


# **SYSTEMS ANALYSIS IN URBAN POLICY-MAKING AND PLANNING**

Edited by  
**Michael Batty**  
and  
**Bruce Hutchinson**



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## PREFACE

The book is organized as follows. In the introduction, the background to the meeting is sketched, the scope of the papers briefly reviewed, and the paper by Vickers which was delivered as the opening address, is presented. Vickers' paper introduced many of the themes developed here, and as such, it represents a useful focus on the subsequent contributions. The background papers are

In September 1980, the Special Programme Panel on Systems Sciences of the North Atlantic Treaty Organization (NATO) sponsored an Advanced Research Institute (ARI) on "Systems Analysis in Urban Policy-Making and Planning" which was held at New College, University of Oxford, from 21st to 27th September. This week-long meeting brought together 35 invited delegates from most countries of the NATO Alliance to discuss the impact which systems analysis has had and is likely to have on urban affairs. The manuscript was submitted to the publisher in June of 1982.

Although the goal of the ARI was to assess the impact of urban systems analysis as seen through the eyes of those closely involved in such work, the meeting also addressed opportunities for future research and development, and therefore in this book we have attempted to synthesize discussions at the meeting with this in mind. But before we describe the structure of this book, it is worth recounting in a little more detail the intentions and organization of the meeting, for this has had an important effect on the type of papers produced here, the way they have been written, and the issues they address.

The structure of the week-long ARI was developed by an Organizing Committee consisting of Michael Batty of the University of Wales, UK, Bruce Hutchinson of the University of Waterloo, Ontario and Douglas Wright, then with the Provincial Government of Ontario, and now with the University of Waterloo. In addition, Donald Clough of the University of Waterloo, delegate to and former Chairman of the NATO Systems Sciences Panel, provided much helpful advice on the organization of the ARI. Bulent Bayraktar, Secretary of the NATO Systems Sciences Panel, also helped in establishing an appropriate focus for the meeting and in inviting a representative list of delegates.

This book represents the outcome of the meeting and as such, the papers included are broadly representative of the ideas discussed at the meeting. Indeed, all the papers included here were circulated prior to the meeting in draft form and were used to direct discussion. None of the papers, with the exception of those

by Vickers, Ridley and Cole which were invited presentations, were formally delivered at the meeting, but all the papers were revised in the light of the discussions. We thus refer to these papers as "background papers", and as they constitute the bulk of this volume, they should be considered in the light of the introduction which presents the original intentions of the ARI, and the Conclusions which present its recommendations.

The book is organized as follows. In the introduction, the background to the meeting is sketched, the scope of the papers briefly reviewed, and the paper by Vickers which was delivered as the opening address, is presented. Vickers' paper introduced many of the themes developed here, and as such, it represents a useful focus on the subsequent contributions. The background papers are then presented, grouped into six parts. Finally, the conclusions comprise a paper by Batty and Spooner, outlining the results of a survey of the participants' attitudes towards certain issues in the field, and a paper written by the editors which synthesizes the recommendations emerging from the meeting.

Although we have imposed a fairly strict order on the papers by grouping them into distinct parts, there are many common themes cutting across these contributions; intending readers might therefore best consider each of these papers as statements of each individual author's view of the contribution, actual or intended, of urban systems analysis to planning. Indeed, this was the stated intention of the organizers in asking participants to write these papers. Accordingly, these papers may be read in any order for in essence they represent "snapshots" of opinions concerning the state of the art in urban systems analysis, among experts working in a field which has emerged during the last two or three decades.

Michael Batty

Waterloo, Ontario

Bruce Hutchinson

April, 1982



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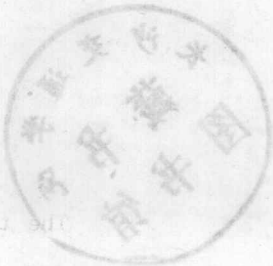
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little analysts varies widely between different aspects of planning. Moreover, the emphasis to these different aspects demands different techniques which embrace the overall scope of systems analysis. For example, short-term problems of planning involving the organization of public utilities and facilities are quite well-defined, and are well-suited to the application of operational research methods. In contrast, longer-term problems of population, transport and dynamic simulations. The organization of these systems analysis and dynamic simulations. The organization of these areas of technical development of information and management building, involves the development of information and management systems. The field is large and an attempt was made to be clear about its scope at the outset of the Institute.

