ROBUSTNESS IN PRACTICE - THE REGIONAL PLANNING OF HEALTH SERVICES

Gordon Best
and Jonathan Rosenhead

Abstract

Earlier work has criticised the dominant tendencies in operational research contributions to health services planning as characterised by optimisation, data hunger, depoliticisation, hierarchy and inflexibility. This paper describes a study which attempted to avoid some at least of these pitfalls. The project was to construct a planning system for a regional health council in Ontario, Canada which would take account of the possible alternative future states of the health care system's environment, and would aim to keep options for future development open. The planning system devised is described in the paper. It is based on robustness analysis, which evaluates alternative initial action sets in terms of the useful flexibility they preserve. Other features include the explicit incorporation of pressures for change generated outside the health care system, and a satisficing approach to the identification of both initial action sets and alternative future configurations of the health care system. It was found possible to borrow and 'radically re-use' techniques or formulations from the mainstream of O.R. contributions. Thus the 'reference projection' method was used to identify inadequacies in performance which future health care system configurations must repair. And DELPHI analysis, normally a method for generating consensus, was used in conjunction with cluster analysis of responses to generate meaningfully different alternative futures.

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+ London School of Economics, Houghton Street, London WC2, England.

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1. INTRODUCTION

Robustness analysis[1] provides a method for strategic planning aimed at the preservation of potentially fruitful future decision options. It does so by treating planning as a sequential decision-making process, and analyses possible initial action sets in terms of their compatibility with attainable system configurations at the planning horizon which appear likely on present information to perform satisfactorily over a range of anticipated system environments. Initial action sets are preferred, other things being equal, which keep open a larger number of these future decision options, and so maintain a wider span of strategic flexibility. The approach may be appropriate where there is a high level of uncertainty about future environmental conditions, about the decisions to be made by related agencies which will affect the future performance of the system, or about how alternative system configurations or performance will be evaluated in the future.[2] It has been described as offering "a language for continuing strategic choice" (Rosenhead 1980).

In this paper we report a case study of the application of robustness analysis, indeed of an extended robustness methodology, to the regional planning of health services. It has been suggested elsewhere by one of the authors (Rosenhead 1978) that the traditional methodology of operational research when applied to problems of health services planning has the following, often inappropriate characteristics:

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[1] Robustness analysis is described in more detail in Rosenhead et al. (1972), and in Rosenhead (1980).

[2] These categories of uncertainty are drawn from Friend and Jessop (1969).

"(1) Problems are formulated in terms of single objectives, or several objectives are transformed into a single objective. This objective is there to be "optimised".

(2) Models are developed which depend on the wholesale quantification of aspects of the social world. This can lead to problems of distortion, or of implausible demands on data availability or credibility.

(3) Project definition and execution are devoid of political content, reinforcing the "scientisation" of political debate. Where conflicting objectives are recognised, they are speedily "resolved".

(4) Problems are formulated as if there were a single decision-maker, with recommended actions to be deduced rationally from his or her objectives.

(5) Problems are formulated as static, in the sense that they are to be solved in toto at one point in time. Attempts are made to abolish the uncertainty in the problem environment, rather than accept it as a defining characteristic."

To avoid these features, it was proposed, planners should prize approaches with the converse qualities; that is, methods which

"(1) make reduced demands on data;

(2) reject optimisation in favour of coordination;

(3) accept uncertainty and try to keep options open;

(4) are not restricted to hierarchical deduction, but facilitate participation;

(5) do not attempt a technocratic abolition of politics."

In this paper we analyse the extent to which it was possible to realise these aspirations in the work carried out for and by the Ottawa-Carleton Regional District Health Council.

2. THE CONTEXT OF THE STUDY

The work which we describe in Sections 3 and 4 below was carried out over a period of approximately 18 months from December 1977 to the summer of 1979. During this period, the present authors were retained by the Ottawa-Carleton Regional District Health Council to advise on the development of a strategic planning methodology for health services planning within the Ottawa-Carleton metropolitan region. During the course of the work, the authors made three visits to Ottawa, spending approximately two months with the Health Council's planning team. In addition the work involved preparation of two major working papers intended to provide detailed documentation of the methodology developed (Best and Rosenhead 1978ab). Much of the present paper is based on these two unpublished documents. In the remainder of this section, we provide an overview of the organisational and planning context within which the work occurred.

In Canada, much of the responsibility for the public regulation and provision of health services is vested in the provincial governments. Indeed, as a result of the introduction of national health insurance legislation in 1974/75, each of the provincial governments has introduced a variety of legislative and other policy mechanisms to administer the national insurance scheme as well as to influence the provision of health services. It is worth stressing, however, that the great majority of activity relating to this latter objective is concerned with monitoring, and attempting to control, expenditure on services. Until very recently, there has been practically no attempt to plan and coordinate

systematically the regional development of health services in a way which would be familiar, for example, to planners working within the British National Health Service.

In so far as progress has been made in developing more systematic approaches to health services planning, it is perhaps fair to say that the province of Ontario has gone further than most of the other provinces. As a part of this initative, the Ontario provincial government introduced legislation in 1975 to provide funds to establish District Health Councils. The legislation provided for 22 Councils covering regions within the province which vary in population from as little as 20,000, to more than 500,000. Each District Health Council (DHC) is an advisory body in a position to make direct recommendations to the Provincial Ministry of Health, but without the authority to implement policy. The primary responsibility of DHC's is to recommend to the Minister "actions which in the Council's views are required to maintain integrated and comprehensive health services within their communities".(2) Despite the absence of executive authority, DHC's are expected to adopt policies and "... given that the Ministry of Health will heed advice and provided that the advice offered is well-judged and viewed as responsible, Councils can exercise a great deal of power" (O-CRDHC 1979).

The Ottawa-Carleton Regional District Health Council (O-CRDHC) was the first to be established in Ontario. In addition it is among the largest, having responsibility for overseeing the health care of a community of more than 600,000. Like all DHC's, Ottawa-Carleton consists of an Executive Council made up of volunteers within the community who are

supported by a full-time staff financed by funds from the Provincial Ministry of Health as well as the Regional Municipality. In terms of operational responsibilities, the Executive Council's role "... can be seen as a combination of coordinating the actions of health services users and providers in the community, guiding those actions within provincial and regional policy, informing the community of health services strengths and weaknesses, and where appropriate, initiating action itself to "fill gaps" in health services or to avoid duplication and wastage of health care resources" (O-CRDHC 1979). The primary role of the full-time staff is to provide the Executive Council with that information and professional advice deemed necessary to support the decision-taking and policy functions.

Because the Ottawa-Carleton DHC was the first to be established, its role was broadened to include a 'demonstration', path-breaking, function. Specifically, additional funds of approximately 100,000 were provided to support a professional planning team. This team's responsibility was to undertake a two year planning programme intended "... to help meet [Council's ultimate] responsibility to plan for the availability of integrated, comprehensive health services in the region" (O-CRDHC 1979). In the first instance, the objectives of the planning programme were seen as:

"- to develop a strategy for planning health services over the long term (the strategy will comprise guidelines, procedures and policies which will assist and inform Council in its decision-making;

- to employ the strategic guidelines, procedures and policies to produce operational plans (operational plans will establish short and medium-term actions to strengthen and improve delivery of health services);
- to assist in the coordination of local health and social services planning;
- to gain experience on behalf of other district health councils in the organization and conduct of health services planning; and
- to begin a program to assist the continuous monitoring and evaluation of the health care organization in Ottawa-Carleton" (O-CRDHC 1979).

