IMPACTS OF GEOGRAPHIC INFORMATION SYSTEMS IN PROCEDURAL PLANNING THEORY AND PLANNING PRACTICE IN SOUTH AFRICA

Martin Drake

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The development of planning procedural theory with an emphasis upon data collection and analysis is reviewed. A brief critique of the Master Plan approach, with an assessment of the likely influence that Geographic Information Systems (GIS) will have upon it and planning practice in South Africa is made. Alternative approaches and their relationship with the new technology are discussed and conclusions drawn as to the impact of GIS on South African Planning.

In order to assess the likely effects of the new technology known broadly as Geographic Information Systems (GIS) on South African town and regional planning, it is necessary to examine briefly the growth and development of procedural planning theory especially since World War II. As this new technology affects data collection and analysis most directly, the emphasis falls on those components which are integral to both town and regional planning theory and practice. The critical appraisals of many planning theorists in the past has resulted in a series of new developments within this body of theory and methodology. While the role and emphasis placed upon data collection and analysis has varied, these have never lost their importance to the town planner.

BACKGROUND

It is today an accepted convention to commence a discussion on procedural theory with Geddes' (1949) concept of "survey before plan" or the "survey-analysis-plan" sequence, which became the dominant planning paradigm from early in the twentieth century to well after World War II. In this, the beginning of planning procedural theory, a clear emphasis was placed upon data collection and analysis. There was a danger that this approach might lead to an over emphasis on data collection at the expense of planning especially when undertaken by bureaucratic officials. Both McLoughlin (1973) and Ravetz (1986) raise this criticism of the Geddesian method. In terms of data collection and analysis, Geddes' emphasis upon synopticism was important and contributed to the development of regional planning. This scale of planning requires a large and comprehensive data base which needs to be analysed and projected while the environment is concurrently monitored and the data base updated. Adams (1932) introduced a new component to the Geddesian approach, which was to precede the survey function. It was the "preliminary outline survey" and was intended to provide a focus for the planning exercise. It would ensure that the limited resources available for data collection and analysis would not be squandered on marginal or irrelevant data.

Further development of planning procedural theory occurred after World War II with the concept of "rational decision-making" which was introduced by Meyerson and Banfield (1955). "Rational" planning and "efficient" planning were seen as being the same thing:

1. The decision-maker considers all of the alternatives (courses of action) open to him.
2. He identifies and evaluates all of the consequences which would follow from the adoption of each alternative.
3. He selects that alternative for which the probable consequences would be preferable in terms of his most valued ends. (Meyerson and Banfield, 1955)

Their well known four-stage model of the rational planning process started with "analysis of the situation". This means that data collection and analysis are seen as the starting point for process. In order to consider *all* alternatives and evaluate *all* consequences a considerable amount of data is required. This leads to technological problems in terms of data acquisition, analysis, storage and projection. The inherent limitations in means to achieve given ends was recognised at the time and the concept of 'satisficing' rather than optimizing was introduced by Simon and March (1959). This gave rise to the notion of bounded rationality (Waterston, 1965). Here the planner "does not examine all possible alternatives nor does he keep searching for the optimum one . . . he selects the first satisfactory solution rather than search for the optimum" (Perrow, in Forester, 1989). Again the type and quality of the data available to the planner significantly affects the selection of a satisfactory solution and hence the outcome of the plan.

The work is followed by Davidoff and Reiner's (1962) Choice Theory of Planning which recognised the limitations of a pure rational approach and attempted to broaden the range of choice by placing emphasis on the effect of the market in achieving as wide a spectrum of satisfaction as possible.

> They "describe rationality in two senses: increasing the reasonableness of decisions and involving full knowledge of the system in question" (Muller, 1990 p 512).

The first step in their process is "value formulation" which deals with the interrelationship between fact and value. Again data collection and analysis are seen as the starting point. Here, however, the type of information to be collected and the way in which it should be analysed differs from that of previous writers such as Geddes - since the emphasis has shifted away from the physical component towards social norms and values within society.

Further criticism of Davidoff and Reiner's Choice Theory for Planning suggests that there is an overemphasis on economics which is equated with efficiency and rational action. In terms of data collection and analysis this is reflected in the large amount of information on market forces and peoples' preferences being collected, which in turn increases pressure on the data bank and its ability to supply the planners with up to date information in a form or structure demanded by them.

The move towards synoptocism in planning (Perloff, 1957) and the integration of comprehensiveness and rationality saw the evolution of the rational-comprehensive approach during the sixties. Planning was seen as a continuous and ongoing process. It was concerned with a wide range of components, not all of which could be dealt with at a purely rational level. A need to improve "the capacity for rationality" and link it with the need to "improve wisdom" was recognised by Webber (1963). Planning was recognised as being involved with both science and art, of having to fuse reason and intuition. The fact that any comprehensive theory of planning must deal with both the scientific and humanistic methods of problem solving was recognised by Harris (1967). Data analysis and projections could well utilize the scientific method, but elements of design and the politics of decision making should fall into the field of humanism. Thus Harris (1967) set data collection and analysis within the field of the scientific method.

It was during this period that technological advances in the computer sciences and cybernetics first began to influence planning procedures. In particular, computers were beginning to be used for data analysis and manipulation. This was relatively limited initially because of the expense and lack of expertise in the field of town and regional planning. However, the influence of this new technology is discernible in the increasing use of mathematical modelling and in the growth of the systems approach to planning.

