you suffer if we do?) and that therefore will lead to environmental conditions progressively deteriorating. The community in such situations would then seek the support of groups in the nation who were equally affected by or likely to be affected by noise however generated. So what we now have is members of the community plus X members of other communities (of the national community) who are concerned not about airports but about noise, and potentially an even larger support for changes to the planning system as a whole which deals with all environmental conditions and such support could affect both district and SOS judgements in the case here reviewed. With regard to public inquiries, we can either redefine the rules (with respect to the procedures, participants, etc) see later or seek to eliminate the need for them by revising the rules for the planning system - whereby for instance specific policies with regard to noise are formulated in advance and which any developer would be governed by.

There are of course other considerations that could have been argued in an "extended view" - e.g. with regard to energy conservation - the slower, cheaper and quieter aircrafts would be a possible consequence. Airports could also be seen as a tool in pursuance of other national development policies (air travel is an advanced technology - and flexibility therefore is an important criteria of investment. We know how many airports were rapidly developed during the war using simple and mobile equipment.

This exercise has been mainly to demonstrate the importance of view - by altering view different space at the same period of time) the judgement changes. Among the general rules for the design of planning games are the definition and consideration of different views (spatial perspectives) separately, and then considerations of their relations at common times.

The lesson from the real case is that the planning process deservedly does not enjoy general acceptance and credance, precisely because those who make major plans also advise the "court of appeal". The planners judge both their own plans and the objections, in a system which allows the public inquiry decision to be arbitrarily overturned and in which the final appeal, as it were to the House of Lords, finds the ombudsman washing his hands because he has no jurisdiction over one of the disputants. The public planning system is not non-manipulative. But it is vital that the system of objection and appeal should be just and seen to be just.

The lesson from the simulation with reference to the decision is that conditions change - in 1973 economic conditions and airtraffic forecast were perceived differently. In 1980 it is unlikely that the developer (BAA) would have been funded or the case arisen (it could of course be argued by the developer that the proposal would be an essential trigger to future economic development in the competition for funds).

(a) We need to plan for changing conditions, e.g. by stipulating frequent planning reviews - by reaching agreements in advance for selected implementation when conditions are favourable - by making decisions without prejudice to other decisions and so on.

(b) Again we make decisions in the light of knowledge at a time - we cannot predict the result of gaming simulation - only describe what they were at a particular time and place and within certain rules of the game and speculate about other prevailing conditions.

(c) The importance of rules is clear - e.g. who makes the first or second move (which can be an advantage or disadvantage, e.g. in chess or skiing). When we know our opponents moves our own may be different. There is the need therefore to play more than one round and/or to circulate statements and questions in advance.

(d) It is important to introduce real players - those directly affected by or who can affect results (only by doing so can we maintain the interest over long periods of time as in the real public inquiry - and by doing so can we know the results).

(e) The need to introduce (as in natures game) random players to represent a population is evident (in, this case, e.g. a musician, an old lady, a mobile executive, etc) - to subdivide and combine in search for agreement.

With regard to the characteristics of planning inquiry the following suggestions were made during post game discussion.

(a) An environmental impact analysis should be undertaken before the inquiry itself starts. If the inquiry is to consider alternative sites, there will need to be an EIA undertaken for each site. Clearly, there would need to be close co-operation between the developer team and the community. It is hoped that this procedure would make the responsible agencies clear in their own minds what the technical specification or the key issues of such technological projects was to be before the inquiry started, rather than during the inquiry itself which was the case at many planning inquiries.

(b) The inquiry itself should take place on completion of EIA. It should have a two-stage format - discursive and adversarial. It was suggested that the first stage should be for the various parties involved to discuss and identify the main issues, and to establish what additional data or information available or might be required, participation in the discussion of this first stage would be sought by submission of a prepared statement of the points one wishes to discuss, both in general and under a range of particular headings, e.g. health and safety, impact on natural environment, economic viability, etc.

The second stage of the inquiry would be a more conventional adversarial type at which witness would be subject in the normal way to examination - in chief cross examination and re-examination. The reason for advocating the adversarial approach is that we believe there is considerable reluctance on the part of many of the proponents of technological projects as was evident in the simulation to reveal some of the relevant factual materials.

(c) It was also suggested that some form of financial assistance should be provided for objectors. This suggestion is not without precedent in other countries as was indicated by one of the participants. "In differing ways assistance to opponents of nuclear power is made available by government in Sweden, Denmark and West Germany".

Finally, it is believed that the simulation was both valuable and successful for the following reasons:

(a) It was a painless way of understanding the practical value of earlier inputs of the course - for example the responsibilities of different levels of government, the planning of social policy, the techniques of communication and planning techniques for the resolution of conflicts.

(b) It encouraged a different sort of imagination and ability than that which the student normally used, in order to plan the strategy and tactics of political pressures or to resist it, and in doing so, clarified for the students the problems which their planning colleagues have to face. It also helps to make the world outside, which treated their careful schemes so cavalierly, more comprehensible even if it remained illogical and irritating.

(c) It forced students to recognise the inter-relationship of the political and the planning system, to work out how it might be manipulated - and thus being forewarned, being forearmed - and to have some experience of the awkward human beings who do not fit into bureaucratic (or scientific) patterns, who mess up theoretical ideals like "facts are sacred", the "rights of minorities", and "all are equal before the law".

The actions and attitudes of groups of students in this simulation during the negotiations and public inquiry certaintly suggested that they became very much aware that "enlightened self interest" may not be the keystone of governmental decisions, and perhaps give them valuable glimpses of the view from the other side of the fence. "My God", said one community participant, in disgust after a particularly difficult session with BAA, "after trying to deal with those secretive bastards, I can see why the public distrust the Civil Service".

8.0 EXPERIMENT VI - PARTICIPATORY DESIGN DECISION MAKING.

8.1. INTRODUCTION

Traditional methods of design are proving inadequate to the task of dealing effectively with the increasingly complex nature of the man-made environment. In a search for better methods the barriers that separate specialists in the various design fields are crumbling. Now the last barrier - that between designer and user - is beginning to fall. Design is at last losing its mystique of lofty artistic ideals which enveloped it for so long.

Planning was the first design field to recognise the need for the participation in design activity of those who, for better or worse, must live with it and perhaps suffer the results. It also pioneered attempts to bridge the gap between planner and "planee" in a systematic way. One contemporary result of these efforts is "advocacy planning". Although design has been concerned with user needs for a long time, this concern has seldom been translated into active participation of the users in the design process. Industrial design has also been very much concerned with the needs and desires of the user. These users, like the users of architecture, rarely participate in the design process in an active manner. Decision making of public sector buildings has been and largely remains the sole domain of the professional designer.

Unfortunately, we lack a methodology for incorporating the user into the decision making process. If user participation in design is to be a meaningful and productive activity then ways of involving the user must be developed. This project is about one such way: the use of gaming simulation techniques.

Design participation game, is a method of design in which the potential users of public buildings are in direct communication with the designer and expresses their design requirements by actually designing an example of the building they wish to use.

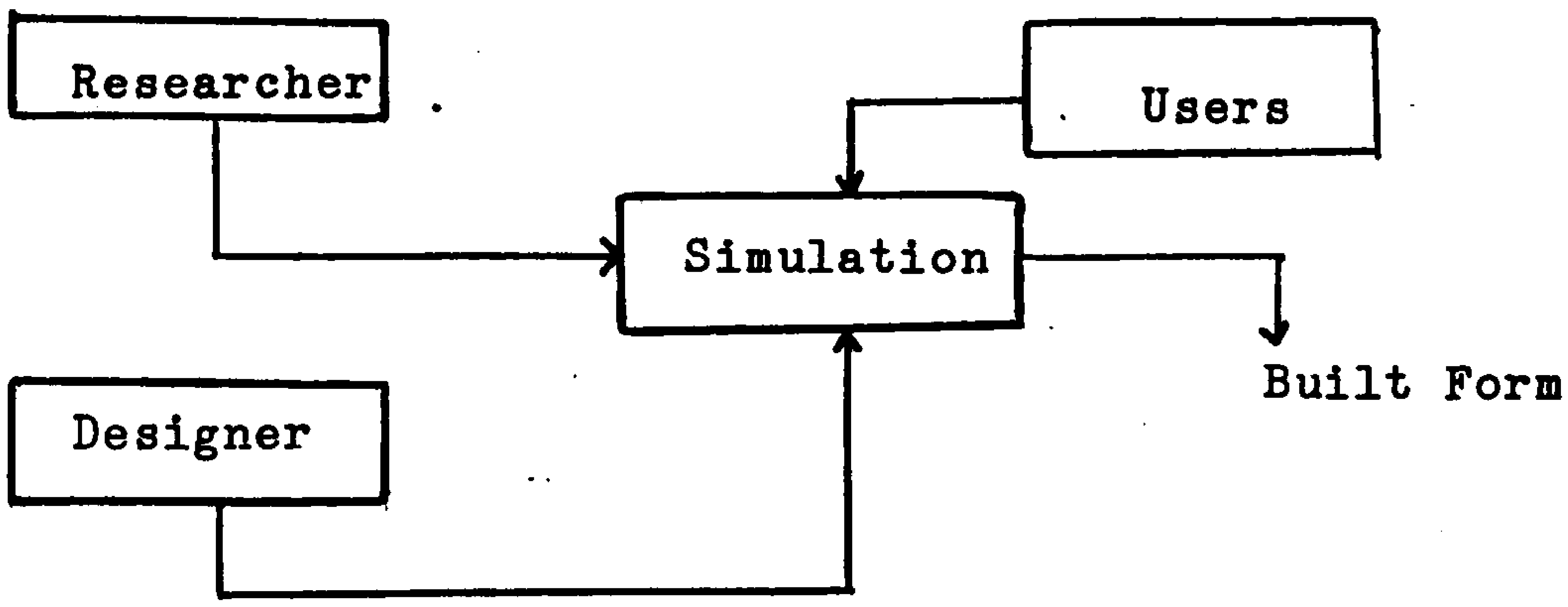


Figure 51

One of the reasons why design participation has not occurred is that building users may appear to be unable to express their requirements or design ideas. The objectives of this project was to explore the effectiveness of gaming simulation techniques as a practical vehicle for user participation in the design process and as an instrument for the prediction of users needs. A second objective was to test whether a computer aided architectural design system (CAAD) could be an appropriate aid for design participation. These objectives were achieved by writing a special computer aided architectural design program called PARTIAL (participation in architectural layout) and by using this program in two pilot studies in which community participants designed a community centre and nursery school. Headteachers designed nursery schools within the statutory requirements laid down by Scottish Education Department.

8.2. A GENERAL OUTLINE OF THE PROGRAM (PARTIAL)

The computer program (PARTIAL) was developed by ABACUS research unit, University of Strathclyde, to enable participants to generate graphically accurate drawings of their design ideas which the calculative aspects of the program advise them how to bring their design within cost and performance limits.

Within PARTIAL there are three self-contained sub-programs:

PARTIAL I is used by the controller to specify the design problem on which the participants will work.
PARTIAL 2 is used by the participants to create their design solution.
PARTIAL 3 is used by the controller to analyse the participants' design solution and the design process used by the participants.

The organisation of the program suite is described in Figure 52.

The controller uses PARTIAL 1 program to write a control file. This is used by the PARTIAL 2 program. When participants design their solutions using PARTIAL 2, the characteristics of the program they appear to be using are completely conditioned by the control file.

As the participants design their layouts two files are created. The Brief file records how the

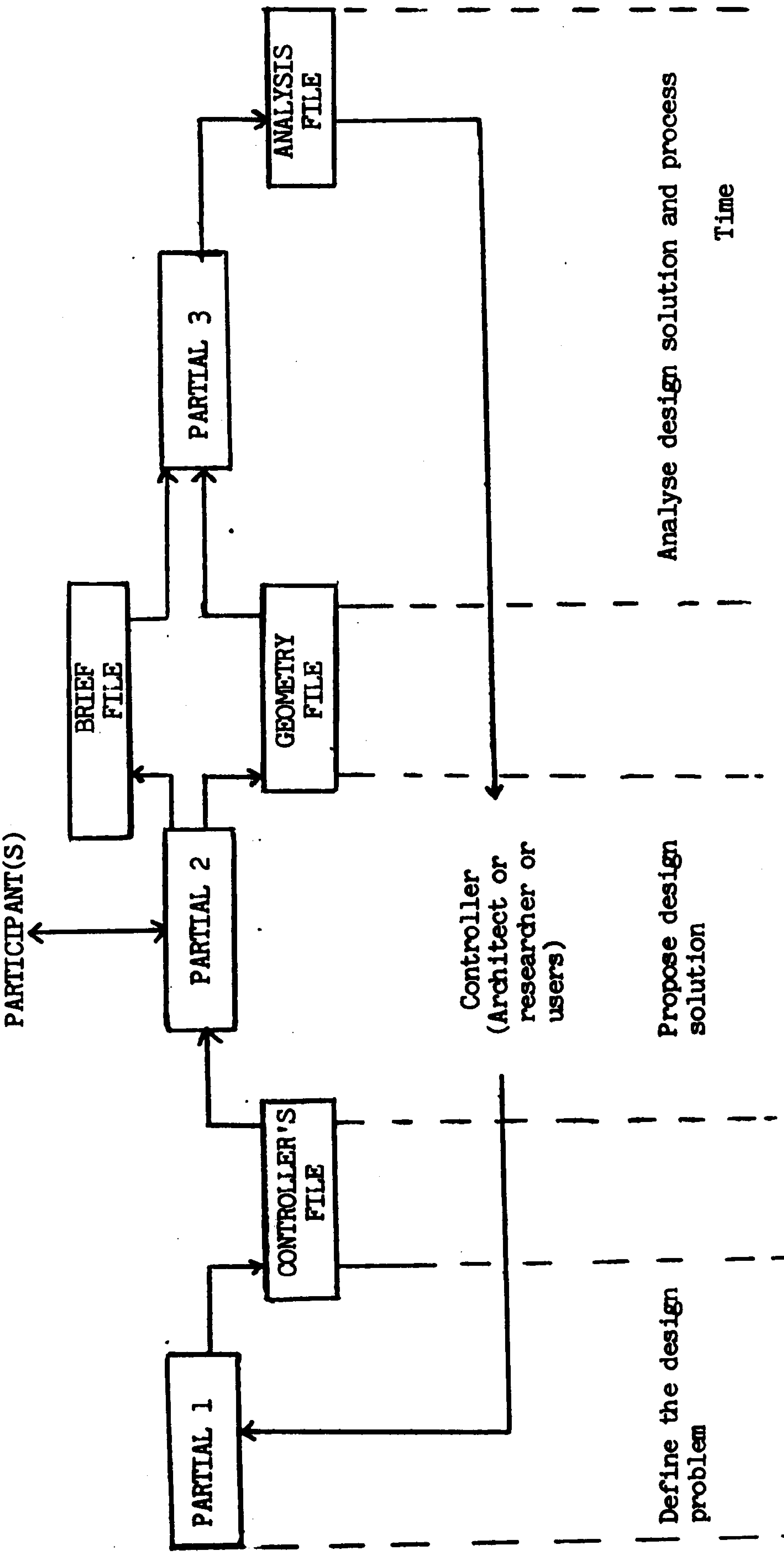

PARTICIPANT(S)
PARTIAL 1
CONTROLLER'S FILE
PARTIAL 2
BRIEF FILE
GEOMETRY FILE
PARTIAL 3
ANALYSIS FILE
Controller (Architect or researcher or users)
Define the design problem
Propose design solution
Analyse design solution and process
Time

Figure 52

participants allocate available space to the different rooms while the Geometry file stores information on how the participants build up and modifify their design geometry.

When the participants have finished designing, the controller can use PARTIAL 3 to access the Brief and the Geometry file to create an Analysis file. Once this file has been created the controller can inspect generalised or detailed information on the participants' design process.

<u>The Structure of Program the Participants Use</u>: This structure represents the hypothesis about the design activity of the future design participants. The basic structure is as in Figure 53.

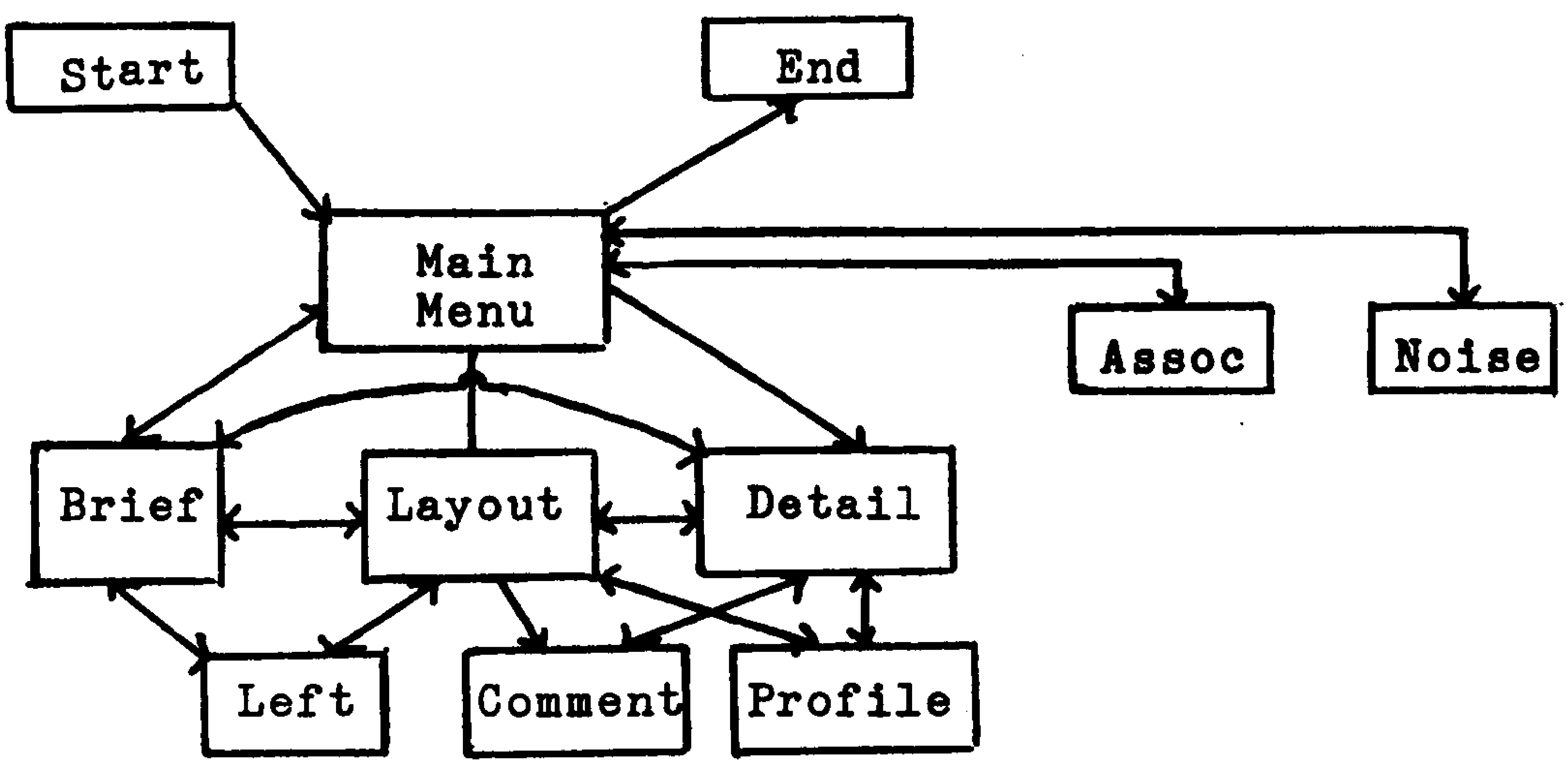


Figure 53. The Structure of PARTIAL 2

We hypothesisted that the main activity of the participants will be to iterate within the Brief-Layout-Detail sequence with the occasional visit to Left, Comment, Profile, Assoc and Noise. Such an activity at one extreme consists of:

- choose the area of all the rooms, changing areas until the complete schedule of accommodation is in acceptable form (Brief)
- draw all the rooms, re-arranging the Layout until it is satisfactory (Layout)
- add the walls, doors and windows (Detail)

How PARTIAL provides the Facilities for Design Participation

The program allows participants to choose the allocation of space to different room types within a fixed maximum area for the whole building. It is believed that this represents a "middle level" of participation. A less extensive form of participation might, for example, only allow the participants to arrange rooms each with a pre-defined and unchangeable area. However, such a limited design process excludes the strategic choice as to how the overall area of a building is going to be allocated to different types of rooms. For example, in our case this limited process would exclude important decisions as to what proportion of the total area of a building should be ancillary rather than public space. A more extensive level of participation might not only allow the participants to allocate space to different room types but might also allow them to select what the upper area limit of the building should be. At this more extensive level of participation we are at the interface bwtween design participation (decision making affecting the use of resources for specific project within an externally and politically defined limit) and political decision making (the allocation of national resources to specific projects).

Often area requirements are buried deep inside building regulations or are distributed over many different ministerial "Design Guides". It is often difficult for professional architects to work out whether their designs fall within regulations, and it is nearly impossible for lay participants to locate and decide them. One of the tasks we gave ourselves was to write an easily understood "accounting system" which could be used to present these area requirements to participants and could also be used to show the participants how their design uses up the total area.

We essentially accepted two concepts. First, there is a minimum requirement. Second, there is maximum area defined as an optional area in addition to minimum area. If the minimum area is zero and the maximum area is infinite then participants have complete freedom to do nothing or everything. At the other end of the scale, if the minimum area is positive and the optional area is zero then for the design to be legitimate it must be no less no more than the specified minimum area. Here the participants have no freedom to make adjustments to the area, but of course they may still have freedom to organise the layout in their preferred way. These concepts of minumum area and optional area in addition to the minimum operate at the three levels:

(i) The overall area of the building, its minimum and optional additional area.

(ii) The area of defined zones in the building (for example the public zone, or the ancillary zone) each with their minimum area and optional additions.

(iii) The total area for all rooms of a given type each with a minimum total area and optional additions. (Also for rooms there may be a minimum and maximum number of rooms allowed for each type, a minimum and maximum size for any room of a given type)

It is quite likely that if the participants selects rooms all with optional area in addition to minimum area then the resultant building will be larger than the maximum allowed. This means that participants have to make trade-offs within room types (defining an appropriate number and size of rooms for each room type) between room types within a single zone, and between zones. Figure 54 shows a 'page' of information that comes up on the computer screen to describe the area limits for the three zones and the total area of building.

PUB = Public Zone ANC = Ancillary Zone C&S = Circulation

	TOTAL ZONE AREA YOU HAVE SELECTED SO FAR	ZONE AREA TO BE ADDED TO MEET MINIMUM REQUIREMENTS	OPTIONAL ZONE AREA IN ADDITION TO THE MINIMUM REQUIREMENTS
ZONE:-PUB	10.50	209.50	25.00
ZONE:-ANC	0.00	90.00	20.00
ZONE:-C&S	0.00	55.00	20.00
	TOTAL AREA YOU HAVE SELECTED SO FAR	AREA TO BE ADDED TO MEET MINIMUM REQUIREMENTS	OPTIONAL IN ADDITION TO THE MINIMUM REQUIREMENTS
	10.50	369.50	50.00

Figure 54

Because this page of information shows the situation at the beginning of the design, the participants have not yet specified the areas of any of the areas except PUB = 10.50, hence the 10.50 under total zone area selected so far. As the participants actually specifies rooms in different zones so the areas of the building under the heading "total zone area selected so far" increases and the zone area to be added to meet minimum requirements and the optional zone area in addition to the minimum requirement decreases.

An important feature of these area limits is that the total optional area available for building is less than the sum of the optional area for all the zones. This implies that even with the building at its maximum size not all the zones can be of their individual maximum size, so the participants have got to make trade-offs between the areas of the different zones which reflects their judgement about what constitutes an appropriate basis for community centre.

Even if a strategic choice has been made as to what percentage of the total area is going to be given over to public rather than ancillary use, there are still important decisions as to how the public area (and other areas) is to be used. This allocation of area within the public zone may well be extremely important to the community hall users because inappropriate allocation may cause dissatisfaction to many users. Figure 55 illustrates the way the program presents this area trade-off problem to the participants for the public zone (PUB).

The first column is the short names of the different room types that can be included in this zone:
MHL = Main hall, LHL = Lesser hall, CAF = Cafe,
FOY = Foyer, REC = Reception, ENT = Entrance.

The second column tells the participants the minimum and maximum area for any room of a given type. For example, any cafe room must be no smaller than 12 square

ROOM TYPE	ZONE:-PUB INDIVIDUAL ROOM AREA MIN	MAX	YOUR ACTIONS SO FAR AREA (BRIEF)	TO BE ADDED TO MEET THE MINIMUM REQUIREMENTS EXTRA NO	EXTRA AREA	OPTIONS IN ADDITION TO THE MINIMUM REQUIREMENTS EXTRA NO	EXTRA AREA
MHL	120.00	160.00	144.50(144.50)	0	0.00	0	15.50
LHL	10.00	70.00	51.00(51.00)	0	0.00	2	19.00
			0.00				
			0.00				
	TOTAL AREA =		51.00				
CAF	12.00	40.00	0.00	0	0.00	1	40.00
FOY	10.00	25.00	22.75(22.75)	0	0.00	0	2.25
REC	8.00	15.00	7.50(7.50)	0	0.50	0	7.00
ENT	2.00	25.00	0.00	0	0.00	2	25.00
			0.00				
	TOTAL AREA =		0.00				

	TOTAL ZONE AREA YOU HAVE SELECTED SO FAR	ZONE AREA TO BE ADDED TO MEET MINIMUM REQUIREMENTS	OPTIONAL ZONE AREA IN ADDITION TO THE MINIMUM REQUIREMENTS
ZONE:-PUB	225.75	0.00	19.25

Figure 55

metres and no larger than 40 square metres, which is quite a range within to choose. The third column tells the participants what they have done so far, for example in the particular case 144.5 square metres have been used for the main hall. The fourth column tells participants the minimum number of rooms and the total minimum area which they must include in their design to meet the minimum requirements while the fifth column shows how many more rooms and how much more total area that can be optionally added to each room type.

During the design process the participants can always ask for up to date account of the area they have left by simply choosing the command 'left'. Let us now look at this same 'page' of information which the participants might have asked for during the design process after they have selected some of the rooms in the public zone to be included in their design. We can see that there are no more rooms which have to be added to meet the minimum requirements for the public zone, but the participants can add some optional area. One may notice the comment under the table of areas which draws the participant's attention to the fact that whatever rooms they now add or whatever existing rooms they have chosen which they now want to enlarge, the total area that can be added to this zone in Figure 55 is 19.25 square metres.

When participants have chosen the area of one room or when they have selected some or all the rooms for their design they can draw the room on the computer screen. They can choose the position and proportions of each room and they can change as many times as they like, the area, the proportions and positions of the rooms until they are satisfied with their design. Most probably they first make an initial choice of the areas of the rooms they consider to be most important, then draw those rooms. This gives the general direction to the layout of the building. Then they fill in the areas around the important room with the smaller, less important rooms.

At any stage they can select the command "Comment" and the computer will tell them in the friendliest possible way how their design is shaping. Figure 56 illustrates two of these comments but these are not absolute criticism of the participants designs. These comments do not tell the participants what ought to happen, they just remind the participants of their own previous ideas about the design of the building.

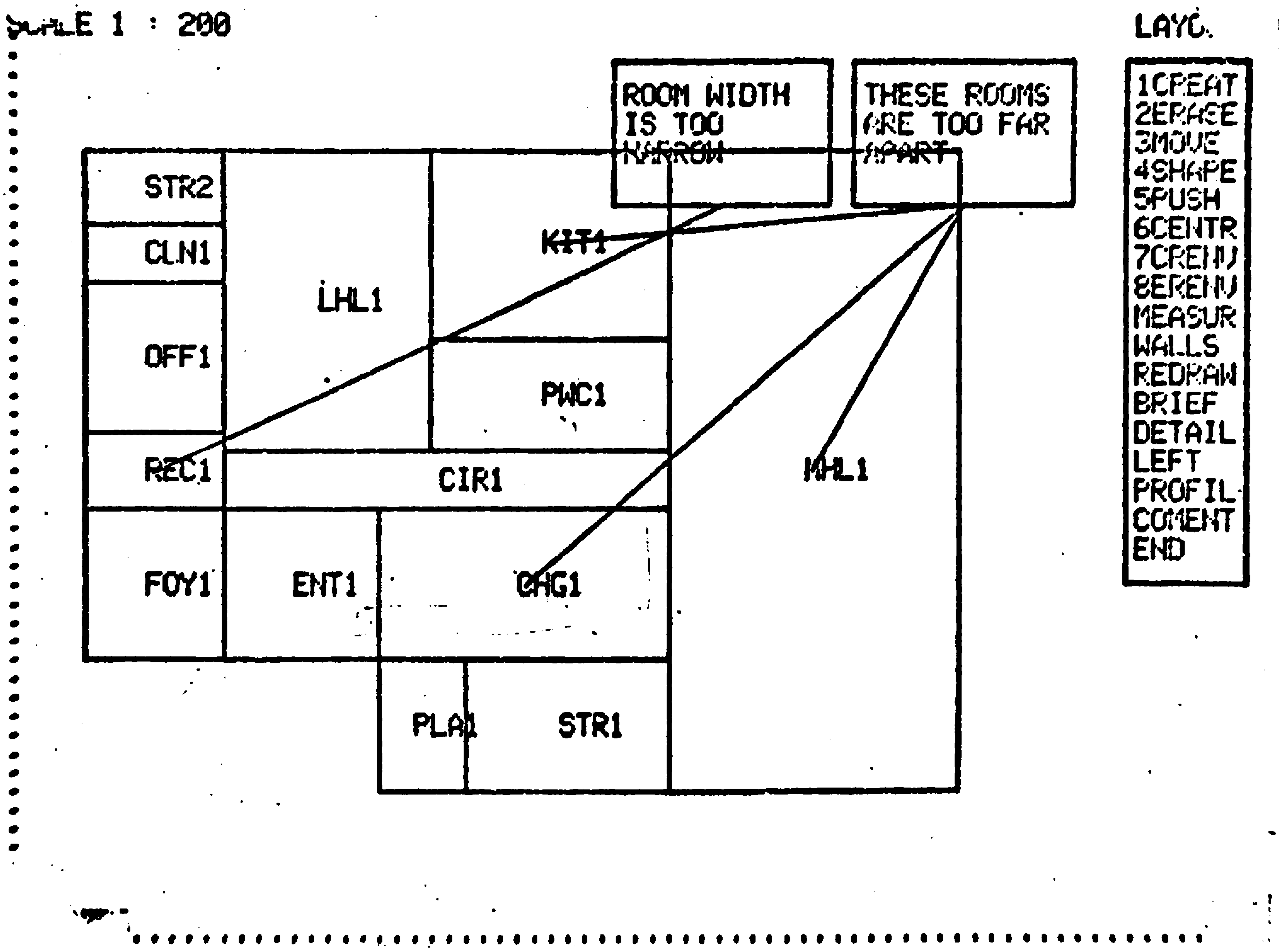


Figure 56

By selecting "Profil" the participants can compare their design against the average performance of five existing professionally designed community centres (Figure 57).

The performance profile shows the percentage deviation of the participants design from the average performance. These are:

(i) total space of the building,

(ii) total area of each zone of the building as defined in the space budget,

(iii) Cost Indicator. This is the sum for each room of its area - the cost of per unit area for a room of that type.

(iv) Circulation/planning efficiency. This measures the average distance between those rooms which the participant has positively associated. (b) privacy, this indicates the number of rooms with inter-connecting doors which are not associated.

(v) Energy Cost Indicator. This is the sum required for heating up the building.

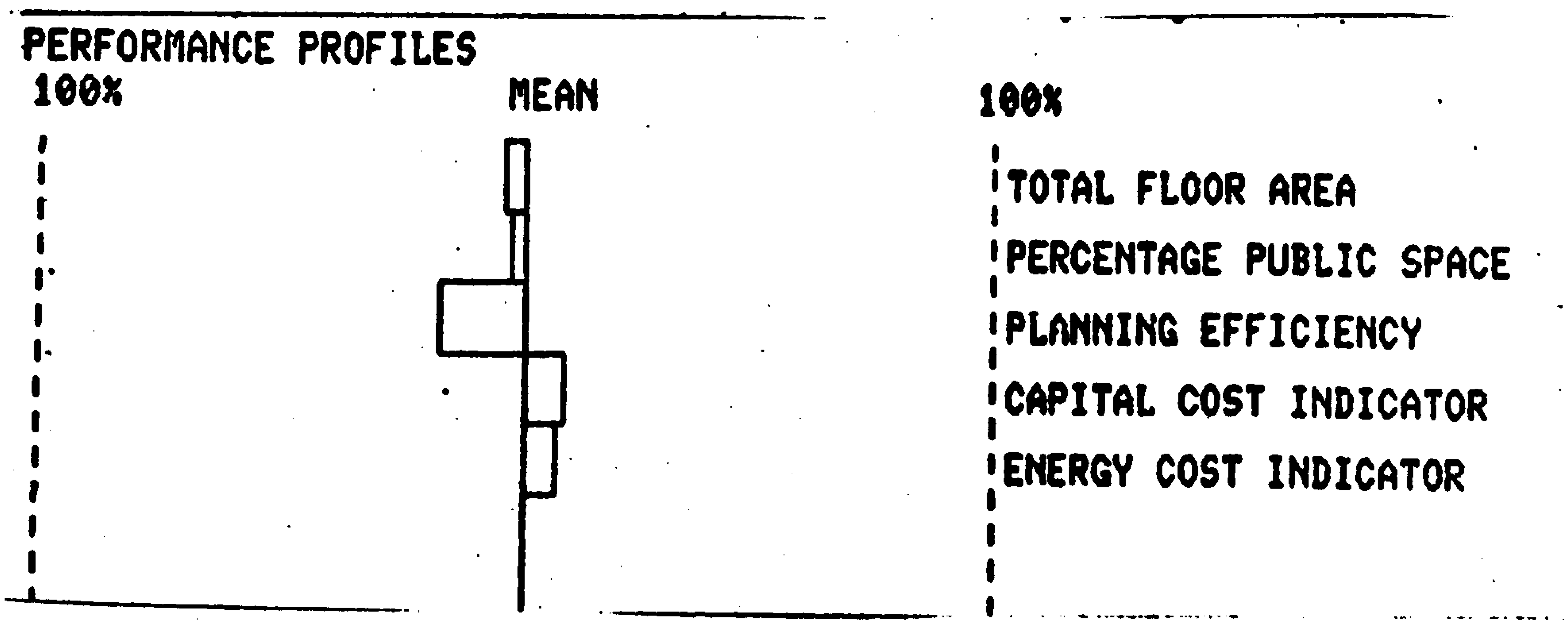


Figure 57

Participants can change their design by changing the area, shape and position of any room and then ask for a performance profile or their new design. They can continue to change and evaluate their design until they are satisfied. They do not have to take the performance profile into consideration if they do not want. It is up to them to weight the importance of the different measures according to their own possible changeable priorities and to set and change their own criteria of acceptable performance on the different measures.

It is believed that this performance information has a powerful role to play in the design participation game. If anybody proposes a design, whether he is a professional architect or local participant, a definitive judgement as to the appropriateness of that design, compared to other designs of the same type should not be made by looking at drawings without also inspecting performance profile makes explicit the consequences of the designer's decision and their inherent value judgement. Such information allows the participants to evaluate and compare their design with existing professional designs and see the advantages and disadvantages of both.

8.3. TESTING

Arden Community Residents designing Community Centre

The Arden corporate group consists of representatives of Arden Tenant's Association and local community groups, local authority departments and local elected members, have applied for outline planning permission for the construction of a community hall within the Arden housing scheme, part of which is located within the Cornwardic "Area for Priority Treatment" (APT) within S W Glasgow. The Arden area itself has no community facilities (sporting or otherwise) and the area has a high percentage of young people when one compares this to the Glasgow average.

The construction of a purpose built community hall would provide a meeting place/base whereby Arden

Tenants Association could provide a wide programme of social, recreational, cultural, educational and creative activities for all age groups within the local community. The Association was particularly anxious to provide youth activities for which there was an urgent need.

The construction of the hall would also provide much needed employment opportunities for unemployed tradesmen and building labourers in the area. Local workers would be engaged through the STEP programme of the Manpower Services commission to carry out the construction operations.

A site for the construction of the community centre has been leased to Arden Tenants Association and outline planning permission for the erection of a new building has been obtained. A soil investigation report carried out by the Scottish Special Housing Association anticipates there would be no special problems for the construction of a single storey community centre. The site is grassed over and contains several recently planted young trees. It is bounded on the north and west by street car parking, adjacent to Kilmuir Drive and on the south and east by Kilmuir Drive itself (see Figure 58).

The department architecture and building science of the University of Strathclyde was asked to provide a design of the community centre. However, the department was aware of the short comings of producing a design based on a linear model. To involve the users in the design process the department decided to introduce a negotiative approach, a simulation which serves to stimulate desires and reaction from the potential users. Residents of Arden community were then invited to take part in a three evening free gaming

Figure 58. Site Plan

exercise. Two groups of students were involved in the project. The first group were given the brief submitted to the Department of Architecture by the Tenants Association to work with. The second group which the researcher was involved with, was attached to the randomly selected participants to generate a layout plan. The final output of the two groups is shown on pages 351 and 353 . The discussion that follows is a report on the simulation exercise (group II).

Procedure:

(i) General discussion - during which participants were encouraged to discuss the community hall in its entirety, the running of the centre, time tabling, component elements and examples from real life - and to translate these preferred social and organisational aspects into physical objectives concerning the designing of the centre.

(ii) Modelling using game pieces by community participants and sketching out of accepted model by student architects.

(iii) The use of the computer program "PARTIAL".

Testing: Phase I - General Discussion: The simulation started with a general discussion of the community hall in its entirety. The eight participants from the community were allowed to discuss what they would like the community hall to look like and its functions. For example, the schoolboy representing the youths feels he is fighting a battle for the young who get a bad break in this area, though there are so many of them - this makes him "edgy" in discussion. He knows little about buildings but has seen one good sports centre and would like Arden to have one with similar facilities, a large sports hall and a small room for discos, dances, social with catering facilities. Would like showers and changing rooms. On the other hand the old age pensioner (70 years) has lived in the area all her life. She has severe rheumatism and walks with difficulty, but is determined to be independent as far as possible. She has a one roomed flat, therefore would welcome somewhere to meet friends. Her family and grand-children are in Australia but she likes contact with small children though she is rather wary of 14 - 18 year olds who represent a view of life she finds difficult to understand. She wants a room suitable for old people to meet, with snacks available. She sees a need for sports facilities for the young but would like old people's room separated if possible.

The following points at the end of the discussion were accepted as a base to start a trial solution. That the community hall should contain the following rooms with associated functional relationship:

The Main Hall: The main hall to facilitate dance functions with small band possibility. A collapsible stage made of different units to be incorporated. It also requires area for sports such as Badminton, Basketball, Netball, indoor Bowls, etc. It should be separated from the lesser hall and requires area for pensioner's club.

Lesser Hall: To be used mainly for table games, e.g. table tennis, snooker, etc. Could be used as a committee room or place for parents to wait for children coming out of the playgroup. Also possible for catering for pensioners' lunches which might only be a small group of nine or ten.

Kitchen: To be connected to both main and lesser hall, should not be associated with office. There should be ample space for cooking facilities. There should be easy access to the kitchen store for deliveries.

Delivery should be from Kilmuir Drive.

Foyer: A place for people to meet before entering changing room or some activity space. May include a few chairs, tables, but must not obstruct circulation.

Reception: To be as small as possible so that there will be direct entry from entrance into amenity area, this is hoped would deter any loitering and be much safer for secutiry.

Entrance: Should face away from Nursery School and on to housing scheme with car parking in front. The reason for this being easy access from car park, safety for children who will not have to cross the main road. There should be an area for general notices which can be read without entering the main building.

Office: The office, which should contain the reception, should hold files, records and general business data. There should be a folding wall dividing the office and office store which could be opened up for meetings if both halls are in use at the same time.

Changing Rooms: Should be connected to the main hall. However, no need for changing room to be connected to lesser hall, as this would only be used for committee meetings or table games which do not require changing of clothing, shower facilities to be incorporated.

Toilets: To be connected to changing rooms and also opens on to corridor for general use. There should be separate toilets for the disabled.

Main Store: To be connected to main hall and to be used to store portable stage, tables, chairs, used during functions, and also to store sports equipment.

A store for the lesser hall is also required for storing table tennis tables, billiard and pool tables.

Corridor: To be closed at both ends to separate areas of sports activity and social functions.

Finally it was accepted that the building should be designed with the handicapped in mind. The building should be on one level. The main problem with the community hall will most likely be vandalism. Therefore the design of the community centre must be biased towards the security problems, especially as regards the roof and window openings.

With the above brief formulated by the local participants the student architects then proceed to make models (game pieces) containing the rooms specified above and also others that were not mentioned, for the second phase of the project.

<u>Phase II - Participants Creation of a Design using Game Pieces</u>: The second evening participants assembled in the same proportion with an additional youth from the local community. The game pieces were introduced to them and they were reminded of the brief that they formulated in the first phase.

Participants play with the game pieces, first each participant was asked to design a layout plan of the community hall from his or her own bias. This was to get participants acquainted with the game pieces. Through trial and error each was able to generate the layout of a community hall he or she would like. However, they were all to design a single community hall constraint by cost, site, and building regulations as such they were asked to come forward with a single layout plan that is accepted by all participants and fit the brief formulated by them earlier.