As these objectives imply, the initial conception of the planning programme reflected the not inconsiderable body of insight and experience possessed by the team recruited to implement it. Indeed, to provide a clearer impression of this aspect of the background to our own study, it is useful to cite a key passage from one of the early working papers prepared by the O-CRDHC planning team:

> "These objectives [i.e. those above] demonstrate Health Council's view that the Planning Program is only the beginning of a continuing planning process. As such, although the work is designed and budgeted over a specific time frame, planning which is beginning now will not end with the termination of the formal study program. Health services planning is not a "once-and-for-all" approach which ends with the production of a "plan" in the traditional sense. This concern for continuity and the objective of developing strategic

guidelines for decision-making point to an approach in which operational planning it seen as a process which is repeated at frequent intervals. This does not mean that the type of comprehensive and intensive study such as that being undertaken during the two-year Planning Program is required at frequent intervals. The essence of the approach, however, is that by undertaking incremental changes to the health care system and then assessing the impacts of these changes within strategic guidelines, Council will learn more about how to develop a pattern of health care delivery which will respond to the needs of the community. Health Council has adopted an approach which recognizes that unpredictable social and economic changes will affect health care. Planning work will have to allow for uncertainty and keep open options for future action. In keeping with this view, the longer-term strategic plan will attempt to guide and inform future decisions rather than specify precisely timed actions. At the same time, Council does not intend to allow urgent problems to be neglected or to await completion of the two years of initial planning. From the start, Council's Planning Team will document findings as they are made, in order to provide updated information which can assist ... Council in its decision-taking. Firm recommendations will emerge as planning proceeds and will not be delayed until the end of the formal program" (O-CRDHC 1978).

This view of health services planning is, of course, in good agreement with that of the present authors (see Rosenhead (1978,1980),

already summarised in Section 1. It goes without saying that we were indeed very fortunate to be invited to make our own contribution within such a context.

3. THE OVERALL APPROACH

In this section we turn to a description of the overall structure of the planning methodology developed during the course of the study. As should be clear from the foregoing, the Ottawa-Carleton planning team were aware of the need to develop a long-term strategic planning framework to assist in policy formulation and to provide a context for short-term decisions, as well as the need for operational plans specifying the resource implications of short-term decisions. This distinction, of course, closely parallels that between the strategic and operational planning cycles characteristic of the present approach to planning within the British National Health Service (D.H.S.S. 1976). The way in which this distinction was made operational in the Ottawa-Carleton context is however important to an understanding of how the general robustness methodology was adapted to the needs and responsibilities of the DHC.

Strategic planning in Ottawa-Carleton was defined as"... the on-going measurement and assessment of the existing and emerging performance of health services in Ottawa-Carleton. In other words, ... identifying problem areas before they become problems ... [and] ... recommending directions in which the development of health services may occur". By contrast, operational planning was intended to provide guidance for more pressing issues. The principal products of operational planning were seen to be twofold: "... first, recommendations for specific sets of actions which ... [can] ... be initiated by Council ... and, secondly, guidelines by which council can respond to [external] actions in an intelligent and flexible way" (O-CRDHC 1979). Accordingly, the activities of operational planning were undertaken with reference to a 3 year 'implementation' horizon, while strategic planning focussed on a more distant 13 year (i.e. 3 + 10) planning

horizon.

The need to adopt both a longer and shorter term perspective on policy and planning issues is, of course, characteristic of many organisations both within and outside the health care sector. The policy mandate and consequent planning-related responsibilities of the O-CRDHC proved, however, to have important implications for the way in which these two perspectives could be realised in the form of a planning methodology. Specifically, the planning responsibilities of the DHC were such that the alternative methodology summarised above was developed and enhanced in ways that we believe provide a vivid demonstration of its value and, indeed, its superiority when contrasted with prevailing orthodoxy.

To be as clear as possible about this point, it is useful to examine the role of the DHC in further detail. Because DHC's lack executive authority, they are not in a strong position either to initiate direct change or to act as prime movers in bringing about the implementation of planning proposals. Rather, one of their primary responsibilities is to 'react' to pressures or proposals for change originating elsewhere within the region. For example, a DHC might act so as to bring the grievances of a community or consumer group to the attention of the provincial Ministry of Health. Equally, a DHC might well react to a health care provider's proposal to expand services by endorsing or dissenting from the proposal and making its reasons known both to the proposer and to the community and the Ministry of Health. Thus, an important responsibility of a DHC is to respond intelligently and publicly to proposals for short-term changes in the health care system. At the same time, however, it has only an indirect and very limited ability to influence which changes may be proposed or where they originate from.

In addition to this role, DHC's are also charged with a strategic responsibility requiring a longer-term perspective on the evolution of the health care system. Specifically, the provincial Ministry of Health regards DHC's as primary agents for influencing the evolving 'trajectory' of health services at a regional level. That is to say, DHC's are expected to act so as to encourage the coordinated and integrated development of health services; so as to discourage duplication and waste; so as to ensure that 'gaps' within the health system are identified and acted upon, and so on. Thus, DHC's are charged with the responsibility of looking forward to a time when the regional delivery of health services will be improved, so as to provide a context for the short term policies they adopt and the decisions they reach.

Again, this dual role of attempting to react to short term pressures for change while trying to steer the system as a whole in a broad, strategic direction, is one that many organistions confront. As will become clearer as we proceed, however, the tension between these two roles in the context of the O-CRDHC presented a number of methodological challenges aptly suited to the key features of the alternative methodology. In particular, two points are worth stressing. First, because of the absence of executive authority and the consequent inability directly to control or influence short-term proposals for change to the system, the DHC was obliged to evaluate such proposals not in the context of a 'master' plan or grand development strategy, but simply as more or less disjointed and incremental changes to the existing system. One basis on which such an evaluation can be made, of course, is simply some judgement about how such changes will influence the performance of the existing system. And as we shall see, this criterion was incorporated in the methodology finally adopted.

A second and equally important criterion however would reflect an assessment of how - in the aggregate - a series of such changes is likely to affect the evolution of the system in the longer-term. That is to say, the strategic view of such a series of incremental changes would be one emphasising their total impact on the system at a future data -- will they lead to a more coordinated system? a system with fewer gaps in services? a system responsive to changes in the demographic structure of the population and so on? And yet as has already been pointed out, the DHC had very little power directly to influence the future form of the health care system. The alternative then, was to discharge their strategic function not with respect to the future, but by reference to a number of futures, any one of which, or any mixture of which, might come to pass.[1]

Thus, the situation prevailing in Ottawa-Carleton at the inception of the present study exhibited two of the key characteristics to which the alternative strategy is a response. On the one hand, there was a need to take immediate decisions in response to pressing problems and in an attempt to improve the existing situation; on the other, there was a need to take these decisions in such a way that desirable future options would be preserved. The methodology developed reflects this, in that it emphasises

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[1] It is worth emphasizing that while, in the case of DHC's, the absence of executive authority highlights the tension between, and the difficulty of reconciling, the short term and long term planning roles, the same kind of problem confronts almost any organization which plans. Thus, few - if any - organisations can effectively prescribe all those changes that are made in the system over which they have nominal control. Equally, few organisations have the power to influence significantly the future conditions within which the system will evolve. Yet traditional approaches to planning frequently seem to be premised on the assumption that both these omnipotent powers are readily available to almost any organisation which chooses to plan.