"The introduction to planning of systems thinking (Emery, 1969), the systems approach (McLoughlin, 1973), systemics (Catanese and Steiss, 1970) and the systems view (Chadwick, 1971) carried rationality and comprehensiveness in planning methodology to a zenith" (Muller, 1990: 513).

These new methodologies incorporated the synoptic principle which demanded a great deal of data and their analysis and manipulation. Information was required continuously and in a variety of forms i.e. numeric, graphic and written. The environment needed to be monitored continually, and plans updated and improved in response to new situations.

Total comprehensiveness proved difficult in practice partly because of its vast data requirements and partly because of the impossibility of examining *all* alternatives and *all* consequences. In addition due to the complex nature of the procedure, public opinion and participation were often neglected. Variations were introduced in order to improve and modify the process. One of the best known of these being a mixed scanning approach (Etzioni 1967) which aimed at making the whole process more flexible.

In practice during the sixties a number of new techniques were developed in Britain and North America. As a result of improvements in computer capabilities larger volumes of data could be processed and new analytical techniques became necessary in order to best utilize this increased capacity. In North America the use of satellite imagery was developed primarily for military purposes, but clearly also had applications in regional planning and development. The discovery of valuable mineral deposits through satellite image processing contributed to the continued refinement and development of these techniques. In Britain, for example, these were used to create or model a number of alternative plans and resource allocation programmes using the computer. This allowed planners to test the impacts of many more alternatives than previously had been possible. The Notts-Derby Regional Study (1969) and the Coventry-Solihull-Warwickshire Sub-regional Planning Study (1971) were milestone studies in this area. Although many parts of the process still had to be undertaken manually, planners recognised the importance of the new technology and began to adjust their planning techniques and procedures to take advantage of this potential. In some cases the techniques were developed ahead of the computer's capacity to handle vast data bases and in the case of regional studies graphic data were plotted manually on to a grid in order to facilitate their easy transfer to computer when the time came (West Central Scotland, Regional Study, 1973).

A planning process suited to the utilization of this new potential was developed by Dekker and Mastop (1979). Known as the "Process of Strategic Choice" it drew on concepts from Operations Research (Friend and Jessop, 1969, 1977) as well as the systems approaches (McLoughlin, 1969; Chadwick, 1971) and significantly, the work on decision making analysis by Openshaw and Whitehead (1976). Strategic choice emphasizes the importance of flexibility in decision making (Gupta and Rosenhead, 1968) and the interrelationship of all stages in the planning process. Planning is seen as a continuous process, cyclical in nature and drawing data continuously from the environment. Data are analysed and reduced to be fed back continuously into whatever stage of the planning cycle requires it (Figures la and b). The process derives a high degree of flexibility from the interconnection of decisions at different stages, and allows for modification and adjustment as new data become available. This increases the robustness of any plans produced (Gupta and Rosenhead, 1963); it allows options to be held open as long as possible and for the selection of that option which closes off the least number of future options.

The failures of many of the legally formalised British Structure Plans helped underline the importance of the concepts of robustness and flexibility, particularly when producing regional plans over a period of five to ten years. A better understanding of the Guption principles has resulted in experimentation with variations of the rational-comprehensive approach. Influenced by concepts such as mixed scanning (Etzioni, 1967) and the process of strategic choice (Dekker and Mastop, 1979) the search has been for a flexible approach, capable of application in Third World situations with their limited and unreliable data, yet still being able to produce implementable plans within the given resource restrictions. The cyclical nature of such approaches allows for the building up of a data base and its continual analysis and refinement, identifying gaps where additional effort need to be directed to gain the correct information with a minimum expenditure of scarce resources.

The traditional blue print approach emphasises physical design and land-use controls as the means by which a planned solution is implemented (Prinsloo, 1972). The design concept and zoning controls are largely preconceived so that the "ideal" solution or "Master Plan" is constructed from a set of values and political policies determined by a central elite group. The very linear and limited planning process consists essentially of a survey of the physical frame and requirements for the preconceived policy (Figure 2). The success or failure of the plan is measured in terms of how much reality can be made to conform to the preconceived "ideal" solution. This solution might be, for example, high density, low cost, mass housing for the poor and unemployed such as Glasgow's Castlemilk development (W.C.S.P., 1974), the Pruit-Igoe housing development, USA (Newman, 1972: 56) or land allocation on racial grounds as applied previously in South Africa. In all cases it represents the particular set of values of the decision-making portion of a society.

COMPONENTS OF THE PLANNING PROCESS

In order to determine the possible points of impact that GIS could have on the planning process, it is necessary to establish a structure for a critique of the traditional approach to planning. This structure, which will take the form of a component analysis, will help identify the weaknesses or problem areas in the traditional blue print approach that can be improved or eliminated by the new technology.

