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EVALUATION AND OPERATION RESEARCH AS MEANS FOR MEETING SERVICE OBJECTIVES AND IMPROVING METHODS OF HEALTH CARE DELIVERY: OPERATION RESEARCH

by

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INTRODUCTION

The health industry is becoming too complex requiring delivery systems with management and manager. At the same time, management decisions must be made with a far wider objective, that of providing the most effective promotive, preventive and curative services with the available resources of manpower, money and material. There is no doubt that for years, people have carried out enquiries about health care delivery before making decisions. However, it appears that they have collected isolated information about doctors, nurses and administrators without considering that the action or inaction of one might affect the other two and make health care delivery system ineffective.

It would appear therefore that the time has come for all those concerned with the delivery of health care to examine the origin of problems instead of just allocating responsibilities. Operational research makes this possible. It aims at developing the general capacity to enquire, to indirectly teach health personnel how to go about collecting information and also how to use this information in solving their problems.

In a short paper such as this, it will be impossible to set out all the ramifications of operational research. An attempt will however be made to discuss each of the following briefly:

1. What is an operational research?
2. Scope of operational research.
3. Identifying and formulating operational research problems.
4. Stages of research and action.

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5. Systems and models.
6. Problems in improving health care delivery system.
7. Elements of concept and Project Formulation.

Definition of Operation Research

Bane* defines operational research as an attack of modern science on complex problems arising in the direction of management of large systems of men, machines, materials and money in industry, business, government and defence. The distinctive approach is to develop a scientific model of the system, incorporating measurements of factors such as chance and risk with which to predict and compare the outcome of alternative decisions, strategies or controls. The purpose is to help management determine its policy and actions scientifically.

The Nuffield Provincial Hospital Trust**had earlier in 1962 seen operational research as endeavours to make the best use of limited resources in complex organizations involving men and machine. It is not so much a discipline as a collection of disciplines, brought together for the purpose of making a scientific attack on practical problems such as arise in systems enbodying a number of interacting parts. It received its primary impetus in the study of military operations during the Second World War, and was later applied successfully on the factory floor and in the commercial office, and has more recently grown towards acceptance as an important adjunct to management in business, government and human organizations of every kind.

The WHO***has crystalized the above two definitions thus "the quantification of management problems in statistical or mathematical terms as to enable solutions or better solutions to be found to these problems".

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* Bane, W.T., Operational Research: Models and Government, C.A.S. Occasional Papers, HMSO, 1968

** Nuffield Provincial Hospital Trust, Towards a Measure of Medical care: Operational Research in the Health Services, Oxford University Press, 1962

*** WHO "Glossary of Terms" used in the Report on a Meeting on the"Role of Operational Studies in Health Services and Education for these services" held in Bangkok, Thailand from 12 to 21 December 1972. Regional Office for South East Asia

Scope of Operational Research

The scope of operational research embraces the selection of topics for research, the use of appropriate methods of investigations, and the analysis and the choice of the methods in which practical action can be initiated. The current scope of operational research can trace its origin to three areas of enquiry:

a) Social behaviour and social organization

b) management and economics

c) mathematics and statistics.

The interest in social behaviour and organization is the oldest. Historically, it has moved from the usual traveller's description of observations to a systematic analysis of social structure and systems of belief, In economics the growth of large scale industry prompted the more systematic concern for the efficiency of production. During the Second World War, groups of physicists, mathematicians, biologists, and engineers worked together to minimize their countries' losses of men and machines and to maximize the losses of those of the enemies. The dispersal of these groups of workers, after the war, spread the ideas and techniques of operational research into more peacefully oriented organizations, in both Government and industry.

The development of statistical methods, particularly in relation to medicine, gained its greatest impetus with the discovery of the power of random allocation methods in the design of statistical surveys and experiments. The statistical theory of probability, which forms the basis of much operational research analysis, has its origin in an interest in decision making in gambling*.