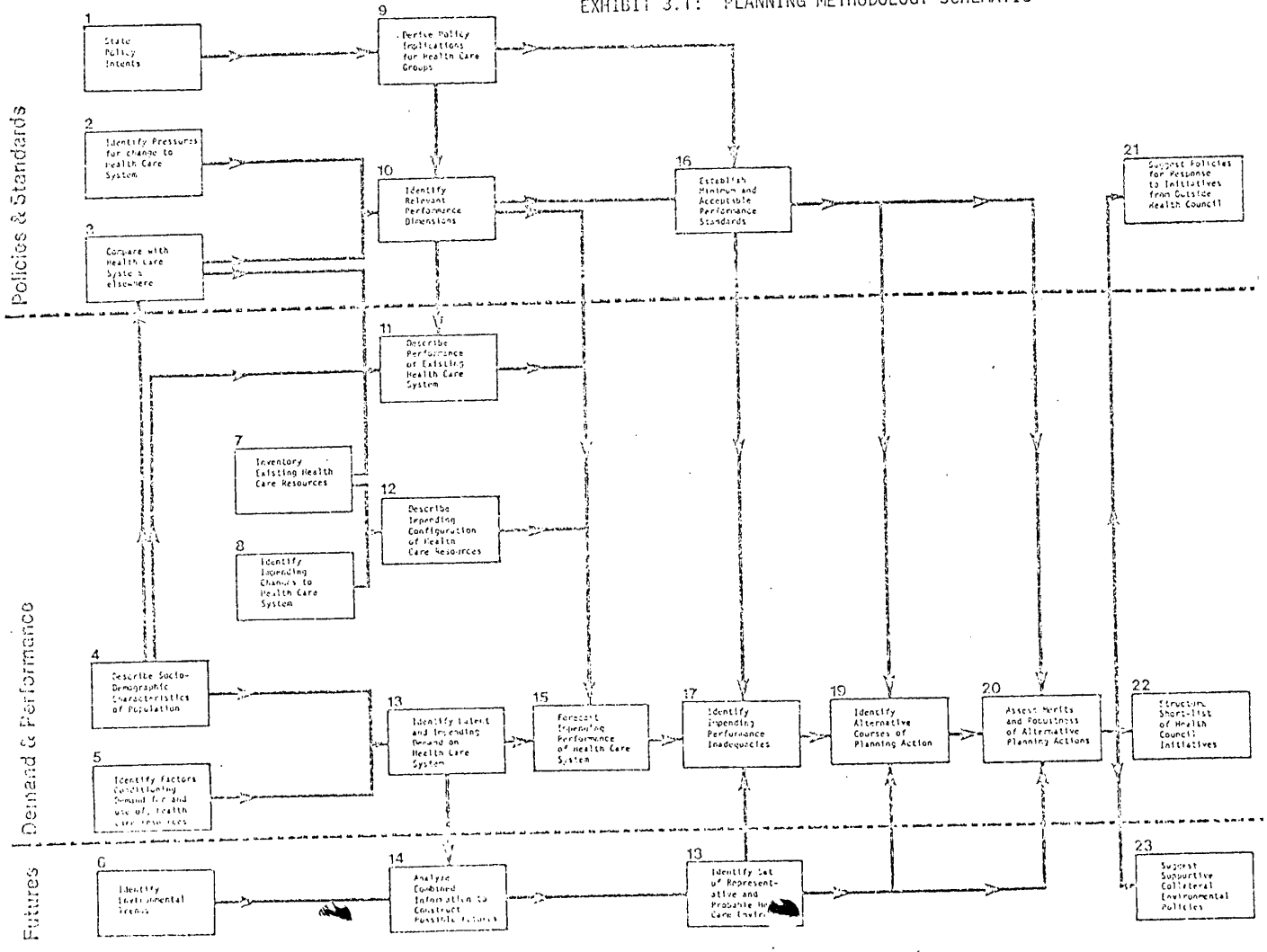
on the one hand, 'candidate' short-term changes which are evaluated with respect to the system's existing performance characteristics; and on the other, the robustness of these same outcomes in the light of alternative future configurations of the system and the performance of these configurations if subjected to alternative future environments.

The overall structure of the methodology is summarised in Figure 1. The essential features of the approach can be explained most clearly in terms of the three horizontal planning streams: "policies and standards", "demand and performance", and "futures". These three systems reflect the multiple emphasis of the DHC's planning programme. Thus, comprehensive health planning was seen to be conducted within the context of Provincial and Regional Government policy, and as a response to community views (policies and standards stream). The intent of planning was seen as to coordinate and provide direction for the deployment of local health care resources (demand and performance). And it was recognized that planning on the basis of future predictions which may not come true, could easily result in an inefficient, inflexible and inappropriate allocation of health care resources (futures).

As is implied, the policies and standards stream is concerned with the formulation of planning policies and the identification of dimensions of performance to which these policies relate (e.g. policies on approriate levels of service provision; on acceptable thresholds of accessibility, and so on). This stream begins with inputs on the comparative performance of Ottawa-Carleton's health care system (box 3) and on local presures for modification to that system (box 2). In addition, it calls for explicit policy statements on desired objectives for the system (box 1). These inputs are then used to derive a set of "minimally acceptable" performance

Figure 1 - "Source - O-CRDHC (1979)

EXHIBIT 3.1: PLANNING METHODOLOGY SCHEMATIC



standards (box 16) which are one of the key elements in the evaluation of performance inadequacies (box 17) and alternative courses of planning action (box 19). The specific output of this stream (box 21) is a set of policy guidelines intended to aid the DHC in responding to initiatives proposed by other agencies, institutions or groups which have some mandate for or concern with health services in the region.

The principal focus of the demand and performance stream is on describing the existing and 'impending' health care system (boxes 7, 8 and 12) and translating this into statements of 'impending' performance inadequacies (box 17). (The impending system consists of the existing configuration of health care resources (box 7) supplemented by imminent modifications (box 8) which will occur before the implementation horizon - i.e. the system that will exist in 3 years time.) The emphasis in this stream is on relating the quantity, availability, and locations of health care resources to both the effective and estimated latent demand for health services (boxes 4, 5 and 13). Data on these attributes are then employed to forecast the impending performance of the system (box 16) and, together with inputs from other streams, to generate and assess actions which may be taken to modify the system (boxes 19 and 20). The principal output of this stream is a short-list of possible and variously desirable planning initiatives or actions which the DHC may wish to promote.

The futures stream is largely concerned with generating that information required for the DHC to develop a longer-term, strategic perspective while, at the same time, not tying their policies and initatives to a single vision (or set of predictions) of the future. This stream condenses various environmental uncertainties (boxes 6 and 14) into a set of discrete, representative and variously probable future states of the

socio-economic environment within which the health care system may operate (box 18). Alternative courses of planning action are then assessed within the context of possible future system configurations, as these would be likely to perform under each of the representative future environments. Short-term planning actions which improve impending performance, and contribute to anticipated satisfactory performance of a large number of configurations under many futures, are defined as 'robust'. Because, however, changes in the environment of the health care system may have a significant impact on health, an output of this stream of work is a set of proposals which the DHC may promote for consideration by bodies in a position to influence environmental factors (e.g. municipal providers of social services; local housing authorities, etc.).