Data Collection

This is typically not done on a continuous basis, but is usually a "one off" exercise for the project or work in

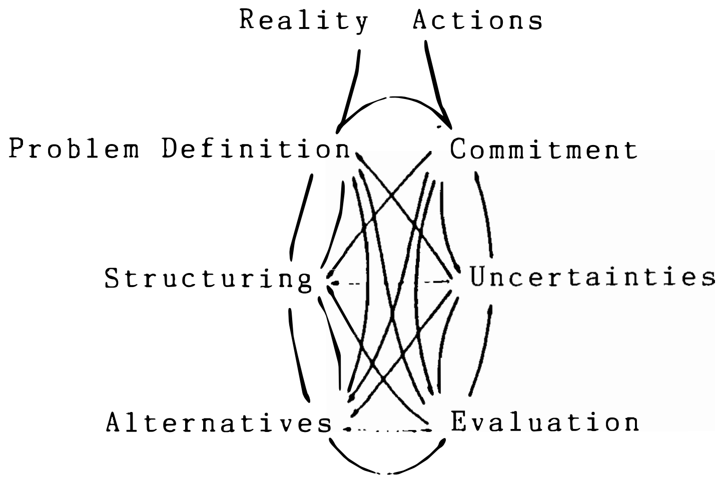

FIGURE 1a: *The Process of Strategic Choice. Source: Dekker and Mastop (1979)*

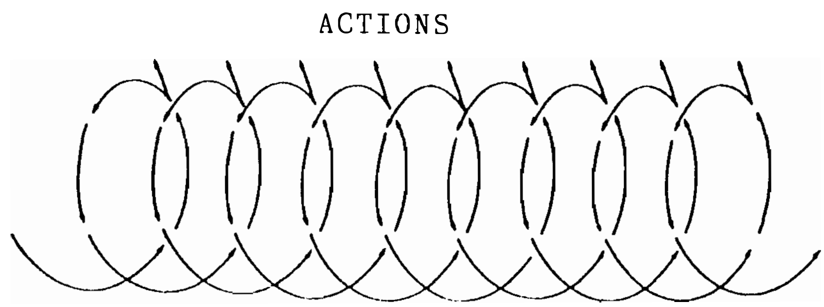

FIGURE 1b:

A Cyclic and Continuous Planning Process. Source: Dekker and Mastop (1979).

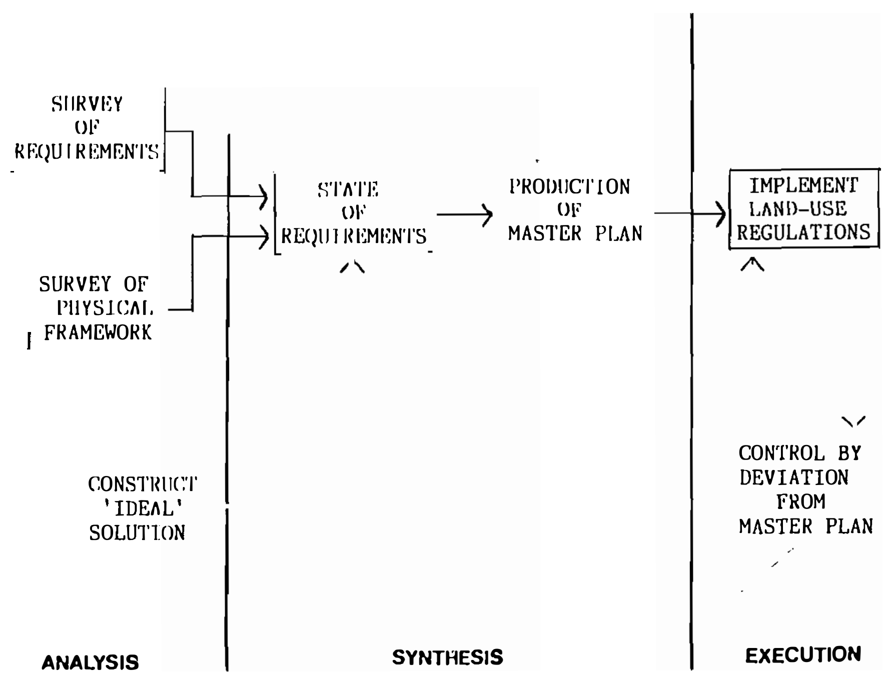

FIGURE 2:

Master Plan or Blue Print Process. Source: I Prinsloo (1972).

hand. This means that regional plans which may take five years to complete are based on data that are five years old when and if implementation commences. There is frequently no clear-cut mechanism for updating data nor for monitoring the plan during implementation.

Analysis of data does not exhibit a high level of rigor in most cases. Analytical techniques are usually limited to a few population projections. The more sophisticated analytical techniques such as Location Quotient, Employment Balance, Social Area Analysis, and Co-hort Survival Projections are generally not considered necessary to complete a survey of requirements or to determine the physical framework; the latter is by and large predetermined. The data collection problem is compounded by the fact that there appears on occasion, to be no clear motive or objective in gathering and analysing the data.

Problem Statement

While one would assume that the reason for the collection and analysing of data would be to produce a ranked or ordered problem statement, this does not appear to be clearly defined in traditional procedures.

The public frequently are not involved in the identification or assessment of problems. Conflicts, opportunities and constraints are rarely clearly identified. Without a clear understanding and definition of problems, any plan that follows is difficult to assess in terms of its ability to solve those problems.