A practical interest in the application of social science concepts to medical problems began in the socio-psychological studies of child development, continued in the fields of psychotherapy and more recently was shown in studies of the effects of the organization and atmosphere of hospitals and similar institutions on both patients and staff**

* Bailey, Norman, T., The Mathematical Approach to Biology and Medicine. John Wiley and Sons, London, 1967.

**Lawrence, J.R., Operational Research and the Social Sciences. Tavistock Publications, 1966

Apart from Leighton's* identification of the relevance of social structure to the successful provision of medical and welfare services to displaced Japanese, the concepts of social structure and process have not been so extensively employed in investigating the practical problems of delivering preventive and curative health services to defined populations.

According to the WHO** recent report of a meeting in Thailand, an organized plan of operational studies seeking to solve direct priority problems might be directed towards answering several or all of the following questions:

1. What are the trends in health service utilization? What are the future changes in demand and supply of services?
2. What are the possible (and probable) repercussions of these trends on the usage of different parts of the health services? What are their likely effects on manpower and finance?
3. What are the major factors which influence the giving and receiving of public health and medical care? Which of these are most easily changed?
4. What mathematical concepts are assumed or can be used in health services and educational policy decisions?

Identifying and Formulating Operational Research Problems

It is implicit in the definitions of operational research that not all problems are suitable for operational research. The characteristics of researchable problems lie not in the subject but in its less obvious structure. It is necessary to accumulate experience in recognizing what is and what is not an operationally soluble problem. Because operational research deals mainly with management and managers, it follows that research workers must give explicit consideration to the nature of decisions that are expected to result from their studies and also to the persons who will be responsible for making them. In many situations in the health services, more than one decision maker is involved. These decision makers may either collaborate or may be in conflict.

* Leighton, Alexander, H. The Government of Men. Princeton University Press, 1945.

**WHO, Report on a Meeting on the Role of Operational Studies in Health Services and Education for these Services held in Bangkok, Thailand, 12 - 21 December 1972, Project SEARO 0116, June 1973.

Sometimes the conflicts might be resolved by rephrasing the problem to include a mutually acceptable objective(such as improving the effectiveness of MCH clinics from 10% to 40%) by opening up new alternatives or by a more precise estimate of the effects of change. It is worth noting that two main conditions exist in which an operational research approach is appropriate. These are:

a) When there is a decision-maker who is motivated to acquire or achieve some aim that has not already been acquired or achieved, and the "management" is in a purposive stage with respect to the system being managed.In other words, there must be both a willingness and the ability to change the system.

b) When there are alternative ways available of achieving the desired ends, which can differ in respect of efficacy, the resources required and the risks involved. (No decision problem exists if there is only one course of action open, or if the alternatives do not differ significantly).