Before proceeding to a more detailed description of the methodology, it is important to stress that Figure 1 represents an 'idealised' picture of those planning activities which actually occurred in Ottawa-Carleton. That is to say, while Figure 1 provides what we believe to be a reasonably accurate picture of the planning methodology developed and pursued by the DHC, it inevitably presents an overly simple version of the activities actually undertaken in attempting to implement that methodology. The captions within each box, for example, represent reasonably discrete tasks within the overall framework. They provide, however, few insights into the nature of the activities which were actually carried out in execution of each task. Equally, the lines connecting different boxes denote only the principal interdependencies between tasks. By contrast, the actual work carried out did not unfold in the relatively tidy left-to-right manner of the diagram nor, in practice, were many planning activities confined to a single box.

In particular, it is worth emphasising that while Figure 1 implies a rather formal methodology incorporating a broadly logical sequence of operations involving quantitative measures of performance, clear statement of policy intent so on, the reality was rather different. To illustrate with an example, box 2 contains the caption, "Identify pressures for change to the health care system". The objective in this case was to gain certain insights into what various groups in the community, key individual or agencies, and service providers, felt to be inadequacies in the delivery of health services. The major activity at this stage involved a survey of over 300 agencies and groups within the region who had some mandate for, or interest in, the delivery of health services.

Arising out of this survey were a wealth of proposals many of which the DHC eventually endorsed. In addition, however, the survey gave rise to a number of (not formally solicited) suggestions on what would be acceptable performance standards (box 16), and on what health-related trends and developments within the region were most significant (box 6). Many of these suggestions were adopted and, indeed, where 'hard' data or measurements were lacking, such informal but informed judgements were utilised as alternatives. Moreover, as is stressed in Section 4 below, we believe this to be a strength rather than a weakness of the approach.

In order to provide a clearer and more detailed understanding of the work, it is useful to conclude this section by looking more closely at two central aspects of the methodology. The first of these is taken from the uppermost stream in Figure 1, and focusses on box 16 - the identification of minimally acceptable standards of performance. Broadly speaking, the objective here was to identify a number of dimensions or in some cases 'metrics', of performance which could be used in two ways. First, to help

identify strengths and weaknesses in the existing delivery of health services (box 7); and secondly, to contribute to the assessment of the performance merits of proposed changes in the delivery of health services (box 19).

The rationale for focussing attention on minimally acceptably performance baselines rather than, for example, optimal levels of performance, is critical to an understanding of the overall approach. Thus, it was not the purpose of the DHC to attempt to specify, and then work toward achieving, an optimal configuration of health services delivery - a task which as we have already pointed out, would require control over all changes made to the system, perfect or near-perfect knowledge of the future, and so on. Rather, the objective was to admit into the analysis a relatively large number of proposed changes, and then to ask whether these would have the effect of bringing system performance up to minimally acceptable standards and/or of improving on performance which was already acceptable. This, of course, was not the only criterion for judging proposed changes . Performance priorities as established by policy; resource and cost constraints; and the robustness of such actions were also incorporated in the assessment (box 20).

The identification of performance dimensions and the setting of minimally acceptable standards involved a number of both formal and informal inputs. As already mentioned, the survey of health and health-related agencies produced a number of insights and proposals relevant to understanding the dimensions along which the community tended to judge performance. Additional information was derived from provincial and regional standards and guidelines were these existed; from comparisons with the standards adopted elsewhere; and, in a small number of cases, on the

basis of 'expert' consensus. Inputs from any or all of these sources, together with the community's perceptions of 'need', were utilised in establishing relevant dimensions and setting performance baselines.

The performance dimensions finally adopted related to the quantity, availability and accessibility of services. The quantity dimension reflected the rates of provision of different services across different sub-groups of the regional population, while the availability and accessibility dimensions reflected both demographic data on the distribution of the population as well as normative - or judgemental - information. The availability dimension was intended to provide some indication of the range of health services available to the regional population (e.g. preventative; primary care; secondary care; etc.), as well as on the 'continuity' of those services (e.g. available on a residential, mobile, ambulatory, etc. basis). Table 1 contains an illustration of some of the data which were collected, and some of the units of performance which were used for measurement along the quantity and availability dimensions. The accessibility dimension was intended to reflect the 'match' between the geographic distribution of the population and that of the various different health services, as well as the relationship of different services to the regional pattern of public transport.

The second example is taken from the futures stream and focusses on the way in which alternative pictures of the future were developed (boxes 14 and 18) and integrated into the analysis. As has already been pointed out, a defining characteristic of the robustness approach is its emphasis on the interaction between present decisions which are the focus of short-term planning, and desirable strategic (development) options which are central to long-term planning. Obviously, actions which are expedient today can,

Excerpt from:

EXHIBIT 2.20: TOTAL 1978 RESOURCE PROVISION

CARE SETTING	1978 RESOURCE PROVISION BY CARE SECTOR					TOTAL RESOURCE PROVISION
	INFANT & CHILD	GERONTOLOGY	MATERNAL	MENTAL HEALTH	PHYSICAL ILLNESS	
Residential Non-Institutional and Residential Institutional	Physician Visits (600; 5/1000)	Physician Visits[a] (2,400; 60/1000)	Physician Visits		Physician Visits	4,900; 9/1000
	Nursing Visits (380; 3/1000)	Nursing Visits[a] (3,000; 75/1000)	Nursing Visits (20; 1/6700)	Nursing Visits (90; 1/5900)	Nursing Visits	8,380; 15/1000
	Allied Health Visits (400; 3/1000)	Allied Health[a] Visits (300; 8/1000)	Allied Health Visits (220; 2/1000)	Allied Health Visits	Allied Health Visits	1,200; 2/1000
	Home Help Visits (200; 2/1000)	Home Help Visits[a] (3,200; 80/1000)	Home Help Visits	Home Help Visits	Home Help Visits	4,200; 8/1000
		Meal Visits[a] (5,700; 140/1000)				5,700; 140/1000 elderly
	Telephone Visits (600; 5/1000)	Telephone Visits[a] (1,600; 40/1000)	Telephone Visits (200; 2/1000)	Telephone Visits (4,100; 8/1000)		5,900; 11/1000
	Public Health Visits	Public Health[a] Visits (1,800; 46/1000)	Public Health Visits (1,700; 13/1000)	Public Health Visits (400; 1/1300)	Public Health Visits	8,200; 8/1000

a. provision ratio based on 1978 non-institutionalized elderly resident population: 39,600.

Parenthesized figures: (total quantity; ratio of provision to care sector population). Quantities of visits are given as monthly averages, estimates are rounded to nearest hundred.

Table 1

Source: O-CRDHC (1979)

through the commitment of resources, pre-empt developments which would be beneficial in the longer-term.

Structural changes to the health care system may result from social, political, demographic or economic events in the future, and although it is impossible to predict which such events will occur, it is possible to investigate different long-term configurations of the system which might prove advantangeous should particular patterns of these events come to pass. In these circumstances it is possible to pose questions such as: "How does this short-term action help to meet current objectives if such and such future conditions occur?" or "Does this action retain flexibility by affording a more viable solution across a broader range of future occurences?", etc.