Goals and Objectives

Without a clear, ranked problem statement, goals and objectives are uncoordinated, unordered, often hidden and laden with egocentric values. In some cases statements of goals are too broad, vague and nebulous. The reduction of goals into objectives or tactical aims is seen as threatening, because it gives the public something concrete with which to judge or assess the plan or its performance. The broader the goal statement, the easier it is to argue that it has been fulfilled. In addition, conflicts between goals when stated in broad terms and objectives do not always become apparent. Anomalies and conflicts are thus not articulated. Goals and objectives compatibility matrices are generally not produced and no detailing of aims and objectives is done for evaluation - because no rigorous evaluation is undertaken. Further, public participation in establishing or ranking of goals is at best limited.

Alternative Generation

In the master plan approach no need for alternatives is perceived because the preconceived solution ensures only one possibility. Thus the planner does not need any procedural theoretical underpinnings or knowledge to support the process. Substantive theories may be utilized as part of the preconceived solution e.g. growth pole theory in planning the decentralization of industry. The lack of alternative plans or solutions is perhaps the greatest weakness of the blue print method. It means that the process is rigid and inflexible and unable to adjust rapidly and easily to changes in the physical, social or economic environment.

Evaluation

In the above circumstances, no alternative plans or solutions need be generated, and no comparative evaluation needs to be undertaken. A whole range of planning theory and evaluative techniques are ignored. The process does not require the use of techniques such as cost benefit analysis (Dupuit, 1844), discounted cash flow (Siemens, Martins, Greenwood, 1973), goals achievement matrix (Hill, 1968), planning balance sheet (Lichfield, 1960), cost effectiveness (Krueckeberg and Silvers, 1974; Bell, Keeney and Raiffa, 1977), threshold analysis (Kozlowski, 1970) or any other evaluative techniques. In addition, public involvement in establishing criteria for the selection of preferred solutions is ignored, as the blue print approach does not utilize any of the public participation techniques which were developed during the sixties and seventies.

Implementation

The blue print approach relies upon a bureaucratic and statutory set of control for its implementation. It has to have legal status for its implementation which means that it tends to be reactive rather than proactive, rigid rather than flexible and vulnerable to sudden change rather than robust.

Since the blue print or master plan approach places great emphasis upon the physical and legal aspects of the plan, policy relating to the socio-economic aspects are often ignored or dealt with separately. This results in a lack of co-ordination and gives rise to conflicts during implementation.

Monitoring and Review

This important stage in the planning process is totally lacking in the blue print approach since the linear nature of the methodology has no feedback mechanisms, no return links to the data base and no means of distinguishing between short term readjustments and long term reworking of the plan. Ideally, the review ought to be undertaken by an independent body with its own data source and criteria for assessment (as is the case in Germany). Changes in the environment can result in changes in the importance and thus ranking of problems, which in turn would require a readjustment of goals and objectives and hence alterations to the plan. This adjustment of the means-end relationship is not possible within the masterplan approach. As in the case of the guide plan procedure, this approach makes little or no concessions to future uncertainties. The act of planning is assumed to remove all uncertainties. Therefore the approach has little robustness, i.e. the ability to absorb or continue to function under the impact of unforeseen changes in the environment.

THE GEOGRAPHIC INFORMATION SYSTEM (GIS)

The basic Geographic Information System (GIS) concept is not new. In fact the Domesday Books of the Normans in Britain nearly a millennium ago was a GIS, although it did not have many maps and no computers were used (Gilfoyle, 1991). It is the improved computer technology of recent years which has allowed this concept to develop into a new technique, the activities of collecting data and analyzing it for use by decision-makers has now been greatly speeded up. Work which previously took many man hours to do manually can now be done in much shorter periods enabling the planner to extend the range and variety of alternative solutions and to identify problems quickly. GIS has been defined as:

"... a set of tools for collecting, storing, retrieving at will, transforming and displaying spatial data from the real world for a particular set of purposes: ... for example ... 'by using the GIS in a similar way that a trainee pilot uses a flight simulator, it is in principle possible for planners and decision makers to explore a range of possible scenarios and to obtain an idea of the consequences of a course of action, before the mistakes have been irrevocably made in the landscape itself". (Burrough, 1987:6)

The GIS technology was developed in countries where town and regional planners were well aware of the faults and shortcomings of the blue print approach and had been experimenting and developing improved approaches to planning since the 1950's. Initially the changes and improvements were slow, public participation limited, technology underdeveloped. Planners had to manually create maps, tables, graphs and calculate projections. With the growth and development of computers the pace of experimentation increased; reform followed with improved public participation. Huge data bases of alpha numeric and graphic data existed. At first the numeric data was computerised and more recently the graphic or mapped information has been incorporated.

Over the years many hundreds of analytical and procedural techniques were developed and tested. The most efficient and effective means of dealing with large data bases were identified. From this knowledge came a demand for an integrated computing package which allowed for the rapid and easy transference of alpha/numeric and graphic data from table to maps and vice versa.

The first GIS-developed software appeared in the early 1960's in Canada. It was designed to manage large collections of data on natural resources and the environment, essentially at a regional scale (Dangermond, 1990). Since then its application has been increasingly associated with urban land records and is currently becoming a standard feature in most of the larger municipalities in South Africa. These systems are structured to focus on the entry, management, manipulation, analysis, query and display of large collections of spatial data. Typically they allow multiple users to access the data base in terms of either alpha/numeric or graphic displays.