## SYSTEMS ANALYSIS IN URBAN POLICY-MAKING AND PLANNING:

### BACKGROUND TO THE NATO ADVANCED RESEARCH INSTITUTE

More specifically, the work of the Advanced Research Institute was structured with the aid of the following questions:

What has been the experience of systems analysts in this area during the last two decades?

### INTRODUCTION

This paper outlines the kinds of issues which guided the organization of the Advanced Research Institute. The goal of the Institute was to assess the impacts of systems analysis on urban policy-making and planning, to discuss the success or failure of such ventures, and to attempt some evaluation of the experience both historically and in terms of the lessons to be learned for future work.

In a wider context, the purpose of the seminar was to explore the age-old problem of the relationship between scientific endeavour and social action; that is, to use systems analysis as a window through which to view the dilemmas, paradoxes, insights and ambiguities which plague the use of any science or rational method in a social context. To this end, the seminar was not focused primarily on the technical issues of systems analysis, but on the use and impact of such technical analysis in a wider political environment.

Accordingly, the definition of systems analysis which guided the organizing committee was fairly liberal and included any rational analysis procedure that contributed to the understanding of urban problems and the prescription of possible solutions to these problems. The term "systems analysis" refers to systematic procedures which are at least partly explicit, and when applied to policy-making and planning enable scientists and decision-makers to do more than simply "muddle-through". Different styles of analysis have developed during the last twenty to thirty years which reflect the various aspects of work which are included under the umbrella term of urban policy-making and planning. The ability to develop scientific distinction between the subject areas comprising systems analysis in urban policy-making and planning, and the methodological themes involving

tific analysis varies quite widely between different aspects of planning. Moreover, the emphasis to these different aspects demands different techniques which embrace the overall scope of systems analysis. For example, short-term problems of planning involving the organization of public utilities and facilities are quite well-defined, and are well-suited to the application of operational research methods. In contrast, longer-term problems of population, transport and housing are more suited to the development of economic systems analysis and dynamic simulations. The organization of these areas of technical work themselves in terms of budgeting and scheduling, involves the development of information and management systems. The field is large and an attempt was made to be clear about its scope at the outset of the Institute.

More specifically, the work of the Advanced Research Institute was structured with the aid of the following questions:

What has been the experience of systems analysis in this area during the last two decades?

How relevant have been the techniques and applications?

What has been learned about the theory of systems analysis and the ways of applying it?

Are the difficulties and contradictions which characterize the field simply manifestations of some broader issue about the relevance of science to human affairs?

How can analysis be improved?

What are the current and likely future issues?

What are the prospects?

What should be done?

Clearly it was not assumed that all of these questions could be answered, at least in any definitive way, but in attempting to evaluate systems analysis in this way, the hope was that the seminar would begin to raise the collective awareness of the delegates concerning these issues. An attempt was made to select delegates to the Institute with a healthy balance of academic and non-academic experience, theoretical insight and practical knowledge, intellectual rigour and political sensitivity to the series of questions around which the seminar was structured.

One final distinction was made and this relates to the distinction between the subject areas comprising systems analysis in urban policy-making and planning, and the methodological themes involving

analysis and planning per se. In essence, the domain of urban planning can be separated into quite distinct areas, the prerogative of different professional groups and different disciplinary perspectives, but cutting across these are common analytical and methodological approaches. The Organizing Committee proposed that the various subject areas be represented in some way in the seminar through the experience and skills of the various participants, but that the prime focus of the seminar would be on extracting commonalities and differences in the approach and impact of various types of systems analysis.

#### THE SCOPE OF THE INSTITUTE

At the risk of oversimplification the Organizing Committee defined five broad clusters of activity which form the substantive basis of systems analysis in urban policy-making and planning. These five areas can be considered as separate subject areas but each area is also distinct in terms of its professional skills, methodological approaches and possibly its impact on practice. These areas are listed as follows:

1. **Public Services Planning:** involving rather well-defined short run problems such as fire and police protection, health care, educational provision and location, the management of existing transport services, and the resource allocation process involving such delivery systems. In this area, systems analysis has been developed in quite straightforward ways using existing OR techniques and simulation methods.
2. **Physical Network Planning:** involving somewhat longer run problems than Item 1 above, often with a strategic emphasis but concerning fairly well-defined network structures in cities such as transport, water supply, sewerage, electricity and so on. Systems analysis has involved the development of more special purpose models and techniques than Item 1 above, and these are embedded in a somewhat looser planning context.
3. **Built-Form Planning:** involving the design of adapted spaces in cities, typically housing and service functions. Such planning is short- to medium-term, involving less direct systems analytic techniques than Items 1 or 2 above but being quite strongly related to Strategic Land Use Planning which is accomplished at a higher level.
4. **Strategic Land Use Planning:** involving much longer range problems where the emphasis is typically on urban spatial organization and the informing theory is largely economic in emphasis. Systems analysis has developed in terms of special purpose computer models, more strongly mirroring economic theory than those discussed so far. Such problems are quite ill-defined and the range of analytic techniques is wide.