The futures stream develops alternative future states of the environment within which the health care system will evolve. The consequences of each of these future states for the performance of the existing (i.e. 'impending') system can then be examined to identify possible future inadequacies in the system. Long-term strategic responses to these inadequacies (in terms of modifications to the quantity, availability or location of services), can then be devised. Alternative future configurations of the health care system then consist of the existing system as transformed by different combinations of these long-term strategic modifications.

Finally, the futures and future configurations are employed together (box 20) to assess the longer-term merits of different short-term courses of action. A course of action which could provide a coherent element of a variety of future configurations performing well across the range of identified futures thereby preserves potentially important future

development options. The 'robustness' of the course of action is a measure of how well this is achieved.

Clearly, a key input to this kind of analysis is the identifiction of a set of representative and not improbable future states of the health care environment. For this purpose, the activities represented by box 6 in Figure 1 were the starting point. The identification of "environmental trends" involved a fairly broad trawl though possible sources of information as to likely future developments within the Ottawa-Carleton Region, Eastern Ontario and in the province of Ontario as a whole. For some factors - for example, population and economic uncertainties - simple trend extrapolation using official statistics provided useful information.

However, trend extrapolation is an area fraught with pitfalls, and even relatively open-ended forecasts become notoriously unreliable beyond a seven to ten-year planning horizon. (In Ottawa-Carleton the strategic planning horizon was 13 years ahead.) In an attempt to develop a more satisfactory approach, the Ottawa-Carleton planning team employed a modified form of the Delphi technique (O-CRDHC 1978b).

Delphi is an iterative technique devised to overcome reliance on individual intuitions about the future by enlisting the help of a panel of informed people. The approach is typified by a succession of questionnaires, or rounds, each constructed using the results of the previous questionnaire to provide controlled feed back to the panel. The method has been characterized as "organized brain-storming". The purpose of the Delphi technique, however, is to foster consensus about the future and this was obviously not suitable for an exercise which aimed to identify probable alternative future states.

As a result, the Planning Team modified the standard technique by submitting the early-round responses to a form of statistical analysis called cluster analysis. Respondents were grouped according to their general propensity to agree on survey change statements. A subsequent round of the survey served to refine the descriptions of alternative scenarios as proposed by alternative clusters of respondents. These alternative clusters formed the basis upon which the combinatorial analyses (box 14) were made.

In order to carry out the combinatorial analysis, it was first necessary to identify a manageable number of reasonably discrete dimensions along which social change might occur. Certain such dimensions were obvious: for example, demographic and economic change. Others were less obvious. The five areas of change utilised in Round 1 of the survey were: government action; population; technology; medicine and economics.

Once the dimensions of possible change were identified, the next task was to combine these changes to produce coherent and consistent possible future states of the health-care environment. Changes in a particular dimension may logically or practically exclude or require changes in a range of other dimensions (e.g. a "stringency spending" future is unlikely to be compatible with a whole range of developments, which, however desirable, would be costly). Producing credible scenarios of alternative futures involved the exercise of judgement with the planning team relying on the Survey for expert opinion.

The third activity (box 18) in the "future" stream was to select from among the considerable number of feasible future scenarios a more limited number of scenarios to render the subsequent analysis tractable. These are representative futures, each standing in for a range of futures: they are not improbable they were selected to be meaningfully different, and they

were selected for their degree of relevance to the outcome of decisions likely to be confronted by DHC during planning. Four representative futures were identified. Within each future, the impending health care system was subjected to analysis and evaluation.

The analysis of a future began with an overall study of its distinctive tendencies and some of its significant characteristics. Those factors in a future environment which could have an impact on the impending health care system were identified, and particular attention was paid to demand and supply factors which could provide a quantitative basis for judgement. For example, demographic tendencies were identified and population projections were assigned to localities within the region. Many of the changes which arose from the survey results encompassed the myriad of issues which have a significant but quantitatively immeasurable effect on health and on health services development. These include such phonomena as the increasing emphais on prevention, changes in the occupational status of women, shifting political influences among health professionals, and more effective treatments of specific diseases. These are factors whose precise impacts on the health care system are not known and certainly are not measurable over a long term. Nonetheless, these changes were also identified in each future in order to provide a more complete view of the conditions - both quantitative and additional - which do and will affect the evolution of health care.

The configuration of the impending health care system was projected onto the significant changes in the future. If, for example, there were currently an inadequancy with respect to a particular health care service, then future changes could often be seen to either exacerbate or relieve this inadequacy. If, as another example, current uses of a particular service or

health professional were expected to change, then pressure for the development of alternative services could be expected. This procedure allowed for an evaluative consideration of the performance of the health care system in light of possible future conditions. In addition, supply factors which were identified in the first stage of the analysis, were used to generate the budgetary parameters within which the future health care system would operate.

The last stage of the procedure brought together the description of the performance of the impending health care system (box 15), DHC policies (boxes 9 and 16) and budgetary constraints to generate long-term strategies for modifying the existing system in response to the different set of future conditions. For example, all of the future configurations developed in this way incorporated a response to, on the one hand, a DHC policy on the availaiblity of care to the elderly and, on the other, future inadequacies in the care for the elderly which arise within all of the projected futures. However, each configuration differed in the way in which this response was realised: and these differences grew out of certain other characteristics not common to all futures - e.g. the likely level of provincial intervention in the Gerontology sector, the strengthening or otherwise of non-institutionalised care delivery etc.

Altogether, the futures survey involved approximately 200 respondents in three rounds of questionning with the clustering into representative groups occurring after round 1. Tables 2-5 present a more detailed picture of this phase of the work. In particular, Table 2 provides an illustration of the form of questionnaire used; Table 3 includes a typical example of how the responses to the questionnaire were clustered following round 1; Table 4 gives an illustration of some of the ways in which the four 'final' futures differed, and Table 5 provides an illustration of how the different future states were used in the construction of alternative future system configurations.

Excerpt from Summary by Group (A, B, C, D, E, F and G) - Round 3

What is the likelihood that this change will occur between 1978 and 1983?	What is the likelihood that this change will occur between 1984 and 1988?	What is the likelihood that this change will occur between 1989 and 1998?
1 - impossible 7 - virtually certain		

C25 The proportion of the government dollar spent on health manpower education will increase

1	2	3	4	5	6	7
d	E G	A B C F				

1	2	3	4	5	6	7
	d	A C E F G	B			

1	2	3	4	5	6	7
		C d E G	A B F			

C26 There will be a decrease in the proportion of the health dollar spent on services rendered by private practioners

1	2	3	4	5	6	7
	E	A C D F G	B			

1	2	3	4	5	6	7
		C D E	A B F G			

1	2	3	4	5	6	7
		E	D A B C F g			

C27 There will be a decrease in the proportion of the health dollar spent on acute care hospitals

1	2	3	4	5	6	7
			A	B C D E F G		

1	2	3	4	5	6	7
			B A	C D E F G		

1	2	3	4	5	6	7
			B D F	A C g	E	

C23 There will be a decrease in the proportion of the health dollar spent on technological research

1	2	3	4	5	6	7
		F	B C E G	A D		

1	2	3	4	5	6	7
		E F G	A D B C			

1	2	3	4	5	6	7
			D	A B C E F G		

C29 There will be an increase in the proportion of the health dollar spent on ambulatory care

1	2	3	4	5	6	7
				A D B C E F G		

1	2	3	4	5	6	7
				B C D F G	A E	

1	2	3	4	5	6	7
				D	B F G	A C E

C30 There will be an increase in the proportion of the health dollar spent on home care