"Common to the GIS type of system is the use of topology (networks) to store relationships among various spatial objects. Topology involves the use of graph theory to abstract and relate cartographic objects using a series of arcs and nodes." (Dangermond, 1990).

The GIS data does not store map features or symbols, but rather organises the features with descriptive characteristics (Figure 3). These can then be extracted and displayed in graphic format, according to a predefined set of symbols. This means that there is a degree of flexibility for end users, particularly in multi-disciplinary organisations.

The data base is stored in a central processing unit and accessed by a network of terminals via the GIS or geographic data management procedures (Figure 4). In the case of a Computer

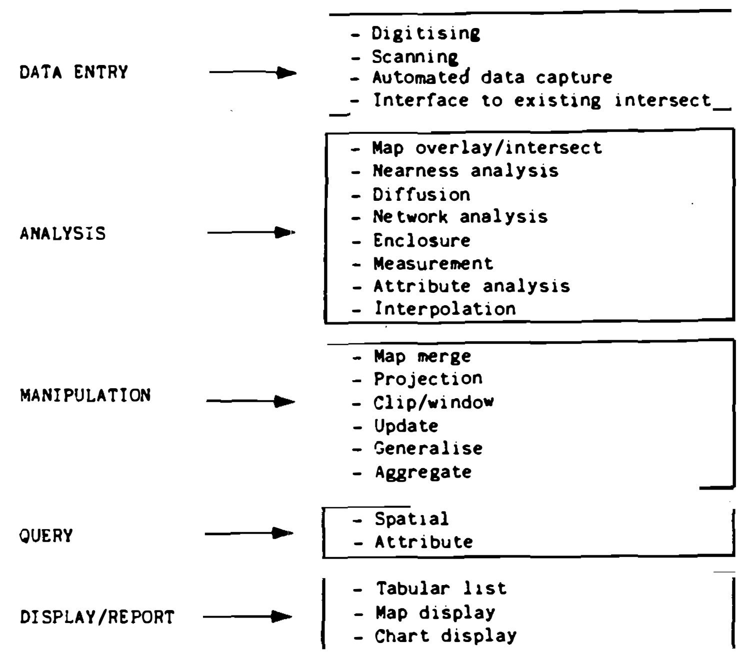

FIGURE 3: *G I S Software Tools. Source: J Dangermond (1990).*

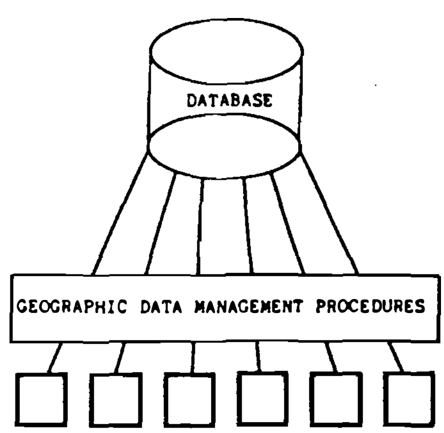

FIGURE 4: *Geographic data management procedures. Source: J Dangermond (1990).*

Aided Design (CAD) system, which does not automatically generate its own data files a "translation" is required. Problems can arise if the original CAD diagram is not accurately drawn; for example, if some of the polygons are not closed then the GIS will not be able to recognise the polygon as such and may classify it as a line (Figure 5). Once the data has been transferred from CAD to GIS then conversion and manipulation of the data can be developed. Any GIS will include a number of manipulative tools, which would be impossible to install or operate in an ordinary CAD system. Some of the more common tools include automatic identification of relationships between and among maps, selection of optimum path in a line network and the analysis of flows across terrain (Dangermond, 1990). Specialised functions can be added by planners where required, allowing for automatic and rapid execution of both analytical and procedural techniques which in the past had been done manually. Thus while the system can be used by traffic engineers to generate flow models, by public administrations for land tax assessment or by environmentalists for impact assessment, it is at the town and regional planning level that the GIS's greatest potential lies. Its flexibility and rapid turn round time allows for the generation and evaluation of a number of alternatives.

Following the same component analysis procedure, one can assess the potential benefits that GIS offers with respect to the traditional rational comprehensive planning process which is most commonly used in the First World. On the basis of this analysis one can assess how GIS may modify and improve planning approaches in the Third World.