Through argument, co-operation and distributional bargaining, participants finally came forward with a solution. Plate 11 shows the group layout model of the community hall. However, since this does not give

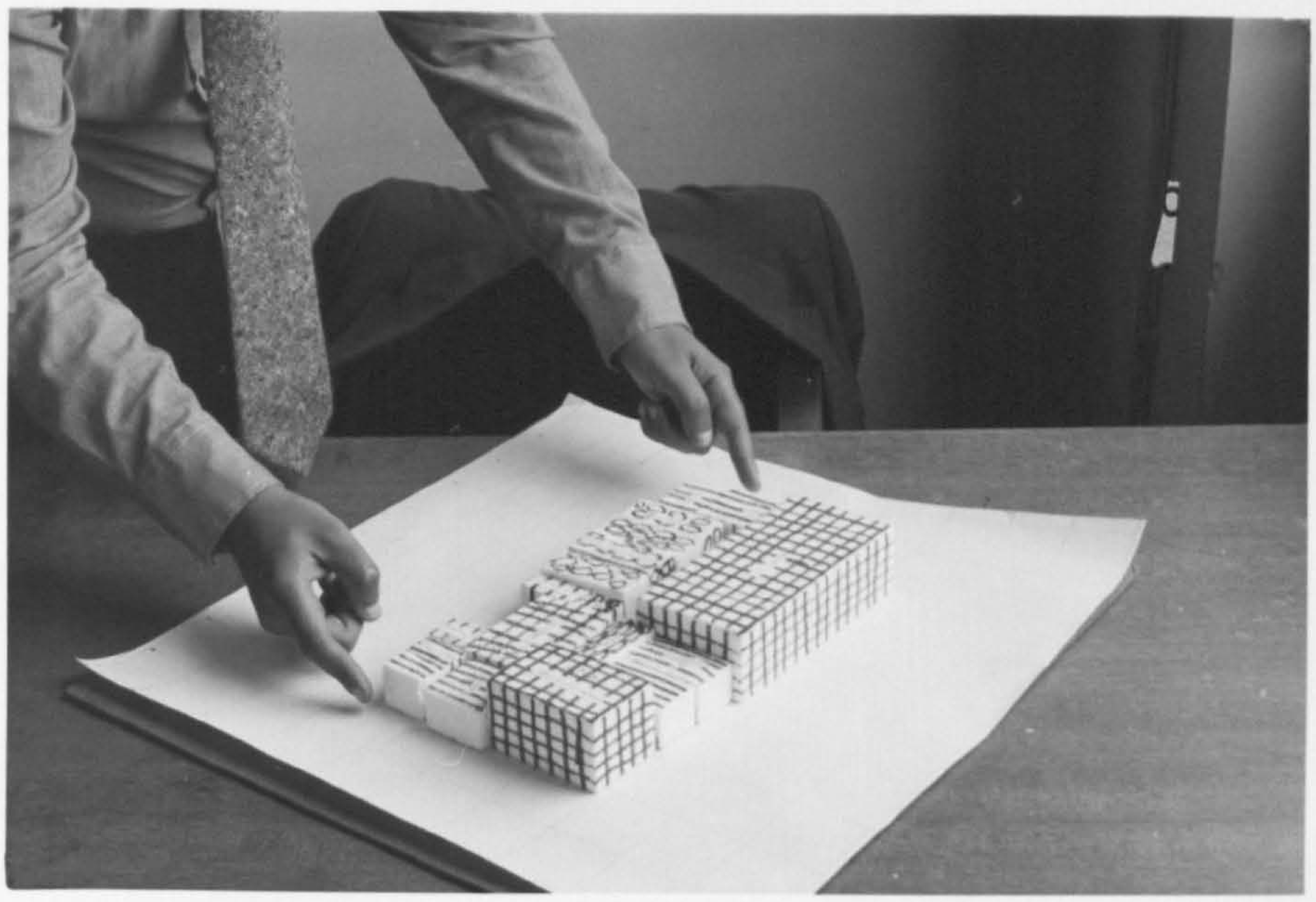


Plate 10 Participant design a layout plan with game pieces

an estimate of cost, planning efficiency and spatial dimension, a ketch of the layout plan was made by student architects to feed the information into the computer.

Phase III - Participants' Creation of a Design using "PARTIAL": There follows a description of participants' usage of the program "PARTIAL" in carrying out modifications to the group design which was selected as the basis for further solution. This is presented in the form of verbal summary of the sequence of

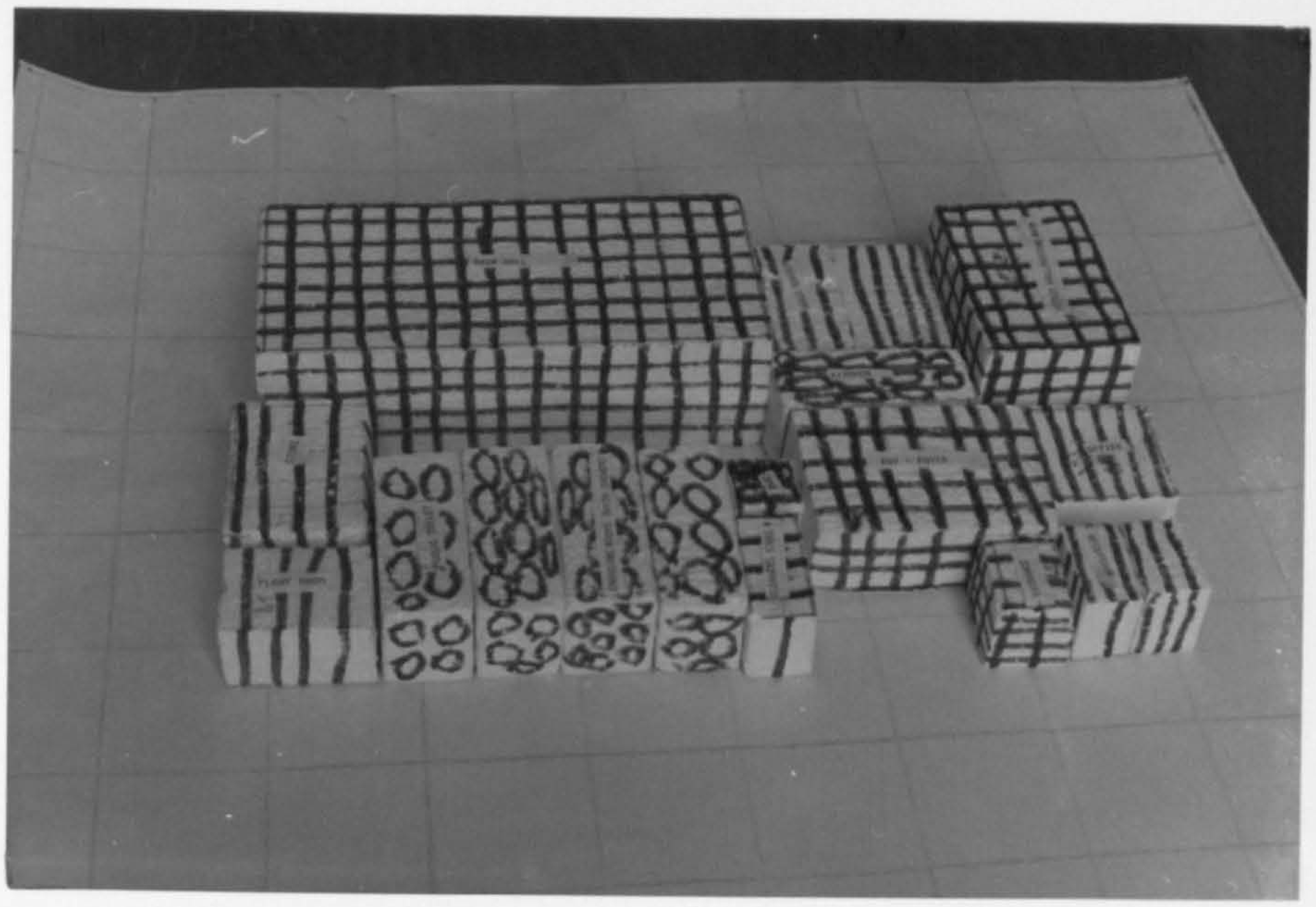


PLATE 11 : Group Solution of Community Hall

decisions which were made together with a reproduction of the plan or information which was conveyed to the participants on the terminal at various points in the process.

As a summary of what follows, it was observed that the process passed through several stages. First, the participants carried out changes to the plan at layout level. This was primarily concerned with the reduction of the overall size of the building, and this involved frequent reference to feedback information on the space budget. Two of these stages are represented in Figures 59 to 70 . Finally the participants interatively modified the features of the building envelope at the detailed level. The final output is represented in Figure 72 .

At the outset the participants reviewed the design upon which the group solution was going to be based (Figure 59), by obtaining information on the design's space allocation and performance profile. As regards the space allocation (Figure 59) the building had been designed at 433.50 square metres which is about 8% over maximum recommended area. The excessive area was over apportioned in particular to circulation. On the building performance aspects, the most significant

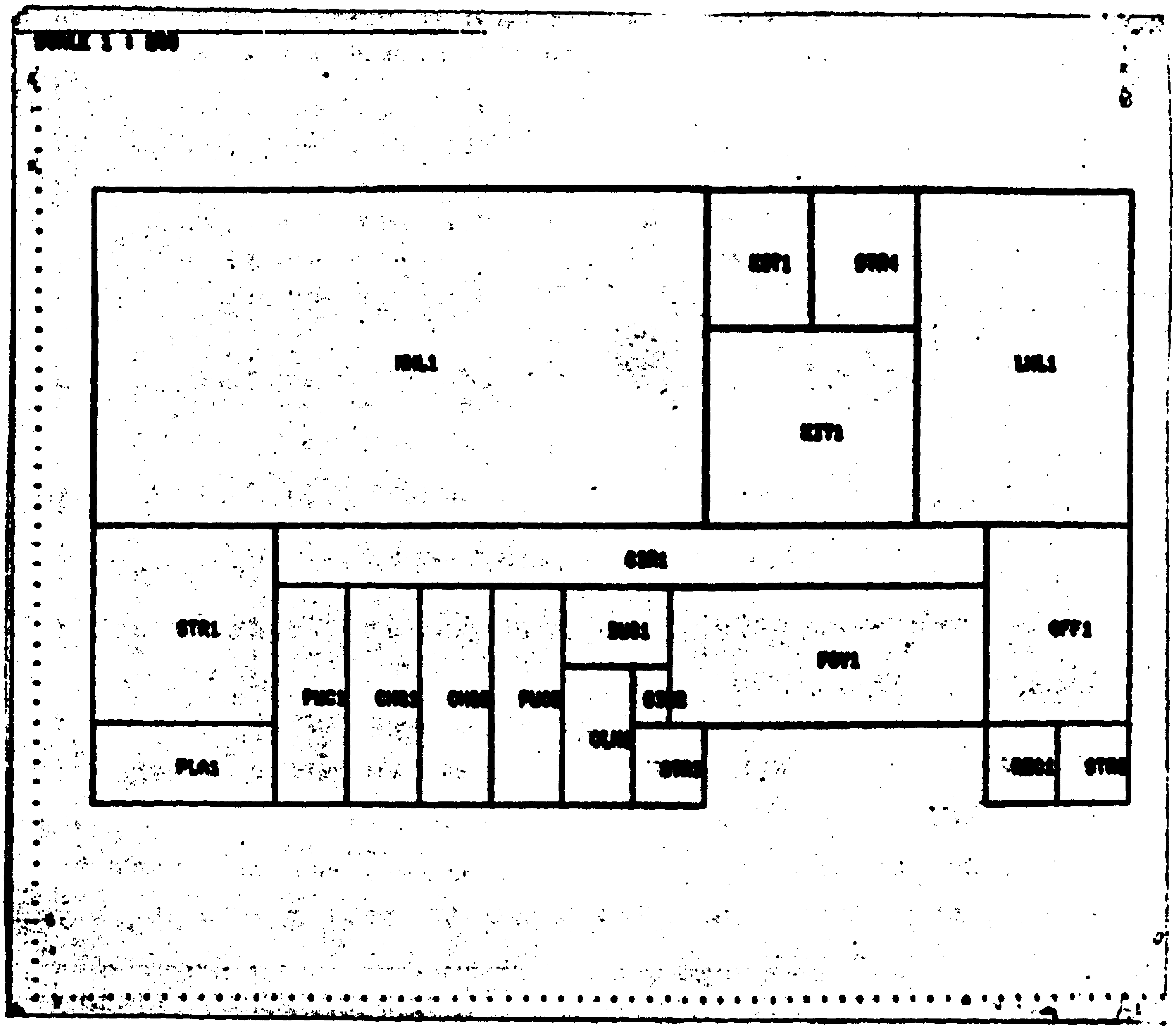


Figure 59. First design solution by participants (layout level).

deviations from the mean of the previous five architect designed solutions were 8 percent increase in total floor area, an 18 percent increase in capital cost and about 42 percent increase in energy cost.

Figure 60 is the detail of an area that has been used up in the public zone. It shows that 231.00 square metres have been used up so far and this falls short

ROOM TYPE	ZONE:-PUB INDIVIDUAL ROOM AREA MIN	MAX	YOUR ACTIONS SO FAR AREA (BRIEF)	TO BE ADDED TO MEET THE MINIMUM REQUIREMENTS EXTRA NO	EXTRA AREA	OPTIONS IN ADDITION TO THE MINIMUM REQUIREMENTS EXTRA NO	EXTRA AREA
MHL	120.00	160.00	144.50(144.50)	0	0.00	0	15.50
LHL	10.00	70.00	51.00(51.00)	0	0.00	2	19.00
			0.00				
			0.00				
	TOTAL AREA =		51.00				
CAF	12.00	40.00	0.00	0	0.00	1	40.00
FOY	10.00	25.00	31.50(31.50)	0	0.00	0	-6.50
REC	8.00	15.00	4.00(4.00)	0	4.00	0	7.00
ENT	2.00	25.00	0.00	0	0.00	2	25.00
			0.00				
	TOTAL AREA =		0.00				
	ZONE:-PUB		TOTAL ZONE AREA YOU HAVE SELECTED SO FAR 231.00	ZONE AREA TO BE ADDED TO MEET MINIMUM REQUIREMENTS 0.00		OPTIONAL ZONE AREA IN ADDITION TO THE MINIMUM REQUIREMENTS 14.00	

Figure 60. Details of used area in the public zone.

of the maximum required area by 14.00 square metres.

The participants then move to the circulation and storage zone and checked the space budget. It shows that 102.5 square metres have been used up so far and that this is in excess of maximum required area by 27 square metres. The excess was identified (see Figure 61) to be due to space created for circulation (CIR I).

A further check of the ancillary zone space budget revealed that 100.25 square metres have been used up and that this falls short of the maximum required area by 10.00 spare metres.

ROOM TYPE	ZONE:-C&S INDIVIDUAL ROOM AREA MIN	MAX	YOUR ACTIONS SO FAR AREA (BRIEF)	TO BE ADDED TO MEET THE MINIMUM REQUIREMENTS EXTRA NO	EXTRA AREA	OPTIONS IN ADDITION TO THE MINIMUM REQUIREMENTS EXTRA NO	EXTRA AREA
STR	4.00	20.00	25.00(25.00) 4.00(4.00) 4.00(10.50) 10.50(0.00)	0	0.00	1	1.50
	TOTAL AREA -		43.50				
CLN	3.00	10.00	7.00(7.00)	0	0.00	0	3.00
KST	5.00	12.00	10.50(10.50)	0	0.00	0	1.50
PLA	5.00	10.00	10.00(10.00)	0	0.00	0	0.00
CIR	1.00	15.00	30.00(30.00) 1.50(0.00) 0.00 0.00 0.00 0.00	0	0.00	5	-16.50
	TOTAL AREA -		31.50				
	ZONE:-C&S		TOTAL ZONE AREA YOU HAVE SELECTED SO FAR 102.50	ZONE AREA TO BE ADDED TO MEET MINIMUM REQUIREMENTS 0.00		OPTIONAL ZONE AREA IN ADDITION TO THE MINIMUM REQUIREMENTS -27.50	

Figure 61

ROOM TYPE	ZONE:-AMC INDIVIDUAL ROOM AREA MIN	MAX	YOUR ACTIONS SO FAR AREA (BRIEF)	TO BE ADDED TO MEET THE MINIMUM REQUIREMENTS EXTRA NO	EXTRA AREA	OPTIONS IN ADDITION TO THE MINIMUM REQUIREMENTS EXTRA NO	EXTRA AREA
KIT	20.00	30.00	30.00(30.00)	0	0.00	0	0.00
PWC	10.00	18.00	11.00(11.00) 11.00(0.00)	1	0.00	0	10.00
	TOTAL AREA -		22.00				
DWC	3.00	8.00	6.00(6.00)	0	0.00	0	2.00
CHG	10.00	15.00	11.00(0.00) 11.00(11.00)	1	0.00	0	8.00
	TOTAL AREA -		22.00				
CLK	4.00	12.00	0.00	0	0.00	1	12.00
OFF	8.00	25.00	20.00(20.00) 0.00	0	0.00	1	5.00
	TOTAL AREA -		20.00				
	ZONE:-AMC		TOTAL ZONE AREA YOU HAVE SELECTED SO FAR 100.00	ZONE AREA TO BE ADDED TO MEET MINIMUM REQUIREMENTS 0.00		OPTIONAL ZONE AREA IN ADDITION TO THE MINIMUM REQUIREMENTS 10.00	

Figure 62

It was felt that the layout of the building, with few reservations was adequate but the performance profile

(Figure 63) was not acceptable.

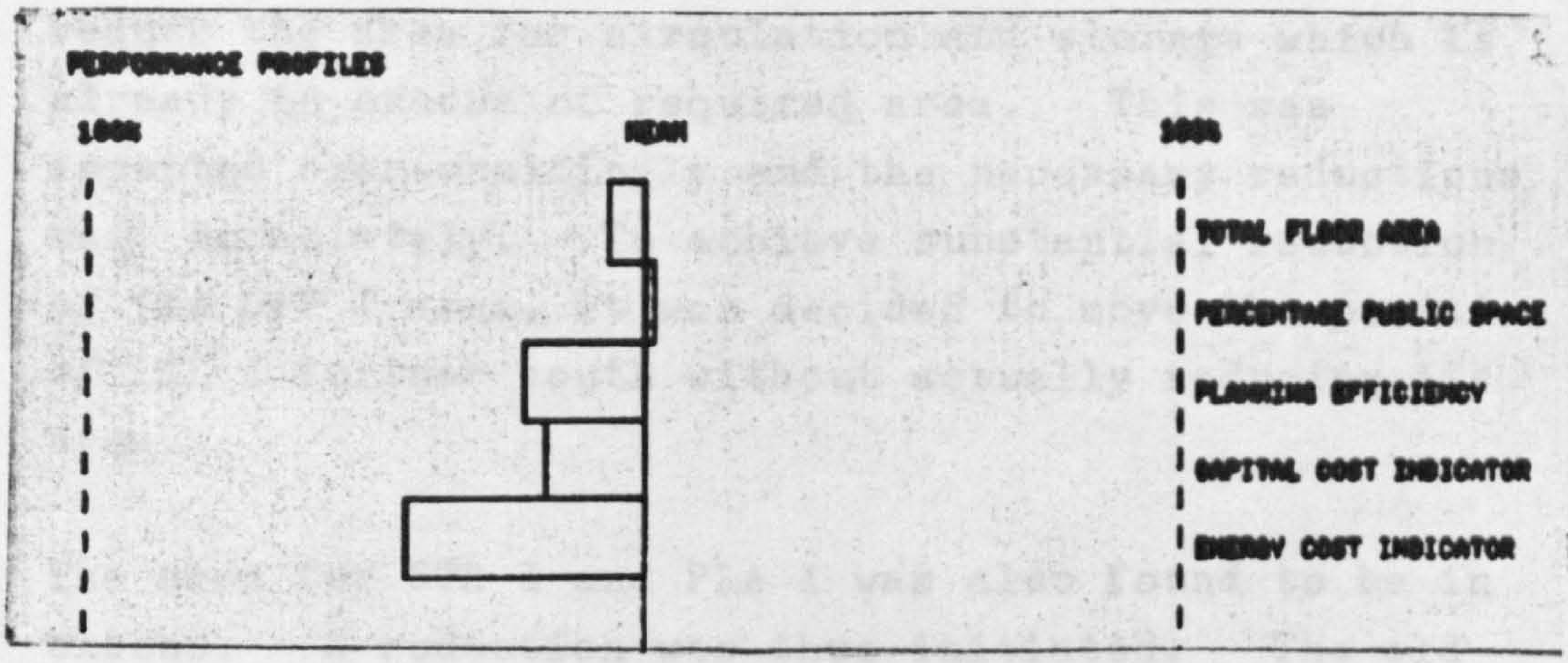


Figure 63

The participants decided to initiate changes at the layout level, with first objective to gradually reduce the building overall area by, to beging with, reducing circulation space area. To achieve this, participants decided to reduce CIR I by increasing PWC I area linking it to MHL I. CIR 3 area was created out of CIR I in the process.

It was pointed out to the participants by the student architects that their first design solution omitted entrance and that consideration should be given to it since this might help to improve the performance profile. A middle-aged lady then suggested that the entrance be created next to REC I in order to fulfil the brief formulated earlier. This was accepted and ENT I was created immediately.

A youth pointed out that he disliked the matched box shape of the community hall and would like the shape to look somehow attractive. Surprisingly this was also accepted by the old age pensioner who felt there is need to adjust the shape. The student architect then suggested that perhaps a way of resolving the problem might be to reduce the area for KST I, STR 4 and the office OFF I, since this would also help to reduce the area for circulation and storage which is already in excess of required area. This was accepted over-whelmingly and the necessary reductions made immediately. To achieve substantial reduction of the OFF I area, it was decided to move the position of LHL I further south without actually reducing its area.

The area for STR I and PLA I was also found to be in excess. A reduction was thus initiated. The old age pensioner insisted on the creation of a Cafe. This posed a lot of questions to the participants as many were against the inclusion of cafe on the grounds that the public zone was already in excess of its required area. However, a vote was taken on this issue and it was decided to get rid of cafe for the time being. Participants now feel enough changes have been carried out and it is now necessary to find out their performance so far by asking the computer to produce up to date information about the action so far. Figure 64 gives detailed information of their action so far.

On page 347 is the participants' second trial solution at layout level. At first sight participants seem to be pleased with this solution. However, let's see in detail its performance profile and how much area each individual room has used so far.

First let's have a look at the area each zone has occupied so far. From Figure 65 is it is quite clear that the total floor area has slightly decreased (from 433.5 m^2 to 424.5 m^2). Participants accepted this as fairly good and proceed to probe each zone separately. Participants checked the space allocation budget (Figure 65); it was apparent that the public zone has

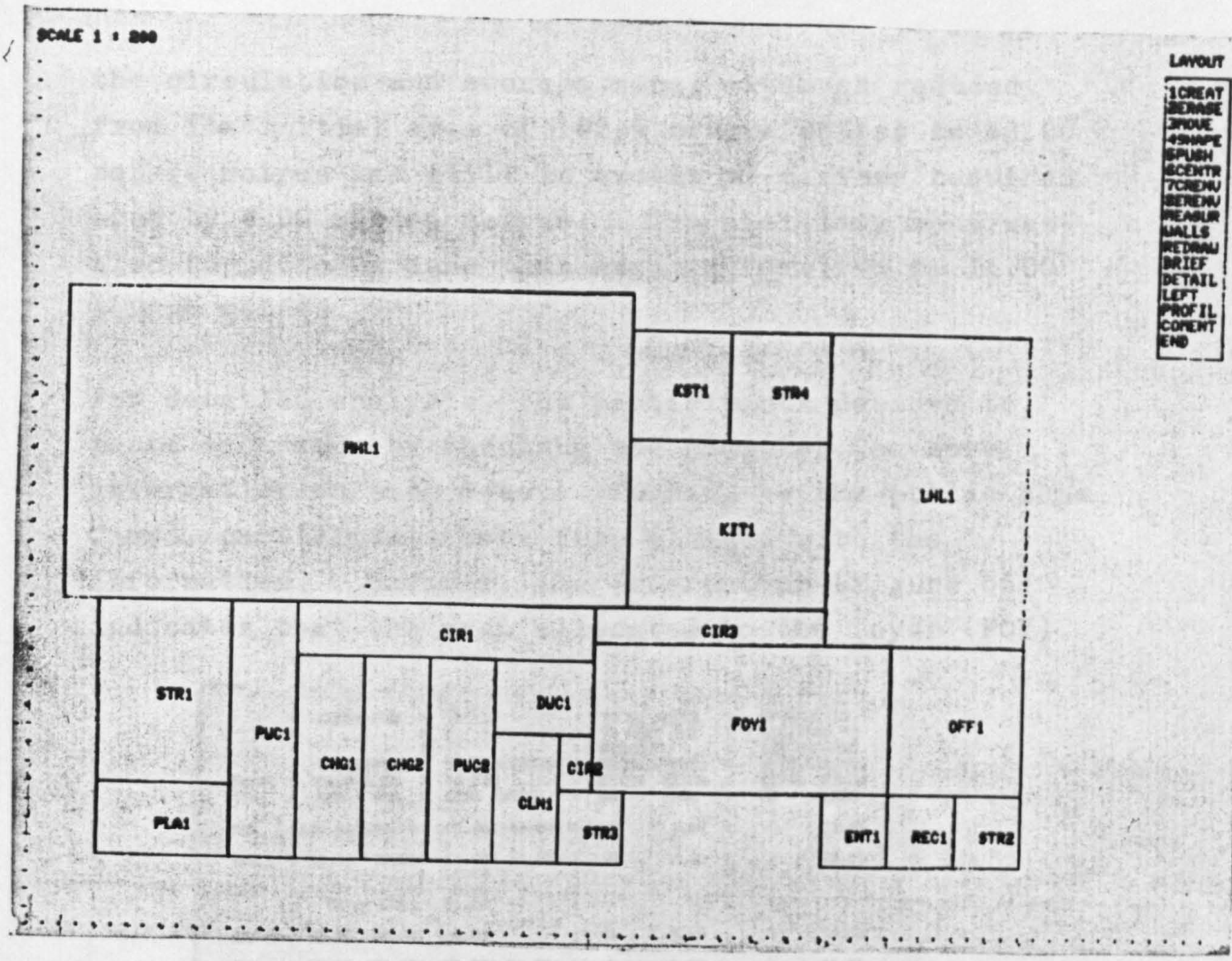


Figure 64. Second design solution by participants (layout level)

increased from its initial area of 231.00 square metres to 245.50. This was accepted as adequate. However,

	TOTAL ZONE AREA YOU HAVE SELECTED SO FAR	ZONE AREA TO BE ADDED TO MEET MINIMUM REQUIREMENTS	OPTIONAL ZONE AREA IN ADDITION TO THE MINIMUM REQUIREMENTS
ZONE:-PUB	245.50	0.00	-0.50
ZONE:-AMC	96.00	0.00	14.00
ZONE:-C&S	63.00	0.00	-8.00
	TOTAL AREA YOU HAVE SELECTED SO FAR	AREA TO BE ADDED TO MEET MINIMUM REQUIREMENTS	OPTIONAL IN ADDITION TO THE MINIMUM REQUIREMENTS
	404.50	0.00	5.50

Figure 65. Space budget allocation - second solution

the circulation and storage zone, although reduced from its initial area of 102.5 square metres to 83.00 square metres was still in excess of maximum required area by 8.00 square metres. The ancillary zone was also found to be less than maximum required by 14.00 square metres.

For detailed analysis, the participants decided to probe each zone by checking the computer for more information on each zone. Turning to the public zone first, participants were very pleased with the information. However, the information (Figure 66) indicates that the area allocated to the foyer (FOY)

ROOM TYPE	ZONE:-PUB INDIVIDUAL ROOM AREA MIN	MAX	YOUR ACTIONS SO FAR AREA (BRIEF)	TO BE ADDED TO MEET THE MINIMUM REQUIREMENTS EXTRA NO	EXTRA AREA	OPTIONS IN ADDITION TO THE MINIMUM REQUIREMENTS EXTRA NO	EXTRA AREA
MHL	120.00	160.00	144.50(145.00)	0	0.00	0	15.50
LHL	10.00	70.00	51.00(51.00) 0.00 0.00	0	0.00	2	19.00
	TOTAL AREA -		51.00				
CAF	12.00	40.00	6.00	0	0.00	0	34.00
FOY	10.00	25.00	36.00(36.00)	0	0.00	0	-11.00
REC	8.00	15.00	4.00(4.00)	0	4.00	0	7.00
ENT	2.00	25.00	4.00(4.00) 0.00	0	0.00	1	21.00
	TOTAL AREA -		4.00				
	ZONE:-PUB		TOTAL ZONE AREA YOU HAVE SELECTED SO FAR 245.50	ZONE AREA TO BE ADDED TO MEET MINIMUM REQUIREMENTS 0.00		OPTIONAL ZONE AREA IN ADDITION TO THE MINIMUM REQUIREMENTS -0.50	

Figure 66

exceeded recommended maximum by 11.00 square metres. However, the general feeling was that it is not bad enough to need re-designing so it was considered as acceptable.

The next issue raised was what was considered the relative over provision of circulation and storage space. Several proposals for this were proposed, discussed and rejected. There included (i) the creation of CAFE in place of CIR 3 but most participants did not wish to create CAFE because it will increase the area of the public zone, (ii) another proposal was to increase the space for REC I, ENT I, STR 2 and STR 3 but this was rejected for the same reason.

ROOM TYPE	ZONE:-ANC INDIVIDUAL ROOM AREA MIN	MAX	YOUR ACTIONS SO FAR AREA (BRIEF)	TO BE ADDED TO MEET THE MINIMUM REQUIREMENTS EXTRA NO	EXTRA AREA	OPTIONS IN ADDITION TO THE MINIMUM REQUIREMENTS EXTRA NO	EXTRA AREA
KIT	20.00	30.00	27.00(27.00)	0	0.00	0	3.00
PUC	10.00	18.00	14.00(14.00)	0	0.00	0	7.00
			11.00(11.00)				
	TOTAL AREA - 25.00						
DUC	3.00	8.00	6.00(6.00)	0	0.00	0	2.00
CHG	10.00	15.00	11.00(11.00)	0	0.00	0	8.00
			11.00(11.00)				
	TOTAL AREA - 22.00						
CLK	4.00	12.00	0.00	0	0.00	1	12.00
OFF	8.00	25.00	16.00(16.00)	0	0.00	1	9.00
			0.00				
	TOTAL AREA - 16.00						
	ZONE:-ANC		TOTAL ZONE AREA YOU HAVE SELECTED SO FAR 96.00	ZONE AREA TO BE ADDED TO MEET MINIMUM REQUIREMENTS 0.00		OPTIONAL ZONE AREA IN ADDITION TO THE MINIMUM REQUIREMENTS 14.00	

Figure 69

The final decision was made simply to postpone consideration of this objective of reducing the building's circulation space and turned to the ancillary space. The group then gained access to

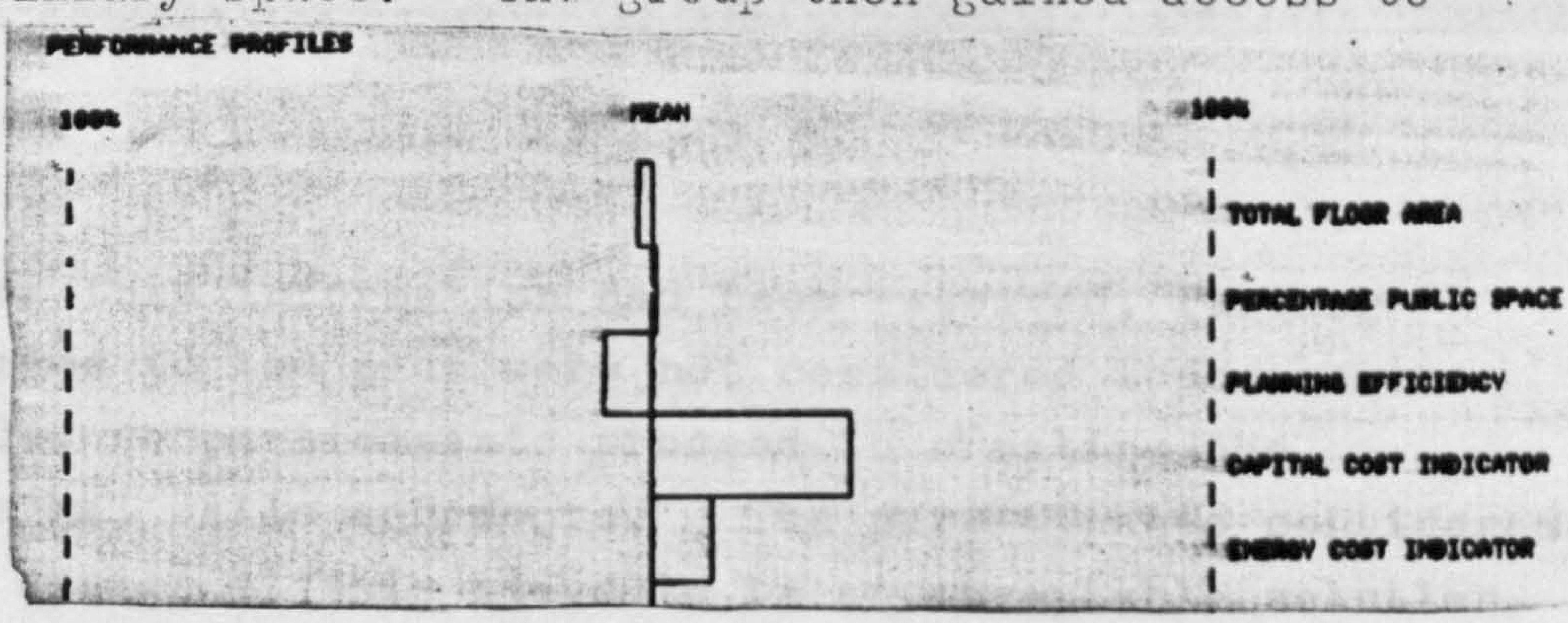


Figure 70

feedback information on the ancillary space (Figure 69.). This was accepted as adequate by the participants. The group then checked the performance profile of their actions so far and moved to the detail level.

The second design solution having been accepted as a base to start with, the participants decided first to create the external walls, doors and windows. The participants then gained access to feedback information at the detail layout level. (Figure 71).

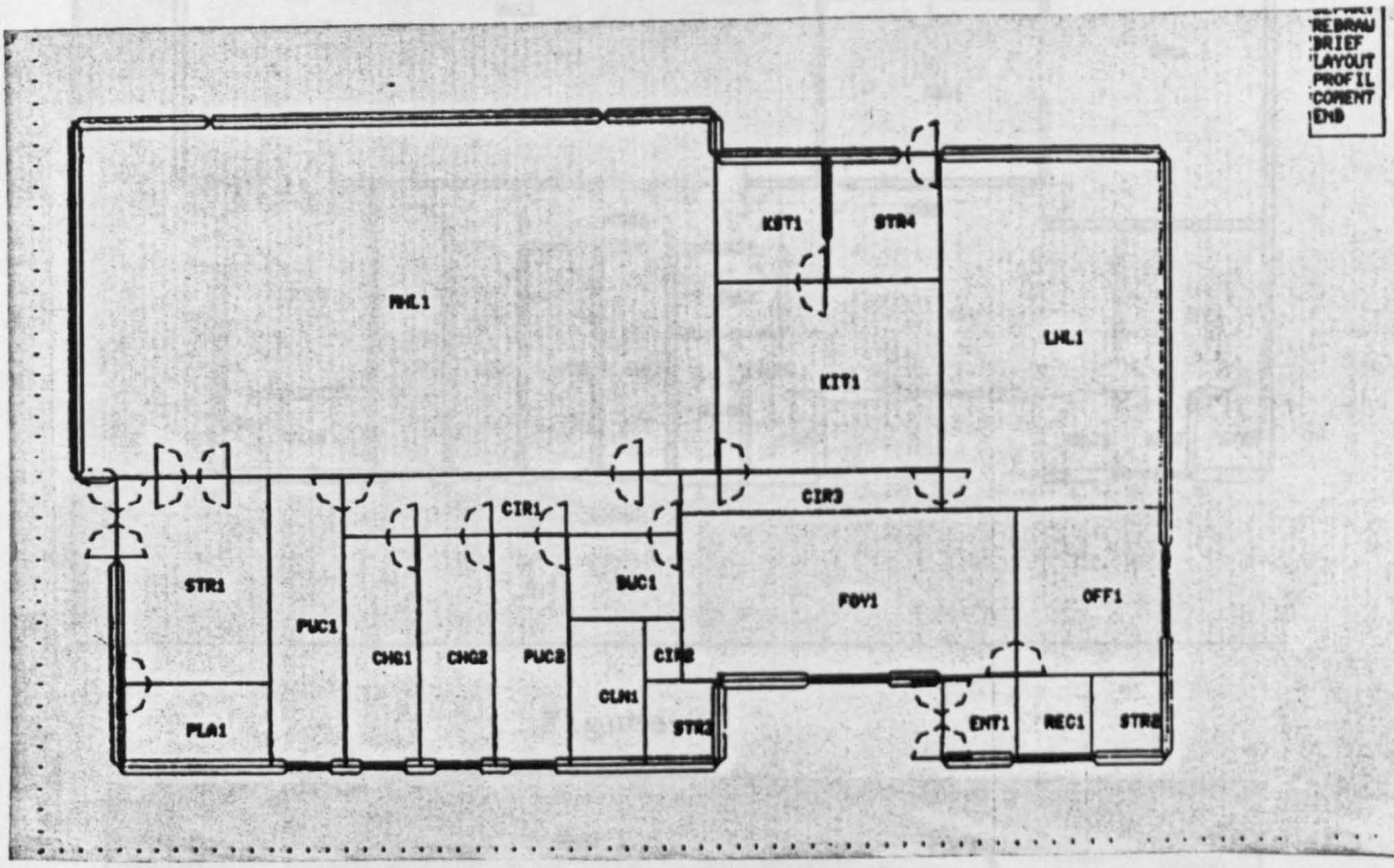


Figure 71

After this information had been received, further changes to the plan were not considered to be worthwhile, so participants proceed to creating the internal walls and doors. The participants considered the design at this stage to be an acceptable solution. A performance profile was taken out of this design.