1	2	3	4	5	6	7
				B D A C E f G		

1	2	3	4	5	6	7
				B C D G	A E F	

1	2	3	4	5	6	7
			d	B F G	A C E	

Table 2

Source - O-CRDHC (1978b)

Excerpt from Figure 4 The Differences between Group Responses

SUBJECT	GROUP A	GROUP B	GROUP C	GROUP D	GROUP E	GROUP F	GROUP G
Health Insurance (cont'd)	L. a minimum charge will not be imposed on users	L. a minimum charge will be imposed on users	L. a minimum charge will not be imposed on users	L. a minimum charge will be imposed on users	L. a minimum charge will not be imposed on users	L. a minimum charge will be imposed on users	L. a minimum charge will be imposed on users
	L. costs to user will not be based on ability to pay	L. costs to user will be based on ability to pay	L. costs to user will not be based on ability to pay	L. costs to user will be based on ability to pay	L. costs to user will not be based on ability to pay	L. costs to user will not be based on ability to pay	L. costs to user will not be based on ability to pay
	gov't action will limit patient choice	gov't action will limit patient choice			gov't action will not limit patient choice	gov't control will limit patient choice	gov't control will limit patient choice
Policy and Legislation	L. DHC's will be given control over health spending	L. DHC's will be given control over health spending		L. DHC's will not be given control over health spending	L. DHC's will not be given control over health spending	L. DHC's will not be given control over health spending	
	S. equalization payments will be made for health care in depressed regions	S. equalization payments will be made for health care in depressed regions			S. equalization payments will not be made for health care in depressed regions		
	health funds will be allocated on the basis of regional priority-setting	health funds will be allocated on the basis of regional priority-setting	health funds will be allocated on the basis of regional priority-setting	health funds will not be allocated on the basis of regional priority-setting	health funds will be allocated on the basis of regional priority-setting		health funds will be allocated on the basis of regional priority-setting
			there will not be increased differences between urban and rural patterns of care		there will be increased differences between urban and rural patterns of care		there will be increased differences between urban and rural patterns of care
	L. gov't will regulate the geographic distribution of MD's	L. gov't will regulate the geographic distribution of MD's			gov't will not regulate the geographic distribution of MD's		

Source: O-CRDHC (1978b)

Table 3

Excerpt from

EXHIBIT B.1: CHANGE STATEMENTS FROM THE FUTURES SURVEY

		FUTURES			
	CATEGORY	1	2	3	4
113	Relative to the total population the proportion of people paying taxes will decline	Environ. discard	yes		yes	yes
*						
115	In real dollar terms the cost of health will increase	Environ. supply	yes	yes	yes	yes
116	Pressure for growth from within the health services sector will decrease	Environ. discard	no	no	no	no
117	Provincial government will be unable to control the cost of health care	Environ. supply		no	yes	no
118	Health care services will increasingly be subject to government scrutiny for efficacy and efficiency	Climate variable	yes	yes	yes	yes
119	The provincial government will delegate more statutory power to professional bodies	Climate variable	no	no	no	no
120	The apportionment of funds to all community health services will be determined by regional priority-setting	Candidate action	yes	yes	no	
121	Employment in the health sector will increasingly be recognized as factor which influences regional economy	Environ. supply	yes		yes	
122	Collective bargaining between government and health professionals will drive up the cost of health care	Environ. supply	yes	yes	yes	yes
123	Ambulatory and non-institutional services will prove less costly than institutional services	Climate variable	yes	yes	yes	yes
124	Government health insurance plans will not be expanded	Environ. demand	no	no	yes	
125	The public will willingly pay more money for health services	Climate variable	no	no	yes	no

Source: O-CRDHC (1979)

Table 4

Excerpt from

EXHIBIT 3.2: COMPARATIVE ORDERS OF MAGNITUDE OF RESOURCE PROVISION IN ALTERNATE FUTURES

CARE SETTING	PRINCIPLE RESOURCE	IMPENDING PROVISION	CONFIGURATION 1	CONFIGURATION 2-a	CONFIGURATION 2-b	CONFIGURATION 3	CONFIGURATION 4
AMBULATORY LOW-TECHNICAL SETTING	Physician visits/month	128,200	118,000	104,600	104,600	146,000	147,200
	Allied health visits/month	-	40,000	35,000	35,000	-	37,000
	Other health visits/month	27,400	32,000	30,000	30,000	32,000	32,000
	Public health visits/month	17,000	26,000	16,600	16,600	16,500	20,400
	Paediatric Day Centre Places	2,100	2,800	2,100	2,100	2,000	2,500
	Adult Day Centre Places	18	200	130	130	130	140
	Psychiatric Day Centre Places[c]	2,227	3,300	3,000	3,000	3,000	3,000

c. Includes psycho-paediatric day centre, social adaptation, addiction, work activity for the mental health sector, psychiatric self-help, and addiction self-help places.

Source: O-CRDHC (1979)

Table 5

4. ELEMENTS OF AN ALTERNATIVE METHODOLOGY

The general shape of the planning system devised for the Ottawa-Carleton Regional District Health Council has been outlined in the previous section. Here we will try to identify and analyse in more detail certain elements of this system which exhibit characteristics of the 'alternative methodology' summarised in Section 1.

(a) Acceptance of uncertainty and maintenance of options

The importance of this dimension in the work for O-CRHDC can be demonstrated at a number of levels.

At the level of abstraction it can be shown that the method adopted for planning (summarised in Figure 1) is in broad outline the same as that proposed elsewhere (Rosenhead 1980) as a methodology for robustness analysis. (This earlier description has in fact been modified and further elaborated in the light of experience of the particular situation of the planning agency, and the specific content of health services planning.) Robustness analysis, as indicated in Section 1, is centrally concerned with the maintenance of flexibility under conditions of uncertainty, and the Ottawa-Carleton approach is informed by the same purpose. A more detailed comparison of the two methods is given in the Appendix.

At the level of aspiration, we may quote the first sentence in the final report of the O-CRDHC Planning Program: "This is not a plan". The report constitutes not a master plan but a strategic evaluation. "The complexities of the health care system, imperfect knowledge of its operation, and uncertainties about future conditions require a planning approach which manages short-term resource commitment while retaining long-term flexibility". The intention is "to produce short-term operational plans which keep options open for long-term development" (O-CRDHC 1979).

At the level of practice, the way in which options for future decisions were maintained has already been indicated in Section 3. The essence lay in the identification of possible action sets and of possible future health care system configurations. The action sets were than analysed in terms of their compatibility with a range of system configurations which, taken together, provide satisfactory performance across the identified alternative future environments. In this way those action sets which left open opportunities for subsequent adaptation to meet a variety of as yet uncertain future events and conditons could be indicated.

At the level of results, as described in Section 3, the Ottawa-Carleton Planning Program was able to identify four alternative future environments for the health care system, and five possible configurations for the system itself reflecting different developmental emphases. "Each of the configurations would entail significant alteration to current and impending resource provision. Many of these changes are appropriately responsive only to the particular characteristics of the future within which they occur. However, study of each of the five configurations shows that several broad areas of development can be pursued over the medium- to long-term with some confidence that they will remain viable across the range of alternative future environments" (O-CRDHC 1979). The report then specifies 13 specific areas in which at least limited development could proceed without foreclosing options in such a way as to endanger system performance.