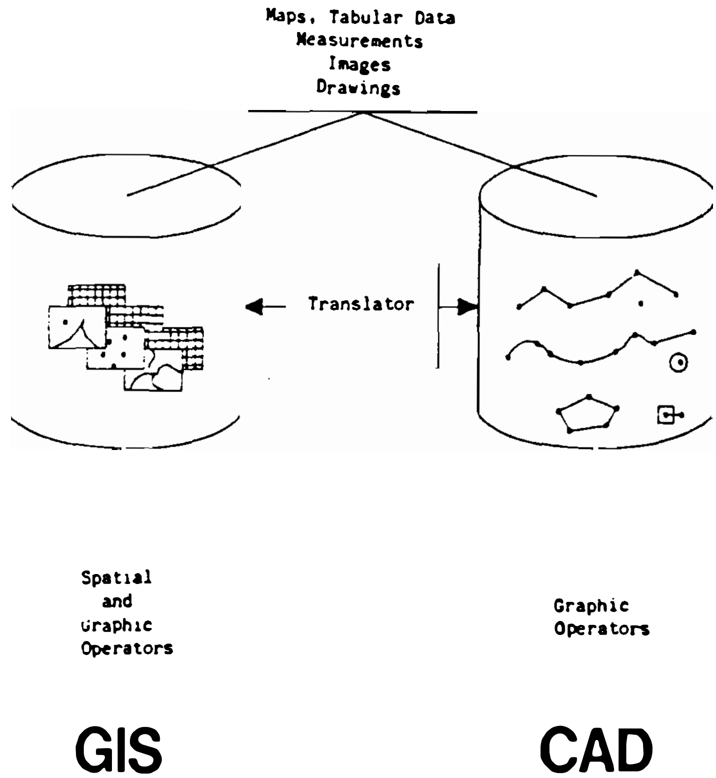

FIGURE 5:

The G I S - CAD interface. Source: J Dangermond (1990).

Data Collection

With an established GIS, data collection on a continuous basis becomes feasible. Data from a wide range of sources can be entered into the system in both graphic and alpha/numeric forms. For example alpha/numeric data, such as population tabulations can be updated by typing or scanning in figures directly from the survey reports. This data can then be manipulated – i.e. projections made and plotted according to any given set of criteria and displayed graphically. This can be completed within a relatively short time. Graphic data, maps and cartographic information can be entered by either typing in the coordinates or all the points on the surveyors diagram or by digitizing it from existing maps. This is less accurate but can be quicker especially if the maps is scanned, i.e. automatically and mechanically digitized. Pictorial data, video and photographic data are usually captured in a raster format which can then be converted to a vector format (i.e. line and numeric coordinates) so that it is compatible with the digitized map data, and can be used to rapidly up date existing maps. In the more sophisticated systems a direct satellite lead into the computer allows for "real time" image observation and processing.

Data that are captured in alpha/numeric format can be manipulated and analysed rapidly by using whatever techniques, tests, analytical procedures the operator decides to write into the programme. This could include:

- co-hort survival projections
- exponential or linear projections
- employment balance projections
- location quotient analysis
- mathematical modelling and so on.

In addition, the output from various analytical techniques can be rapidly plotted at any scale and upon any suitable base map held within the system. This rapid conversion of alpha/numeric data into a graphic format is extremely useful for such techniques as:

- social area analysis
- potential surface analysis
- locational analysis
- mathematical modelling
- three dimensional modelling

Should the output be required in bar charts, pie charts or alpha/numeric tables, this is equally feasible and is useful for such techniques as:

- input/output analysis
- shift/share analysis
- social accounting

In sum, data can be collected from numerous sources, written, graphic, numeric, photographic or pictorial and entered directly into the data base. It can be manipulated and analysed by a wide range of people with different interests, concerns and professions. The motive or objective in collecting data is to allow the various disciplines access to the data base in order to pursue their own specialised interests.

Similarly, output can be written tabular, pictorial, graphic or map form, or any combination of these. This is extremely valuable from a town and regional planning perspective, because it allows for communication with a wide range of the public; particularly illiterate groups for whom pictorial or video communication clearly has advantages. This will greatly assist in determining a community's problems, needs and wants, which in turn will assist in establishing priorities.

Problem Statement

Because GIS can handle large amounts of data and communicate the results of analysis in various forms both visual and written, the identification and ranked ordering of problems becomes easier. Two-way communication between communities allows for the identification of conflicts, opportunities and constraints at local levels. In this regard, GIS can play an educative role allowing local groups or bodies to rapidly identify existing and potential problems and their impact on the community.

Goals and Objectives

If a community is able to assess and agree on the problems affecting it, it can also set its own goals and objectives for overcoming these problems. These problems, goals and objectives can be quantified and tested for conflicts by using GIS. Alterations, reassessments and reevaluation can occur much more rapidly than has been previously possible, so discussion, adjustment and representation can occur before conditions have changed, to the extent that analysis and objectives become outdated.

Alternative Generation

In theoretical terms an infinite number of alternative futures exist, from degenerations backwards through the whole range of tangential developments to straight ahead projections of the status quo. The great range of variables that could affect the future means that conceptually any diagrammatic representation must be multidimensional. In graphic forms planners have been previously limited to just three. Furthermore, the number of features considered by planners through data collection have been limited and the ability to analyse and manipulate data rapidly has been restricted. Planning has consequently been characterized by a degree of uncertainty which requires management in three ways (Friend and Jessop, 1977).

Firstly, uncertainty in the knowledge of the external environment has been dealt with by further data collections and analysis. With the new technology, potential in this area has increased.

Secondly, uncertainty in related fields of choice has meant extending the field of consideration. This is where a wider range of possible alternatives can be considered in order to increase the built-in flexibility of any adopted plan (i.e. the ability of the plan to accommodate change within itself without having to regenerate the entire plan). Here again GIS can play an important role in allowing for rapid regeneration of part or all of a plan as new data is obtained from the environment.