5. Corporate Planning: involving a higher level decision-making function than those areas sketched above, but typically coordinating the resource allocation process and budgeting requirements of the shorter-term demands made by Items 1, 2, 3 and 4 above.

These subject areas, apart possibly from Corporate Planning, are largely organized in terms of the application of techniques to specific problems within appropriate domains. Corporate Planning exists as a higher level function, but it too is concerned with a fairly narrow focus on resource allocation which lends itself to specific techniques of analysis. From all these areas, two distinct methodological characteristics emerge. The first relates to analysis. Clearly, the way in which systems analysis is pursued, the theories which are used as a basis for the appropriate systems models, and the specific techniques in use can be compared and assessed. Second, there is the relationship of these subject areas to planning or design; in effect this is the relationship to the wider political and organizational environment. In terms of both the methodology of analysis and of planning, there are a series of themes which can be drawn out. These can be broadly structured as follows, noting that the division into methodological themes is somewhat arbitrary in comparison to that made for subject areas; for the subject area division relates to how the field is actually organized, whereas the methodological division relates to the themes that were explored in the seminar. Part of the seminar was to generate common methodological assessments of systems analysis. Five broad themes can be distinguished relating to analysis and planning, and these are:

1. Methods of Analysis: involving the specific techniques applied, theories on which such techniques are based, and the scientific-experimental method used in their selection and validation.
2. The Use of Analysis in Planning: involving the juxtaposition of the systems analytic process with the narrow technical process of design and planning; and the contrast of positive analysis with normative.
3. The Decision-Making Environment: involving the organizational and political environment in which systems analysis is used, and the contradictory demands and aspirations of technicians, scientists, bureaucrats and politicians.
4. The Philosophic Basis of Systems Analysis: involving the link between theory and practice, thus leading to the assessment of systems analysis in urban policy-making and planning as a specific case of the impact and relationship of science to society.

5. Analysis of and Speculation on Future Decisions: Involving an assessment of the overall experience and designs for the appropriate types of systems analysis in the appropriate contexts and environments.

The Advanced Research Institute attempted to address both subject areas and methodological themes, and the clearest way to conceive its scope is to imagine a concatenation of the five areas with the five methodological themes. This then provided the scope of the seminar, but before the concatenation of areas and themes is discussed it is worth digressing slightly to try to give more flavour to the seminar which the Organizing Committee had in mind.

#### EXISTING ASSESSMENTS OF SYSTEMS ANALYSIS

In a short paper such as this it is impossible to do more than sketch the key issues which characterize the field. Moreover, in a field so diverse as this one, everyone will have a slightly different interpretation as to the significance of these issues, and everyone will perceive the organization of the field differently. However, one way of providing a clearer idea of what the organizers had in mind is to discuss the subject areas and methodological themes in terms of the pertinent literature already devoted to these issues. Thus, in this section the issues raised above are clarified in terms of what the organizers considered to be the literature most relevant to the issues already raised. In the following exposition an attempt is made to be as brief as possible, emphasizing only the books, not papers available, and with the selection having been made on the basis of the predilections of the Organizing Committee.

The five subject areas are easiest to identify in terms of existing literature because systems analysis has been developed as part of these areas. The co-directors of the ARI originate from the Physical Network Planning - Strategic Land Use Planning areas and have both written about these topics. The book on transport planning by Hutchinson (1974) gives a comprehensive account of the modelling styles involved, that by Batty (1976) on land use modelling is slightly narrower, focusing on applications. The book by Beltrami (1977) on public systems analysis gives a good account of the models in the public services - delivery systems area, and it seemed to the organizers that these areas of modelling, reflecting the previous subject areas of physical network planning, strategic land use planning and public services planning are the best defined of any of those considered. In terms of built form planning, the book by Martin and March (1972) is representative, but this field is less organized than those just described. So is that of corporate planning where the work of Wildavsky (1974) is well-known. But in these latter two areas, the issues are slightly broader and the subject areas less well-defined.