Stages of research and action

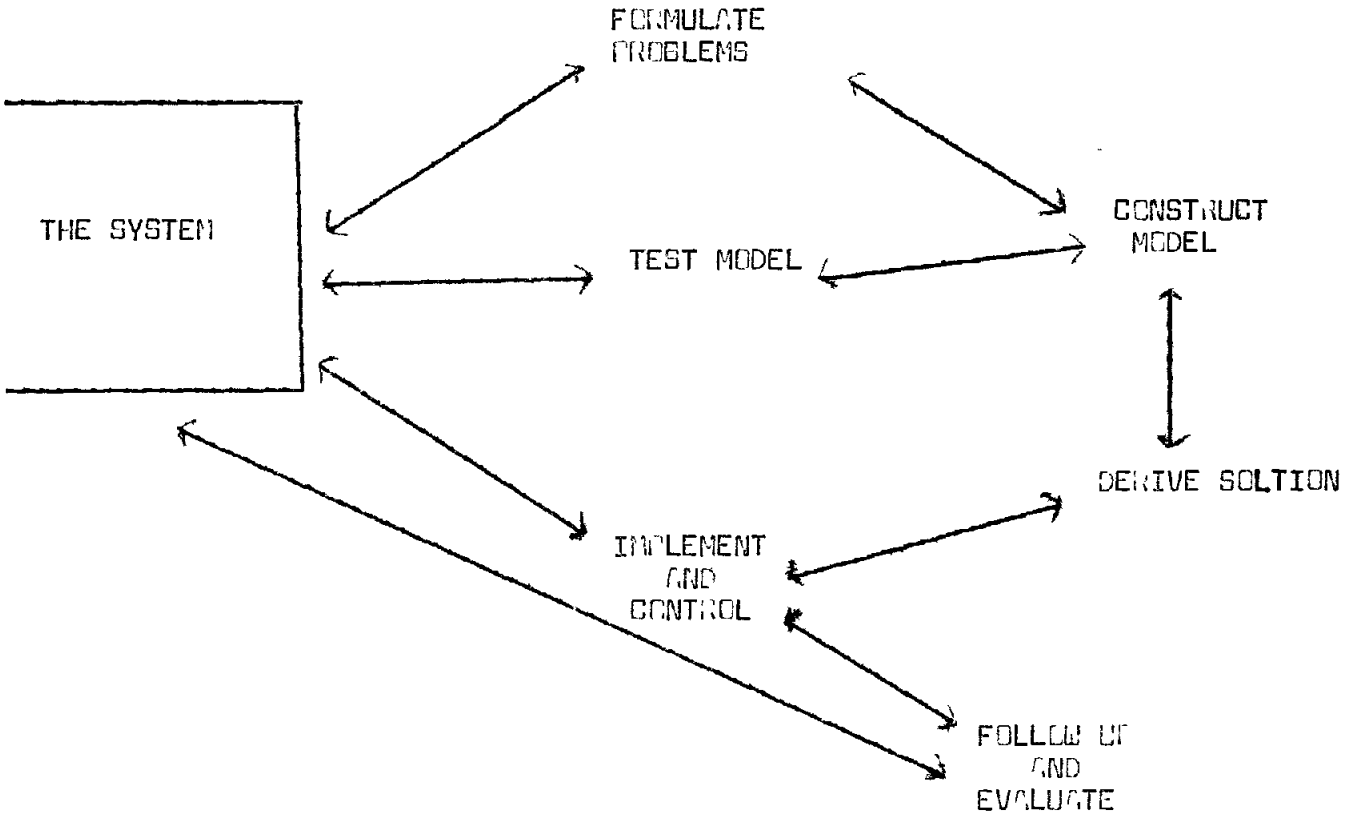
Before an operational research can utilize the full benefits of a system approach, it must move through the following steps:

a) The problem must be diagnosed and objectives set.
b) Models must be developed.
c) The system must be examined.
d) Models and observations must be manipulated to provide solutions
e) Implementation
f) Monitoring
g) Evaluation.

Stages of research and action are not linear. They are involved in constant referral back to the real life system, with a recycling through the the procedure as uncertainties become resolved. It must be emphasized that setting up an operational study require systematization at all stages and necessarily meant that provision for adequate preparations for monitoring and evaluating the solution, once reached, must be incorporated at an easily stage (See Figure I).

FIGURE I

STAGES OF THE OPERATION RESEARCH PROJECT



SOURCE: WHO PROJECT SEARO P116, 1973

Systems and Models

Allport defines system as "any recognizable delimited aggregate of dynamic elements that are in some way interconnected and interdependent and that continue to operate together according to certain laws and in such a way as to produce some characteristic total effect. A system, in other words, is something that is concerned with some kind of activity and preserves a kind of integration and unity; and a particular system can be recognized as distinct from other systems to which, however, it may be dynamically related. Systems may be complex, they may be made up of interdependent sub-systems, each of which, though less autonomous than the entire aggregate, is nevertheless fairly distinguishable in operation."[8]

In health care delivery, system can be looked at as a set of resources organized for a common purpose. And "system approach" would be the analysis of systems and their objectives with a view to re-allocating resources to improve performance.