Thirdly, uncertainty as to the appropriateness of value judgements and the degree to which any one alternative is susceptible to changes in values can be tested as part of the evaluation. The GIS can facilitate this through the use of such techniques as the analysis of interconnected decision areas (AIDA) (Friend and Jessop, 1977) and robustness analysis (Gupta and Rosenhead 1963). The latter is based on the idea that the "best" current alternative may not be the "best" in the future, therefore, decision making should be structured so as to close as few "best" options as possible. The planner thus abandons the search for an unknowable future optimality in favour of the more modest and practical goal of future flexibility. With this inbuilt flexibility the plan can withstand or adjust to unforeseen future events without having to be totally scrapped. In order to test and model future options, the GIS data base can be utilized to produce a wider range of alternatives than can be generated manually.

Evaluation

The wide range of alternatives will require analysis in terms of their impacts on critical decision areas as well as evaluation. Again GIS has the potential to allow for the concurrent use of a wide range of evaluative techniques. The goals achievement matrix (Hill, 1968) could be run in conjunction with cost benefit analysis (Dupuit, 1844); planning balance sheet (Litchfield, 1960), cost effectiveness analysis (Krueckeberg and Silvers, 1974, Bell, Keeney and Raiffa, 1977), or threshold analysis (Kozlowski, 1870). The rapid turn round time for running these evaluations could also be used to encourage community or individual participation. The currently popular "what if?" concept can be tested at this stage for a large number of people.

Graphic three dimensional models can be generated (in colour) at any scale and rotated to give any perspective so as to demonstrate the physical appearance of an alternative to an illiterate audience. Responses can be immediately fed into the computer and their physical effects on the model tested. Other socio-economic impacts can be calculated and stored in the alpha/numeric data base. These can be retrieved in tabular form or displayed graphically as pie charts, etc. The impact upon decision makers should be positive since the estimated effect of a decision taken today on the future can be shown almost instantaneously for any given set of assumptions. Interactive presentations with decision makers asking various "what if?" questions could reduce volumes of report writing.

Implementation

Implementation procedures could still follow traditional lines, but GIS will enable a rapid and more effective monitoring and overview of the plan's implementation. The authorities and public have the potential ability to pick up both deviations from the plan and the influence changes in the environment will have on the plan. These new data can be fed back into the data base and utilized by the planners to update all or part of the plan, and can also be used by the community to question and influence the planning authority.

Faster reaction or "turn round time" in the community is going to put pressure on planners and decision makers to improve their own response times.

USE OF THE GIS

The underlying assumption is that the GIS technology will become relatively ubiquitous. The various groups that will acquire access to this technology range from trade unions to local communities, from research institutions to business organisations. With costs stretching from millions down to a current low of R20 000,00, the constraint appears to be educational rather than economic or technological (Marrao, 1990). It can be anticipated that over a relatively short period of time access to GIS will become available to an increasingly vocal and demanding sector of the public which has traditionally been excluded from decision making in planning.

The impacts of GIS upon the traditional South African blue print or master plan approach are likely to be manifest in a shift in emphasis from exclusive to inclusive, and from rigid to adaptive and interactive. The rapid responses to plans by increasingly more vocal communities will result in more frequent periods of review and hence a cyclical process will evolve. There is nothing startling about these trends and changes since they have already occurred in other parts of the world. In South Africa, the GIS technology will thus assist in the development of a new or revised planning process: one which is likely to have numerous variations and combinations, but generally would fall into the main stream of the tradition of rational comprehensive planning. It can be expected to have its own modifications for African conditions as well as local variations. These might include elements of mixed scanning (Etzoni, 1967) or strategic choice (Dekker and Mastop, 1979). A variation of the latter approach has been experimented with and found to have some potential within a Third World setting (Figure 6). Conceptually this draws upon a range of theories starting most obviously with strategic choice, but introduces a dynamic element to emphasise the interactions between reality and theory over time (Figure 7). Crisis conditions emphasise the need to