(b) Coordination rather than optimisation

There are those who claim that any method of assigning a scale-value measure of desirability to decision alternatives amounts to optimisation. Indeed any act of choice, they say, confers on the selected alternative the appelation 'optimal' since it was, in practice, preferred over its

competitors. Such is the cognitive impact of paradigmatic blinkers.

Any plausibility which this sort of reductionism might have when applied to the single activity of robustness analysis, is weakened when viewed in the context of the complex of activities which constitute robustness methodology. A crucial role is given to the identification of minimal and acceptable standards of performance - in the OCRDHC example, standards of provision of health care services per head of population. The method is therefore one based on 'satisficing', one of the possible opposites of 'optimisation'. While by definition there is only one 'best' way, there can in principle be a multitude of solutions which are 'satisfactory'. Robustness analysis does indeed produce a ranking of possible action sets in terms of their consistency with these satisfactory solutions - but as only one factor in the analysis of potential actions. Thus one output of robustness analysis in the Ottawa-Carleton methodology is the activity "structure short-list of Health Council initiatives". (Not "select most robust action for implementation".) The implication is that the robustness approach enables decision-makers to organise their thoughts about uncertainty and flexibility, but not that these are their only concerns.

Thus we hold that it is reasonable to regard the robustness approach as 'non-optimising'. It still remains to demonstrate that it can facillitate coordination.

Any optimising approach is encumbered with the need to consider all possible combinations of decisions. This is generally only feasible where analytic or algorithmic methods permit the discovery of the optimum without explicit consideration of all alternatives. By contrast, what are sometimes called "what if..." methods (such as simulation) concentrate on drawing out

the consequences of particular decisions of interest; the decisions to be examined are a matter for judgement rather than algorithm, as is the comparative evaluation of the alternatives considered. "What if..." methods operate by tracing the logical and practical connections between component parts of the system under study. They are thus deeply concerned with the internal coordination of that system.

The robustness methodology employs a version of the "what if..." approach. It asks, and attempts to answer, questions of the form "what actions might we usefully be able to take in the future, if we commit ourselves now to this particular set of initial decisions". So, instead of relating action to consequential outcomes, it relates action to possible sequential actions. The method is thus essentially concerned with the coordination of actions, particularly those which are separated in time.

The planning system devised for Ottawa-Carleton goes beyond such implicit coordination of the actions of a single decision-making body, to construct a format for the coordination of actions of a variety of bodies, linked together by their involvement in the local provision of health services. Two of the three end products of the robustness analysis itself were of this type. One of these was the construction of possible guidelines for response by the Regional District Health Council to proposed initiatives from health services providers. This was necessitated by the coordinating role and limited executive authority of O-CRDHC - not uncommon among social planning agencies, but rarely appreciated adequately in operational research studies. The O.R. achievement on this aspect of planning problems is quite limited (Stringer 1967; Friend et al. 1974).

The second element of coordination was the attempt to affect the 'future environment' to which the health care system would be subjected, in

so far as elements of that future were controlled by other bodies whose policies might be influenced. Here again, we found the mainstream O.R. paradigm, with its assumption of a clear boundary between the system (which is partially controllable) and the environment (generator of random disorder), unhelpful. It proved to be, not a helpful conceptual structure supporting constructive analysis, but rather a mental shackle restricting perception of the practical problem.

(c) Reduced demands on data

The major requirement for data inputs arises in the "demand and performance" stream of the Ottawa-Carleton methodology, already described in Section 3. There are a number of facets of this approach which reduce the level of quantification and the total demand for data.

The approach uses the identification of impending and future performance inadequacies to generate, respectively, alternative action sets for immediate implementation, and possible alternative future configurations of the health care system. This is a satisficing approach and based on resource inputs. The need for measures of the benefit of outputs, perhaps involving sophisticated and speculative inference from past behaviour[1], is avoided. Each resource is measured in its own units, with no requirement for inter-resource trade-off values.

Another factor reducing the demands for hard data is the greater reliance on subjective inputs. Thus impending performance inadequacies are identified, not just by a mechanical comparison of resources and population, but also as a result of comments obtained during the survey of health care delivery agencies. The same source provided direct suggestions as to

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[1] As in the 'Balance of Care' or 'Inferred Worth' model - see, for example, Gibbs (1978).

possible components of initial action sets, as did the exercise to discover pressures for change in the wider community. The alternative feasible and adequate health care system configurations for any of the identified futures are generated not by an automatic process, but by an interactive procedure. In this the judgement of planners and Health Council members is applied to the predicted inadequacies in performance, to provide alternative means of meeting these inadequacies. In these and other ways the 'hard' and 'soft' data are used to supplement and complement each other. The application of judgement reduces the need for collection of apparently objective but often dubious quantitative information. And, equally, the role of 'hard' data is relegated, appropriately, to that of stimulating and supporting the judgemental process.

(d) Facillitation of participation

It should be clear that a good deal of the evidence in the previous section also supports the contention that the Ottawa-Carleton methodology can facillitate participation. In so far as a reliance on a high quantification, high technology approach to decision analysis is the cause of the exclusion of the mass of those affected from involvement in the decision-making process, the substitution of a low-technology approach based on the inter-action of data and judgement can make the process more transparent and accessible. To this extent, the methodology described in this paper has the potential of making participation more widespread and effective.

Another factor which inhibits public participation is the monolithic nature of strategic plans, in which the broad shape of the whole system under study some ten to twenty years into the future is sketched out in greater or less detail. Especially for those not practiced in the

manipulation of abstract concepts it can be difficult to relate the future to the current state, and so gain a sense of the significance of the changes proposed. To the extent that this factor reduced participation, the Ottawa-Carleton methodology has potential to facillitate it. Its concentration on the next step in decision-making (then explored in terms of its compatibility with alternative futures) provides a concrete point of reference - the possible marginal changes to a known and experienced system.

However there are other non-technical barriers impeding participation in planning. Most members of our society have a reasonable expectation that their contribution to decision-making is unwelcome, or will be welcomed only to be ignored. The experience of powerlessness outweighs the rhetoric, however sincere, of planners. Where real interests clash, the powerful do not voluntarily cede their advantage. Indeed, the entire structure of representative democracy, and the elaborate theories which justify it, rests on a deliberate exclusion of the mass from effective involvement in the decision-making process (Pateman 1970). It is not, perhaps, over cynical to see the mathematization of planning as having progressed in large part because it reinforces this pre-existing exclusion.

We were able in the Ottawa-Carleton context to obtain agreement to the 'pressures for change' exercise, itself a modest step towards participation. The Regional District Health Council's openness to this proposal, as well as to a more transparent methodology, is and was most welcome. It is, however, worth noting the Council's status as a non-executive agency - a coordinative body with influence but no powers of command. It is at least possible that agencies whose decisions dispose of large resources and so affect directly the interests of influential groups in society may find less appeal in a greater openness which can facillitate public participation.

(e) No abolition of politics

The methods of rational comprehensive planning (including operational research) have contributed to what has been called "the sublimation of politics" (Fay 1975), in which active debate between partisans is replaced by the 'scientific' pronouncements of experts. Alternative methods alone cannot revive politics - but they can assist the resuscitation, and in a variety of ways. Indeed it can be asserted that the aspects of the alternative methodology already described in this section each contributes in part to the enabling of political debate.