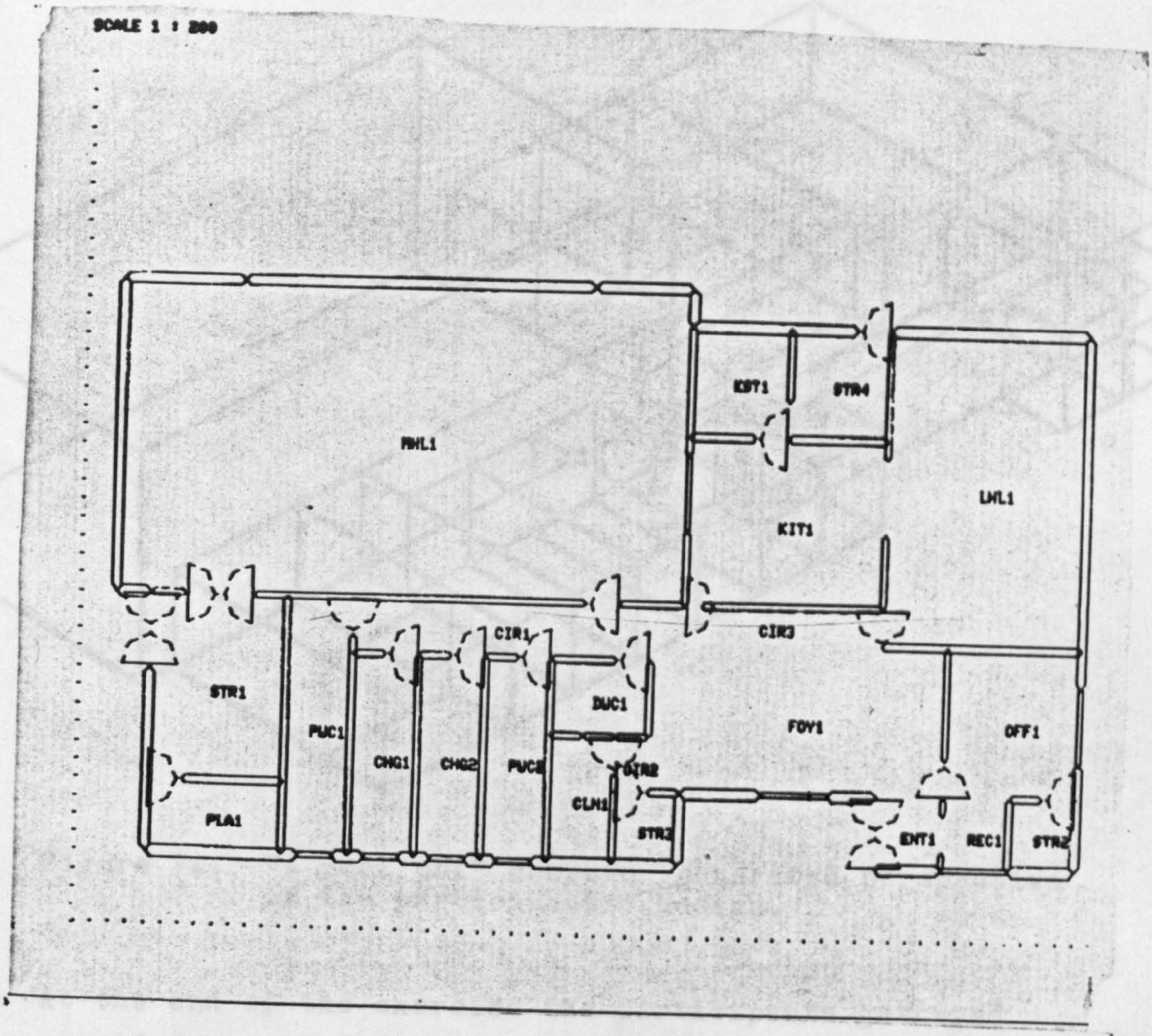


Figure 72

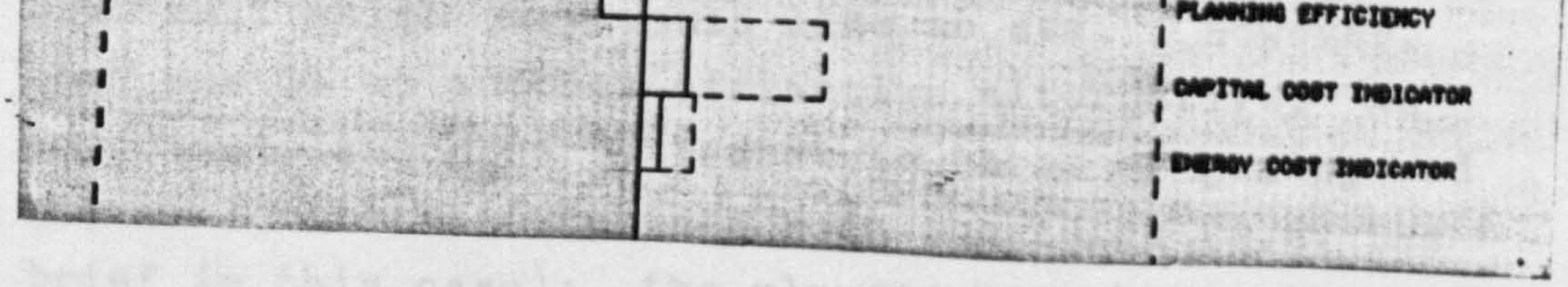


Figure 73

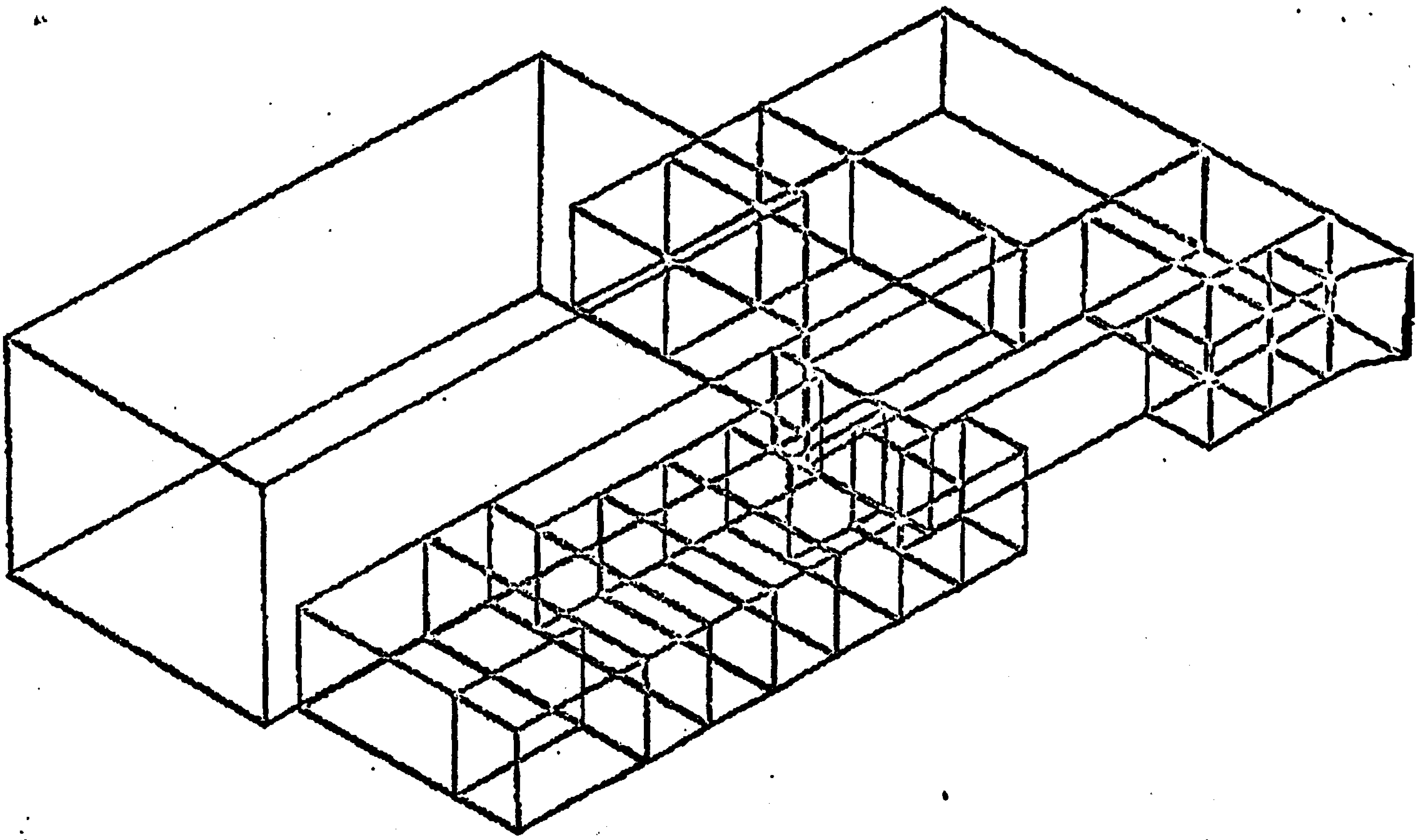


Figure 74. "A roof off" computer generated perspective of the participants' design.

At the end of the exercise the participants gathered around for de-briefing. The design solution produced by another group of student architects based on a brief submitted by Arden Tenants Association was presented to the community participants (Figures 75 and 76).

The general reaction by the community participants was, that it did not separate the lesser hall from the main hall which they would like to see. However, many see it as another attractive alternative. An important lesson to be learnt in terms of gaming and simulation is that variation in the rules (i.e. the brief in this case); the players can change the output.

Comparing the two solutions one could see that the major difference is the emphasis each group placed on the planning efficiency. While the student architects tend to improve planning efficiency, the community participants tend to care less on planning efficiency. However, the community participants solution tends to attain the mean percentage public space whereas the all-students solution tends to use less public space. A major criticism by participants was the inability of the computer to access daylight/sunlight measures. This was taken into consideration as can be seen in the next experiment.

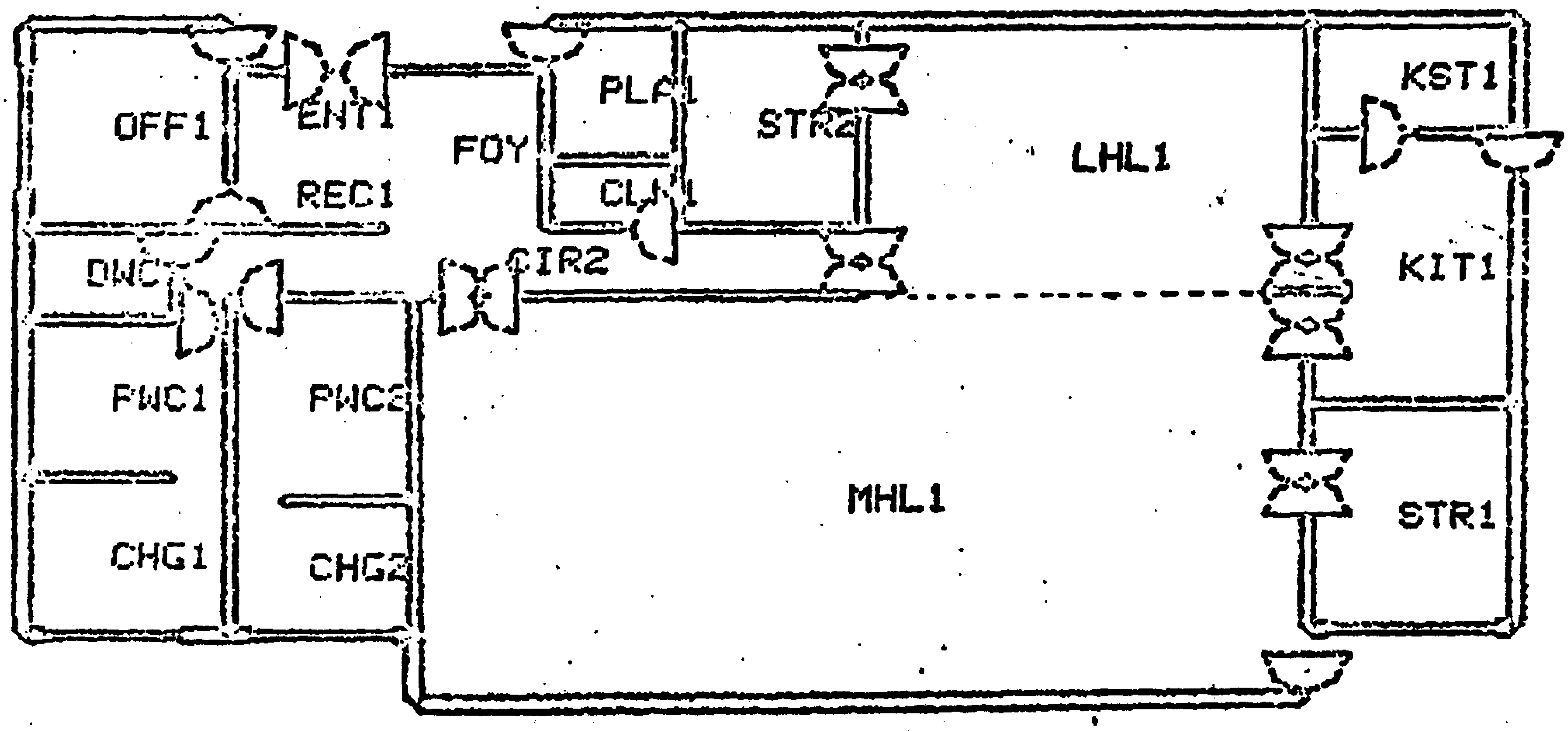


Figure 75. Scheme produced by second group (all students).

	TOTAL ZONE AREA YOU HAVE SELECTED SO FAR	ZONE AREA TO BE ADDED TO MEET MINIMUM REQUIREMENTS	OPTIONAL ZONE AREA IN ADDITION TO THE MINIMUM REQUIREMENTS
ZONE:-PUB	225.00	0.	20.00
ZONE:-ANC	102.25	0.	7.75
ZONE:-C&S	96.00	0.	-21.00

TOTAL AREA YOU HAVE SELECTED SO FAR	AREA TO BE ADDED TO MEET MINIMUM REQUIREMENTS	OPTIONAL IN ADDITION TO THE MINIMUM REQUIREMENTS
423.25	0.	6.75

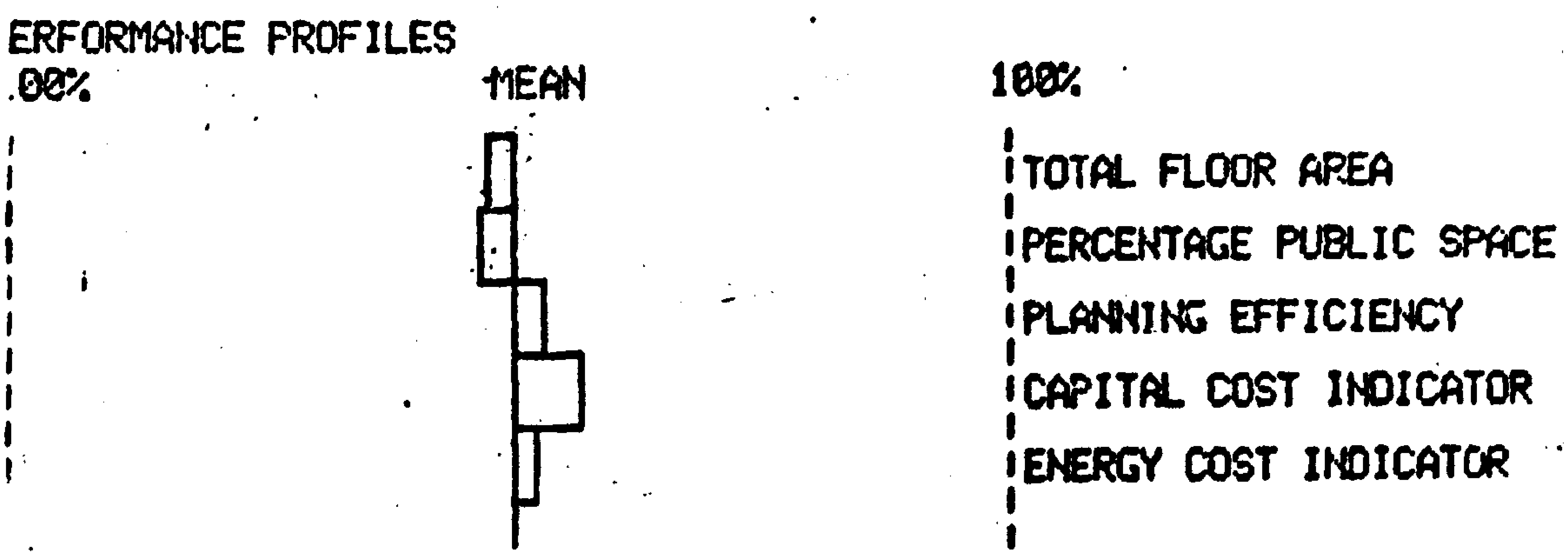


Figure 76. Space budget allocation and performance profile.

8.4. TESTING

Nursery School Teachers Designing Nursery School

Unlike the first exercise the second exercise had three stages:

- first, an evaluation stage where participants inspected and judged existing designs,
- second, a design stage where individual participants used "PARTIAL" to generate their own solutions,
- third, a group design decision making stage where participants discussed their requirements for a

design solution, how their own design embodied these requirements and then collectively generate a single compromise solution.

<u>Evaluating Existing Nursery School Designs</u>: Each participant (six) was asked to evaluate five existing nursery school designs. The purpose of this introductions was to familiarise the participants with the computer graphics conventions; the idea of a Space Budget and the way existing nursery schools utilise the Scottish Education Department's space budget. Thus for each nursery school there was a plan drawing drawn with the PARTIAL computer graphic conventions and a set of points from the LEFT function in PARTIAL describing how each design fitted within the various area constraints in the space budget. By inspecting this documentation for each of the five designs the six teachers evaluate these existing nursery schools and at the same time familiarise themselves with the conventions used by PARTIAL.

To focus the participants attention on this part of the procedure, each participant was asked to rate each design on a 1 to 10 scale. We believe that design participants should be professional users of the building under consideration. So in this pilot study six practicing teachers were involved. However, we recognised how difficult it was for them to give time to this pilot study. Because of this time problem we intentionally did not want to have a lengthy introduction and therefore no explicit test was made of their ability to read or draw architectural plan drawings. In a full study into design participation it would of course be important to make such tests.

Individual Design using PARTIAL: After reviewing all the existing designs (five professionally produced) each participant proceeded to generate his/her individual design using PARTIAL.

The Group Design Session: When the participants had each finished their individual design session a group meeting was convened, attended by all six participants. This group design session had three phases. First, after a discussion a fourteen point specification for a nursery school was agreed.

(i) A building should be flexible enough to be used as one to two units.

(ii) One large playroom for each half of the nursery.

(iii) Access to outside play area from both play rooms.

(iv) One entrance which adequately provides access to both halves of nursery.

(v) Cloakroom to be entered through playroom

(vi) Childrens toilet adjacent to cloakroom.

(vii) Staff toilet close to staffroom.

(viii) Head teachers room close to staff toilet.

(ix) Staffroom adjacent to kitchen

(x) Home bay adjacent to kitchen.

(xi) Parents room close to playroom and central to both halves of nursery

(xii) Quiet room central to both halves of nursery.

(xiii) Utility room to be central to both playrooms and should be large enough to be multipurpose.

(xiv) Head teachers room, staffroom removed from noisy room.

Second, after reviewing all existing designs (five professionally produced) and six designed by the participants, a school designed by one of the participants was selected as a basis from which a group design might evolve. (Figure 77).

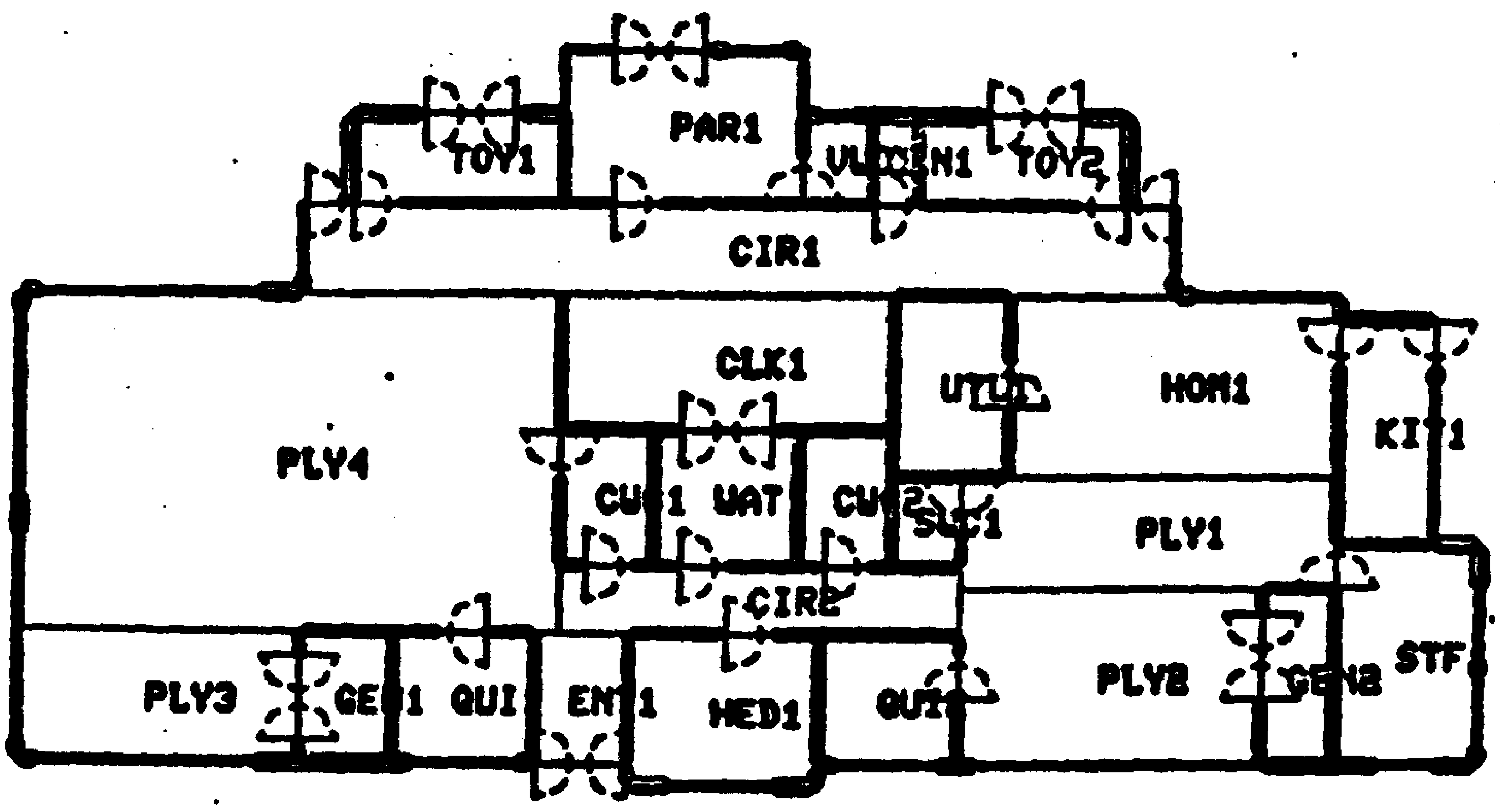


Figure 77. The participant's design selected by the group of participants as the basis for further discussion

Third, this design was modified by the participants to form the group design solution. There follows a description of participants' usage of the program PARTIAL in carrying out modifications to the individual design which was selected as the basis for the group solution. This is (as in Experiment 1) presented in the form of a verbal summary of the sequence of decisions which were made, together with a reproduction of the plan or information which was conveyed to the participants on the terminal at various points in the process.

As a summary of what follows, it was observed that the process passed through two stages. Firstly, the group carried out changes to the plan at layout level. This was primarily concerned with the reduction of the overall size of the building and involved frequent reference to feedback information on the space budget. Relatively minor changes were made to the inter-relationship of spaces in the design. This stage is represented in Figures 78 to 89 Secondly, the group interatively modified the features of the building envelope (at the 'detail' level), in order to improve the balance between the building's energy costs and the provision of natural daylighting in the play areas. This process involved an interative interchange between the plan itself and the performance profile until an acceptable solution was reached.

The group at the outset reviewed the design upon which the group solution was to be based (Figures 78 and 79), by obtaining information on the space allocation (Figure 79), the building had to be designed at 48.5 square metres or 14% over the maximum recommended area. The 'excessive' area was over-apportioned in particular to circulation. On the building performance aspects, the most significant deviations from the mean of the previous five architect-designed solutions were the 22% increase in the total floor area, a 38% increase in capital cost, a 45% increase in energy cost, and a 42% increase in natural daylighting in play areas.

It was concluded that the layout of the building, with a few exceptions, was adequate, however its performance profile was not acceptable. The participants decided to initiate changes at the layout level, with the first objective to gradually reduce the building overall area by reducing circulation space and play areas. To this end they measured the area of CIR I

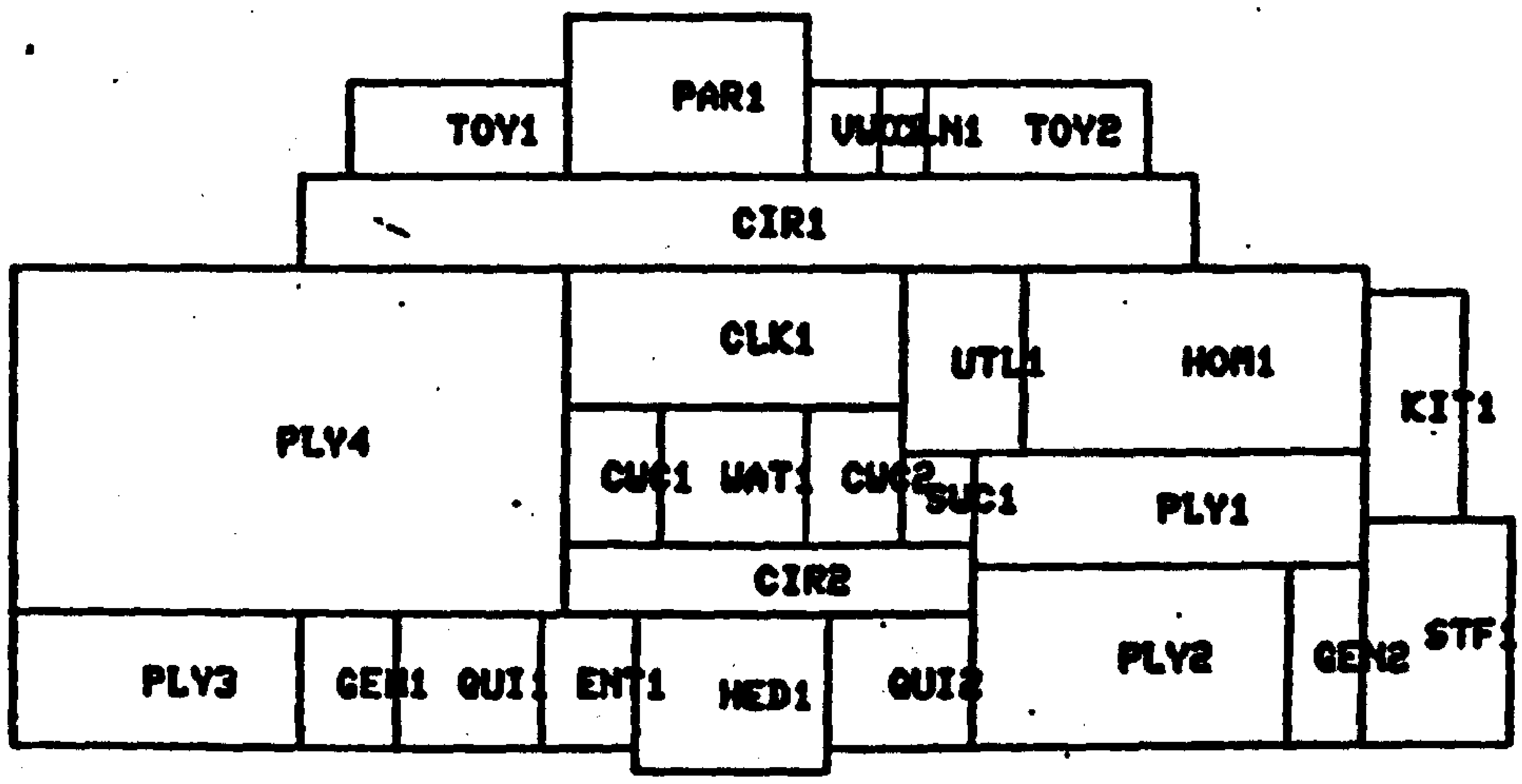


Figure 78

	TOTAL ZONE AREA YOU HAVE SELECTED SO FAR	ZONE AREA TO BE ADDED TO MEET MINIMUM REQUIREMENTS	OPTIONAL ZONE AREA IN ADDITION TO THE MINIMUM REQUIREMENTS
ZONE:-EDU	196.25	0.00	-6.25
ZONE:-ANC	96.50	0.00	-7.50
ZONE:-STR	50.00	0.00	15.50
ZONE:-CIR	55.75	0.00	-25.75
	TOTAL AREA YOU HAVE SELECTED SO FAR	AREA TO BE ADDED TO MEET MINIMUM REQUIREMENTS	OPTIONAL IN ADDITION TO THE MINIMUM REQUIREMENTS
	398.50	0.00	-48.50

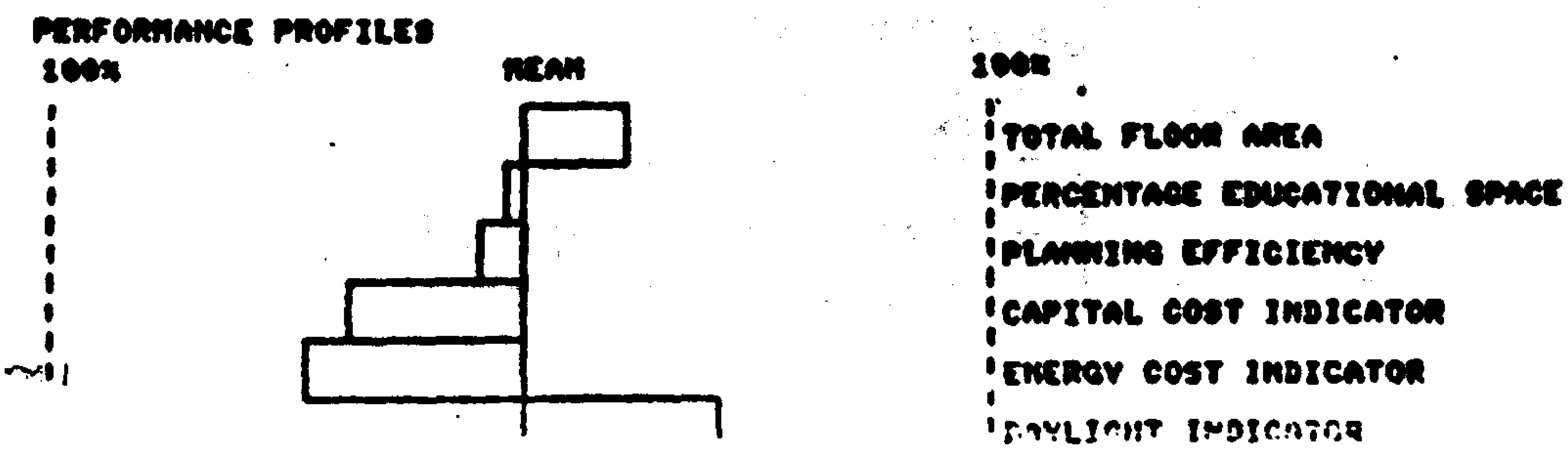


Figure 79

and measured its area if it were to be reduced in width from 2 metres to 1.5 metres. This would lead to a reduction in area from 37 to 24.75 square metres. This reduction was then carried out.

The areas TOY1, PAR1, VWC1, CLN1 and TOY2 were then moved to a position adjacent to the new CIR1's boundary.

The participants then decided that space could further be saved by reducing what was considered to be an excessively large cloakroom area CLK1. This area and its proposed new area were measured. If this was accompanied by a reduction in the size of the utility room (from 10 square metres to 7.5), it was then realised that the circulation area CIR1 could be further reduced by fitting this between PLY4 and HOM1, rather than above them. The group then reduced the sizes of CLK1 and UTL. The group then measured the area of play areas 3 and 4, with their width reduced from 11.5 metres to 10.5 metres and re-drew them at the new areas (Figure 80).

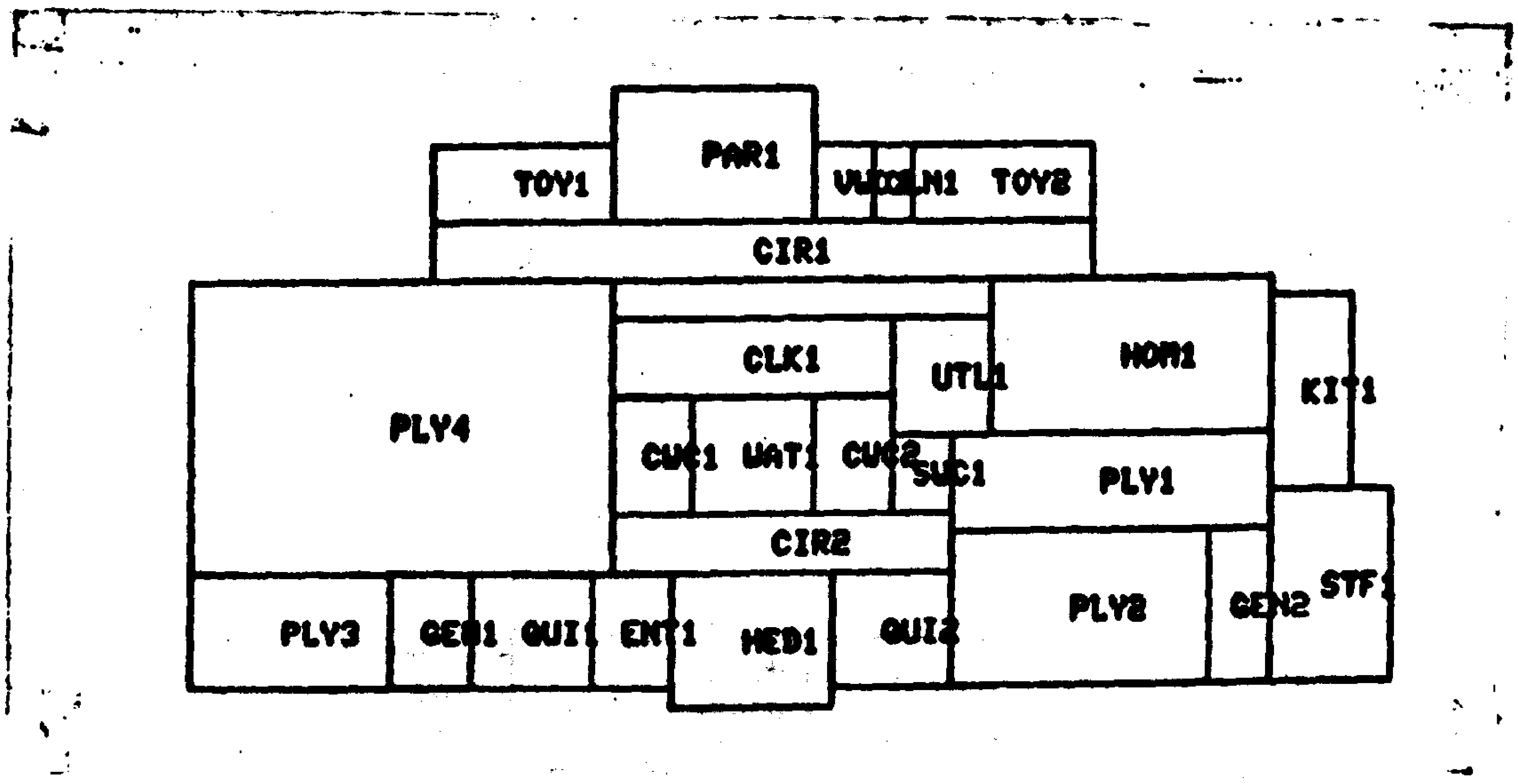


Figure 80.

The group then assessed the building's new overall areas by checking the space budget (Figure 81). It was now 25.75 square metres in excess of the recommended maximum.

	TOTAL ZONE AREA YOU HAVE SELECTED SO FAR	ZONE AREA TO BE ADDED TO MEET MINIMUM REQUIREMENTS	OPTIONAL ZONE AREA IN ADDITION TO THE MINIMUM REQUIREMENTS
ZONE:-EDU	185.75	0.00	4.25
ZONE:-ANC	96.50	0.00	-7.50
ZONE:-STR	50.00	0.00	15.50
ZONE:-CIR	43.50	0.00	-13.50
	TOTAL AREA YOU HAVE SELECTED SO FAR	AREA TO BE ADDED TO MEET MINIMUM REQUIREMENTS	OPTIONAL IN ADDITION TO THE MINIMUM REQUIREMENTS
	375.75	0.00	-25.75

Figure 81

The group then measured the new size of CIR1 (14.25 square metres). This new size of CIR1 was then created, and the areas TOY1, VWC1, CLN1 and TOY2 moved down to their new position. This created a problem with the position of TOY2, since it now "jutted out", and could not be drawn on PARTIAL as an L-shaped area. This problem was resolved by naming the area between TOY2 and HOM1 as "BED1" although there was never any intention for this, in practice, to be a separate area (Figure 82).

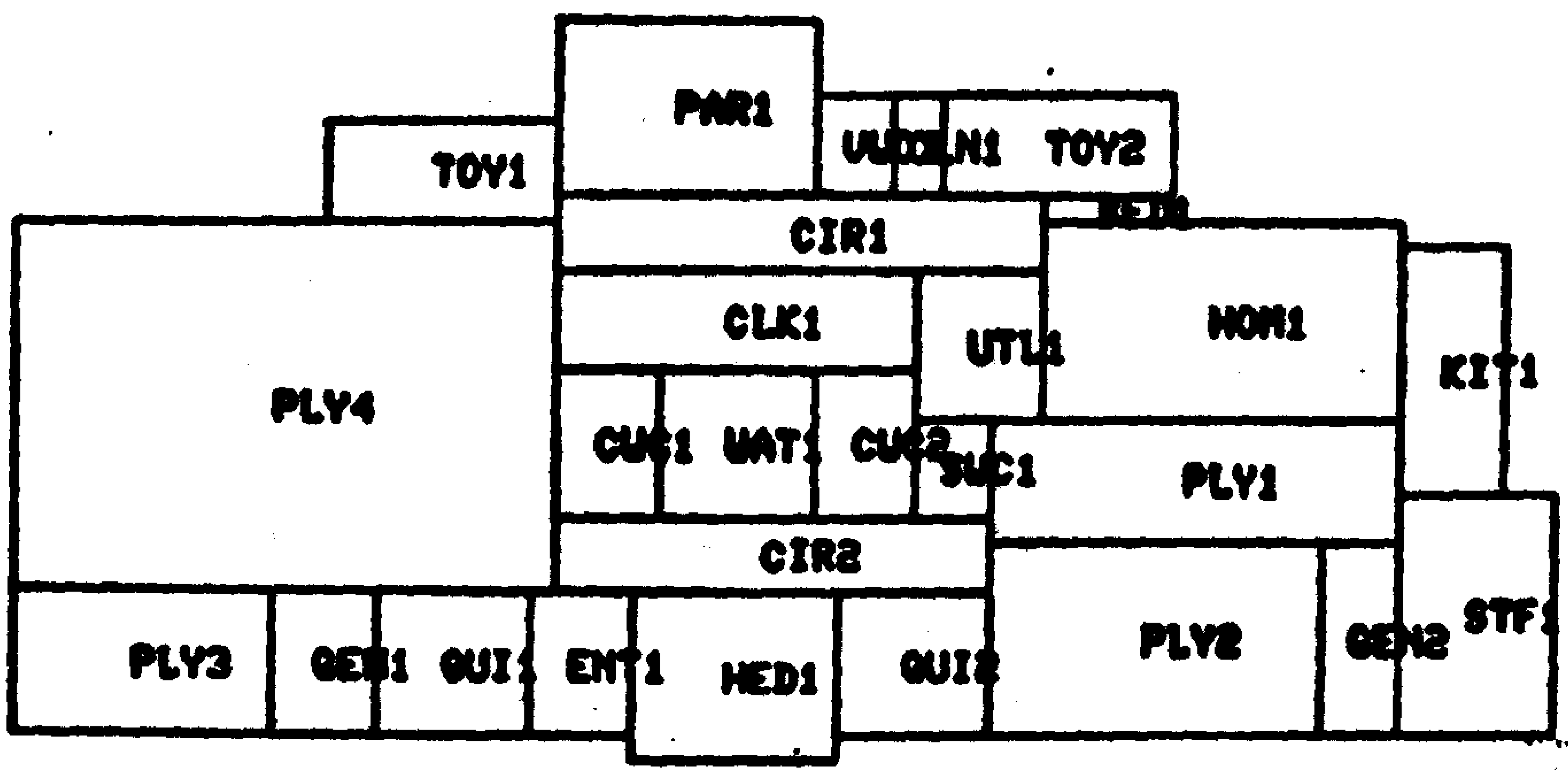


Figure 82

The group then gained access to feedback information on the effects of their size reduction by checking the space budget (Figure 83). They were at this point, 7 square metres above the maximum recommendation.

	TOTAL ZONE AREA YOU HAVE SELECTED SO FAR	ZONE AREA TO BE ADDED TO MEET MINIMUM REQUIREMENTS	OPTIONAL ZONE AREA IN ADDITION TO THE MINIMUM REQUIREMENTS
ZONE:-EDU	185.75	0.00	4.25
ZONE:-ANC	87.00	0.00	2.00
ZONE:-STR	51.25	0.00	14.25
ZONE:-CIR	33.00	0.00	-3.00

	TOTAL AREA YOU HAVE SELECTED SO FAR	AREA TO BE ADDED TO MEET MINIMUM REQUIREMENTS	OPTIONAL IN ADDITION TO THE MINIMUM REQUIREMENTS
	357.00	0.00	-7.00

Figure 83

The group then postponed consideration of this objective of reducing the building's total area and considered the unfavourable position of the utility room; its position was unfavourable because it was located on the same side of the school as the kitchen (KIT), and hence did not give equal access from both sides of the school to water. It was decided to interchange its position with the general store GEN1. This was not considered to "imbalance" storage provision. The two areas were, however, of uneven size. Their floor areas were measured, and it was considered that a reduction in size of the utility room from 7.5 square metres to 6 square metres (the size of GEN1) was not feasible. It was decided to reduce the size of QUI1, to increase the size of GEN1 to 7.5 square metres - storage was noted to be underprovided relative to other zones - and maintain the utility room at its present area. The group then measured the reduced size of the quiet room, carried out the interchange of UTL1 and GEN1 and re-drew the quiet room at its reduced size. (Figure 84).