These books deal variously with the substance of these subject areas, as well as with the techniques of systems analysis, that is model-building techniques. But these contributions do not really deal directly with any of the methodological issues concerned with planning with the exception of Wildavsky's. There are quite a few books which deal with philosophic/theoretical rationale for systems analysis in planning: a good example is that by Chadwick (1971). But in terms of the Institute, of more pertinent interest were those contributions which have attempted some assessment of the application of systems analysis, and have emphasized the wider methodological issues. The history of systems analysis documenting the successes and failures in these fields is dealt with by several authors, in particular by Hoos (1972) for corporate planning and more generally, and by Boyce, Day and McDonald (1970) for strategic land use planning. In terms of the critiques which have been developed, these can be seen as emphasizing theoretical problems and/or organizational problems: that is, as emphasizing the analytic aspects of systems analysis, or the social context in which it fits. Drake's (1973) book on transport modelling projects, Brewer's (1973) book on particular land use modelling experiences in Pittsburgh and San Francisco, and Greenberger, Crenson and Crissey's (1976) book on several experiences in socio-economic modelling are all excellent examples of the kind of assessment which the Organizing Committee hoped to make as a result of the seminar. Another essential component in the assessment is work such as that by Pack (1978) which emphasizes the actual scale and amount of systems analysis in urban policy-making.

There are many more contributions to the field in the form of other books, papers and reports which are important, many of which are identified in the papers presented by delegates. These books provide something of the flavour that was expected to be generated during the seminar. To conclude this brief excursion into the literature, it is worth noting the major themes which emerge from these existing assessments. In applying systems analysis to planning, there is always a mismatch between the theory available and that required to inform about the problem. Moreover, this appears to be compounded by the different motivations displayed by analysts and decision-makers. There is also an organizational problem in that the appropriate environments are seldom available for the proper application of such techniques. There are resource problems based on manpower, computer capacity and data limitations. And there are problems posed by investing time and money in techniques which are eventually judged to be inappropriate. Finally, there are problems reflecting different perceptions of what is possible in the scientific and political domains. All these and more emerge from the critiques and formed the heart of the material to be assimilated, discussed and evaluated during the seminar.

## ORGANIZATION OF THE INSTITUTE

The week-long seminar was structured around a series of major and minor questions with various sub-sets of the delegates asked to address these questions with respect to the principal subject areas identified previously, and to report their findings to a plenary session for further discussion. These questions are:

What has been the experience in applying rational analysis techniques to urban problems?

What issues have been addressed and what types of techniques have been used?

Were decisions actually based fully or partially on the results of these analyses?

What disciplines were involved in the development and application of these techniques?

Why are the results frequently ignored from the perspective of the analyst?

Is it because of data limitations?

Is it because urban phenomena are very complex and models are trivial representations?

Is there a fundamental mismatch between analysis time and decision-making time?

What have we learned from trying to implement urban systems analyses?

What has been the experience in the organizational/political area?

What conditions or restrains the responses of organizations?

What have we learned in the areas of data, education and the computing area and why?

Are there attitudinal problems and is there a basic incompatibility between the attitudes of the analyst and the administrator/decision-maker?

Are there differences in experience across cultures?



Are the difficulties in the urban field simply a manifestation of the broader issue about the relevance of science to human affairs?

Is there a crisis of confidence in urban management?

Is this crisis unique to the urban field?

Are the techniques simply an intellectual fabrication?

What are the current and expected urban issues and what processes should be followed to respond to these issues?

Are there differences in the perceptions of urban problems between institutions and groups?

What uncertainties are there about defining future issues?

Should we plan for the future or adapt to changes?

What things can be realistically achieved by the public sector?

What should be done and what should the various actors do?

Can the formal analysis of urban problems be made more effective through the development of better techniques?

Will developments in computer technology and better data bases improve the effectiveness of systems analyses?

Will organizational changes help to solve the problems and improve the effectiveness of systems analysis?

## CONCLUSIONS

As mentioned in the Introduction, this is a large area with extremely diverse aspects, and in the event, it was not expected that a completely balanced picture could be provided. Some interests were bound to be represented more than others. Moreover, none of the questions can be answered definitively, if at all, but at least it appeared to be a suitable way of raising awareness about