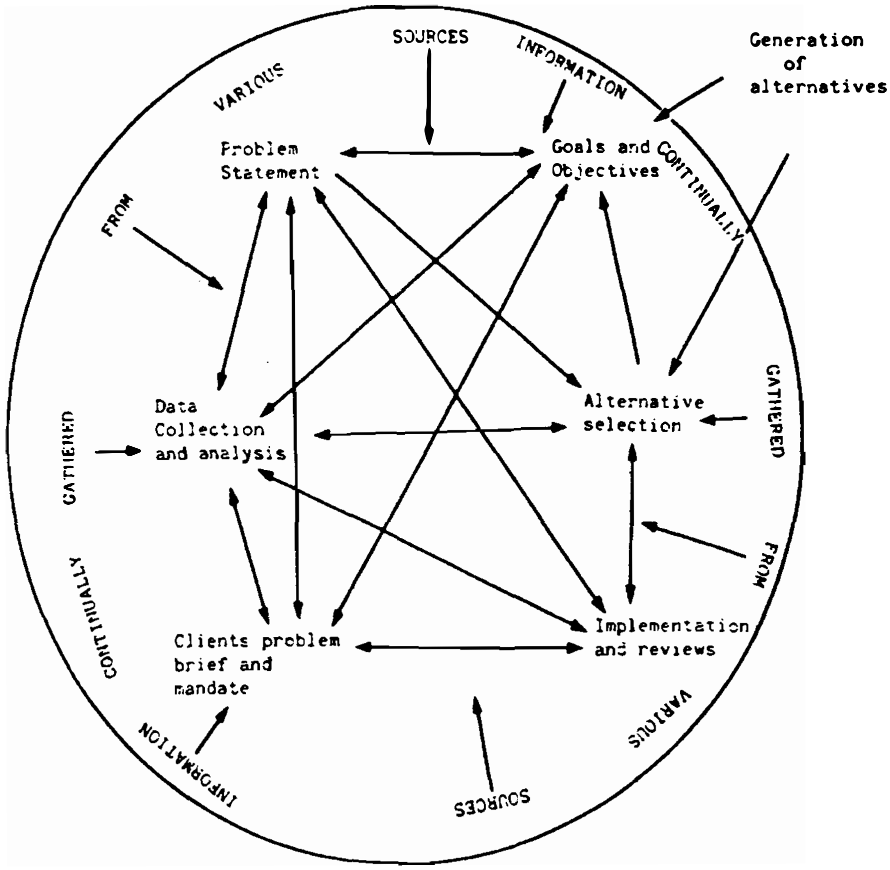

FIGURE 6:

Strategic Choice; a variation developed for use in the African third world.

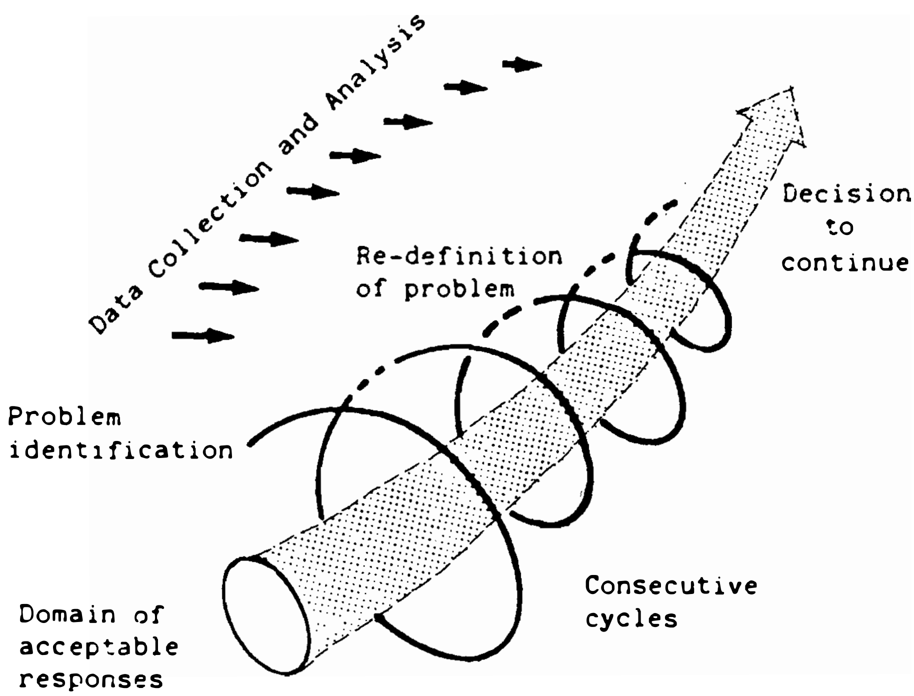

FIGURE 7:

Planning Development Spiral. Source: J Zeisel (1981).

shorten the lag time between plan and action. Traditionally planners have followed the convention that planning should precede action, i.e. that planned action is better than unplanned action. This concept has been challenged in a Third World context by planners who have had to deal with deep and long enduring crises (Treuner, 1977). In these extreme situations any sensible action may be beneficial, even if later it has to be superseded by other actions based upon better knowledge and understanding. One of the great advantages of immediate action is that it can gain a commitment and support from a sceptical local community, which might otherwise suffer the disillusionment of having to wait without any action for several years while a plan is completed. Although this can be seen as a radical inversion of the accepted planning process, experience gained in Asia has shown its benefits.

There is a potential within GIS for planners to begin data collection and analysis from remote sources so that when they do appear on site and interact with the community they are able to engage in action immediately and incorporate the support of the local community.

CONCLUSION

By not maximizing the benefits of this new technology planning will remain cumbersome and costly. GIS has been developed from a planning ethos which recognises and encourages public participation at various stages of the planning process. The process, therefore, actively seeks to serve the best interest of *all* members of the community, and GIS can provide essential support for this objective in South Africa. This technology is currently being used in the republic by a wide range of private and public concerns in planning future strategies and policies: from the marketing and distribution of goods to water resource development policy. The more widespread the use of this technology becomes, the more conflicts of interest are likely to be highlighted and the greater the pressure upon the authorities to resolve conflict through rational planned development - which is acceptable to the communities involved. Therefore, with increasingly sophisticated facts and figures at the public's disposal, one can expect an intensification of public involvement and the questioning of planning decisions. This means that planning authorities will be expected to give rational explanations concerning the choices that have been made in the plans they present to the public.

In the introductory sections of this article an overview of the development of procedural planning theory - from the Geddesian through to the strategic choice methodologies - was given as too an indication of the place and importance of the information or data base applicable to the respective procedures. While the application of GIS is unlikely to result in a fundamental restructuring of planning procedures or procedural theory, there is no doubt that it will exercise a profound impact on the practical activities pertaining to any procedure. The potential benefits of this technology to all sectors of South African society must be recognised if the planning profession is to be in a position to discharge its responsibilities effectively in the challenging years ahead.

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