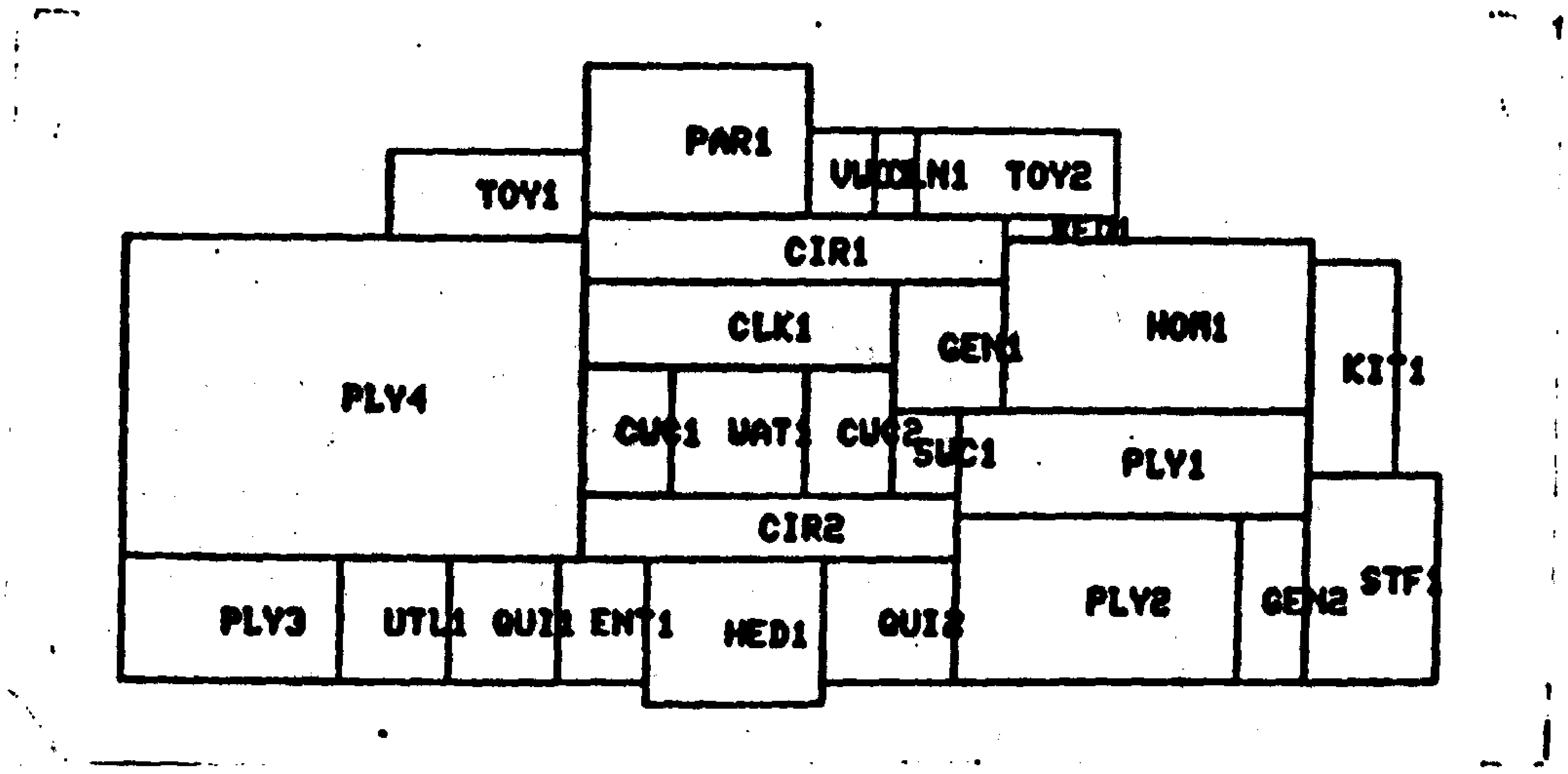


Figure 84

The size of the cleaner's cupboard was then discussed as being unsatisfactory, and several proposals for this were proposed, discussed, and rejected. These included (i) increasing its size to 5 square metres by extending its area to cover the area occupied by the visitor's toilet, and moving the visitor's toilet to a position adjacent to the staff toilet, by reducing the area of PLY1, but none of the group wished to reduce play space, (ii) another proposal was to position a larger cleaner's cupboard next to the utility room, thereby reducing the size of PLY3; but this was rejected for the same reason, (iii) a third proposal was to merely increase the size of CLN1 and move TOY2's position to accommodate this. This proposal was rejected because it involved an increase in the total area of the school. Whilst these proposals were being discussed, "background information" was sought by obtaining information on the space budget for ancillary and storage zones, (Figures

The final decision was to simply increase the size of the cleaner's cupboard by 2 square metres and correspondingly decrease the size of TOY2. After measuring the proposed new areas, this manipulation was carried out (Figure 87).

ROOM TYPE	ZONE:-ANC INDIVIDUAL ROOM AREA MIN	MAX	YOUR ACTIONS SO FAR AREA (BRIEF)	TO BE ADDED TO MEET THE MINIMUM REQUIREMENTS EXTRA NO	EXTRA AREA	OPTIONS IN ADDITION TO THE MINIMUM REQUIREMENTS EXTRA NO	EXTRA AREA
MED	9.00	15.00	14.00(14.00)	0	0.00	0	1.00
WAT	1.50	27.00	9.00(9.00)	0	0.00	1	27.00
			0.00				
	TOTAL AREA =		9.00				
PAR	7.00	20.00	17.50(17.50)	0	0.00	0	2.50
KIT	8.00	16.00	10.00(10.00)	0	0.00	0	6.00
UTL	7.50	12.00	7.50(7.50)	0	0.00	0	4.50
CLK	1.50	25.00	14.00(14.00)	0	6.00	1	11.00
			0.00				
	TOTAL AREA =		14.00				
STF	8.00	21.00	15.00(15.00)	0	0.00	0	6.00
	ZONE:-ANC		TOTAL ZONE AREA YOU HAVE SELECTED SO FAR 87.00	ZONE AREA TO BE ADDED TO MEET MINIMUM REQUIREMENTS 0.00		OPTIONAL ZONE AREA IN ADDITION TO THE MINIMUM REQUIREMENTS 2.00	

Figure 85

ROOM TYPE	ZONE:-STR INDIVIDUAL ROOM AREA MIN	MAX	YOUR ACTIONS SO FAR AREA (BRIEF)	TO BE ADDED TO MEET THE MINIMUM REQUIREMENTS EXTRA NO	EXTRA AREA	OPTIONS IN ADDITION TO THE MINIMUM REQUIREMENTS EXTRA NO	EXTRA AREA
TOY	1.50	25.00	9.00(9.00)	0	0.00	1	7.00
			9.00(0.00)				
	TOTAL AREA =		18.00				
GEN	2.50	15.00	7.50(7.50)	0	0.00	0	2.50
			6.00(6.00)				
	TOTAL AREA =		13.50				
BED	1.00	3.00	1.25(1.50)	0	0.00	0	1.75
CUC	5.50	20.00	6.00(6.00)	0	0.50	2	12.50
			6.00(0.00)				
			0.00				
	TOTAL AREA =		12.00				
SUC	2.00	3.00	3.00(3.00)	0	0.00	0	0.00
UUC	2.00	3.20	3.00(3.00)	0	0.00	0	0.20
CLN	1.50	5.00	2.00(2.00)	0	0.00	0	3.00
	ZONE:-STR		TOTAL ZONE AREA YOU HAVE SELECTED SO FAR 52.75	ZONE AREA TO BE ADDED TO MEET MINIMUM REQUIREMENTS 0.00		OPTIONAL ZONE AREA IN ADDITION TO THE MINIMUM REQUIREMENTS 12.75	

Figure 86

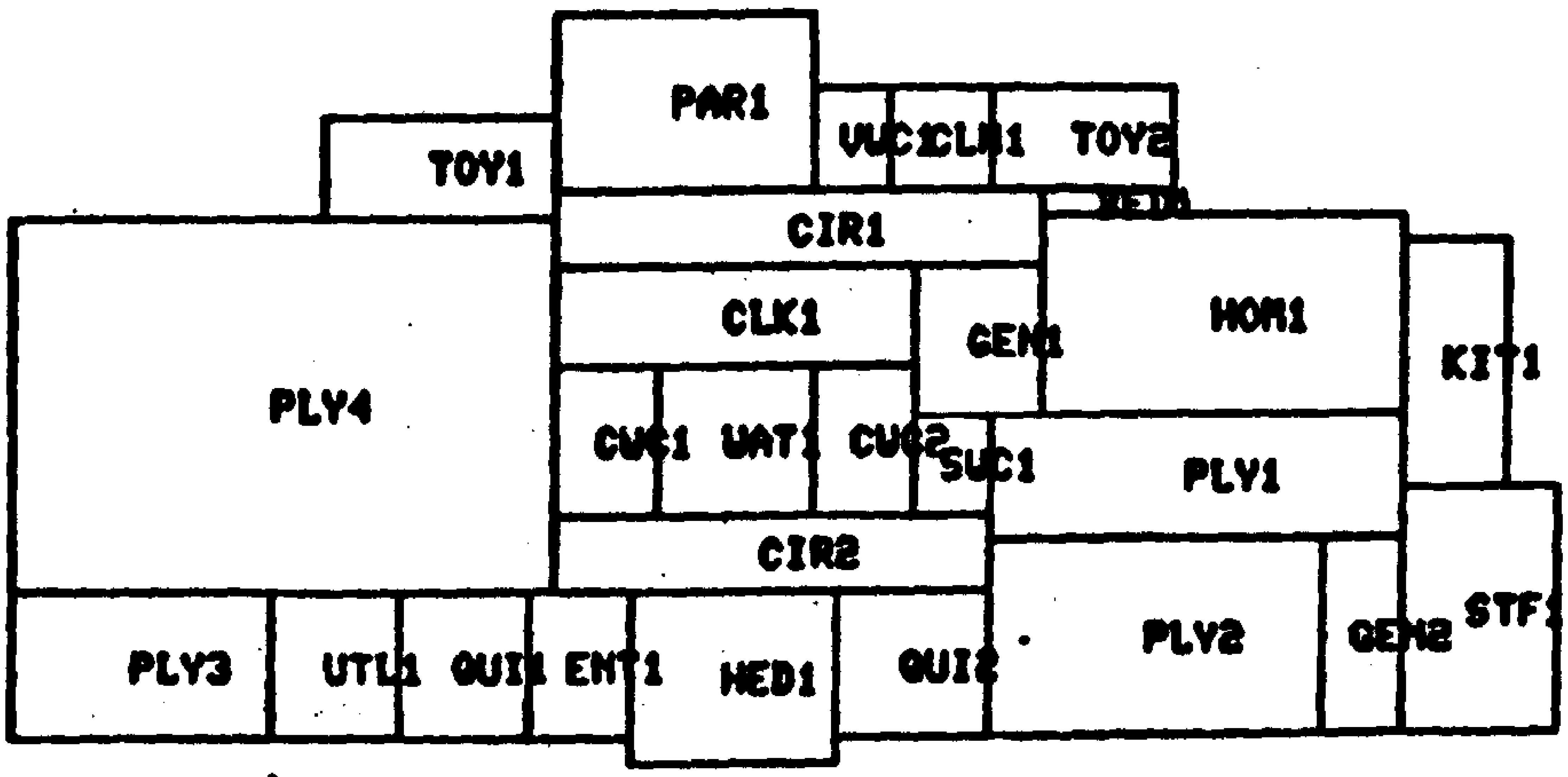


Figure 87

The next issue raised was what was considered the relative under-provision of education space, and the relative over-provision of circulation space. This was considered to be resolved when it was made clear that the part of CIR2 adjacent to quiet room 2 (QUI2) was, in any case, intended to serve as an extension of playrooms 1 and 2. The problem became a semantic one, since it could be resolved by renaming this part of CIR2 as playspace (PLY5). This operation was then carried out. (Figure 88).

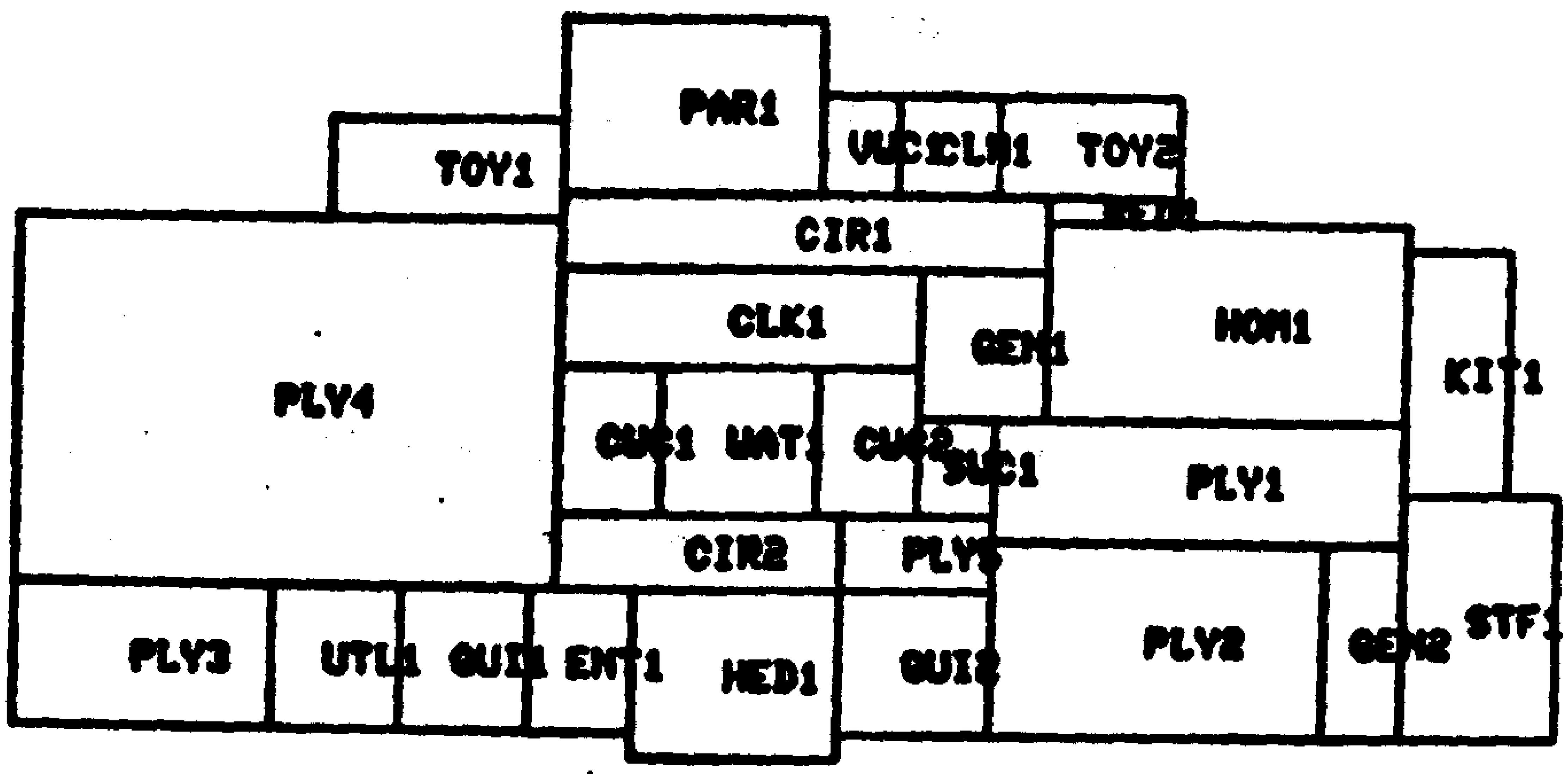


Figure 88

The group then returned to the problem of the building's total area, which was 7 square metres above the recommended maximum. It was decided to reduce the sizes of PLY4 and PLY3 by reduring their width by a further 0.5 metres. The new areas were measured and the alteration made. A further reduction was carried out by reduing the size of the head teacher's room (HED1), to bring its external wall adjacent to the adjoining rooms. It was also considered that this would make the plan more 'neat'. This alteration was also carried out. (Figure 89).

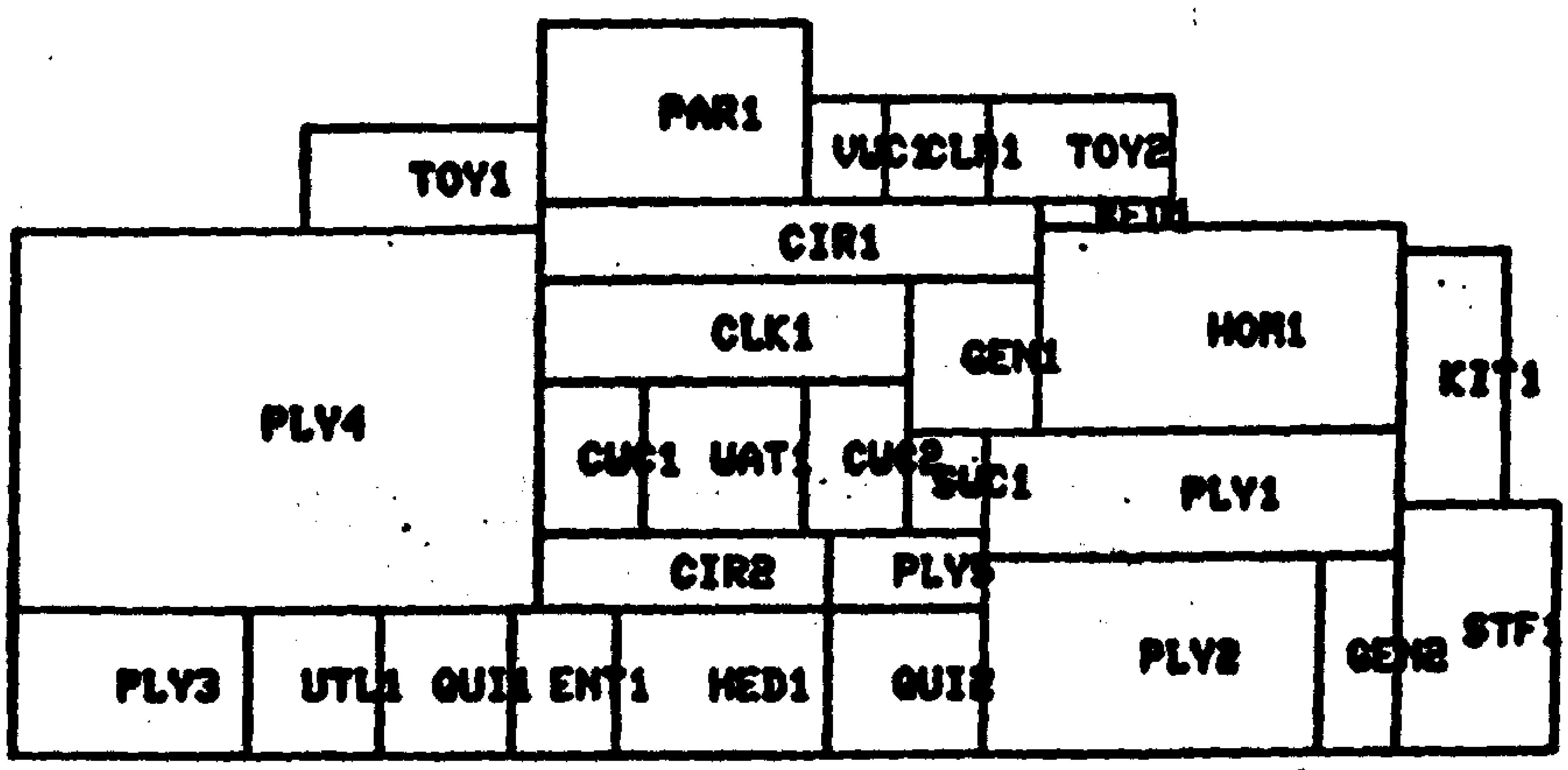


Figure 89

The participants then reviewed the consequences of these actions by checking the space budget (Figure 90), which was now 0.25 square metres below the recommended maximum. It was decided that no further changes to the layout were necessary.

The group then checked the performance profile at layout level (Figure 91) and moved on to the detailed level.

	TOTAL ZONE AREA YOU HAVE SELECTED SO FAR	ZONE AREA TO BE ADDED TO MEET MINIMUM REQUIREMENTS	OPTIONAL ZONE AREA IN ADDITION TO THE MINIMUM REQUIREMENTS
ZONE:-EDU	183.50	0.00	6.50
ZONE:-ANC	85.00	0.00	4.00
ZONE:-STR	52.75	0.00	12.75
ZONE:-CIR	28.50	0.00	1.50
	TOTAL AREA YOU HAVE SELECTED SO FAR	AREA TO BE ADDED TO MEET MINIMUM REQUIREMENTS	OPTIONAL IN ADDITION TO THE MINIMUM REQUIREMENTS
	349.75	0.00	0.25

Figure 90

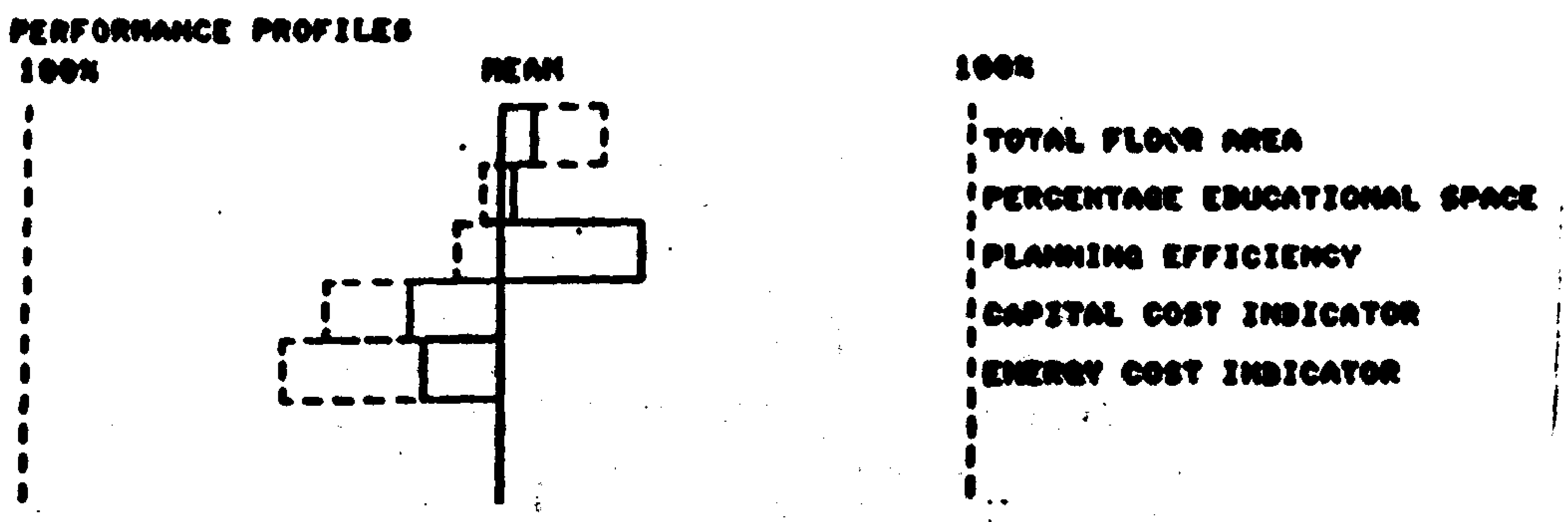


Figure 91

Since they had carried out changes at the layout level without correspondingly changing the position of walls, doors and windows, a large number of these features were now in an incongruous position (Figure 92).

The required changes were made, with the design (Figure 93) reflecting the "ideal" designation of external surfaces as walls or windows. This "ideal" included the provision of the maximum possible window space for educational areas, for maximum natural lighting and view out.

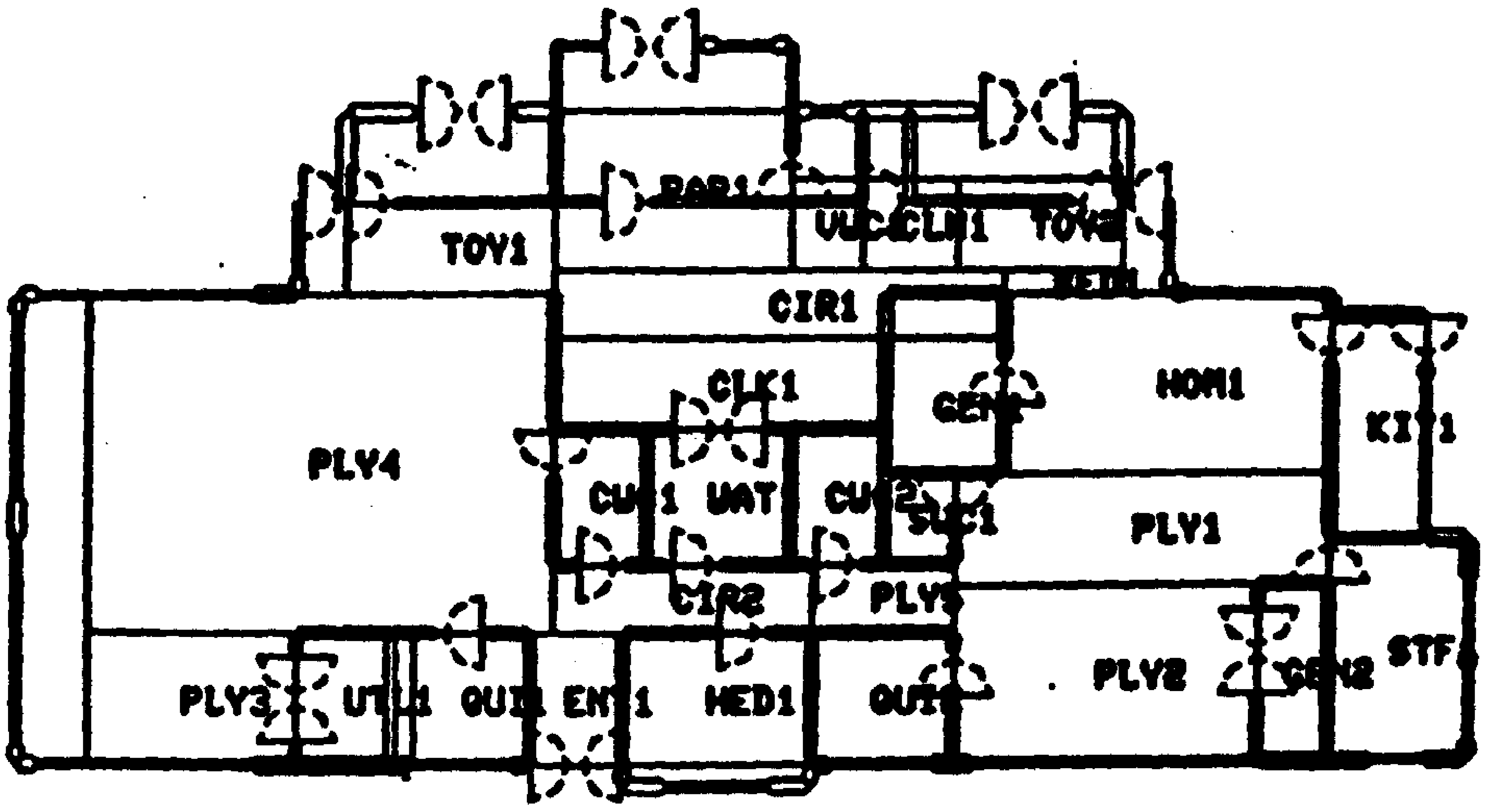


Figure 92

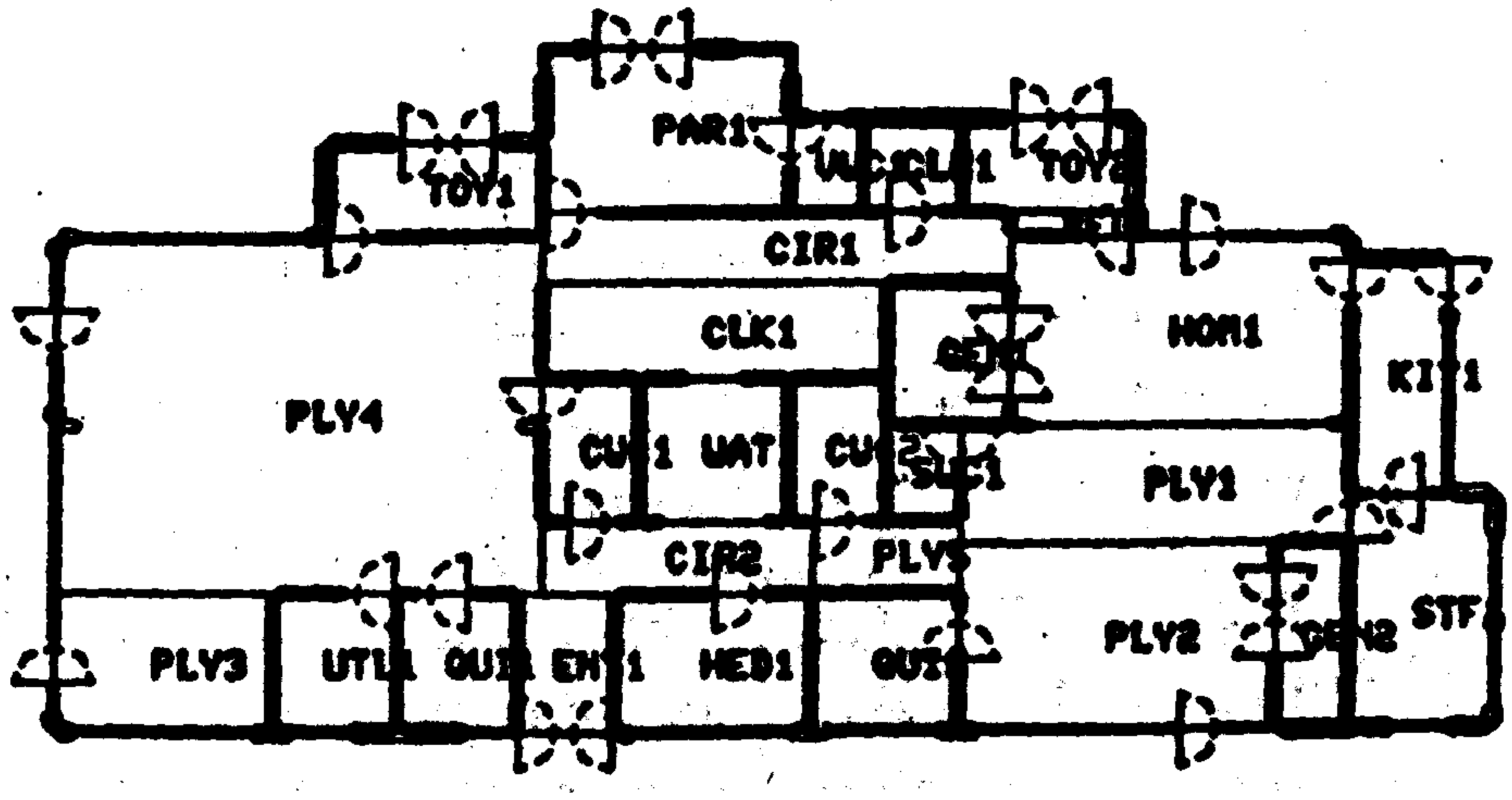


Figure 93

A performance profile was taken out of this design (Figure 94) and it was decided that the balance between acceptable energy cost (28% over mean) and acceptable daylighting was unbalanced in favour of the day-lighting (40% above mean)

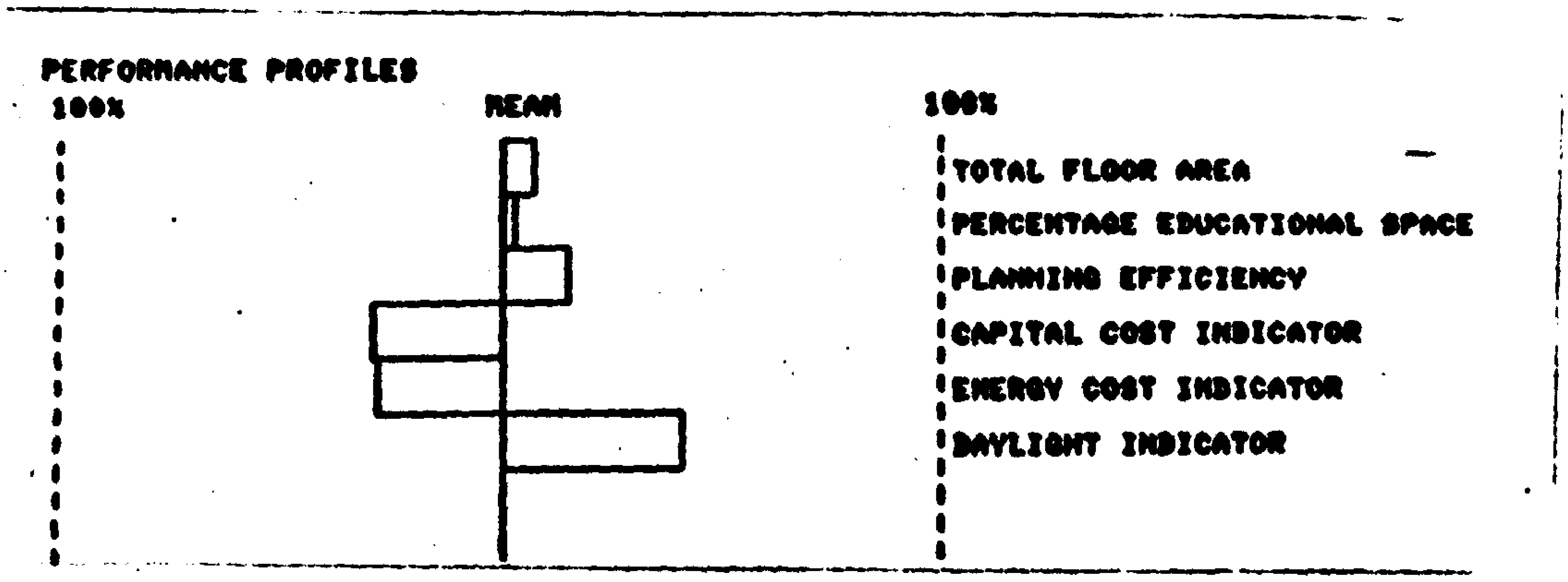


Figure 94

The group then decided to experiment by replacing a section of window area in PLY4 with wall and discovering what effect this had on the energy cost/daylighting balance. This they did (Figures 95 and 96) and found the effect to be quite significant.

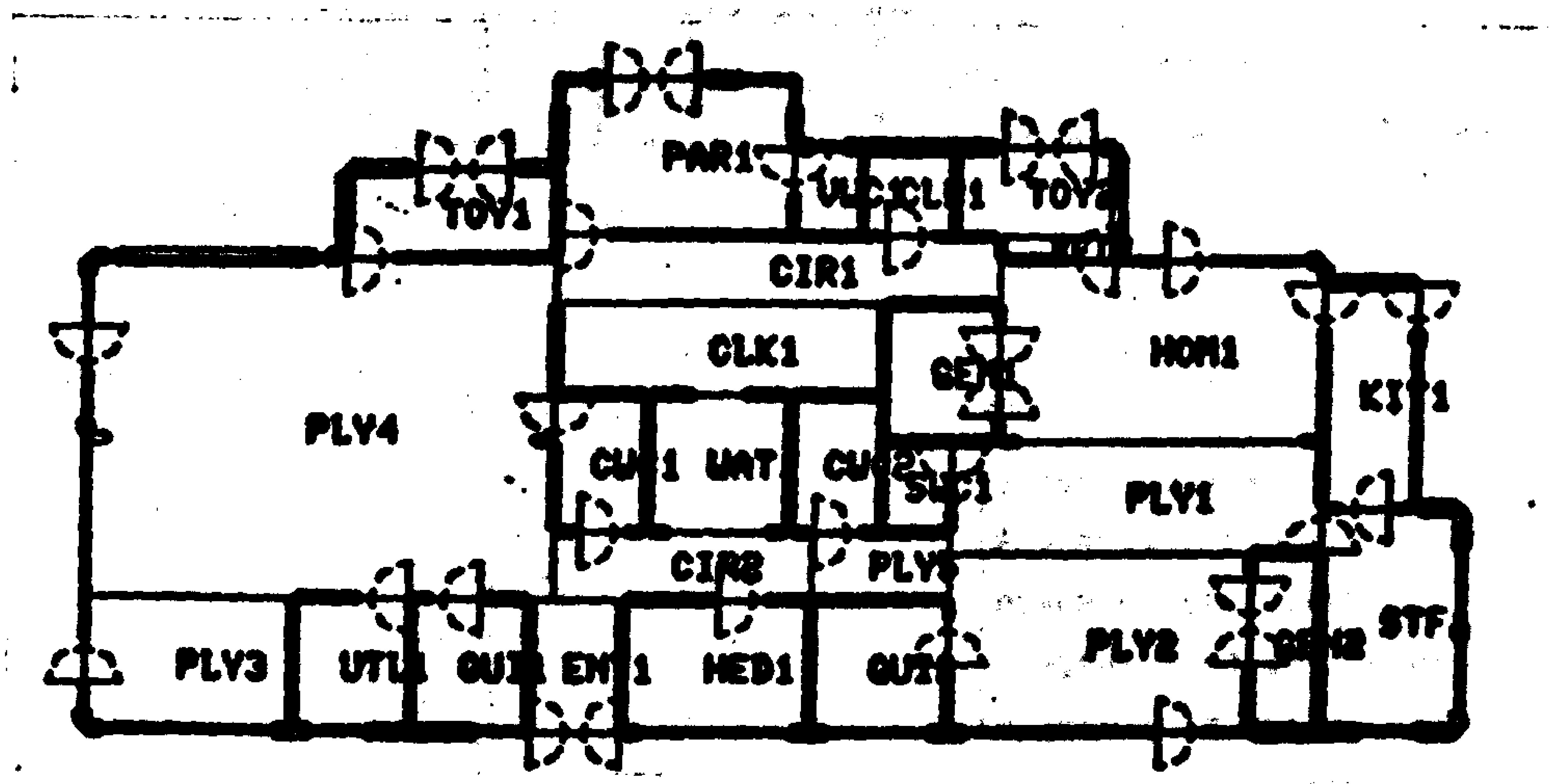


Figure 95

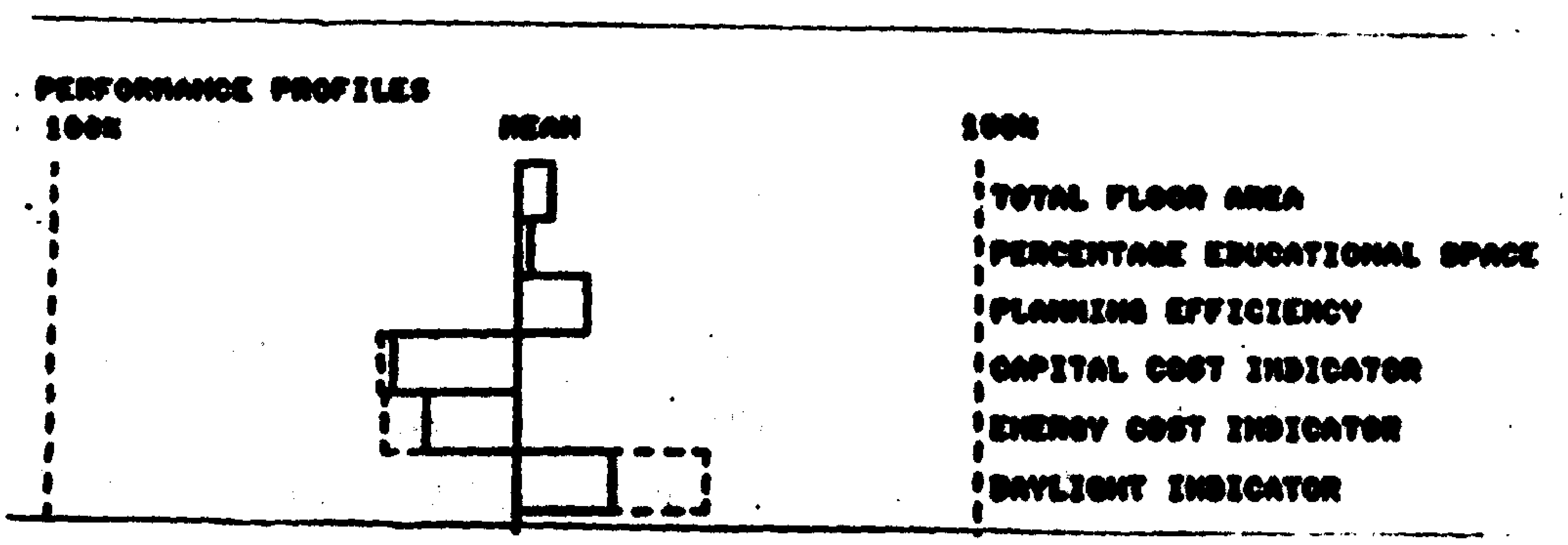


Figure 96

After this information had been received, it was decided that changes to the energy cost/daylight balance would be of the desired order if the window to wall ratio was reduced in approximately equal proportions through all play areas. This was carried out (Figure 97) with performance profile being checked and found unsatisfactory (Figure 98).

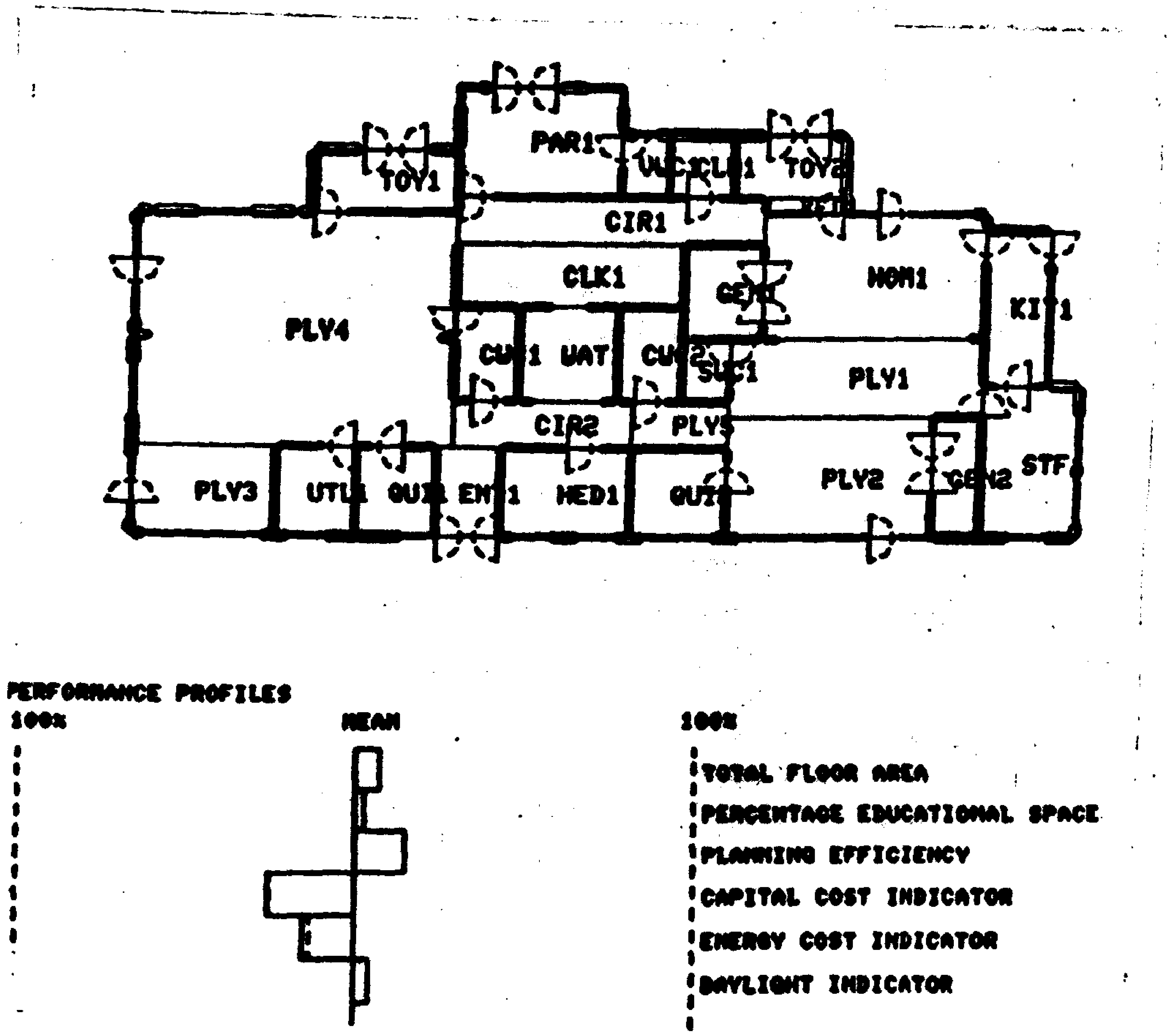


Figure 98

Therefore, the wall in PLY2 was replaced. It was still felt that the energy cost/daylighting balance still needed adjusting, so one of the sections of wall area in PLY3 was also replaced by window (Figure 99), and the performance profile was again checked after this modification (Figure 100), and it was decided that the energy cost/daylight balance was now acceptable, in the sense that further changes were not expected to improve this balance.