However one further feature of the method developed for Ottawa-Carleton which is particularly relevant to the repoliticisation of the planning process is its handling of the identification of possible futures for the environment of the health care system. In the project description which secured funding for the planning programme (prior to our involvement in the work) a commitment was made to the use of the "Delphi" technique for this purpose. Delphi is a method "which seeks to induce opinion convergence" (Helmer 1966), and so to generate consensus among experts. Such an approach would certainly have gone far to negate any other attempts made to avoid the depoliticisation of planning, since politics is concerned with the interplay of conflicting interests and opinions. A method which assumes or manipulates a consensus thereby suppresses conflict which can thus express itself only outside the planning process.

The unwelcome techniques thus forced on us could fit easily within our overall methodology only if it could be adapted so as to produce a number of significantly different alternative futures - that is, to generate conflict rather than consensus. This was achieved, as described earlier, by subjecting the early responses to cluster analysis in order to partition the

panel into sub-groups which were internally homogeneous in the structure of their expressed opinions, and externally distinct. The consensus generating procedures of Delphi were then performed separately within each group, with a view to producing a range of maximally divergent but internally cohesive alternative futures.

This adaptation of a technique from the classical methodology is perhaps a modest example of the potential for 'radical reuse' of existing technology.[1] It cannot, of course, summon up conflicts where none exist, or of itself activate political debate which may be held in check by other forces. But it does at least indicate that the planning process itself has some potential for refashioning in such a way as not to constitute in itself an obstacle to such debate.

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[1] Another example of 'radical reuse' is in the process (described in Section 3 above) by which the predicted inadequacies of performance should there be no change in the health care system are used to generate possible future system configurations. This procedure is similar to that of 'reference projection' - see Ackoff (1976), also Ozbekhan (1977). But Ackoff performs only one reference projection, and uses it largely to motivate members of the organisation under study to accept the need for far-reaching changes. As incorporated in the Ottawa-Carleton methodology, multiple projections identify directions and magnitudes of changes which may be required.

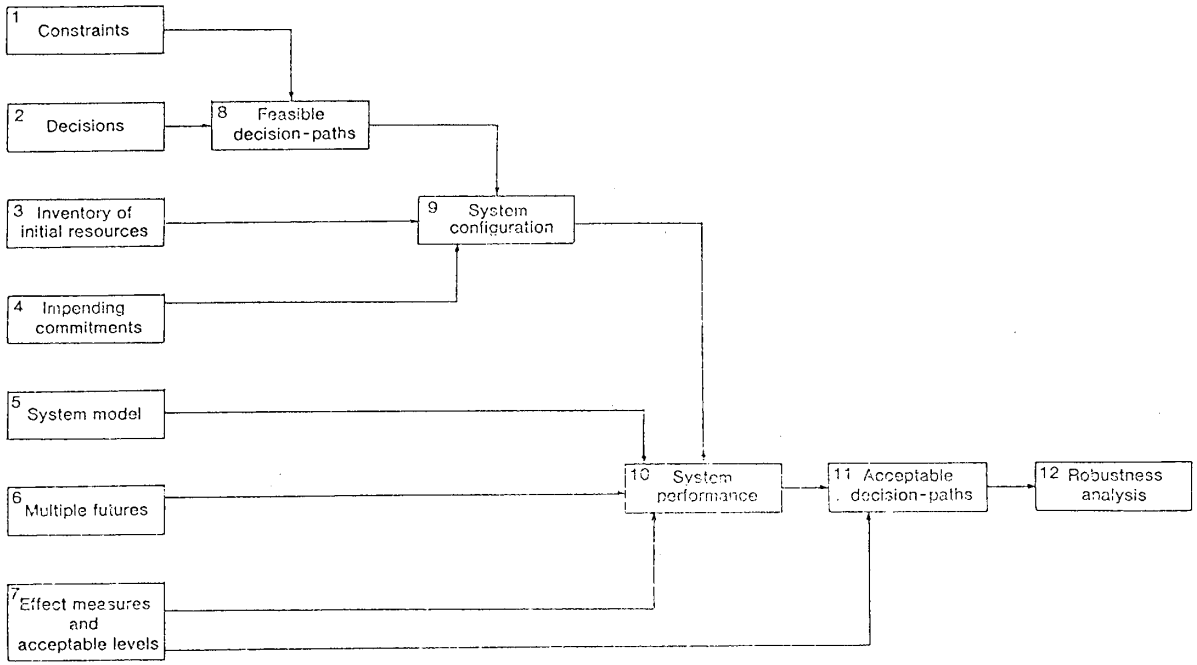

FIG. 1. *Flow diagram of robustness methodology.*

Source: Rosenhead (1980)

Figure 2

5. CONCLUSIONS

The work reported here is only a part of that carried out by the O-CRDHC planning team. The account given is perforce a personal one, in that our involvement in the work was necessarily selective and intermittent. Indeed our final visit occurred some nine months before the end of the project, and a great deal of the effort required to make accepted general principles operational (with inevitable adaptations to particular circumstances) was deployed during this final period. Nevertheless, a reading of the final project report will confirm that the approach described in this paper remained a major informing principle of the planning team's work.

In the present document we have had twin aims

- to demonstrate that an approach based on robustness analysis is by no means incompatible with the demands of health services planning;
- and to illustrate the differences between this (as an example of the 'alternative methodology') and the classical operational research or health planning approach too often adopted unquestioningly and unnecessarily.

Our hope is that, to the extent that we have been successful in these aims, this paper may encourage others to adopt a planning methodology which aims at the maintenance of flexibility under uncertainty, and serve to widen somewhat the circle of those planners who subject their own activity to critical scrutiny.

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APPENDIX

COMPARISON OF ROBUSTNESS AND OTTAWA-CARLETON METHODOLOGIES

The methodology employed at Ottawa-Carleton, and the earlier general description of robustness methodology (Rosenhead 1980) can usefully be compared through their diagramatic representations - Figures 1 and 2 respectively.

The parallels are in many cases clear. Elements 7, 8 and 20 in the Ottawa-Carleton methodology correspond respectively to elements 3, 4 and 12 in the robustness methodology. In some cases a single element in the robustness methodology has been expanded into its particular constituent activities for the circumstances of Ottawa-Carleton. Thus element 5 of the robustness diagram (system model) is replaced by items 4, 5 and 13 - a model of the demand for health care services. Similarly Ottawa-Carleton activities 6, 14 and 18 give a more detailed breakdown of the identification of alternative multiple futures (box 6 of the robustness methodology); while the identification of measures and acceptable levels of performance (element 7 in the robustness methodology) is factored down in the Ottawa-Carleton methodology into a cluster of activities (nos. 1, 2, 3, 9, 10 and 16) involving policy formulation, community pressures and comparative analysis.

There are also a number of instructive cases where the parallelism breaks down. Thus the identification of three different types of output from robustness analysis (Ottawa-Carleton boxes 21, 22 and 23) was not previously conceptualised and thus has no equivalent in the general robustness methodology diagram. Also, although the Ottawa-Carleton diagram does not indicate this, activity 2 (identification of pressures for change)

has inputs directly into a number of activities later in the sequence, as has been described.

However, perhaps the major change is from the handling of system performance and of alternative and feasible decisions and decision sequences (items 1, 2, 8, 9, 10 and 11) in the general robustness methodology. The elements in the Ottawa-Carleton methodology which produce the corresponding input to the robustness analysis activity are items 11, 12, 15, 17 and 19, but they do so by a different logical process - which has been sketched in Section 3 above.