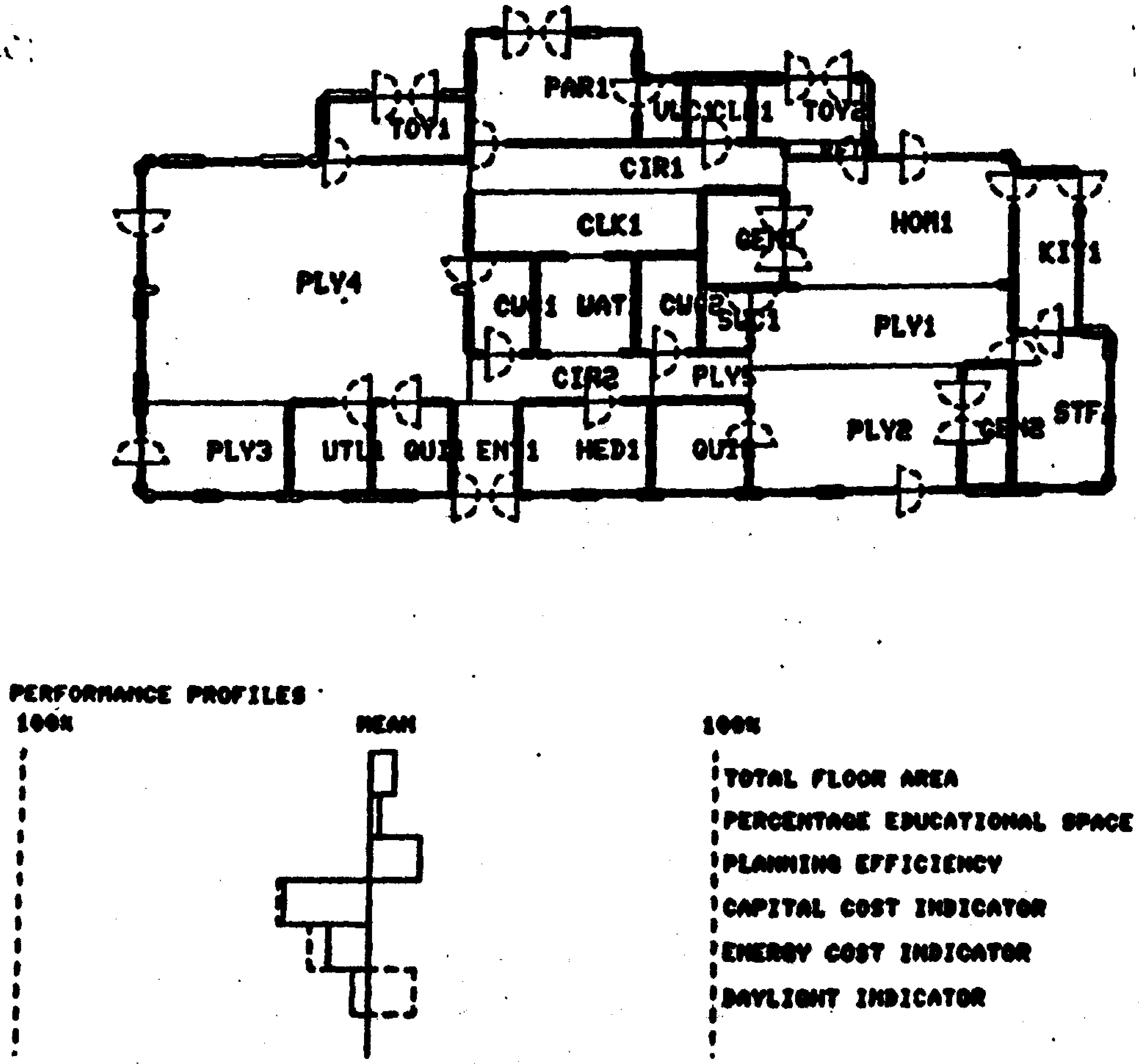


Figure 100

Further changes to the plan were not considered to be worthwhile, so after having the design redrawn with the artificial area boundaries removed (Figure 101) the group considered the design to be an acceptable solution.

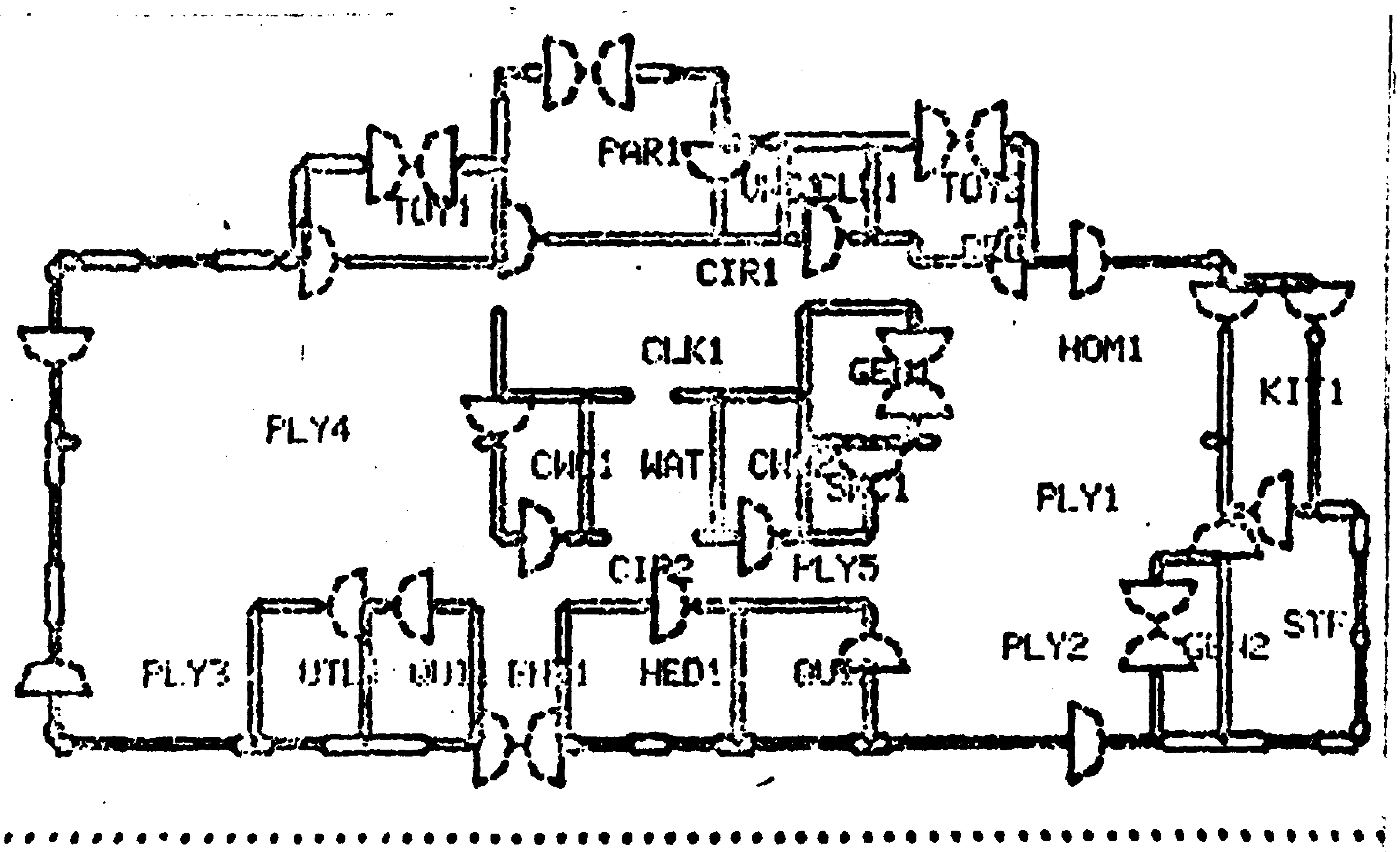


Figure 101

8.5. DISCUSSION AND CONCLUSION

While the ideology of design participation may challenge and question the professional's exclusive right to make all design decisions, there need be no conflict between the participants and the professional. The objectivity of the computer graphics representation of the plan (whether participant or professional generated), and the objectivity of the computer appraisal of alternative design solutions provides an essential common language between the professional and the participants so that even if a collective design process between the professional and participants does not lead to co-operation it will at least lead to rational disagreement rather than confrontation.

By using the computer based system in the simulation, participants can produce a graphically accurate drawing of their design idea (using computer graphics) while the calculative aspects of the program perform a value-free tutorial role and help the participants to bring their design with cost and performance limits. The principle advantage of this technique is that it gives the participants the freedom to generate their own unique design without necessarily being dependent on the advice and influence of a professional designer. It enables a group of participants including the professional designer to sit around the same computer terminal and design a joint scheme where the consequence of any individual participant's suggestion can be objectively evaluated by other members of the design group as was the case in the two pilot experiments.

During the design process the participants learn how to combine their own subjective requirements with the necessary technical objectives within the same design. They learn about the trade-offs intrinsic to the design process by directly experiencing a design situation where they have to make such trade-off decisions. After such a simulation process, participants may be in a better position to distinguish between dissatisfaction with the built environment that stems from an apparent misuse of available resources (a design function) and an apparent lack of resources (a political function). Using the program, participants can see how difficult it is to resolve the conflicting design requirements and may begin to appreciate the difficulties which the designer faces. By observing the participants' design and by recording the participants' justification for the features in these designs, the architects can gain a valuable insight into the relation between building features and user satisfaction.

In a sense the facility for participants to design their own solution means that it is now possible to by-pass existing questionnaire techniques. If a questionnaire has been used to elicit the participant's preference to a set of existing alternative designs these may well identify only a limited and possibly not fully representative combination of the different attributes which could potentially be included in a new design of the same building type. Because the participants can design their own alternative with its unique selection of attributes, they are now in a far better position to choose between their or other professionally produced designs. If a questionnaire is used to elicit a participant's requirements for a design solution then it may be extremely difficult to use this procedure to explain to the participants the essential trade-offs that have to be made in design.

There is now no need to ask participants explicit questions about their requirements because by actually creating their own design they have effectively answered such questions. The computer has helped them to produce a technically viable solution in which there are no mutual incompatible aspects whereas there may well have been mutually incompatible answers to such a questionnaire. Essentially the suggestion is that traditional methods used by social researchers planners and architects to investigate and identify the specific needs of specific building users is inadequate.

First questionnaires used to determine the needs and subjective preferences of users may fail to present the user with anything like a realistic range of available alternatives. Second, the interpretation of questionnaire answers may well be influenced by current design or social theories, and the architectural styles or technical solutions in vogue. Third, decision making powers resides unquestioned and unchallenged in the hands of professionals. While it is perfectly valid to conduct surveys to assess, at generalised levels, the consequences of architectural decisions in terms of satisfaction of the users, different techniques aimed less at producing overall generalisations and geared more to reproducing the needs of the individual building user have to be employed in an attempt to raise the level of expectation. Design participation games as illustrated in this study offer one of such techniques.

However satisfactied or dissatisfied the participants may feel with their own design compared with the professionally designed alternatives, they have at least the satisfaction of participating at whatever level they feel confident, and thus no longer feels excluded from a decision making process to which they aspire.

The existence of untrained participants using this program to generate solutions which have no less technical limitations than professionally designed solutions means that the professional designer will no longer be able to dismiss the growing movement towards participation on the pretext that design is too complex an activity for the untrained layman.

The design participation game, besides being a strategy for participatory planning and awareness is also a useful design research instrument. The simulation provides information crucial to understanding the design process especially to the way public building users perceive relationships between spaces and functional uses. In examining players actions one sees how spatial concepts can be manipulated to solve specific, discrete problems that might emerge in a survey or be recognised by a professional. The simulation revealed different ways space-activity relationships can be expressed that might not occur to designers, much less be revealed in meetings between architects and residents/users under conditions which frequently frustrate communication.

The Implications of Design Participation Games for the Designer

In a conventional, non-participatory design process, the various interest groups within a particular client organisation may already compete with each other for available monetary resources when writing the designer's brief. In a design participation game these interest groups are not only competing for monetary resources but may also be offering conflicting advices as to the architectural utilisation of these resources. Thus, participation may well raise the temperature of this intra-client competition.

In such a situation, the designer may assume, or be forced to assume the role of referee to arbitrate between these different interest groups. With his professional training and experience he should have no problem in balancing the demands of the different interest groups and drawing the participants attention to the consequences of any outlandish suggestions.

He also has a far more important and creative role to play to help the participants to develop a design solution which satisfies the different requirements of each interest group, requirements which originally have have appeared to be unreconcilable with any single design solution.

In this context having seen the design statement which identifies the negotiating position of the different interest groups, the designer may generate his own design solution which may be "better" integration of the disparate design ideas of the different interest groups than any compromise solution which the participants could have developed themselves. The designer's own solution might be considered better than the participants in the sense that it might be more acceptable to the participants, than their own negotiated scheme.

Even if an acceptable compromise design can be evolved, as in the pilot experiments in this study, the designer has yet another important role to play. This is to make sure that the participants do not design a building that so exactly fits their present requirements that it is not flexible enough and cannot be adopted to the variation in use. As in any other non-participatory design process the designer may have to consider how he should balance his responsibility to his immediate client and the building users with more ambiguous responsibility he may feel to provide a building which is of value to future generations of users.

It can be argued that by involving the users in the game the designer can show the participants how difficult it is to resolve the conflicting design requirements and the participants may well begin to have a more sensitive appreciation of the difficulties which the professional designer faces. In particular the participants may begin to differentiate between the design decisions which relate to the use of available resources and the political decisions determining the overall level of resourcees available to the particular design project over which neither the designer nor the participants has any direct control.

Limitation of Design Participation Game

Design participation games described above have important limitations, the most obvious of which is the need to modify the activity to suit the requirement of particular application. The graphics used to symbolize different design components, for instance, may have to be changed for use with different groups. New game pieces may have to be added, the game task modified and so on. Expensive pretesting is required. The cooperation of community/user groups and public officials is essential but may be difficult to obtain since the simulation activity may be perceived as being contrary to their interest. Community leaders may have to be persuaded that an attempt to solicit the desires of their constituents does not subvert their role and, instead, enhances their ability to cater with public officials and their expertise of leadership more generally. On the other hand, government officials may have to be convinced that citizens can make significant contributions to the design of their living environment. These are formidable tasks but surmountable if there is conviction that citizens must be meaningfully involved in planning the conditions under which they live.

The use of the computer as a neutral language in carrying out the accounting functions in the simulation has its own limitation that should be mentioned. First the program "PARTIAL" makes no evaluation of the structural validity of the participant's design. This was not an immediate requirement in the pilot study but a structure facility would have to be included in PARTIAL for other applications.

Second, the program does not have a facility to account for or place furniture or equipment within rooms, nor does it allow the participant to specify building components before room boundaries have been defined. This would be a restriction to a participant who when asked to design his housing unit started by saying that he wanted the settee here, the TV there and the front door over there. If the program is to be able to offer the participants the facilities to design in their own way (however illogical this may appear to a professional designer) then these facilities are required.

Third, the program offers the comment facilities whereby the participant's design is checked for a number of architecturally inappropriate conditions. This involves the checking of every element of the design geometry against every other element and for all the comments specified in the control file. This is obviously a computational load on the computer which, if it cannot be serviced in a few seconds delays the participants at every move.

Fourth, the use of the standard Tektronix 4010 storage screen terminal presented considerable problems because it has no selective erase facility available. This means that if the user wants to erase a room there are two choices. Either the room is crossed out, with the room and its crossing out symbol still displayed on the screen, or the whole picture has to be redrawn without the erased room. This problem also crops up with the use of the COMMENT and HELP function. If one set of comments have been displayed or information describing the use of one particular command has been displayed then these cannot be removed when they are no longer required without redrawing the whole picture.

Finally, the problem is further complicated because in a multi-user system the responsiveness of the system to any one user depends on the demands of the other users. For example, it was found that PARTIAL was convenient to use outside peak times but most frustrating to use during the normal 9.00 to 5.30 period. By chance this did not really affect the projects since many of the participants in both experiments preferred to use the system in the evening.

Some Lessons We Have Learned

There are times when the capability of the computer model can be most effective in assisting the decision making or dispute-settlement process. But there are also times when the human interaction should not be distracted. The game controller must never let the computer get in the way of this human interaction.

No participants will have confidence in the model until he/she has had a chance to change something in it, or until the original expections are confirmed by the model's solutions. Tinkering with the model is much like playing a new electronic game. It is necessary to test conventional wisdom and to revise previously accepted "myths" before becoming ready to use the model as an aid in solving real-life design problems.

It would be best to have all participants cooperate in building the model - agreeing on the data that is put into it and accepting the logic which drives it. If this is not possible, adequate time must be permitted to allow the participants to become familiar with the model, to question the underlying logic and data, and to have a chance to change unacceptable features of the model by consensus.

A computer model aggregates complexity and makes it simple. But unless the participants understand and accept the method by which the model aggregates, the outputs will be ignored. Since humans also aggregate to make decisions in complex problems, they will accept the aggregation capability of the computer if they believe that it is being accomplished using a logic similar to their own.

For environmental decisions and disputes, one of the greatest problems is to develop quantitative measurements for environmental factors. In the current research project, we have been working with an index developed by ABACUS. We have learned that we must either provide more time for participants to become familiar with and develop confidence in the values, or else permit the participants to become involved in their formation.

Every model has logic and constraints that drive it. The dynamics of negotiation and discussion also develop consensus logic before a consensus decision can be reached. The game controller must be able to anticipate the new logic as it develops and modify the problem solving process to immediately take advantage of the momentum towards consensus. The new logic must then be programmed into the model. We must develop better ways for doing this quickly and accurately.

Gaming and simulation techniques seem to possess much usefulness, so far hardly tapped, for developing methods of bridging the gap between user and designer. However, gaming is only one approach. If participatory design is to reach its full potential a multitude of different approaches must be developed, each predicated on the right of each individual to influence the shaping of the environment about him.

9. EXPERIMENT VII - GAMING SIMULATION IN THE PLANNING PROCESS

9.1. Introduction

The experiment on which this report is based is in some way a mixture between the traditional approach and a game. It has attempted to combine the close resemblance to a well-defined piece of professional work with the facility of feedback offered by simulation. Only, instead of building a model of the environment one has built a fairly abstract model of the "socio political process", and let it interact with our planning proposals.

My views on project work reflect my thinking on planning, as one tries to introduce into projects an element of self guidance which should exist in any planning team. This team I see as engaging in a dialogue with a community over a set of alternative plans. For the dialogue to become realistic it must not be construed as a dialogue between two coherent bodies, The community consists of various groups engaged in a complicated game of co-operation and conflict, mostly with prodecural limits. This experiment is about how a similarly complex game could be played within planning teams. Beyond this, I assume in project work that the exercise forms part of an on-going process performed by a larger multi-planning agency. This means that the terms of reference and other guidelines received by the study group are deemed to have resulted from the deliberations of a strategic planning agency, and that this instruction defines the resources (a segment of the total action space available to the multi-planning agency as a whole) for a planning team. No claims are therefore made for this exercise to be comprehensible in the sense of investigating all alternative courses of action, simply because no one planning agency can engage in such comprehensive planning. The only claim is that it presents an attempt at rational planning made by a planning team which itself operates in the context of rational comprehensive planning performed by a multi-planning agency.

My third view about project work concerns the difficulty in linking a simulated exercise to its social and political context. Standard solutions, for instance, what planning educators term life projects, may not really be the answer. Therefore, the study group simulated the political process which would develop around a set of proposals using bargaining, criticism and voting procedures. It is proposed in this study that a similar approach could be used by a planning team engaged in solving real-life problems. This would be to the advantage of the community, which would in participating, learn a great deal about itself and its options for the future. The aims of the politics of rational planning which derive from this experiment are, then, to structure the planning process in such a way that it may achieve the maximum degree of rationality on the one hand (this involving the use of planning strategies) and maximum interprenetration between planning and the political process on the other (this involving simulation exercises). The following therefore, is slightly idealised account of project on which these experiences were based and how this may be relevant to planning in the outside world.

9.2 General Outline of the Process

There are three points to be made about the concepts to the planning process which is developed during the exercise. One is that it is an intentionally rational procedure of problem solving, and that it must therefore, by and large, generate and evaluate alternative plans.

Secondly, we came to think of planning as an iterative process - planners and a community agreeing on a preferred course of action over a set of plans. Here, we tried to avoid mechanistic ideas on goal setting, that is, that goals are set by the socio-political process and then translated into action programmes by planners. It is rather stipulated; (a) that the type of problem to which a Town map addressed itself was circumscribed by statutory powers reflecting goals of a general kind, that is, that physical development should be controlled; (b) that some of the substantive ends of our plan had been set on a countrywide level - and quite rightly so; (c) that, as for the goals that were to be set within that context these would be defined by the planners and the socio-political process in close collaboration. It is simply that goals are influenced as much by what is possible as by what is desirable. Technical considerations made by planners, and political considerations made by elected representatives, or spokesman of a pressure group should rub off on each other during the planning process. Finally one is concerned about how to achieve rationality in spite of the limitations of human problem solving capacity.

The process consists of the generation of alternative solutions based on a set of dominant characteristics and evaluation against a set of specific conditions followed by a socio-political game with feedback loops providing opportunities for further development to meet conditions and for a second generation in which revealed (recessive in Mendel's theory) characteristics are considered as new genetic material.

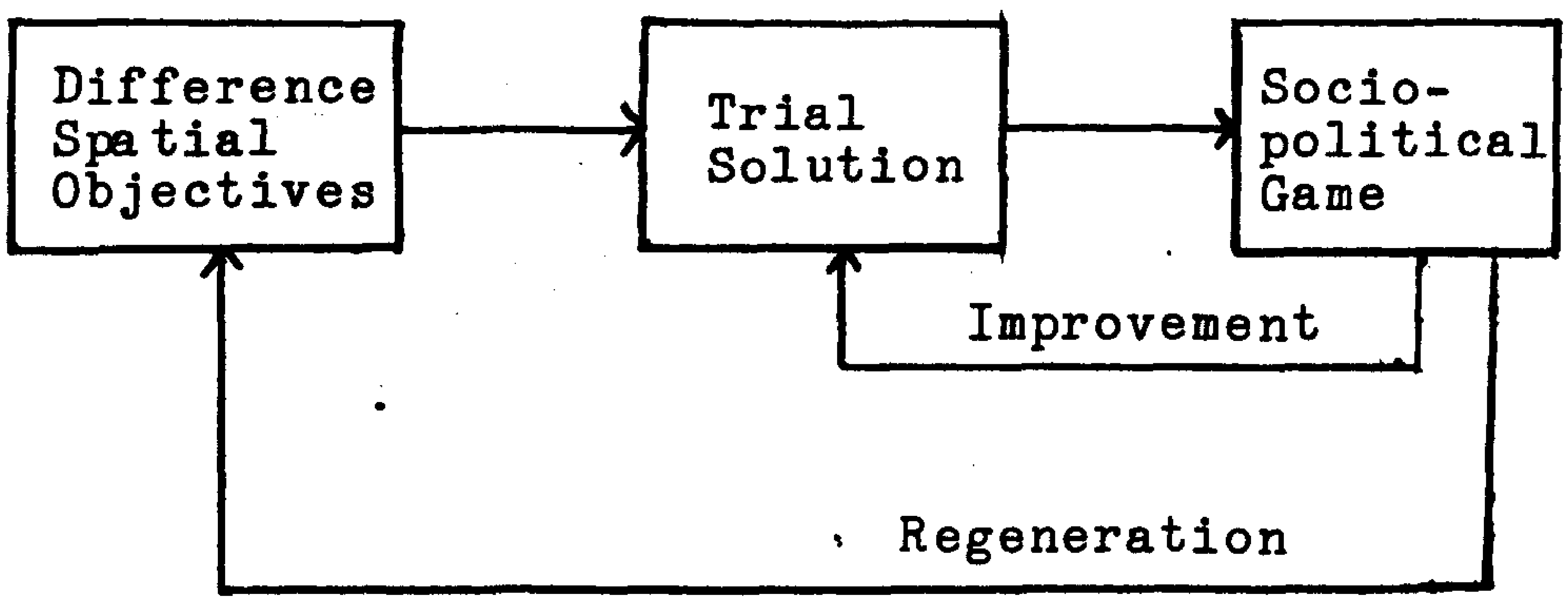


Figure 102. The Planning Process

The importance of the feedback cannot be over emphasised in the one case allowing different solutions to be properly explored (suspending judgement) and in the other case allowing the transition to be made from individual objectives and solutions to a co-operate planning approach in which objectives and solutions are combined. The process may be seen as a set of related operations and techniques which can be usefully applied to any approach. Only a few examples are summarised.

Generation: (What are the alternatives?). Alternative trial solutions can be generated be selecting different objectives, and treating each in turn as dominant. It is useful to start with a quota of three solutions to outline a range, to include present state and to prevent early polarisation of judgement (for and against a view or for one view rather than another). A fourth solution can then be seen as a combination of characteristics based on further work.

Evaluation: (How do the solutions compare?) One can compare solutions having similar characteristics (onions and onions) or different characteristics (onions and bananas) and this allows in planning for the transformation from individual to group values. Criteria can be grouped (e.g. cost and performance) and measurement suggested. One can use different measurements for each factor or translate these into common measurements (e.g. for money, space, energy, etc) and it is useful to translate all statements and measurements so that they can be read to positive scale.

The Socio-political Game: The idea is to devise some way by which somebody would talk back to the planner (us) as regards the way in which our plan would affect various interest groups. Here it is suggested that input and criticism be made by all levels, viz. from the national level down to the individual members of society. The game could thus be seen as a means of communication by which the conflicting claims of different interest groups could be revealed. Mutual communication and expression of views through open public presentations and discussions would allow democratic participation. The practice of democracy and the making of choices by the users is particularly critical and essential in the selection of (i) values and objectives, (ii) alternatives generated and finally (iii) the means of their implementation.

The structure of such a game involves (i) identifying the roles of the individuals, informal groups and formal groups having an interest in the policy area, (ii) defining the ways in which the various interest may be expressed within a bargaining and exchange context, (iii) defining particular areas in which each role may act, given its powers, objectives, responsibilities and constraints, (iv) devising a way of recording inputs, criticism, behavioural changes of each role and when necessary defining a suitable unit that will enable the interests to be measured, recording gains and losses.

<u>Improvement:</u> (How far can the criticisms be met?). This enables further development to take place while still retaining the genetic differences (e.g. the mini motorcar can be the smallest for four people and still made safer, cheaper or more comfortable). Each critical factor is considered independently. This leads towards a convergence of solutions within the set of selected criteria.

The difference between improvement and innovation (or first generation) lies at the limits in holding all but one factor constant or holding one factor or objective constant and allowing all other factors to vary. In the evolutionary process both limits and combination between limits occur.

<u>Regeneration:</u> (What condition should any solution satisfy?). This involves selecting priorities, setting limits and more specific definition of objectives. This can lead to further convergence or to a new divergence if the conditions are seen as a new genetic pool. The process is then repeated as in Figure 102

The planning process, as described above, cannot, of course, ensure that the resolved plan will in the end be any better than if it was made in any other way. A carpenter with even the best tools may still build a faulty house. All that the tools can do is to make it somewhat easier for him to get the job done correctly. The most important requirement for the tools is that they work and do what he expects from them. In this spirit, I move to discuss a test case in which the process is applied.

9.3. TESTING AND EXPERIENCE - QUEENS DOCK

To stimulate the use of the technique a pilot experiment was carried out at the urban development level focussing on the Queens Dock of Glasgow. Below is a brief discussion of the experiment.

The Brief: To explore the potential of the "Queens Dock" for initial discussions with possible consumers and investors (it should be noted that nature designs by trial and error - so the idea presented here is for elimination and transformation).

The Site - Existing Condition: The site is now owned by the District Council and the docks are partially filled into a metre below quarry level with demolished building materials. Most of the warehouses are demolished, and those remaining are used to store some caravans (temporary homes) and materials for the regional council.

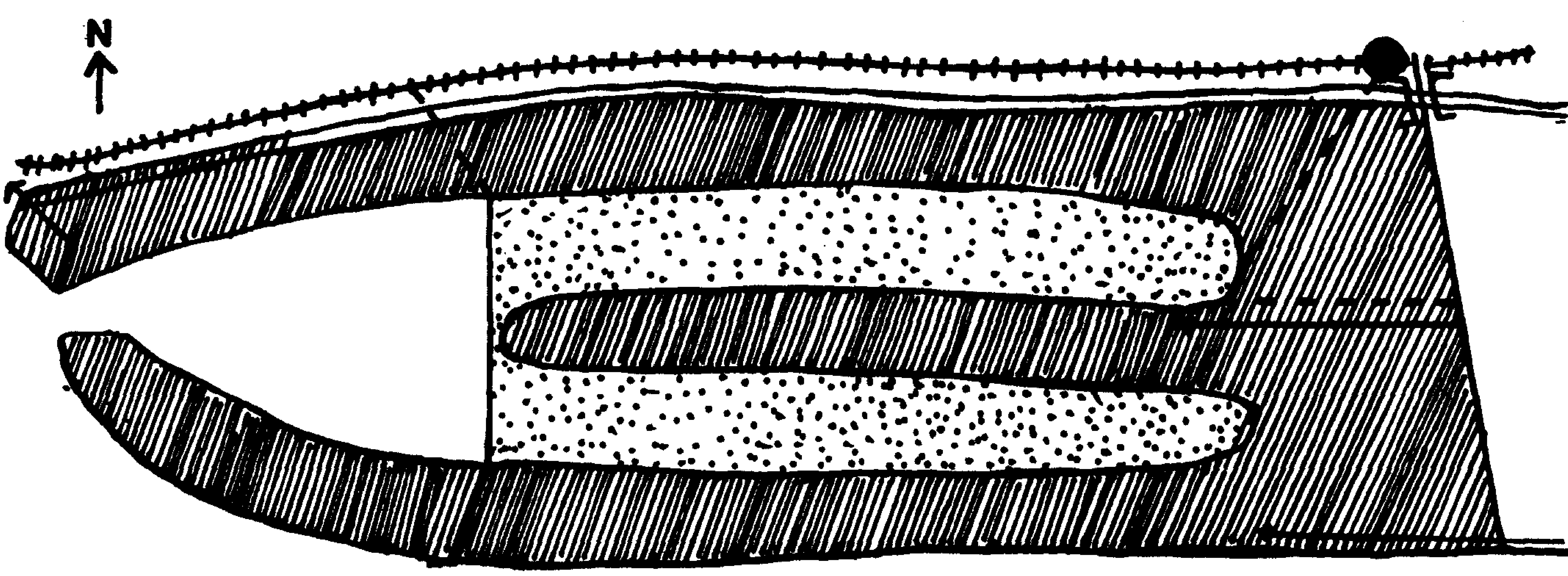
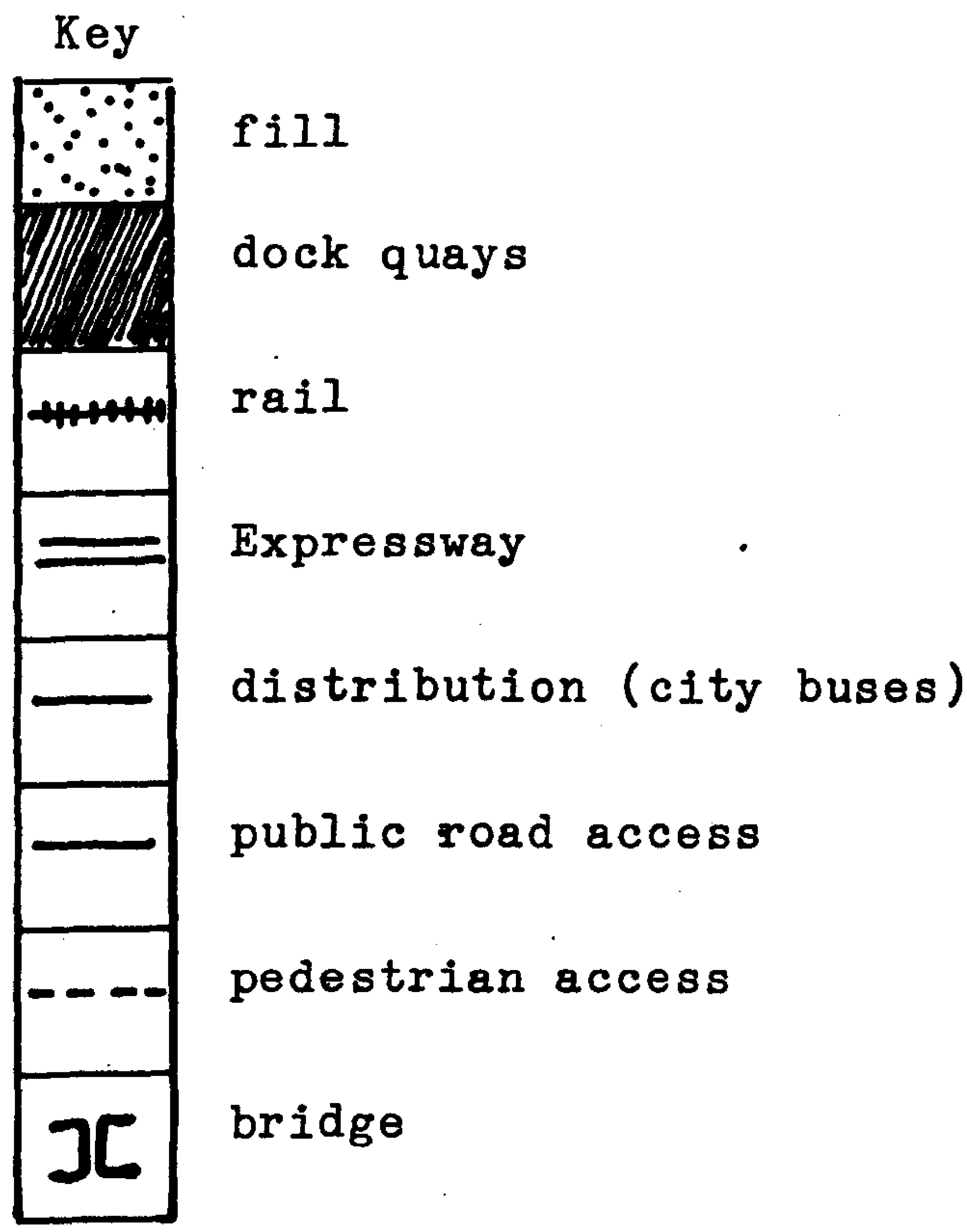


Figure 103. The site existing state

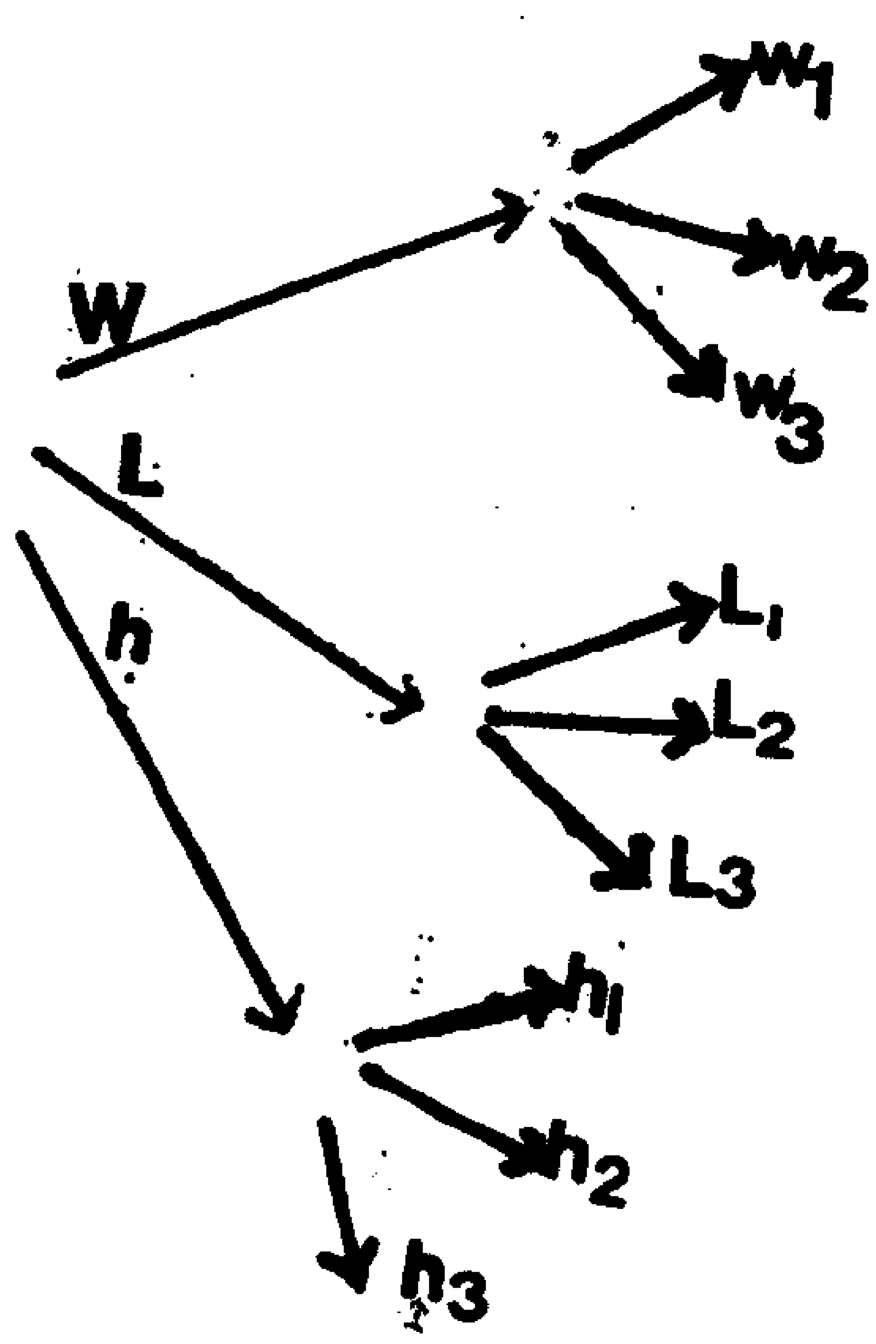


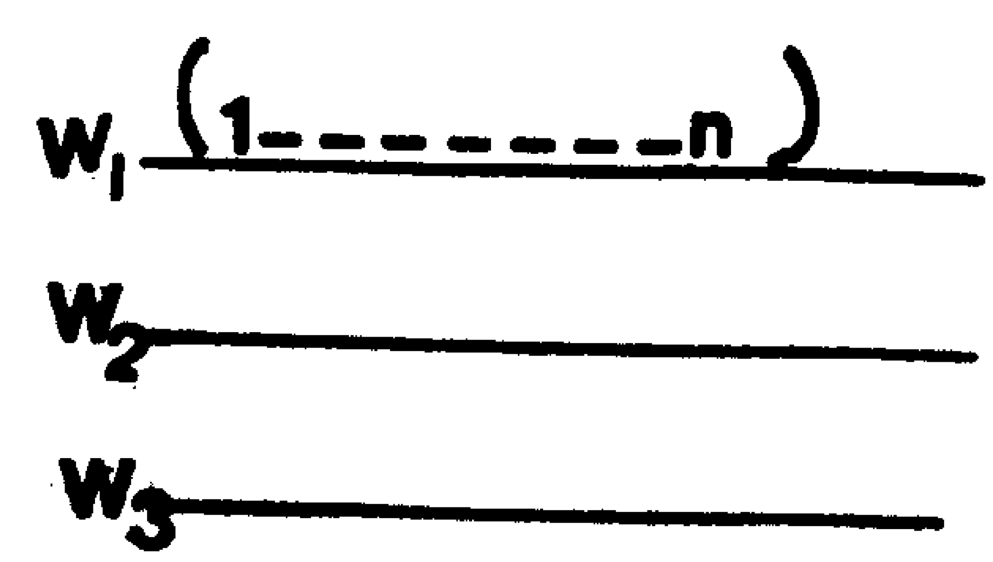
There are a few buildings in good structural condition at the eastern end of the site - one being used by the dock labour board. The dock is bounded to the north by an expressway, to the east by a city distribition road passing underneath it which is a bus route and to the south by the River Clyde. There is a pedestrian under-pass to the north-east linking to a suburban rail system and also pedestrian and road access to the east of the site.

The site is within 1 km of the Glasgow ring road and motorway which bridges the river to the east and bounds the central area (central business district) It is within 2 km of the main line stations within the central area. The river is tidal and provides access downstream to a container port. Queens Dock is one of the two central sites of great importance from the regional and district point of view. At present the dock is being considered as an exhibition centre and consultants have been engaged by the SDA to carry out a feasibility study. It should be noted that within 1 km of the site there is a University, a hospital and the headquarters of the regional council.

<u>Generation:</u> The land has been zoned for industrial use in the symbolismof the last district plan (1965 which included symbols for housing public open space and commerce). Therefore a range of models were generated emphasising different needs (for work; leisure and homes) and different varieties were developed and compared. One example of each is illustrated (see photographs and key diagrams).

Three groups were formed, each representing a different sectorial interest (work, leisure, homes). Each group generated three alternative design solutions and evaluate them according to the group agreed criteria.





The highest ranking solutions were then presented to the socio-political process to discuss.

<u>Alternative - L2:</u> The following assumptions were made in the development of this alternative.

(i) Location of the dock is ideal for large scale recreational development,

(ii) A riverside is traditionally a popular site for social and recreational activities,

(iii) Under utilised were housing is no longer justified in the centre. Change of land use is necessary.

(iv) The site is large enough to permit a wide range of activities for all ages and tastes.

(v) Expressway, river and industrial premises provide effective barriers to residential and other sensitive uses.

The following concepts and policies were thus adopted in the generation of this alternative.

(i) Intensification of uses for leisure - not only for open air landwater games but random and original both for active (advice) and passive exhibitions of what people do in spare time.

(ii) Reclamation of land to the west for park land - moulded and planted to provide a variety of environment (protected from wind/noise) for outdoor activities.

(iii) Provision of indoor leisure centre - which could also serve as an information centre, wildlife study and preservation, making of cloths and also a planning forum, i.e. a place where public policies are formulated and tested.

(iv) Structural flexibility.

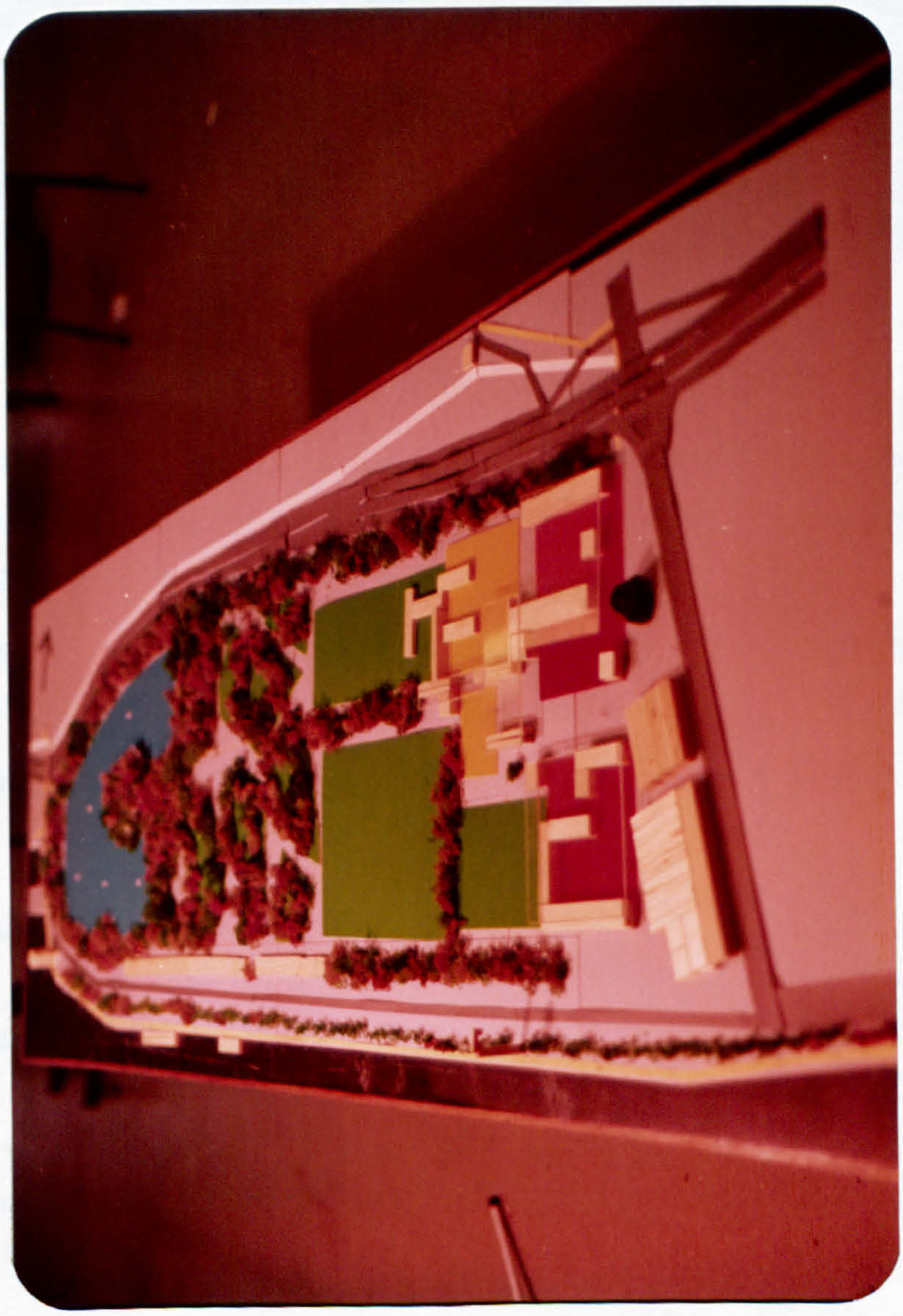


PLATE 12

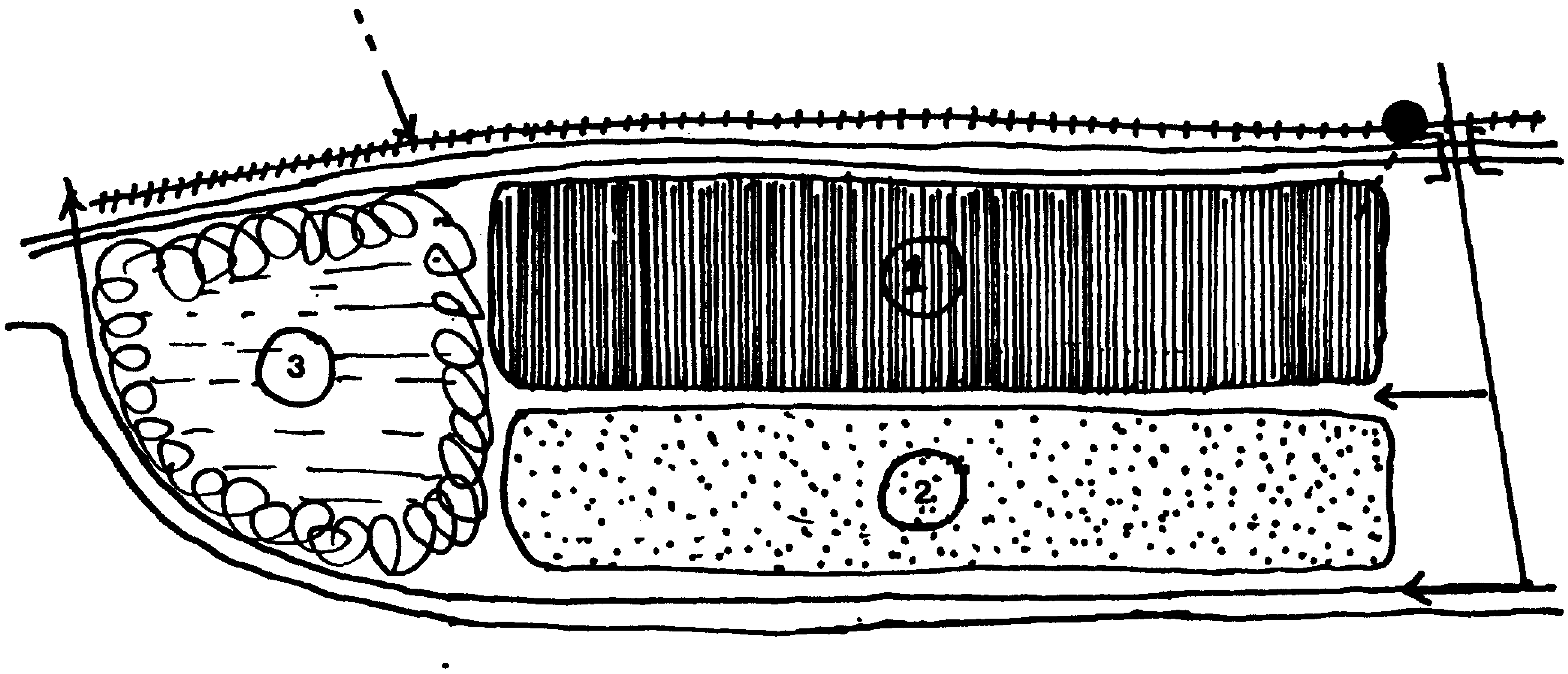


Figure 104. Alternative L2

1. Open air and covered hobbies - demonstrations, advice, exhibitions, for useful and possibly profitable leisure activities.
2. Sports area for local population (including urban population).
3. Park including lake for a variety of local needs.

L2 was assumed to perform well with respect to criteria such as (i) meeting the needs of both local (within easy working distance) population of residents and workers also district and regional residents; (ii) little capital cost (preparation accounted as job creation, etc); (iii) least prejudice to other alternatives.

Alternative W3 - The following assumptions were made for the development of this alternative.

(i) There is an urgent need to create jobs

(ii) There will be a rapid expansion in the service sector, a continued decline of manufacturing industry in the central area.

(iii) There is the need to improve the design of products (particularly those we share and purchase) and improve skills (of design production and management).

The following concepts and policies were thus used in the generation of this plan.

(i) Provision of design centre (crystal palace) consisting of a simple glazed roof structure,

(ii) Structural flexibility,

(iii) Emphasis on display and design centre both for consumer and producer choices, i.e.

   (a) areas divided to the display of products related to, e.g. education, health, housing, transport, forestry and farming.

   (b) the provision of a community work area and a general administrative centre.

(iv) Provision of public parking space.

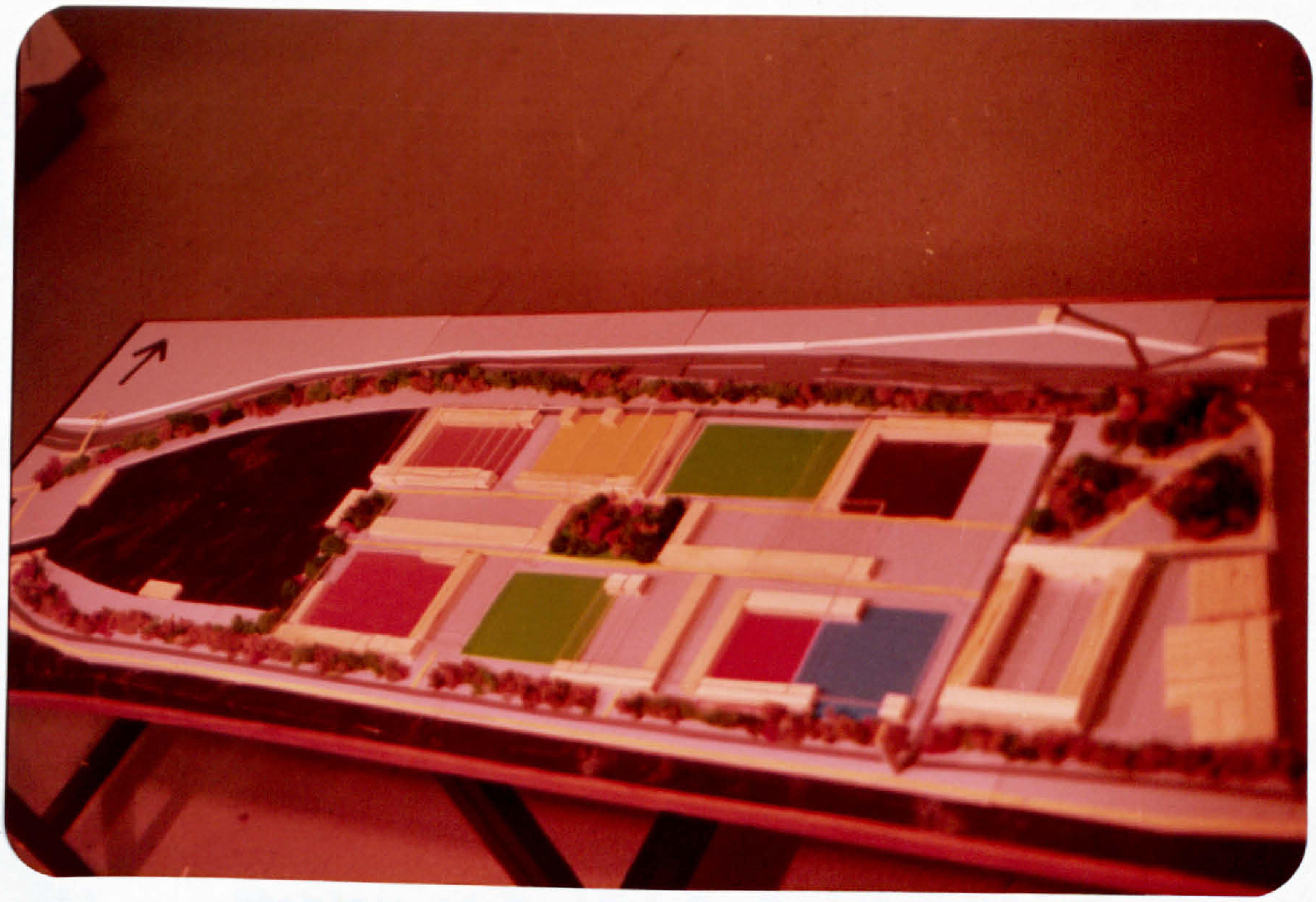


PLATE 13

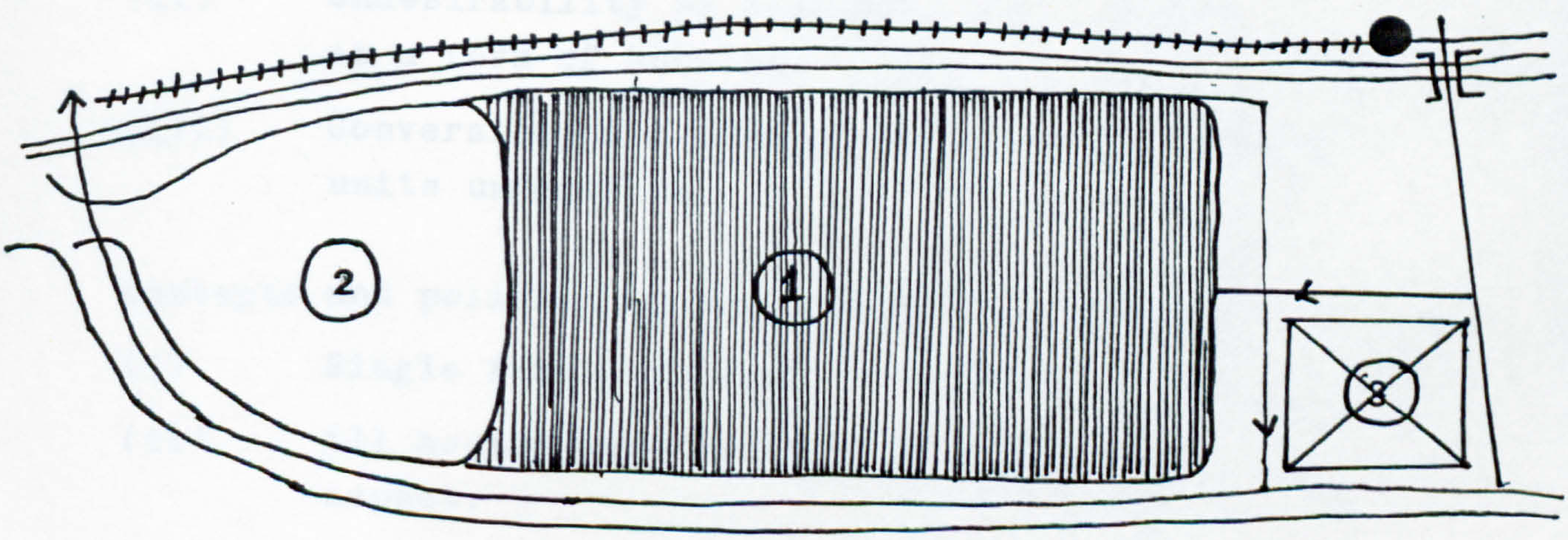


Figure 105. Alternative W3

1. Includes outdoor and indoor exhibition areas and evaluation and development areas for public purchases and community work.
2. As above - water related products and services.
3. Administration and Exhibitions of the best of best

W3 was assumed to perform well against specific criteria and measurements such as: (i) influencing performance of any product we all use (therefore affects the whole environment); (ii) capital (reallocation of existing public expenditure, e.g. to producers); (iii) return through large orders - reduction in prices (competitive producers); (iv) structural flexibility, dismantalable and mobile structures; (v) flexibility in use - responsive to changing requirements and resources - by including community projects allows for full use of labour in changing conditions.

Alternative H2: The following assumptions were made for the development of this alternative.

(i) Shortage of housing in the central area of Glasgow.

(ii) Undesirability of high-rise tower blocks as a form of housing.

(iii) Conversion of existing warehouse to dwelling units unfeasible.

Concepts and policies in the generation includes.

(i) Single family housing (all one storey)

(ii) All houses have south or west exposure aspect.

(iii) Provision of larger open spaces as parks and playfields

(iv) Houses attached and clustered to all open areas for common use and child playing areas.

(v) Since conversaion of warehouses is impractical, all housing will be new.

(vi) Integration of pedestrian ways to all commercial public/community facilities.

(vii) Pedestrian links between different modes of transport

(viii) Existing infrastructure to be fully utilised

(ix) Landscaped barrier to noise from expressway (see plate

H2 is assumed to perform well with respect to criteria such as (i) sunlight to all houses and private open space, (ii) safe access by foot to listed needs, (iii) variety of accommodation for any life span.

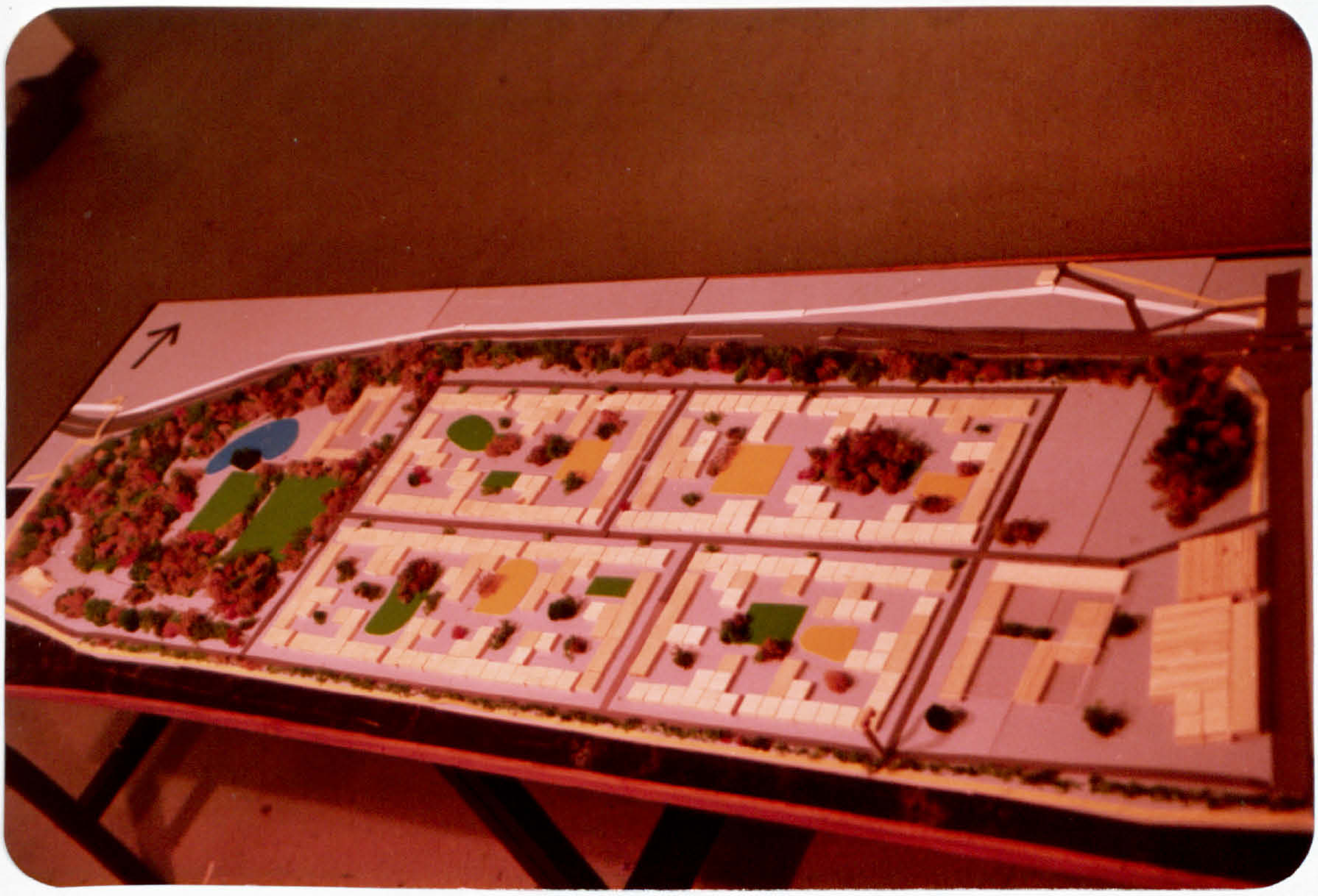


PLATE 14

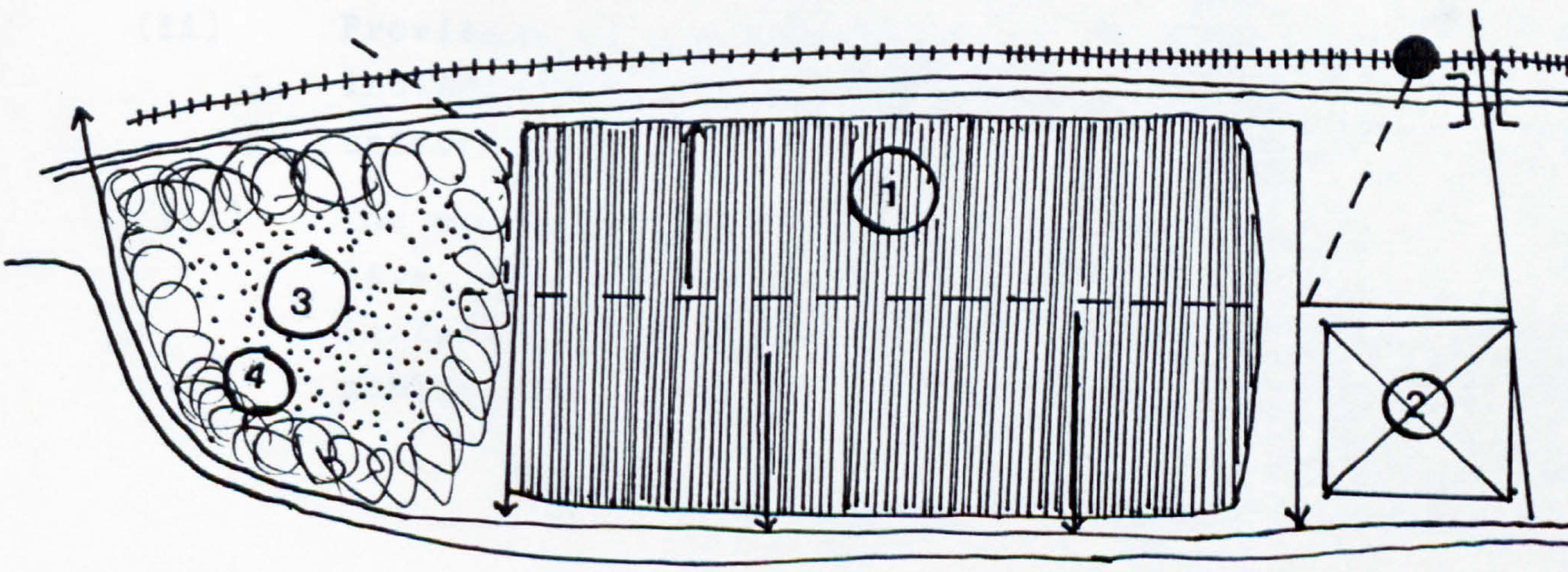


Figure 106. Alternative H2

1. Is housing (all one storey) wide frontage with private open space and children's play areas, etc.
2. Shops and workshops,
3. Community educational/recreational centre.

4. Park.

Main pedestrian ways connecting to public transport, etc.

<u>Alternative H1:</u> This can be imagined as meeting criticism of the above three. The following assumptions were made for the development of the alternative for mixed uses:

(i) There is the need to conserve energy.

(ii) There is the need to create jobs

(iii) A wide range and mix of uses is required in the area.

The following concepts and policies were thus adopted in the generation of this alternative.

(i) The provision of an exhibition centre

(ii) Provision of housing, for transient population including businessmen, students, hospital and university staffs.

(iii) The encouragement of private developer (i.e. a rich Arab) and commercial or including some combination of private and public investment.

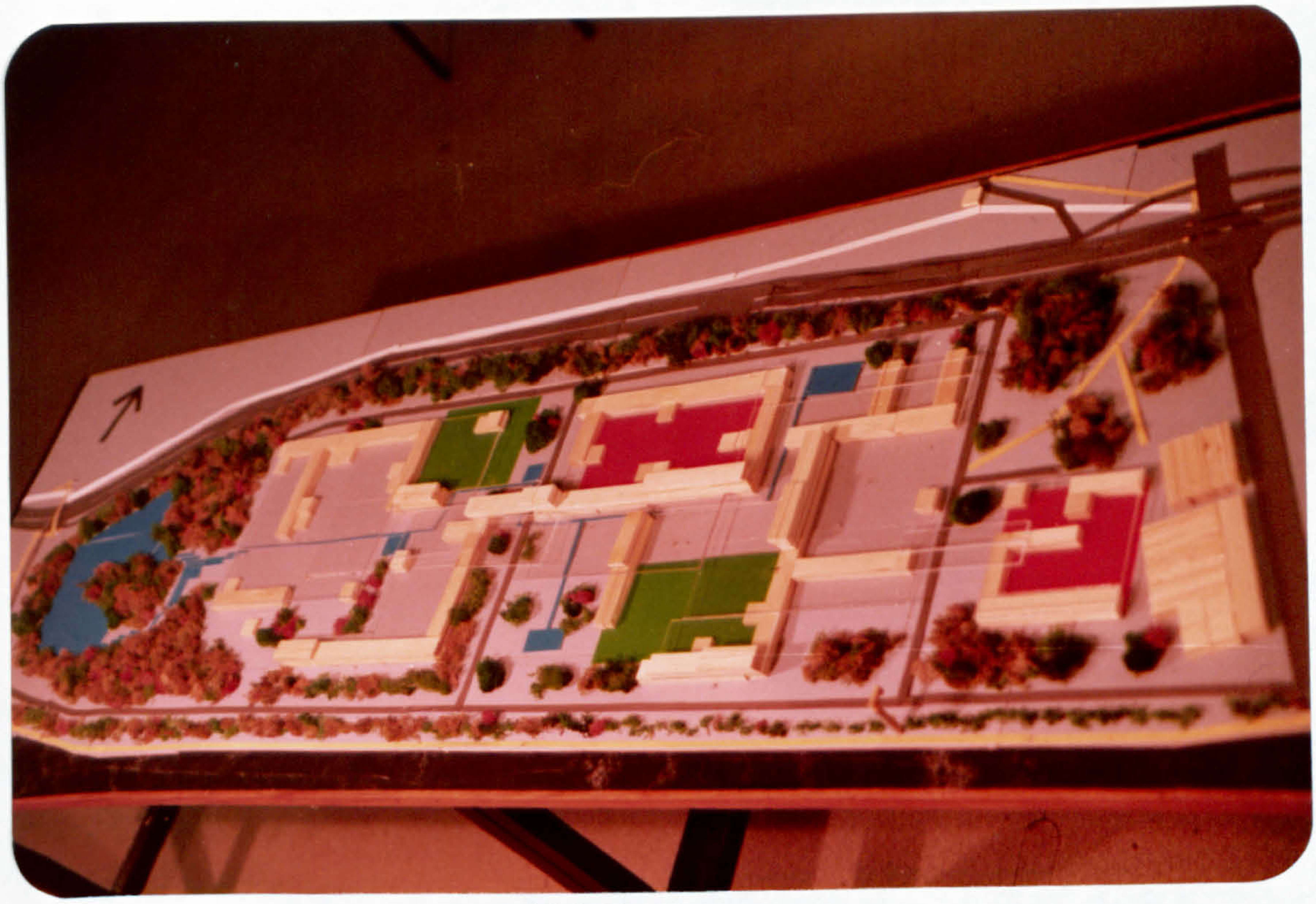


PLATE 15

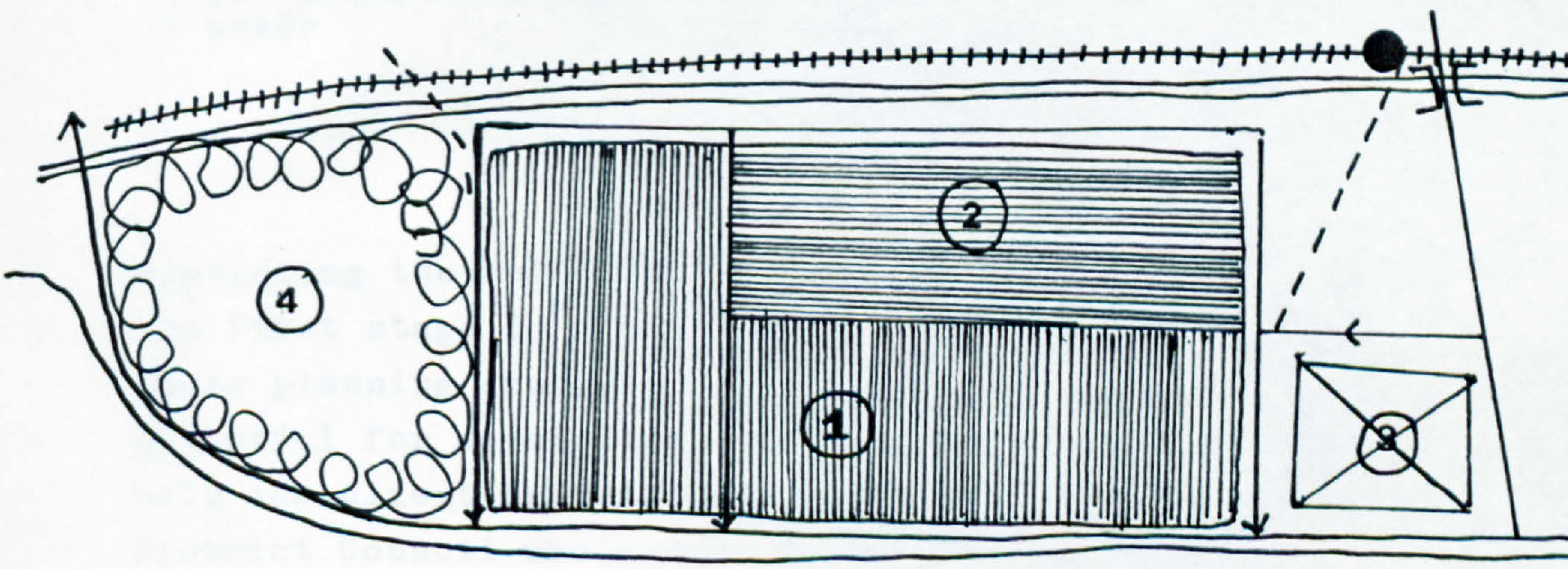


Figure 107

1. Housing for transient population.
2. Commercial acitivies
3. Shops and workshops.

Evaluation: The four alternatives were then compared by assessing their performance against the following criteria: creation of jobs; response to changing conditions; capital cost of implementation; least prejudice to other proposals; people affected; range of needs (see below:). Alternative W_3 was the highest scoring in the eyes of the planners. However to test it was felt that the alternatives should be assessed by the public.

	L2	W3	H2	H1
Creation of jobs	1	4	2	3
Response to changing conditions	4	3	1	2
Capital cost of implementation	4	3	1	2
Least prejudice to other proposals	3	2	1	4
People affected, therefore range of needs	3	4	1	2
	15	16	6	13

Simulating the Political Process: This is imagined as the first stage in a real world time planning game - where planning executives are asked to explore the potential for development of a defined area in order to help the client in this case assumed to be Glasgow District Council who owned the land to formulate landuse and investment policies. The first play as already discussed is by the planners themselves and its objective is to prepare and demonstrate a game where different interests and views can be introduced. Four alternatives were produced (see alternatives L2, W2, H1, H2) mainly to make sure that the pieces in the model would allow almost any player to be admitted together with a mechanism for comparison. This was sent to the individual planning committee members inviting them to a meeting (simulation). The purposes of which are outlined as the following,

(i) To criticise the alternative proposals (which any particular developments would then attempt to satisfy),

(ii) To decide which if any of the alternatives should be eliminated (and therefore where further work should be concentrated if say time available),

(iii) To ask for permission to consult other players regional and community council representatives, public and private development agencies and possibly set up a working party of those most interested for a second or third round.

In the absence of the real world players, staff were invited to choose roles from any of the following suggested roles:

(a) Glasgow District Councillor
(b) Community representative - near the site or anywhere in Glasgow or the region
(c) Strathclyde Regional Councillor
(d) Scottish Development Agency (a national agency)
(e) A major private developer (possibly foreign)
(f) Secretary of State for Scotland or his representative.

There were remarkable insights to be gained into the socio-political process from this exercise. Remarkable new pieces of information came to light from the participants. It was evident from the simulation that the region will not back a single industrial development. The district was interested in a hypermarket but not residential development. This conflicts with the community representative's interest in residential and recreational development. SDA on the other hand indicated their interest in the trade exhibition scheme. Region accepts this concept and expressed willingness to back developments that are flexible to changing conditions and that will create jobs. Private developer expressed worries about the economic prospect, high rate and vandalism in Glasgow and advocated for massive landscaping.

As the game proceeds, the staff participants find themselves involved. Arguments and discussions take on a very serious, real life appearance, people are by turn thoughtful and reflective, sceptical, stubborn and acquiescent.

As it happened alternative W3 withstood all the assaults thanks to the cunning manoeuvres of the regional councillor and the ignorance of the District Councillor for not knowing what he actually wanted. But we felt in any case that we had learned enough to warrant a complete re-evaluation of all the strategies using a much more refined scale of measurement and the introduction of more criteria. The following suggestions were made at the end of the exercise The need to evaluate the alternatives more tightly and the need to consider design experiments of what is going on in other parts of Glasgow.

On the whole the staff were pleased with the exercise as one of them, when asked about his reaction to the simulation said, "The exercise replicates what happens in real life. Decision taken rationally and quickly". The criticisms and comments will be taken into account in the second round (improvement and regeneration) during the recycling of the projects which is yet to come at the time of writing. A similar experiment was conducted successfully with real community participants from Faifley in Clydebank district. And the output was eventually adopted as a local plan for Faifley.

9.4. DISCUSSION AND CONCLUSION

The suggestion is that simulation similar to the one described above could usefully be introduced into real life planning exercises. Concerning the position of planners in relation to the political process, and concerning the internal structure of planning teams, the following suggestions are made: That planners should work in self cirecting teams. They should be allowed and encouraged to take sectional points of view and to establish links with the outside world. Their debates and reports should be made public. There should be basic agreement amongst themselves and with other participants on procedures by which decisions would be made.

If simulation of the type proposed in this study is effectively employed to increase communication among the planners and interest groups/clients, at least the quality of decisions on planning issues will be improved, the impact of individual decisions on future time will be less destructive and the inevitable conflict between different interest groups will be minimised or at least rationalised.

The simulation itself ought to be played in public. The media could relay it into every home; it could be stored and replayed and provide argument both inside and outside the Council Chamber. One can conceive of it receiving the publicity of quiz shows and public discussions. With the upsurge of local radio, and possibly even of closed-circuit television for local communities, there would be quite a few opportunities for making a series of simulations of this kind into a very potent stimulant for local democracy.

In a real life situation, planners would gain additionally from this procedure, considerable knowledge of the activities and intentions of politicians and interest groups in their community. Similarly, political representatives could not help making more informed decisions in terms of the facts of the situation and the implications of their choice.

Through simulations of the type proposed in this study it is possible to expand the scope of plan evaluation to incorporate the motivation, behaviour and likely response of those who ultimately bear the consequence of planning decision. Political competition and perception very often ignored in evaluation methods is revealed and could be analysed and incorporated in a second round. We simply do not know enough about preference functions and political power structures, for example, to reduce them to deductive statement that can fit meaningfully into cost benefit calculations of the sort often required by planners and decision makers. For such calculations much more must be known about the behaviour of the individuals and groups affected by the planning decision. Simulation of the type proposed shows promise as a way to incorporate perception and political competition in evaluation studies.

There is no reason why politicians, adminstrators and members of the public should not join in with the planners in playing out certain roles. This is already done in the training of managers and planners, with joint training and role-swapping giving particularly good results in terms of mutual understanding (Taylor, 1971). Cases are known where games have been put to practical use. In the Federal Republic of Germany, case studies involving administrators, politicians and planners were simulated using the provision of a new bill in the field of urban renewal. This apparently resulted in some modification to those provisions (Sacks, 1971). In the United States, so called "charrettes" (ten-day symposia) are experimented with to "help the community indulge in meaningful decision making". Perhaps this would become the rule rather than the exception.

The great amount of learning experience which the participants will undergo will outweigh any costs in terms of time and effort spent on apparently pointless exercises which do not lead directly to any tangible results. By actual investigation politicians find out much more about alternatives open to them which they rarely seem able to do nowadays. They could also, during simulations, enter coalitions which they would not dream of entering outside them and find out more about their political colleagues and opponents. The range of options would be much more wider than at the present so that the staging of such simulations as part of the planning process seems both feasible and worthwhile. They would probably be no more costly in terms of time and effort than is political intrigue, but they would speed it up, bring it to the open, and make it less serious. They would certainly not be more costly than bad decisions. In this way simulations may improve the quality of that process upon which the idea of decision making in democracies is based, i.e. public debate - which is nothing but a mock fight enabling politicians having a real stake in public decision making to sit back and watch before they take their choice. Simulations give rules to this mock fight so that it shows results. Political representatives can still turn their thumbs down and reject the outcome, though they cannot avoid doing so with more knowledge than previously.

The idea of planning teams playing simulation "games" with the public may appear almost frivolous to some planners engaged in the deadly serious business of formulating complicated programmes. But the military engaged in the equally serious business of defence have invented this device for exactly the same purpose of investigating alternative strategies. Indeed this was the approach taken by the Japanese in their September 1941 war games. Recall that a simulated attack on Pearl Harbour predicted United States losses. The Japanese had no assurance that this was the optimum strategy. In fact, history tells us that considerable opposition to the plan developed when the Japanese officers were made aware of the possible consequences of such a strategy.

Secondly, to introduce simulation in no way reduces the technical competence required by planners. But the questions which they investigate may become more relevant to the political process evolving around the formulation of every programme with benefits for the effectiveness of planning as well as the intelligence of political decisions. Lastly, it may be held that this procedure foreshadows what a future planning society may be like; that is, one that is busily engaged in the direction of itself, drawing in all the sections of a community.

A simulation "game" of the kind proposed may therefore seem strange in today's conditions of isolated planning agencies making fairly disjointed efforts. But in a future situation, where planning may be performed on several levels simultaneously involving many facets with complicated links between them, procedures such as these may very well become an accepted part of life (such as public debate was for Greeks). Thus, in a planning society, planning may not only be an accepted way of governing, but of going about public business generally, an art form, a pursuit with some intrinsic value.

PART III : GENERAL CONCLUSION

10. GENERAL CONCLUSION

To recapitulate, the main aim of this research has been to explore the usefulness of gaming simulation techniques in the study of environmental change and development, i.e. as a common language for effective communication and learning; as a practical vehicle for participation; as an effective training device for developing a flexible planning style; and as a means for policy formulation and testing. A number of experiments (seven) were undertaken in which so to speak, the stage, the actors and the plays are varied and useful rules (all games are defined by rules) are tested and developed.

The recommendations and suggestions are not intended to be the end result in themselves but as a means to an end. The research thus looks upon itself as an end to the beginning of an idea.

10.1. Evaluation of Gaming Simulation as a Planning Tool

Since the results of each experiment were summarised at the end of each case, only a general evaluation of gaming simulation as a useful tool in the following areas (learning and communication, participation, policy analysis and decision making) will be dicussed.

10.1.1. Learning and Communication

Evidence for this exists in all the seven experiments presented in this research that the result of a gaming simulation exercise usually produce insights into one (and sometimes all) of the following areas:

(i) Identification and understanding of the interactions between two or more rules, e.g. initiation of contacts, their timing and purpose, leading to an evaluation of the resulting opportunities for co-operation and likelihood of conflict (Experiments 1, 2, 3, 5 and 6)

(ii) Identification of information requirements and the use of information by the roles (Experiments 1, 2, 4 and 5),

(iii) Identification of the problem/opportunity areas created by complex issues or decisions which may not always be the direct concern of the role represented in the exercise (Experiments 1, 2,3, 4, 5, 6 and 7)

(iv) Exposure of the assumptions underlying the decision making behaviour of key groups (Experiments 1, 2, 3, 4, 5, 6 and 7).

In addition to having instructive qualities for researchers and teachers in urban and regional planning, game design also presents instructive opportunities for the students. Here gaming simulation from the results in this study appear to encourage the student's approach to the simulated situation to be more sophisticated and comprehensive. Rather than seeing the idiosyncrasies of a particular situation as in the usual studio project, the students discover and argue the general validity of the structure of the model underlying the game. If the game model is found unsatisfactory as was the case in all the experiments, then attempting to improve it, he/she is questioning his/her own understanding of the situation modelled, clarifying them and adding to them. Thus, re-designing or modifying the model is one way of maximising the usefulness of the technique as an effective learning tool.

The value of gaming simulation as a learning device also rests in addition to the fact that they (experiments

1 to 7) demand active involvement by the learners. There is the old chinese proverb that is also echoed in the worlds of many educational theorists. It sums up much wisdom in few words, "I hear and I forget, I see and I remember, I do and I understand". The planning gaming simulation models illustrated in this research permit not simply doing but doing with others. Players are amongst other things introduced to: a variety of interests in conflict (Experiments 1, 2, 3, 4, 5 and 7); a varying degree of stress; a number of sequential decisions where they are not in complete control; and a quick and repeated feedback (Experiments 2, 4 and 6) on the adequacy of their performance. Through endeavouring to manipulate the simulated system and by experiencing consequences attached to their actions and the actions of others, the player on trial and error basis acts out their understanding of an analogue central to real life process.

With the current rate of information obsolescence set back at several many years, young professionals should be equipped with more than just one state of the art, specifically, they should enter their careers with the confidence that they have had sufficient practice not only in solving single answer problems - but also open ended problems. The experiments demonstrated in this study addresses this challenge and represents an effective device which holds potential in many areas of planning for increasing student motivation and learning.

The seven experiments presented in this study suggests that gaming simulation offers active, synthetic approach to communication. It is active because participants explore environments, look for clues to system constraints, interact with others (Experiments 1, 2, 3

5, 6 and 7) and so come to discover ways in which they must modify their perceptions, responses and strategies. It is synthetic, in that it offers the possibility of holistic learning (Experiments 1, 2, 3 and 4). Over seventy percent of the participants considered experiment three for instance as an effective means of communication. Analysis of alliances and transactions that took place in experiments one and three show that the professional and public roles interacted with each other. In experiment six real life community participants interact with government officials, to design a community centre, with the computer used as a neutral language and students and staff architects as umpires. Generally the development testing and analysis of the seven models illustrated in this research shows that gaming simulation could improve communication between various roles, discovering and learning about complex problems in a holistic or gestalt manner and encourage alternative generation and testing.

Complex reality is here and must be dealt with. To the extent that goodwill exists among men, there will always be enormous difficulty in resolving problems because each man's model of reality differs, Planners must find new ways to conceptualise complexity, to transmit it to one another, as well as to formulate specific models about future complexity from our known but limited base. Gaming simulation is one device that could be useful for presenting a dynamic model which is an abstraction of complex reality. Within the context of a game we develop a special language which permits the various respondents to talk to each other (as in experiment 1, 2, 3, 5, 6 and 7) with greater clarity than they might do through traditional communication modes. Games can be viewed as abstract symbolic maps of various multi-dimensional phenomena.

As such they serve as a basic reference or filling system for participants who are concerned with that phenomenon. If these constructs are properly elaborated, they can represent not only present reality but a future possibility.

The above mentioned potentials could be an outstanding contribution to the planning system since increased communication among the public, the planners and the decision makers will improve the quality of decisions on individual issues; the impact of such decision on future time will be less destructive and the inevitable conflict between man and the environment will be revealed and possibly resolved. Through the proper application of the technique one finds very strong promise for re-establishing the comprehension of totality which is necessary for intelligent management of the planning system.

10.1.2. Participation

Gaming simulation technique has the benefit of replicating the complexity of planning situations in terms which may be comprehended by the layman, and of providing an arena in which the coincident and conflicting interests of the public and the planning agency may be represented. In addition, the participants to the "simulation" benefit from experiencing the simulated roles of other participants. In this study gaming simulations have been used to aid participation in two ways; firstly, by representatives of interested groups playing their own roles, experiencing the intergroup interaction and witnessing the impact their performance has, as was the case in experiment 6; and secondly, by individuals acting out other roles, to gain an insight into other dimensions of the decision making process in planning as was the case in experiments 3, 5 and 7. In both cases gaming appear to increase understanding of the planning problem, the first step in ensuring that participation is soundly based. My experience in using games suggests that people enjoy taking part. Following sessions of my own simulations, participants have commented that for them, the simulation process has provided an opportunity to appreciate something close to the "whole process" at one time (Experiment 3). This applies as much to the professional planner as to the layman.

My experience in conducting a number of urban simulations with community groups lends to support the facts that participation in simulation does increase players' sense of efficacy. For example in BUG, the primary emphasis was placed on citizens' understanding of the system with which they must deal, what constraints operate on the system, what the "rules of the game" are in the system, and developing the best set of strategies and tactics to use in particular community situations. I recall one occasion when BUG was used to simulate a case that was making headlines: fishermen in a Scottish village were fighting developers who wanted to promote tourism, threatening their traditional environment and life styles. The board reflected the existing conditions and players represented the various interest groups involved. After a couple of hours participants were leaning toward one of the alternative courses of action available. Participants generally showed a greater sense of efficacy following the simulation session. In talking about the game, many participants expressed an increased awareness of the complexity of the system being simulated and the enormous problems of inter-relationship among programmes, agencies, individuals and the units of government in the resolution of even the simplest problem facing the community. They also expressed a greater feeling of being able to deal with the complexities of the system.

The results of experiment six (design participation game) indicated that simulation is useful in sensitizing architects and designers to the heterogeneous needs of the users of public buildings and that the technique is an aid to understanding outcomes of the design process as applied to local communities. And also one observes that compared to the use of survey instruments, a simulation of the type illustrated in experiment six may be more flexible, less likely to be applied in a manner that would erode the citizen's role in decision making, and is perhaps easier to accept. A simulation of this type, besides being a strategy for participatory design decision making and an awareness experience, is also a useful design research instrument. The simulation provides information crucial to understanding the design process, especially in respect to the way building users perceive relationships between spaces and functional uses. In examining players action one sees how spatial concepts can be manipulated to solve specific discrete problems that might not emerge in a survey or recognised by a professional.

The potential of gaming simulation as a practical venicle for participation is also illustrated in experiment seven. The public are encouraged to participate in the planning process - criticise and suggest reasonable options to alternative strategies. In the evaluation stage they play their part again in adding more criteria and in giving their own acceptable scores to all options. This safeguards that their options will be fairly evaluated with explicit reasons for the final choice of alternatives in subsequent plays. This is different from intuitive planning, where seeming inferior or unfeasible options are opted out of the way at the very beginning of the process, giving public opinion no room for testing at all. It makes the whole planning process more democratic. It is on sharing knowledge, on communication, between government and people that democracy depends. Democracy may only be effective in that it reveals; makes visible the different and conflicting choices, before searching for agreements and thereby gains in sensitivity. Individual and collective choice is built into the process. We learn from each other and behaviour and decision is changed.

The above mentioned potential could be an outstanding contribution to planning since decision making through a process of this kind could help to ensure that compromises and trade-offs are fully explored with most people getting a fairer deal than they would without it. The negotiation of a compromise or trade off between parties will generate a commitment to the specification arrived at: it is, I suggest, the optimal way of generating commitment during a planning process. It conforms most closely to the rules of "natural justice".

Besides using simulation as a practical vehicle for participation, simulation can be used to train planners the need for participation in planning. This was the philosophy behind experiment two. The model was used for a critical awareness of systems of authority and distribution of power in a social system. One interesting indicator of the effect of the gaming sessions is the change in the kinds of responses many participants gave to pre and post game questions. Participants' attitudes changed towards more participation in planning.

If a planner wishes to achieve congruence between his terms of reference and the public outlook, and if the public wish to understand and be understood in planning affairs, a context must be found in which the public, as individuals, can be commitedly involved in acting for the future in a way that would make such institutions relevant. Gaming simulation as illustrated in experiments 3, 6 and 7 appear to bridge the gap between the planner and the public. The modelled milieu of a game can in effect be a laboratory where ideas can be developed and tested prior to actual implementation and where the planner can accumulate a factual foundation to base his ideas.

The average human being has the ability to deal with complex phenomena when they are presented in a coherent context. We need not suffer the hazards of depending on an elite unless we are unable to find expedient devices for introducing the citizen to complexity. It is only when we dichotomise, specialise and truncate that the citizen falls by the wayside. Planners must rely on the intelligent consensus of a broad citizen base if we are to sustain democracy. Gaming simulation techniques as illustrated seem to possess much usefulness, so far hardly tapped, for developing methods of bridging the gap between the planner and the public. However, gaming is only one possible approach. If participatory planning is to reach its full potential a multitude of different approaches must be developed, each predicated on the right of each individual to influence the shaping of the environment about him.

10.1.3. Policy Analysis

The technique of gaming simulation as a way of bringing experts together, can do much to facilitate a policy study. Admittedly the predictive quality of such an

exercise is very clearly a function of the quality of intuitive insight provided by experts involved.
In contrast by allowing for the introduction of judgement at every step (Experiments 1, 2, 3, 4, 5 and 7) the game provides an opportunity to take into account intangible factors often considered outside the scope of analysis.

Another useful feature of gaming simulation in policy studies is that it permits a very detailed and descriptive demonstration of a proposed policy or plan in more or less rich context (Experiment 7). The view and understanding of a policy that one can develop from a written description can be much more poorer than the view and understanding developed when one has seen it demonstrated in a dynamic although highly synthetic on-going simulation. One thing that gaming simulation is not only doing, but awfully good at is demanding careful sequential analysis of plans, decisions, events and intelligence (Experiments 1, 2, 3, 4, 5, and 7).

The potential of gaming simulation as a practical vehicle for testing policies is also illustrated by experiment four GUTS: here a player influences the state of the transport system by the following hierarchy of decision choices, policy --> strategy --> action. Associated with each general policy is a number of specific strategies available to the players each consistent with their own policy. As the game proceeds, the computer prompts a player towards a particular policy choice and presents him with a number of strategy alternatives. The strategy choice determines what decision variables the player will control in order to effect that strategy. Finally in executing the strategy (action) the player is reminded of previous values (trends) of the state variables and is prompted towards new values. In this manner the simulation provides a safe environment for participants to test different policies. Just as the doctors test their drugs on rats before recommendation for use by man, planners involved in formulating policies could test the effects of their policies through gaming simulation before recommending it for action.

Everyone, sometime or other, has wanted a crystal ball to peer into the future. We need some real world equivalent more than ever before, man needs to be able to reminisce about the future, to explore 'what if' questions in involved and highly speculative environments. These mythical constructs must be explicit, so that those who have an interest in them can comprehend and when necessary, challenge the relationship which they represent. If these constructions were built, we would have a model of future reality which is subject to continuous modification and redefinition, dependent on the best judgement and information of those most likely to be affected. Gaming simulation is one prospect for assisting us with this task. It permits the policy maker to gain some sense of how the system responds to his particular policy.

It seems clear that the practical application of gaming simulation to policy analysis is still for the future. Nevertheless, tools such as gaming simulation can provide the policy maker with a good acclimatisation to many of the necessary concepts and techniques. At least in this experimental stage, policy analysis gaming simulations can help in laying ground work for sorely needed improvement in the policy planning process. Gaming like any other policy analysis technique, undoubtedly would be most fruitful when applied with clear objectives in mind to well structured problems. In the analysis of major questions of public policy, it may be well worth the sacrifice of precision in handling some of the elements that can be readily quantified to gain other benefits.

10.1.4. Decision Making

The way that decision makers seek information, their decision heuristics, and the leverage points that they use in the real world are as yet unknown social factors. Because it is possible to observe these types of patterns within gaming simulation (as in Experiments 1, 2, 3, 5 and 7), it becomes a very valuable research tool. If we can learn regularities of social behaviour then it may be possible to ascertain what are better decision patterns and use this for the solution of practical problems.

Gaming simulation as illustrated in experiments 1 to 7, is concerned with the provision of an environment in which the process of decision making can be simulated. In decision making situation is not the "reality" that is important but rather the decision maker's perception of that reality that is crucial. Such perceptions may be erroneous for any one of a large number of reasons, but so long as they remain implicit rather than explicit, such errors will remain undetected.

Gaming can assist in such a situation by facilitating two processes, namely - that of enabling the decision maker(s) to make his (their) perception of the situation explicit - that of communication between the public, the planner and the decision maker. In practice these two processes are intricably bound together in such a way that they may be difficult to distinguish. In this study it has been demonstrated that (Experiment 7) gaming simulation can link the two processes, and do it in such a way that the danger of the planner's perceptions being imposed upon the decision maker or the public can be avoided. One way of communication is replaced by a dialogue fruitful to all sides.

My experience in this study indicates that gaming simulation is a useful technique for learning about decision making. The group organisation of the experiments, particularly experiments 1 and 5, also deepens the understanding of the decision making process. Even the individual participant in these experiments faces a staged introduction to decision making. Participants acquire critical thinking, analytical and decision making skills. This is supported by a student's comment after experiment I, ".....I learn the importance of establishing policies and making long range plans". "It helps a person realise the need to develop decision making skills in an environment which involves uncertainty and restraint." "Encouraging systematic analysis of the rewards of alternative strategy".

Participants in experiments 1 to 7 show competitive, co-operative behaviour in their appreciation of the situation. The simulation bring together not only the participants and concrete statistical and environmental data (Experiments 1, 5 and 7), but the vagaries of chance and the effect of human relationships. As the participants think for themselves about the decision they may take during the simulation, they also come to understand the impact and consequence of their own and others' action. Almost every element or component in the decision making process are introduced. Data selected and organised, the relevant recognised and the trivial dismissed as in experiment 2, strategies are invented and alternative courses of action planned and implemented (as in Experiments 1, 2, 3, 4 and 7). The occurrence of uncertainty is held in account and co-operation and competition organised and managed as in experiments 1, 2, 3, 5 and 7. From the above it could be said that gaming simulation is potentially a very flexible and useful framework in which to practice decision making and observe it at work. It incorporates different levels of decision making, diverse varieties of phenomena and considerable open-endedness.

Planners could learn the consequence of their decisions in simulation and in the light of this, make enlightened decisions before applying themselves to real world. This will involve definition and redefinition of objectives and trial solutions. This is very much in relevance with reference to public policies and land use decisions with long term effects.

10.2 IMPLICATIONS ON THE USE OF GAMING SIMULATION IN PLANNING

The idea of planners playing simulation games with the public may appear to be psychologically disturbing to some planners engaged in the deadly serious business of formulating complicated programmes. They may say that gaming simulation is only a good academic exercise but not practical. But the military engaged in the equally serious business of defence have invented this device for exactly the same purpose of investigating alternative strategies. My only point here is that planners already in possession of intuitive skills could, with the assistance of this technique, expand and elaborate explicitly their decision making capabilities. Initial mistrust of the technique can only prevent a wider apprecaition of its value and limitations.

Even when the technique is accepted as a planning too many would argue that the value of gaming simulation lies in that it is descriptive rather than prescriptive (however this depends on the design of games). Gaming simulation techniques are essentially tools for studying the effects of methods and strategies of operational decision making and for experimenting with alternatives in risk-free environments. The simulation should not prescribe an absolute solution in a particular situation, either in terms of the physical results of the process, or of an optimum strategy; the number of players are too great, the motives are too mixed, and there are too many alternative strategies available. But it does systematically simplify and shorten complex and long drawn-out processes, in the course of which methods and strategies may be tried and their physical and operational effects seen. It is a way of learning before action.

In my more fanciful moments, I envisage a city procurring a series of gaming simulation devices and setting them up in a large room in the basement of the city hall. In much the same way that the military chiefs in the movie "Dr Strangelove" used their war room to thrash out key tactical and strategic problems, decision makers would use this "game room" to explore tactical and strategic problems for the city. Thus, the game room could become the new political forum; however, it is a forum in which decisions are not final and participants are not held accountable for their behaviour when they go upstairs to council chambers. But when they do go up to council chambers, they will have a better understanding of the problems and a better feeling for the nature of the arguments for and against assorted policy actions.

Planning embraces a wider range than presently covered by one technique. Therefore for an effective application of gaming and simulation in planning education and practice further research should be done to integrate gaming simulation technique with other valuable planning techniques such as Delphi technique as was used in experiment one, cost and benefit analysis, environmental impact analysis, threshhold analysis, etc. In this connection a strong theoretical basis is needed in the education programme for planners in order to understand the merits and dangers of these techniques. However, a game design can include and combine many of the above techniques.

Many planners emphasise that no matter how carefully they are designed, games fail to achieve realism in a great many respects and thus not interested in the technique. However realism depends on perception and definition. ,My main point here is that the fact that the modelled situation is unreal can have advantages. This couldn't happen in real life, can in my experience provide a fruitful starting point for a discussion of what in fact, does happen - something not always easy to determine.

Finally, many planners would argue that gaming simulation requires considerable resources in terms of time and expertise. This frightens many away because of the possible substantial costs involved in designing and developing any simulation model. It could be argued however that design costs are a very small fraction of those involved in the development of complicated models and probably no more than a few weeks work could be invested in developing a gaming model. Games can be designed in a few weeks or less with little cost and with powerful educational and practical results. The cost required for a particular gaming model depends, of course, upon the degree of detail being used, the system it is intended to represent, and the amount of previous work upon which the game construction may be based. The simpler the model the easier it is for use.

Given proper resources and good staffing, gaming simulation could become the foundation on which to build an open, explicit, integrated and rational community based planning process. The approach could be experimented as in this research to as wide a variety as possible of problem situation - from national, regional, urban, rural to individual level. I must emphasise that the application of scientific methods in planning will not solve all environmental problems. They are only aids to better decision making and plan making.

10.3 PROSPECTS FOR GAMING SIMULATION IN PLANNING

The prospects for gaming simulation in planning depends upon the abilities of educators and planners to take advantage of the enhanced learning process apparently created in gaming situations. Obviously, learning is fundamental to the classroom. Equally obvious is the potential application of gaming simulation as aids in teaching the principles of urban and regional planning and development. But learning is not limited to the classroom. Almost by definition, any planning effort seeks first to learn more of the system and environment being planned. Perhaps the brightest prospects for gaming simulation lie within the planning agency, where gaming simulation might someday become an integral part of the planning process.
A more detailed discussion of how gaming simulation might be applied in both teaching and planning follows.

10.3.1. Teaching

As aids in teaching, gaming simulations show promise of useful application in both basic and continuing education. For basic education, gaming simulation could be integrated into university curricula; in continuing education, gaming simulation could be employed both in extension programmes and short course seminars.

University Programmes: The multidisciplinary aspects of urban and regional planning and the complexity of the environmental system makes curricula difficult to plan and courses difficult to teach. The traditional approach is to teach planning principles through readings and lectures. To introduce more realism projects and case studies have also been employed. Projects are useful because students are encouraged to go through the actual motions of planning. Studies are restricted, however, both in scope and depth because of time limitations. Case studies compress time so that a greater number of situations can be analysed, but realism and stimulation are low. Gaming simulation provides a means of overcoming these difficulties. Experience with gaming simulation in this research is encouraging.

An interesting idea was proposed by a participant after experiment four. He suggested intramural type competition with urban development games. "Why not extend this to intercollegiate competition? After all, the sporting games played today at almost all institutions of higher learning are, in many ways, merely descendents of ancient contests of skill and prowess. These contests were designed to reward those skills highly valued when the struggle was for physical survival. Today, technological advancement and urbanisation lead us into a new era where the struggle is for social survival. Given the present struggle, it would seem appropriate to organise intercollegiate competition in gaming simulation. It would not be expected that such games would replace existing sports, but at least they would reward those skills more appropriate to the problems that must be faced today".

Continuing Education: Another prospect for gaming simulation is their use in extension courses and special seminars. In todays world of accelerated technological change and multidisciplinary approaches, many professionals presently working in planning and administration have been unable to keep up. The courses they took in college have now been squeezed out by planning theory, modern mathematics, system analysis and computer science. Many of these professionals have spent years in one functional aspect of planning and have become experts in their field. They lack, however, the broad perspective necessary for today's team concepts and multidisciplinary approaches. Gaming simulation in extension courses and in the job training programme would provide a relatively painless method of closing this educational gap. The advantages of using gaming simulation in extension courses and seminars could be summed up as follows:

(i) Gaming simulation of a typical community allows (citizens) a detachment from their own community and subsequently a more objective view of the material presented.

(ii) Gaming allows a new perception of familiar problems.

(iii) Gaming simulation provides an "ice-breaker" enabling an effective learning environment to be created.

10.3.2. Planning

Ultimately, gaming simulation may become an important part of the planning process. To achieve full potential planning games would be developed into a full scale gaming simulation. Various environmental systems would be monitored and resulting data fed directly into the gaming simulation model. Proposed policy changes concerning the operation and development of the system would be played out in full. This would enable planners and decision makers to determine in advance the benefits of implementing the change and the possible consequences associated with it.

Of course, the complexity of the world would never allow complete achievement of a perfect gaming simulation. Nevertheless, employment of gaming simulation in planning is potentially useful simply because of the need for more understanding of the models being used to simulate urban and regional systems. Presently, many planning agencies employ simulation models to evaluate alternative development plans. However, much of the potential benefit of these simulations is lost. A variety of reasons have been observed. Those developing the simulations have moved on to other jobs without adequately documenting their work or training the people left behind. In some cases, sponsors, not really understanding the model and distressed with cost over-runs, have been reluctant to supply additional funds for data collection. Finally decision makers and the public, again not understanding the principles underlying the simulation, ignore results and proceed as before in a completely subjective manner. Potentially, gaming simulation may some day prove helpful in the three phases identified.

In planning agencies, gaming simulation can serve multiple purposes. Internally, gaming simulation may be used to upgrade knowledge within the agency. Older members may be introduced to new principles and practices in much the same way as extension courses work. New members could be indoctrinated in the use of the full scale simulation being developed or already employed. Also small scale gaming models could be developed prior to investing considerable time and effort on full scale simulator. This would allow analysts to become thoroughly familiar with the dynamics of the process and systems with which they were dealing. During development, the gaming simulation model would serve as a promotional device. Its use to demonstrate principles employed in the full scale simulation would possibly aid gaining financial and public support. Continued development would eventually lead to the game being fully integrated into a full scale gaming simulation for use in evaluating alternative development strategies.

10.3.3. Participation

An exciting prospect for gaming simulation concerns the relationship between planners and the public. Perhaps gaming simulation could lubricate the socio-political process which now reconciles differences over proposed improvements. The educational and communicative properties of gaming simulation would provide a direct channel between planners and the public. For the administrator-planner, planning gaming simulation models provides a vehicle for demonstrating planning principles, for illustrating rational and consistent decisions, and for reconciling multiple goals. For the public there is the opportunity to gain an early voice in planning. The model would communicate public values and goals. Through the medium of the game the so-called intangible social and political factors would be transformed into economic terms. Also conflicts would become known. Prohibitively costly concessions necessary to appease opposting interests could be evaluated in advance of plan preparation. Likewise, unacceptable projects could be identified prior to construction. Perhaps the expansion of Turnhouse, Edinburgh airport could have been avoided had gaming been employed in the planning and decision making process. Gaming as a practical vehicle for participation forces the citizen to consider community problems from new perspectives and also forces a fresh assessment of the citizens own 'real world role'.

Finally, I would suggest that gaming simulation is a potentially useful tool for those frustrated by the lack of public acceptance of soundly planned projects. The accomplishment of two tasks might improve the responsiveness of plans. The first task is for designers and planners to improve their understanding of the changing needs of an increasing dynamic and complex society. The second task is to increase public understanding of the principles and problems underlying our judgement. In both cases gaming simulation offers promise for expediting this learning process.

10.3.4. On the Application of Gaming Simulation to Planning in Developing Countries

The relevance of gaming simulation to planning in the developing countries is immense, not only as a teaching tool for development planners but also as a problem solving tool which would enable them to explore consequences of their development proposals both in the political and social sectors. Some of the aspects in which it could be specifically useful are:

(i) The effect of certain policies on the population.

(ii) The reaction of governments and individuals to government proposals could be explored by means of gaming simulation.

(iii) The comprehensive exploration of a planning problem.

(iv) As a tool to determine value consensus in communities.

10.3.5. On the Use of Gaming Simulation in Community Action Groups in the Developing Countries

This aspect is closely related with that above and its separation into two different aspects is only a matter of clarity in the arguments. The suggestions made here are based on two main hypotheses.

(a) It is possible to organise and educate communities by showing them their situation and possible alternatives to it.

(b) The education and organisation of cummunities increases their capability to deal with local problems and also increases the feedback to local and national governments, so improving the functioning of the politically shared system of control.

The suggestion is that if a community has a tool with which they can evaluate the effects of their actions and at the same time see their behaviour and that of other parties involved with them, they will be able to tackle their problems with more reality and efficiency than before; it will allow them also to test their actions before putting them into action, to study the feasibility of their proposals.

Some of the aspects in which gaming simulation can be of more use are:

(i) In exploring strategies in village meetings

(ii) In learning about parties' attitudes and limitations

(iii) In educating members of the community in relation with their problems

(iv) In training members of the community in decision making.

10.4. SOME FINAL THOUGHT ON THE DESIGN OF OPERATIONAL GAMING MODELS

Supposing we consider public planning as a game (after all we see that there are existing rules and games are defined by rules). The following lessons that emerge from this study might be useful to bear in mind when designing and playing such games.

10.4.1. Players

In principle at least anyone should be able to take part as player and spectator. We need the greatest possible variety of participants to maximise learning before action. We can nominate roles which are different to those normally (perceived) played by individuals - and this can be useful in a number of educational ways and also serves to involve those who may feel their status is threatened.

In practice we can imagine professionals designing and testing games and a series of plays involving sets of elected representatives and random selection of potential investors and consumers. Clearly the aim of any well designed game should be to allow the players to change role and indeed the roles are defined by the proposals for co-operative action that emerges from the game.

10.4.2. Purpose

As our motives are multipurpose and changing (and as we do not know them ourselves) a general rule should be not to infer motives but to only judge what is done within the conditions of the game. Perhaps the most important observation is that we are dealing with many purposes and many games - public planning is a game of games and its purpose is to help define the rules that will govern future events and behaviour. It is necessary to be clear about the kinds of decisions we want to make or able to make, e.g. to distinguish between control with respect to landuse and to actions involving public investment and between changes to human behaviour and to the environment before considering their inter-related effects.

10.4.3. Space and Time

The time rules should be carefully defined and a balance struck between the need to communicate and learn and the need to respond quickly to changing conditions. We should consider independently different proposals in different spatial perspectives and their effects over the same period of time. We can accept as a framework the relevant British Laws, e.g. with regard to land development and landuse controls five years reviews. And with regard to public investment annual reviews (which in order to respond to prevailing conditions should involve the previous preparation of collection of proposals from which a selection can be made).

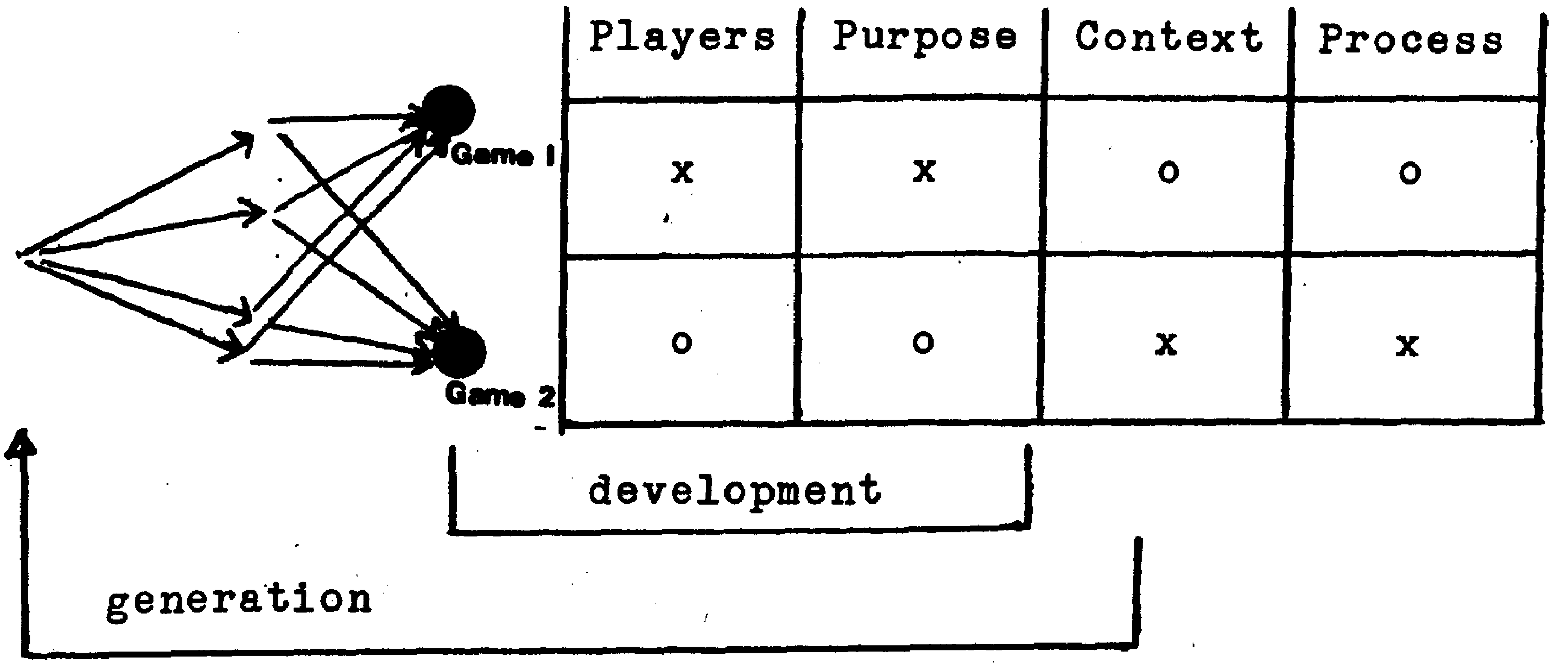
10.4.4. Process

The process of making decisions to act should be hard - if simulations are to help us avoid creating future problems or at least to prepare us for them. It is necessary to generate alternatives to compare them and to choose between them. But if we are to learn we must suspend judgement, consult others, introduce other players with different criteria and see how far the alternatives can be developed to satisfy these. This could be regarded as one round of a game. Rather than make judgements about actions we should make judgements about the criteria we all agree to use to initiate and to assess the results of another round which may lead to action. Here a first play (a sequence of moves) is therefore mainly educational and concerned with decisions within a game and the second play with decisions external to the game (with proposals for action) involving decisions to design and play further games.

The above are the minimum procedures to ensure that we do not simply eliminate (e.g. a or b) but allow for transformation - for evolutionary change (e.g. some of a and b is c).

10.4.5. Using the Variables

Supposing players, purposes, context, and process are considered as related variables and o symbolises no restrictions (or rules) and x symbolises some restrictions (or rules) and there are of course infinite decisions about them that could be made, then the illustration on page 435 shows just two of the combinations (forgetting permutations for the moment). All such variables (properties of games) are assumed to have some restrictions (in theory illustrated in part I) and that there are dangers in education of



learning to copy the rules (status quo) rather than discovering. Clearly we must be clear about what we are to learn (and I think the answer is to become better designers of games) and this means a great variety of experiments - and indeed a process where the denoting of rules for one variable (like the collection of players) are given proceeding to the emphasis on process.

In designing public planning simulations combining learning and practice the main emphasis should be on the search for invariant with regard to process and context (space/time) independently that is of material content, e.g. people and purposes (which are defined by proposals) and are a result of the game.

10.5. SUMMARY OF FINDINGS AND RECOMMENDATIONS FOR FURTHER RESEARCH

Lastly I would like to summarise the main points that emerged from this research.

10.5.1. Advantages of Gaming Simulation in Planning

(i) Gaming simulation techniques in planning offers active and synthetic approach to communication. It furthers communication by allowing people to know each other in applied atmosphere (experiment six). Communicates nature of complexity (experiments 1, 2, 3 and 4). Allows participants to learn the new common language of the game and thus communicate without official jargon (experiments 3, 4, 6 and 7). These potentials could be an outstanding contribution to planning since increased communication among the public, the planners and the decision makers will improve the quality of decisions on individual issues, the impact of such decisions on future time will be less destructive and conflict between them will be revealed and possibly resolved.

(ii) Participation resulted in learning and attitude change. The most common types of attitude change are greater realism and the greater approval or disapproval of the real persons whose role the participant plays in the game (experiments 1, 2, 3, 5 and 7). In experiment 2 in particular, simulation was demonstrated to be an effective tool for training planners to change from rigid to flexible planning styles.

(iii) The experiments suggest that gaming simulation is a useful means of participation in planning and decision making. Participants provided information about their personal opinions through responses made during the simulation exercies. Most participants found the simulation experiments enjoyable and worthwhile experience. Evidence in experiments 3, 6 and 7 suggests that simulation gaming can be used to obtain citizen opinion about planning issues; that people will be willing and even enthusiastic about participation in planning oriented simulation. It is a valuable tool in this respect because it could be a good vehicle for helping individuals and groups within a community to expose values and behaviour for making explicit what has been implicit (experiment 6).

(iv) It is an important tool for education both for the planner and the public alike. As a teaching technique in planner education, there is evidence (in experiments 1 to 7) that it highiens the interest and motivation of planning students; it offers an opportunity for applying and testing knowledge gained from learning and other experiences. Participation gives the students insight, empathy and greater understanding of the world as seen by decision makers. The same kind of outcome applies to continuing education; learning of principles, processes, structures, interrelationships, etc. It is wondered whether in fact it is not just an educational means but should be an integral part of practice to consider in the formulation of policies (or different rules and their effects).

(v) The experiments in this research suggest that gaming simulation in planning provides a risk free or safe environment for "future testing". Players are allowed to try out alternative forms of plans, policies, resouce allocation, etc, with the simulated context (experiments 1, 2, 3, 4, 5, 6 and 7) to test the efficacy of their ideas, the costs and rewards of various options and the difficulties of going from the present structure to the desired future one (experiments 1, 2, 3, 4, 6 and 7). The exploration of possible futures can thus take place in the light of added insight into the relative costs and rewards of alternative strategies. The modelled milieu of a game can in effect be a laboratory where ideas can be developed and tested prior to actual implementation and where the environmental planner can accumulate a factual foundation on which to base his ideas.

(vi) It appears to offer means of creativity - demonstrating generally realism in plan making in addition to, or better than those afforded by formal survey, case studies through archives, literature research or pure computer simulation.

(vii) The experiments suggest that simulation in planning provides a good training environment for those who wish to develop and improve skill in decision making. Businessmen, diplomats have been using simulation to cultivate abilities of persuasion, bargaining and strategy planning; planners could derive similar benefits from the technique. Through the experience of participation planners can gain practice in handling complexity; ambiguity; high risk; high salience, etc.

In summary, I contend that socio-political decision making is one of the most complex activities undertaken by mankind. Furthermore, it is poorly understood by most planners, simulationists and analysts. Therefore it is naive ignorance which leads us to expect too much fidelity from mathematically based simulation models and unrealistic decision making skill from community and governmental leaders. A great benefit can be derived from the building and use of simple and direct simulations intended to be used as only one element in a complex socio-political decision making paradigm. We must recognise we are still ignorant of the nature of this element in the paradigm because the socio-political decision making paradigm is itself still a matter of theoretical conjecture. Therefore, if we are to be competent simulationists in the service of society, we must shift our emphasis from modelling rigid mathematically based structures to that of including uncertain behaviourally based dynamics, and use the so called decision maker as our guide.

10.5.2. Some Difficulties of Gaming Simulation in Planning

(i) Simplification of participation and restricted running time linked to ease of computation has prevented the development of objective role structure and move towards reality. Similarly, attempts to simulate reality and increase importance of roles has increased the computation, as well as the time and resources required to operate the model, hence removing much of the spontaneity and involvement essential for gaming simulation.

(ii) The participants, to assess a potential move and control to evaluate it, must process a tremendous amount of information. Time constraints and lack of analytical support sometimes forces this to be done too superficially (experiments 1, 2 and 3).

(iii) After a series of games is over, it is hard to reproduce the data and carry out a thorough analysis. This can however be countered by the use of online, timeshared computing with multiple consoles, graphic displays and natural languages can do much to speed up play and thus permit repetitions (experiments 4 and 6). It can also take over much of the record keeping and supply analytic substance both during the game for planning and evaluation, and afterwards in assisting in the analysis. However, the use of the computer is not without difficulties (experiment 6).

(iv) Participants in some models may become involved in ways of beating the model instead of focussing on the variables of the model. The individual or team may try to establish ways of shortcutting the model's procedures or devoting less effort to areas within the model in which they may not sufficiently be penalised. In real life these same areas or variables may be of critical significance.

(v) Difficulties of getting players. My experience over the past three years indicated that many professional planners, instructors, resist the concept of gaming simulation as a planning tool. Possibly this resistance emanates partly from (a) status is involved, (b) lack of interest in innovation and change and (c) many planners seem to be more comfortable when they rely on intuition. The other factor might be due to premature judgements reached after superficial contact with demonstration sessions or cursory perusals of literature.

10.5.3. Further Research

In addition to further research needed to improve the models used in this research, further research is required in the following areas.

(i) What would be the effect of altering the rules of the game on decision making in the formulation of a democratic planning system? For example, if one had the same context, what would happen if you have different sets of players? Would they come out with the same decisions? Secondly, if one alters the rule of the process would it change the decision or not?

(ii) Further research is also required to use gaming simulation in cases where decision theory is too complex or too poorly defined formally for any direct method for deduction. Validation of such theory development results will come from comparing the game behaviour with the researcher's holistic understanding of reality, and may be assisted by developing alternative simulations for comparative evaluations.

(iii) In a completely separate direction further research is required to use players to design their own games, usually through adaption of a frame game to their own purpose when experts in a field are the players, the design will reveal their perception of the system's major dimensions. Laymen, people living in the system in question, will provide more individual phenomenological data as they design or plan on the basis of their function in the system. In both cases the researcher must synthesise the player's definition of roles, goals, resources, constraints, etc. This direction will require players to state explicitly their concept of the system and serves a directed but open in-depth interview.

Finally, further research is required to integrate gaming simulation techniques with other valuable planning techniques in decision making such as Delphi Techniques; Cost Benefit Analysis: Environmental Impact Analysis; Threshold Analysis, etc. A game design can include many of the above techniques.

APPENDIX A

A NORMATIVE MODEL FOR OUR ROLES AS THE PROFESSIONALS

I would like to propose that professionals adopt the following principles to guide their work in planning, design, operations or analysis activities.

Principle I : Range of Alternatives

There must be a range of alternatives available. The range of alternatives must be sufficiently broad so as to represent real choices, and must include the option of not doing anything.

Principle II : Identification of Effects

There must be adequate information on the effects of alternatives. This information must include not only the beneficial effects of the alternatives, but also the adverse effects; must include the incidence of those effects; and must include particularly any effects that any particular interest thinks are important, whether or not those effects are readily quantified.

Principle III : Public Involvement

There must be full opportunity for timely and constructive involvement of affected interests in the process, such that every interest.....individual or group.....which may potentially be affected by the changes being considered has full and timely access to all relevant information and has full opporunity to influence the process constructively.

Principle IV : Equity

Where significant adverse impacts might result for some interests in order that benefits can be provided for others, those adversely impacted should be adequately compensated.

Principle V : Uncertainty

Uncertainties which may exist should be explicitly recognised. Uncertainties in predicted effects should be explicitly identified. Some alternatives should be designed for staged implementation so as to retain flexibility in the face of uncertainty. Careful consideration should be given to identifying future options foreclosed and future options left open by proposed alternatives. The process should be flexible, allowing periodic reviews of prior decisions and possible revisions of prior choices.

Principle VI : The Decision Process

The process of reaching decisions should be open, participatory, and decisive, resulting in decisions that are implementable and implemented.

APPENDIX B

GAMING SIMULATION IN TECHNOLOGICAL ASSESSMENT : A CONCEPTUAL MODEL

The traditional approach to impact analysis in technology is outlined in Figure 108

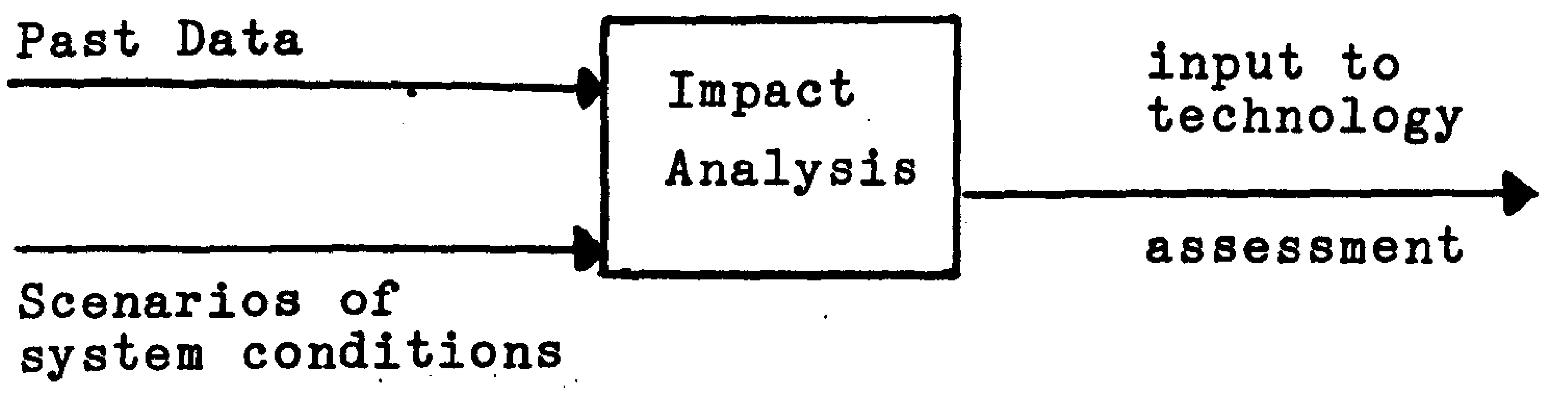


Figure Traditional Approach to Impact Analysis.

Past data relevant to the analysis are collected and combined with assumptions about future system conditions to form the basic input to the impact analysis. Future system conditions are generally developed through the use of "surprise free" forecasts or through the construction of scenarios.

Obviously "surprise free" forecasts have many limitations, particularly with regard to public oriented technologies such as energy, environment and transportation technologies. The future conditions which will affect these technologies have given little indication of being "surprise free". For example, the oil boycott of 1974 has had major influences on a wide range of technologies.

Scenarios, on the other hand, are able to look at a wide range of future conditions but lack predictability. The scenario is a function of the analyst's view of possible future conditions. The scenario assumes a future which can be used to assess the role of a particular technology. With a well selected collection of scenarios, the impact analysis can be conducted for a broad range of future conditions.

While the scenario is effective in generating a series of potential futures, it does not help in determining how individuals will react in these futures. The most common assumption is that individuals will act rationally according to some prescribed goal. This assumption is questionable in many cases. For example, technology oriented to the reduction of traffic fatalities has been rejected in many cases. The original assumptions of the likely behaviour of individuals using such technology did not anticipate the animosity which accompanied it.

A simulation game used as an aid in technology assessment can circumvent these problems. A conceptual model of this process is shown in Figure 109

In the process, an interactive simulation is developed with the capability of accepting input from the various decision makers who will have an impact on the eventual utilisation of the technology. These decision makers may represent a well structured organisation, such as a potential manufacturer of the technology, or they may represent a loosely organised group such as the consumers of technology.

Through repeated simulations with different groups representing the various decision makers, a profile

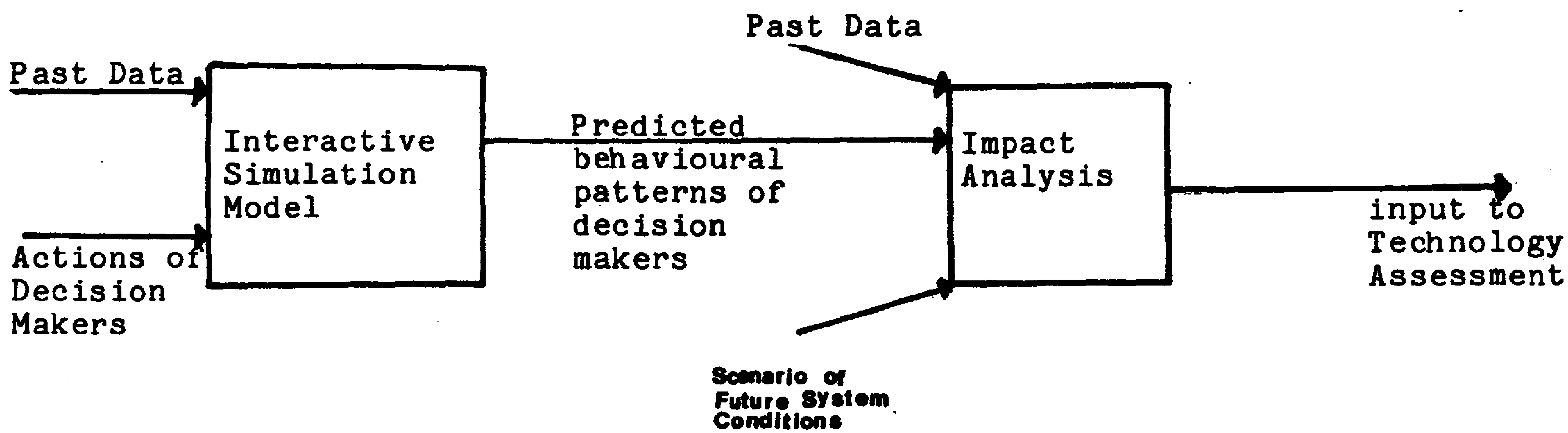


Figure 10.9 The Use of an Interactive Simulation in Impact Analysis

of bevavioural actions can be developed for each set of decision makers. These profiles can then become an input to the impact analysis along with past data and scenarios of future system conditions.

This approach alleviates the necessity to assume goals for individuals which may or may not be true. The process of developing these profiles will not be easy and will require the expertise of a broad range of disciplines. The output from this process should lead to much improved technology assessment methodology.

The dynamic nature of the profile is one of the most valuable assets from using this approach. An initial adverse reaction to a technology may be ameliorated as the decision makers see that more undesirable options result from the non-acceptance of the technology. If such a pattern is detected, the technology assessment should identify this situation. Technology assessment must be able to account for changing attitudes of society.

An Example Application

While this is conceptual in nature, it would be helpful to examine a particular application of this concept. Electric utilities have long had a problem in meeting peak electric demands. In order to meet these demands, expensive reserve generating capacity has been built. One technological solution to this problem is the development of a load control system, which could selectively curtail loads during peak demands. For example, hot water heaters, washing machines, or television sets could be turned off whenever peak demand conditions present environmental emergencies or the potential of blackouts.

In order for such a technology to be successful, it must be acceptable to the general public as well as the utilities. A simulation game in this case should bring together the actions of the different decision makers who will affect the eventual technological assessment of the land control system.

Representative decision makers in this example would be the utility industry, the consuming public, environmental groups, regulatory agencies (e.g. those who rule on utility prices and enforce environmental legislation), civil liberty groups, and legislatures. The role of each of these groups would be spelled out clearly in the design phase of the game. A sample of likely decisions for this sample would be:

<u>Utility Industry Decision Makers</u>

(i) Decide on the amount of capital investment which will be devoted to load control system.

(ii) Decide on rate requests

(iii) Provide lobbying before legislative decision makers

(iv) Determine the mix of facilities for meeting future utility demands (i.e. nuclear versus coal versus other possibilities)

(v) Determine the extent of use of load control systems.

Consuming Public Decision Makers

(i) Provide input to legislative decision makers on the acceptability of load control systems.

(ii) Provide lobbying input for utility rate requests.

Environmental Group Decision Makers

(i) Provide lobbying input to legislative and regulatory decision makers for environmental concerns.

(ii) Set priorities for environmental actions

(iii) Suggest legislation for environmental concerns.

Regulatory Agency Decision Makers

(i) Decide on rate requests by the utility decision makers

(ii) Rule on any consumer complaints related to load control

(iii) Enforce environmental regulations

Civil Liberty Decision Makers

(i) Provide lobbying input to legislative decision makers on matters relating to load control systems.

Legislative Decision Makers

(i) Decide on legislation relation to the use of load control systems.

(ii) Decide on environmental legislation.

(iii) Provide legislative authority for regulatory agencies.

Once the decision makers are established and the rules of the model developed, the next step is the preparation of scenarios describing future energy conditions. It may be desirable to have these scenarios developed from existing analyses of the problem area in question. In a load control system example, scenarios of many kinds would be considered for use in the gaming exercises. The scenarios in this example should contain information on energy supplies and demands, the state of energy technology, and other societal factors important in energy matters.

The gaming exercise would then begin by selecting individuals who represent the various decision groups. They will then be presented with an energy scenario. The entire scenario may not be presented initially, since it may be desirable to see how the decision makers react under various levels of uncertainty.

The decision makers would then be confronted with a round of decisions. For example, the utility decision makers, after reviewing projected supply and demand figures, may introduce the idea of placing load control devices on hot water heaters and washers and dryers. They would lobby for such a proposal with the legislative decision makers. At the same time they may present rate requests to the regulatory decision makers which show the impact of savings that load control could bring about. In addition, they would reveal their plans for meeting future energy needs. The consuming public, environmental groups, and civil liberty group decision makers would provide lobbying efforts with regard to the utility requests as well as suggesting their own legislation.

The legislative decision makers must then make a decision regarding the load control proposal. Depending upon their decision, the game could take different directions. If the load control proposal is rejected, the game will proceed to the next time period with the simulation generating new conditions f from the general outline of the scenario. New decisions will then be required. Of particular interest in this process is the observed changes in the various decision groups as time progresses. For example, do the consuming public decision makers react differently to load control when it becomes evident what the impact such a system has on their utility rates?

If a load control system is approved, the game will then shift to a greater emphasis on the implementation and utilisation of the load control system. As the game presents new supply/demand situations, utilities may decide to alter the use of load control by expanding its use on other appliances or user categories (e.g. industrial users). Again the reactions of the various groups under such circumstances will be of interest.

This general process would then be repeated for a given length of time. Replications of the experiment under the same game conditions with different decision makers would then be conducted to see what effect the participating individuals have on the outcome of the process. Different scenarios and participating individuals would also be used to gain a broader base for the technology assessment.

The most significant outcome of this process will be the determination of how decision maker behaviour changes with time. For example, the consuming public may initially oppose a load control system. As time progresses, potential electricity shortages may become more severe with accompanying higher prices. Higher electricity demands may also trigger greater environmental problems and higher tax rates to subsidise research and development programmes involving new forms of energy. The point at which reaction to a new technology becomes favourable and the condition under which this occurs will be of prime interest in the development of the technology assessment. On the other hand, a technology may be adopted initially with little adverse reaction. As time progresses, the interaction of this technology with other elements of the system may indicate a negative impact for the technology.

By using the interactive simulation process, a dynamic assessment is possible. For a technology assessment to be effective it must be able to anticipate both present and future impacts for a new technology. While the interactive simulation process appears to be an attractive methodological development in technology assessment, there are many problems with its use which must be investigated.

Foremost among these concerns is whether a valid behavioural profile can be developed from the process outlined here. Two potential difficulties are apparent. First is the question as to whether or not the participants under the simulated conditions would approximate their behaviour if they were exposed to a similar real life condition. Second is the problem of whether consenses profiles can be developed. Obviously, different individuals representing the decision maker categories will be different in their decision behaviour. The question which must be resolved is whether the variation from one simulation trial to another is small enough for a consensus behavioural profile to be generated.

A second problem with this process is whether a model can be developed which will accurately reflect the actual system under which the model will operate. A couple of observations should be made concerning this point. First, the difficulty in developing an accurate model in an ill-defined decision environment is not a problem unique to the process outlined here. Perhaps the unique modelling problem associated with this approach is the characterisation of the decisions which the different participants should make. If the proper decisions are not selected, the behavioural profiles which result may be of limited usefulness. In the load control example, there may be a problem deciding what type of impact the consuming public should have. What type of decisions should they be asked to make? Giving consumer decision makers too large or too small a role in the overall process could distort the eventual impact analysis.

Closely associated with the problem of the proper role of decision makers is the diffulty in the development of a proper conflict resolution system. Given the input of the various decision makers, how should conflicting decisions be resolved in favour of one decision maker over another? For example, suppose that the simulation process identifies a conflict between the desire of the utilities to install a load control system and consumers who are opposed to such systems. Some systems must be developed for measuring the degree of conflict which exists between decision makers and then letting the legislative decision makers resolve the conflict based upon the influence level of decision makers.

The selection of individuals to represent the different decision making groups is also a considerable uncertainty. How can researchers using this approach be sure that the participants in the simulation are giving a valid description of the behaviour of the decision making groups which they represent? Undoubtedly sophisticated sampling procedures used by professional pollsters can be used in this regard.

With the multitude of unanswered questions regarding the role of simulation gaming in technology assessment, are the potential benefits from this approach worth the costs of developing such a procedure? While the research costs will be high, the potential benefits are even greater. With research and development costs running into billions, the development of and reliance upon a technology which may prove socially unacceptable is a situation which must be avoided. The magnitude of R & D costs and the severity of national problems (e.g. energy, environment, transportation) depending upon such R & D are so great that research into simulation gaming approaches in technology assessment does appear to be a viable undertaking.

APPENDIX C

EXPLANATORY NOTES TO THE CLASSIFICATION

Identification

The full name of the model, its abbreviated title is listed under this, followed by the designer(s), be it single author, group, firm or institution. The approximate date of publication or application of the model is also noted.

Spatial Coverage

This heading refers to the model's territorial or spatial focus which may be concentrated on a single geographical area or may present more than one activity zone.

Subject Area Coverage

The material presented under this heading is thought to be self explanatory and covers a range of disciplinary activities often involved in the environmental development process. Subjects considered includes Administration, Architecture, Transportation, Urban Design, Physical Planning, Public Policy, studies including politics, economics and others.

Design Characteristics

Despite the limited number of planning gaming simulation models available it is already possible to identify certain general design characteristics which reflect the basic nature of the model in terms of: level of abstraction; interaction and interchange;

role playing improvisation and the inclusion of opportunities for players to utilise qualitative factors which may or may not be quantitatively expressed; the amount of feedback generated through 'play', and the general operational complexity from both the administrators' and players' points of view.

Administrative Characteristics

This section identifies major manpower and timetabling requirements of particular importance to the users - it covers the total number of administrators required, the total number of players and where over thirty people can play the maximum number is specified in the 30^{++} column; the minimum number of hours required to effectively run the particular model.

Functions

This section identifies the actual function of the model. Higher education models could be described as models to introduce, roles, rule, systems and processes with an even greater emphasis on active involvement and problem solving; public education models could be described as that of higher education models but often are orientated towards the creation of citizen forum involvement; staff training models could be described as simulated experience in developing, for example, leadership, interdisciplinary and organisational skills. Data collection models could be described as open-ended models which elicit information from participants, e.g. in terms of consumer preferences; consensus determination models could be described as models in which attitudes trade offs and pressure group stances are explored through open-ended frameworks; research exploration models could be described as basic laboratory exercises for the generation of new frameworks and responses to prescribed or evolving dynamic situations, particularly useful for group behaviour research; policy analysis models could be described as models in which the options and implications attached to decision making are revealed and evaluated.

Name of Model	Designers	Approx. Date	Spatial Coverage: Regional +	Spatial Coverage: City or Town	Spatial Coverage: Districts & Below	Subject Area Coverage: Administration	Architecture	Tranportation	Economics	Urban Design	Phy. Planning	Management	Politics	Sociology	Others	Function: Higher Education	Public Education	Staff Trainning	Data Collection	Consensus Determinat	Reseach	Policy Analysis	Design Characteristics: Computer Operated	Manual Operated	Level of Abstraction: High	Int	Low	Interaction: High	Int	Low	Role Playing Improvisation: High	Int	Low	Amount of Feedback: High	Int	Low	Operational Complexities: High	Int	Low	Importance of Random Numbers: High	Int	Low	Administrative Characteristics: Number of Players: 1–10	11–20	21+	Number of Controllers: 1	2+	Number of Yrs per Cycle: 0–1	2–5	Time – Hrs: 1–8	9+
METROPOLIS	R. D. DUKE	1964		●		●			●		●		●			●	●	●						●	●			●			●				●			●			●				●	●		●	●		●
METRO-APEX	R. D. DUKE	1968		●					●		●				●			●			●	●	●		●				●			●		●			●								●		●		●		●
COMMUNITY LAND USE GAME CLUG	A. G. FELDT	1963		●	●		●			●	●					●	●				●			●	●			●				●			●				●		●			●	●	●		●		●	●
ILAG: INLOGOV: LOCAL AUTH GAME	ARMSTRONG R.H.R	1968			●	●			●		●		●	●		●		●				●		●		●		●			●			●				●				●			●	●		●		●	●
NEXUS	ARMSTRONG R.H.R	1973			●	●			●		●		●			●		●				●		●		●		●			●				●				●						●	●			●	●	
SNUS: SIMULATED NUTRITION SYSTEM	R.D. DUKE	1976	●			●			●						●	●	●	●						●	●			●			●			●			●				●				●	●		●		●	●
POLICY NEGOTIATION GAME	F.L.GOODMAN	1969	●	●	●	●							●	●	●					●				●		●			●			●			●				●				●	●	●		●		●	●	●
ROUTE LOCATION GAME	CREIGHTON	1968		●					●			●					●							●		●			●			●			●				●			●			●	●				●	
NEIGHBOURHOOD	ABT ASSOC	1966			●	●			●		●		●	●			●							●				●			●			●					●						●	●				●	
RIVER BASIN	P. HOUSE	1971		●	●				●		●		●	●							●		●		●			●				●		●			●								●		●	●			●
CITY I	P. HOUSE	1968		●			●							●	●				●		●		●		●			●			●				●			●				●			●	●		●			●
DESIGN A HOUSE GAME	G. TIPPLE	1977			●		●							●	●				●		●		●							●				●					●						●		●			●	
JUSTRE AN INTERCITY TRANSPORT POLICY	L. WILLUMSEN	1975		●				●								●		●				●	●		●				●		●			●			●							●					●	●	
THE MILTION KEYNES GAMING SIMULATION MODEL	R. SARLY-	1973		●				●			●					●	●							●					●		●				●				●			●			●			●	●	●	●
A SYSTEMS ANALYSIS MODEL OF URBANISATION & CHANGE	P ROGERS STEINITZ	1968		●							●			●								●	●		●					●			●	●			●					●	●			●					●

Name of Model	Designers	Approax Date	Spatial Coverag: Regional+	Spatial Coverag: City or Town	Spatial Coverag: Districts & Below	Subject Coverage: Administration	Subject Coverage: Architecture	Subject Coverage: Tranportation	Subject Coverage: Economics	Subject Coverage: Urban Design	Subject Coverage: Phy-Planning	Subject Coverage: Management	Subject Coverage: Politics	Subject Coverage: Sociology	Subject Coverage: Others	Function: Higher Education	Function: Public Education	Function: Staff Trainning	Function: Data Collection	Function: Consensus Determinat	Function: Reseach	Function: Policy Analysis	Computer Operated	Manual Operated	Level of Abstraction: High	Level of Abstraction: Int	Level of Abstraction: Low	Interaction: High	Interaction: Int	Interaction: Low	Role Playing Improvisation: High	Role Playing Improvisation: Int	Role Playing Improvisation: Low	Amount of Feedback: High	Amount of Feedback: Int	Amount of Feedback: Low	Operational Complexities: High	Operational Complexities: Int	Operational Complexities: Low	Importance of Random Numbers: High	Importance of Random Numbers: Int	Importance of Random Numbers: Low	Number of Players: 1–10	Number of Players: 11–20	Number of Players: 21+	Number of Controllers: 1	Number of Controllers: 2+	Number of Yrs per Cycle: 0–1	Number of Yrs per Cycle: 2–5	Time – Hrs: 1–8	Time – Hrs: 9+
A Method of Generating Land Use Plan	R. Hunter	1974	●	●	●					●	●					●					●	●	●	●						●			●	●					●				●			●				●	●
INHABS	C. W. Green	1972			●		●			●	●				●	●	●	●			●				●			●			●			●					●		●			●	●	●		●		●	●
Build a Community Dev Game	J. Orlando	1969			●						●		●			●	●		●	●			●		●			●			●			●				●						●	●		●	●		●	●
Ruglug—Rubulug	R. Bachler, R. Boyle	1374		●						●	●					●	●						●	●	●			●			●			●				●			●				●	●		●			●
GISDIS	J. Harris	1978	●	●					●		●		●	●							●	●	●		●				●		●			●			●								●	●				●	●
Design Games; Keeps Pop	H. Sanoff	1976			●		●			●						●				●				●			●			●			●		●				●				●	●		●				●	
Priority Evaluation Game	G. Hornville	1970	●			●			●		●	●		●		●		●		●				●			●	●	●		●			●					●			●		●		●		●	●	●	
CUPID	Mathur; K	1974			●		●									●			●	●			●		●									●					●				●	●		●				●	
Hex Game	R. D. Duke	1976	●			●			●		●		●	●		●		●				●		●	●			●	●		●			●			●				●				●	●			●		●
BUG: Basic Urban Game	D. Mackie	1970		●						●	●		●	●		●					●			●	●			●			●			●					●			●		●	●	●		●			●
SODIT: Scottish Oil Investigation Tool	D. Mackie	1972		●		●			●		●		●	●		●	●		●		●	●		●			●	●			●			●					●					●		●				●	
Community Land Act Game	D. Mackie	1975	●	●		●			●		●	●	●		●			●				●		●	●			●			●			●					●			●		●	●	●	●	●		●	●
Inner City Game	D. Mackie	1976			●		●	●	●		●	●	●	●		●		●				●		●	●			●			●			●					●						●	●				●	●
Callagrande	D. Mackie	1977	●			●			●				●			●		●			●			●	●			●			●			●					●			●			●	●			●	●	
Local & Regional Planning Model	Warneryd	1973	●	●		●			●		●		●	●		●		●			●	●		●	●			●			●			●				●	●			●		●		●			●		●

NAME OF MODEL	DESIGNERS	APPROAX DATE	SPATIAL COVERAGE			SUBJECT AREA COVERAGE										FUNCTION							DESIGN CHARACTERISTICS																				ADMINISTRATIVE CHARACTERISTICS								
			REGIONAL +	CITY OR TOWN	DISTRICTS & BELOW	ADMINISTRATION	ARCHITECTURE	TRANPORTATION	ECONOMICS	URBAN DESIGN	PHY- PLANNING	MANAGEMENT	POLITICS	SOCIOLOGY	OTHERS	HIGHER EDUCATION	PUBLIC EDUCATION	STAFF TRAINNING	DATA COLLECTION	CONSENSUS DETERMINAT	RESEACH	POLICY ANALYSIS	COMPUTER OPERATED	MANUAL OPERATED	LEVEL OF ABSTRACTION			INTERACTION			ROLE PLAYING IMPROVISATION			AMOUNT OF FEEDBACK			OPERATIONAL COMPLEXITIES			IMPORTANCE OF RANDOM NUMBERS			NUMBER OF PLAYERS			NUMBER OF CONTROLLERS		NUMBER OF YRS PER CYCLE		TIME - HRS	
																									HIGH	INT	LOW	HIGH	INT	LOW	HIGH	INT	LOW	HIGH	INT	LOW	HIGH	INT	LOW	HIGH	INT	LOW	1-10	11-20	21+	1	2+	0-1	2-5	1-8	9+
AFRICAN VILLAGE SIMULATION	T.J BENIBO	1981			•				•		•	•		•	•			•			•			•	•				•		•			•					•		•			•		•		•		•	
DESIGN PARTICIPATION GAME	T. MAVER	1980			•		•									•	•		•	•			•					•						•				•					•			•					•
NATIONAL INVESTMENT DECISION GAME	D. MACKIE T.J BENIBO	1980	•			•			•				•			•		•				•		•	•			•			•				•				•			•			•	•			•	•	
GUTS: A GAME ON URBAN TRANSPORT SIMULATION	L. WILLUMSEN	1979		•				•								•		•					•		•					•			•	•				•					•		•	•		•		•	
EDINBURGH AIRPORT SIMULATION	R. HUNTER T.J BENIBO	1981		•					•		•		•		•	•								•		•		•			•				•				•					•		•				•	
THE PROCESS: A SOCIO-POLITICAL GAME	R. HUNTER	1981	•	•	•			•			•								•	•		•		•				•			•			•									•	•	•	•					•
POWER PLAY: REGIONAL ENERGY GAME	L. WOLF	1977	•									•	•		•	•		•				•		•	•				•		•			•					•		•			•		•		•	•	•	
STAPOL	D LITTLE	1972	•						•			•	•	•	•	•		•		•		•		•			•		•			•			•				•						•	•		•	•	•	
AQUARIUS	R. A. HOWARD	1977		•		•												•			•	•	•	•	•			•			•			•			•								•		•		•		•
DAM: A COMPUTER IMPLEMENTED WATER RESOURCE GAME	R. T. LACKEY	1974		•		•			•		•	•				•		•			•	•	•		•			•	•		•			•			•								•		•			?	•
GEM: GLOBAL ECONOMIC MODEL	D. HELMER	1976	•						•				•		•	•		•				•		•	•			•			•				•				•			•			•	•				•	•

REFERENCES

ACKOFF, R L and ARNOFF (1957): Introduction to Operational Research, Wiley, N.Y.

ACKOFF, R L and F E EMERY (1972): On Purposeful Systems; on Interdisciplinary Analysis of Individual and Social Behaviour as a System of Purposeful Events, Tavistock, London.

ADELMAN, F l and I ADELMAN (1971): "Simulation of City Politics" paper presented to the Joint National Conference on Major Systems, Anaheim, CA.

ALEXANDER, C (1964): Notes on Synthesis of Forms, Harvard University Press.

ARMSTRONG, R H R (1970): The Use of Operational Gaming in the Field of Local Government Studies in Armstrong, R H R and J L Taylor (eds), Instructional Simulation System in Higher Education, pp.67-111.

ARMSTRONG, R H R (1970): "Operational Gaming and P.P.B.S" in P.P.B.S. and Decision Making in Local Government PTRC Procedings, Vol.2, pp.15-16, London.

ARMSTRONG, R H R and HOBSON, M (1969): The Use of Gaming Simulation Techniques in the Decision Making Process U N Seminar, Washington.

ARMSTRONG, R H R and J L TAYLOR (1971): Feedback on Instructional Simulation Systems, Cambridge Institute of Education.

AKTIN, R H (1974): Mathematical Structures in Human Affaires. Heinemann Education Book

ARNSTEIN, S R (1969): A Ladder of Citizen Participation Journal of AIP, Vol.35, No. 4.

BALDWIN, J D (1969): Influences Detrimental to Simulation and Gaming. American Behavioural Scientist, 11, pp.14-20.

BAUER, R A and GERGEN, K J (1968): The Study of Policy Formation. The Free Press, N.Y.

BECKER, H A and GOUDAPPEL, H M (eds)(1972): Developments in Simulation and Gaming, Utrecht, Netherlands, Boom Meppel.

BEE, A J and M R DANDO (1977): Operational Research for Complex Conflicts: A Gaming Methodology for the Development of a Decision Making Monitor, Opl Res Q, 28, 4.

BEER, S (1965): The World, the Flesh and the Metal. Nature, Jan. 16

BELL, C (1970): "A Development Game". Decision Making in a Simulated Less Developed Economy: In Armstrong R H R and Taylor J L (eds) Instructional Simulation System in Higher Education, pp.127-134.

BELLMAN, R et al (1957): On the Constitution of a Multi-Stage, Multi-Person Business Game. Operational Research, 5th Aug.

BENIBO, T J (1979): "The Application of Modern Mathematical Ideas in Planning". Unpublished MSc Thesis DURP University of Strathclyde, Glasgow.

BENIBO, T J (1982): "Gaming Simulation Techniques for Public Policy Studies and participation in Planning". Seminar paper DURB.

BENJAMIN, S (1968): Operational Gaming in Architecture Ekistics, 26, 157.

BERNHOLTZ, A (1968): Some Thoughts in Computers, Role Playing and Design Ekistics, 157, Vol.26.

BLOOMFIELD, L P and N J PADEFORD (1959): Three Experiments in Political Gaming. American Political Science Review, 53, 1105-1115.

BONTA, J (ed)(1979): "Gaming" Journal of Architectural Education 33, 1.

BOOCOCK SARANE, S and SCHILD, E O (eds)(1968): Simulation Games in Learning, Beverley Hills, California Sage Publication Inc

BOTVINNICK, M M (1971): Computers Chess and Language Planning, Harlow Longman

BRODY, R A (1963): Some Systematic Effects of the Spread of Nuclear Weapon Technology. A Study through Simulation of Multi-Nuclear Future Journal of Conflict Resolution 7

BROOKS, H (1976): Environmental Decision Making: Analysis and Values 115-137 in L H Tribe et al (eds) When Values Conflict. Cambridge MA Ballinger

CAKIN, S (1976): "An Experimental Study of Evaluation in Building Design" Journal of the Faculty of Architecture (METU, Ankara) 2(1)

CHADWICK, G F (1971): A Systems View of Planning; Oxford Pergamon.

COLEMAN, J S (1972): The Mathematics of Collective Action, London. Heineman Education Books

COLEMAN, J S (1975): Social Processes and Simulation Games pp.180-247 in C S Greenblast and R D Duke (eds) Gaming Simulation. Rationale, Design and Applications. Beverly Hill C A Sage

COLEMAN, J S (1975) Collective Decisions pp.395-409 in C S Greenblast and R D Duke (eds) Gaming Simulation; Rationale, Design and Applications. Beverly Hills C S Sage

DAVIDSON, D et al (1957): Decision Making: An Experimental Approach in W Edwards (Edit) Decision Making. Penguin 8 London.

DRUCKMAN, D (1971): Understanding the Operation of Complex Systems: Some Uses of Simulation Design. Simulation and Games, 2.

DUKE, R D (1964): Gaming Simulation in Urban Research, Inst. for Community Development and Service, Continuing Education. Service, Michigan State Univ, East Lansing, Michigan.

DUKE, R D (1974): Gaming: A Future's Language. Beverly Hills Sage Pubilications Inc.

DUKE, R D (1974): Reminiscing about the Future: New Language for Citizen Participation in Planning in Procedings of PTRC Seminar Univ. of Warwick.

DUKE, R D and C S GREENBLAST (1975): Gaming Simulation: Rationale, Design and Applications. John Wiley & Sons.

EISEMON, T (1975): Requirements for Citizen Participation in Public Housing: The Truax Technique. Environment- and Behaviour, Vol. 17, No. 1.

EMERY, E D and T P ENGER (1972): Computer Gaming and Learning in an Introductory Economics Course. Journal of Economic Education pp.77-85.

EMERY, F E (Edit)(1969): Systems Thinking. Penguin X71 London.

ENZER, S (1970): A Case Study Using Forecasting as a Decision Making Aid. Futures. Vol. 2. No. 4.

FAURHEAD, J N (1968): Business Games in Industrial and Univ. Education in Proceedings of PTRC Seminar, Univ. of Manchester.

FELDT, Allan G (1966): Operational Gaming in Planning Education Journal of AIP. 32, pp.17-23.

FELDT, Allan G (1972): Community Land Use Game CLUG (Players Manual). Free Press, New York

FRIEDMAN, J (1969): Notes of Societal Action. Journal of AIP Vol. 35, No. 5.

FRIEND, J K and JESSOP, W N (1969): Local Government and Strategic Choice: An Operational Approach to the Processes of Public Planning. London. Tavistock Publications.

FRY, F F (1970): Route Local Game. Traffic Quarterly Saugatuck Connecticut.

FULLER BUCKMINISTER (1969): The World Game. Ekistics 28 October 286-291.

GORDON, T J, ENZER, S and R BOCHBERG (1970): An Experiment in Simulation Gaming for Social Policy Studies. Technological Forecasting Vol. 1.

GOULD, P (1963): Man Against his Environment. A Game Theoretic Framework. Annals of the Association of American Geographers.

GREEN, C (1964): The Simulation of Vernacular Urban Growth - in Planning Games Procedings of PTRC Seminar, Univ. of Warwick

GREEN, C (1971): INHABS 3 Operating Manual, Cheltenham Paper No. 5.

GREEN, C (1973): Design, Games and Language. Build International Vol. 6, No. 6.

GREEN, C (1979): Playing Design Games in Bonta, J (ed) 1979 'Gaming' Journal of Architectural Education 33, 1

GREENBLAST, C S and R D DUKE (1979): Games Generating Games - A Trilogy of Games for Community and Classroom. Beverly Hills C A Sage Publications.

GUETZKOV, H (ed)(1962): Simulation in Social Science Readings Englewood Cliffs, N J Prentice Hall.

GUETZKOV, H and KOTLER, P and SCHULTZ, R (1972): Simulation in Social and Administrative Science, Englewood Cliffs, N J Prentice Hall½

GUTENSCHWAGER, G (1979): Gaming, Education and Change in Bronta, J (ed) 1979 'Gaming' Journal of Architectural Education 33, 1.

HALL, P (1967): New Techniques in Regional Planning. Experience of Transport Studies. Regional Studies, Vol. 1, pp.17-21.

HALL, A S and J ALGIE (1973): A Work Game for Social Services. Simulation Vol. 21, No. 6.

HAMPTON, J M (1976): SIMMIDA : A Business Decision Making Game. Operational Research Quarterly Vol. 27, No.1.

HASELL, J (1979): The Grande Frame Game : A Communication Tool for Designers in Bonta, J (ed) 1979. 'Gaming' Journal of Architectural Education 33, 1.

HELMAR, Olaf (1972): Cross Impact Gaming. Futures, Vol. 4, No. 2.

HORNVILLE, (1971): Evaluating Community Preferences: Environment and Planning, Vol. 3, 33-50.

HOUSE, P (1973): The Urban Environmental Ststem: Modelling for Research, Policy Making and Education. Sage Publication, Beverly Hills.

HOUSE, P and PATTERSON, P D (1969): An Environmental Gaming Simulation Laboratory. Journal of AIP Vol. XXXV No. 6.

HUGHES, L and MANN, L (1969): Systems and Planning Theory, Journal of AIP Vol. 35, No. 5.

INBAR, M (1970): Developing Social Simulations. New York Free Press.

ISARD, W and SMITH T E (1967): Location Games: With Applications to Classical Location Problems, Papers of Regional Science Association Vol. 19.

JANTSCH, E (1967): Forecasting the Future. Science Journal Oct. p.40.

KALZIER, C F (1967): Modern Mathematics in Social Science.

KENNEDY (1973): Theoretical Framework for the Use of Urban Simulation Games in Education and Urban Planning. Simulation and Games Vol. 4.

LAESSIG, R E and WOLF, L P (1973): ERG - Energy Resource Game. Simulation Gaming of Regional Energy Management. Simulation and Games Vol. 4. No. 3

LAWRENCE, R (1979): "Dual Representation of Domestic Space" pp.119-129 in A SIEDEL and S DANFORD of the Tenth EDRA Conference, Washington DC

LAWRENCE, R (1980): The Simulation of Domestic Space Simulation and Games Vol. 2, No. 3. pp.279-300.

LITTLE, D (1972): Social Indicators, Policy Analysis and Simulation. Futures (Sept): 220-231.

LONG, N E (1958): The Local Community as an Ecology of Games. American Journal of Sociology, 64.

LORSTARD, M H (1976): Nutrition Planning Through Gaming. Food and Agriculture Organisation of the U.N.

LUCE, R D and RAIFFA, F (1957): Games and Decisions. New York John Wiley & Sons Inc.

MACKIE, D (1973): Gaming as a Research Tool In Architectural Psychology. In architectural psychology proceedings of Lund Conference (ed) R Kuller, Dowden, Hutchinson & Roses Inc.

MACHIE, D (1974): Game Plan. In Planning Games Proceeding of PTRC Seminars, Univ. of Warwick

MACKIE, D (1976): Contract Gaming. In Planning Games Proceedings of PTRC Seminars, Univ. of Warwick.

MATHUR, K S (1974): CUPID: A Computer Game. Architectural Design Vol. XLIV

MAR, B W (1974): Problems Encountered in Multidisciplinary Resource and Environmental Simulation Model Development. Journal of Environmental Management 2.

MAVER, T W (1971): Simulation and Solution Teams. Proceedings of Design Participation Conference, Manchester.

MAVER, T W (1976): Democracy and Design Decision Making Proceedings of CAD 76, London.

MAVER, T W (1977): "Building Appraisal" Chapter in Computer Application in Architecture. Applied Science Publishers.

McLOUGHLIN, J B (1969): Urban and Regional Planning. A Systems Approach. London Faber.

MELER, R L and DUKE, R D (1969): Gaming Simulation for Urban Planning. Journal of AIP 32 Jan. pp.3-17.

MUTCH, W E S (1977): The Expansion of Turnhouse, Edinburgh Airport in Sewell, W R D and J T Copper (1977) Public Participation in Planning. John Wiley & Sons.

NEUMANN, J V and MORGENSTERN (1944): Theory of Games and Economic Behaviour, New Jersey. Princetown Univ. Press.

NEWELL, A and SIMMON, H A (1972): Human Problem Solving, Prentice Hall.

ONAFOWOKAN, A O (1976): An Application of Combinatorial Approach to Physical Planning using the Computer. Unpublished PhD Thesis of DURP, Univ. of Strathclyde.

POPPER, R K (1959): The Logic of Scientific Discovery, New York.

PYATOK, M (1974): Participation in School Plannings, A Proposed Game, in Tester, D K (1974) Designing The Method.

QUADE, E S (1975): Analysis of Public Decisions. American Elsenier Publishing Inc.

RAE, J (1969): 'Games' Architectural Journal No. 15 Vol. 149, pp.977-983.

RAE, J (1970): Gaming, Decision Making and Social Skills in Armstrong, R H R and Taylor, J L (eds) Instructional Simulation System in Higher Education, pp.141-169

RAPOPORT, A (1960): Fights, Games and Debates, An Arbor Univ. of Michigan Press.

RAY, P and DUKE, R D (1968): The Environment of Decision Makers in Urban Gaming Simulation in William Coplin (ed) Simulation in the Study of Politics Markham.

RHYNE, R F (1973): Communicating Holistic Insight, Fields Within Fields.....Within Fields 5, 93-104. New York, (World Institute Council)

ROWLEY and WILSON, S (1975): The Analysis of Housing and Travel Preferences. A Gaming Approach. Environment and Planning Vol. 7 No. 2.

SANOFF, H (1974): SEARCH - A Simulation: Systematic Evaluation of Architectural Requirements for Community Housing, in Tester, D, Designing The Method.

SANOFF, H (1974): Role: Relating Objectives for Learning to Education in Tester, D. Designing The Method.

SANOFF, H and G BARBOUR (1974): An Alternative Strategy for Planning an Alternative School, in Tester, D. Designing the Method.

SARLY , R M (1974): The Milton Keynes Gaming Simulation Model. in Planning Games Proceedings of PTRC Seminar Univ. of Warwick.

SARLY , R M (1974): P.R.A.I.S.E., Policy Resolution Analysis, Interactive Simulation and Evaluation in Planning Games Proceedings, PTRC Seminars Univ. of Warwick.

SARLY , R M (1973): Change and the Technology of Interactive Simulation in Journal of RIPI No. 4. Vol. 60.

SARLY ., R M (1973): "The Planning Game" in Building Design No. 164.

SHEPHARDS, R (1968): The Possibilities of using War Games to Train Army Commanders. Royal Military College of Science, Shriveham.

SHUBIK, K (1975): Games for Society, Business and War; Towards a Theory of Gaming, Elservier, New York.

SHUBIK, K (1975): The Uses and Methods of Gaming, Elservier, New York.

SIEGEL, A et al (1969): Man-Machine Simulation Models, Wiley N.Y.

SLOMAN, M (1976): How Operational Gaming can Help with the Introduction of New Technology. Operational Research Quarterly, Vol. 27, No. 1.

SMOKE, P (1970): Simulating Human World. Science Journal Vol. 6. No. 7.

STANLEY, B (1968): Operational Gaming in Architecture Ekistics 157, Vol. 28.

TAYLOR, J L (1971): Instructional Planning Systems, A Gaming Simulation Approach to Urban Problems. Cambridge Univ. Press.

TESTER, D (1974): Designing The Method. The Student Publication for the School of Design. North Carolina State Univ. Releigh, N.C. 27607

THOMAS, C J and DEEMER, W L (1957): The Role of Operational Gaming in Operations Research. Operations Research 5, 1 (Feb).

TIPPLE, G (1977): Design a House Game: The Use of Priority Evaluator in Zambia. Town Planning Review Vol. 48 No. 2 April.

WARREN, R L (1968): Model Cities First Round: Politics, Planning and Participation. Journal of AIP Vol. 35. No.4

WEBER, H (1974): The Evolution of a Place to Dwell. Anatomy of Residential Site and Dwelling Design as a Participatory Process and Product. In Tester, D Designing the Method.

WILLUMSEN, L G (1976): JUTRE - An Intercity Transport Policy Game, Proceedings PTRC, Summer Annual Meeting Univ. of Warwick, PTRC Education and Research Services Ltd. London.

WILLUMSEN, L G and ORTUZAR, J D (1978): Learning to Manage Transport Systems, Traffic Engineering and Control, 19(5), 236-239.

WILSON, A G (1974): Urban and Regional Models in Geography and Planning, John Wiley & Sons, London.

WILSON, F (1975): City Planning. The Games of Human Settlement. Van Nostrand Rheinhold Company.

WITTGENSTEIN (1967): Philisophical Investigations, Basil Blackwell, Oxford.

WOOD, J (1964): The Lloyds Life Exercise in Tester, D. Designing the Method.

WRIGHT, J R (1977): Power Play : A Simulation Game for the Analysis of Complex Regional Energy Issues. MSc Thesis Univ. of Washington.