One could look at system by its component parts and their relationships, by the boundaries around it or by the task it performs. Invariably, the primary task of all systems gives rise to secondary tasks, such as training, research, satisfying career aspirations of staff, coping with stress (in both patients and staff) caused by the primary task, and the supply and involvement of materials.

A system approach requires the definition of a model as a basis for analysis. A model must be seen as a substitute representation of reality and as an idealization. A model is defined as a respresentation of the significant features of the problem under study. It can be a simple verbal description or a three-dimensional design or it can be an abstract, logical or mathematical representation.

The goals of systems analysis is to define models of the first kind, which are useful for maximizing the allocation of resources towards a system's objective. Systems analysis is

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8. Allport, F.H., Theories of Perception and the Concept of Structure. Wiley, New York, 1955.

used for planning, improved methods of delivery, analysis of effectiveness and decision analysis.

However, in order to use this approach, it is esential to:

a) make an assessment of the current environmental state;

b) formulate objectives;

c) recognize the difference between the existing and the desired environmental state;

d) determine a set of feasible alternatives for achieving these objectives;

e) determine the set of consequences of each alternative;

f) identify some criteria on the basisof which to choose between alternatives;

g) programmes selection or decision making.

Problem in Improving Health Care Delivery System.

One problem which I have observed in improving the effectiveness of our health care delivery system is in the confusion of roles in the minds of the professionals. In the last analysis, the professional is a technician - an adviser to the policy makers. The Permanent Secretary in the Ministry of Health is the policy- maker, the ultimate decision-maker. The decision-maker needs a systematized information (project formulation) to assist him in making a decision which will then permit smoother implementation and final evaluation.

It would seem that the professionals (nurse and doctors) rather than give advise, which is based on a well formulated project, generally take the decisions themselves and expect the decision-maker to accept the decision. For example, professionals tell the Permanent Secretary to build more hospitals, more health centres, recruit more experts and so on.

Most of these requests have no basis except pages of tables containing number of attendances, deliveries, postnatal examinations, visits, immunizations and the like. Percentages and ratios are not usually included.

Neither are the objectives of the actions stated. Nor then can the decision-maker make sensible decisions. Because of the importance I attach to good project formulation, I shall end this paper with a list of some of the elements included in a good project formulation and planning.

Elements* of Concept and Project Formulation.

A. Concept Phase

1. Identify the problem

Is the problem worthy of project attention?
The identification comes form the recognition of a need by a higher authority or as a part of the strategic planning function of the Ministry's planning group if one exists.

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* These elements are extracts from a paper delivered by D.J.T ele and Reproduced in WHO: Project GE ma 0110, New Delhi, 1973,

2. Quantify the problem

This is done by analysis, which must consider the population to be served, the disease or other technical need and the socio-economic environment. It is important to perform these as carefully as possible within a broad concept of the total system in which the problem resides. Projections of the problem must be made into the future to properly place the problem in context.

3. Establish Specific Project Objectives

This should be a concise and precise statement of the objectives of the project as conceived at this stage in the formulation. It must be sufficiently specific to permit evaluation of success, without ambiguity, at project completion. The statement should not be limited by current budgets or time horizons. Schedule and budget considerations come later.

4. Identify constraints

This is an explicit listing of planning constraints as perceived by the planners. It should include both legal and policy restrictions. Completion of this task ensures unnecessary re-planning at a later stage.

5. Outline alternative schemes to meet objectives.

This process requires the greatest demands on creativity. The process would normally be done in a brainstorming session with free-wheeling thought to all the ways by which the objectives can be met. Several broad concepts for programme achievement should be outlined for later evaluation.

6. Establish criteria for choice of delivery system.

The criteria for choice should be tailored to the project under consideration, but generally cost-effectiveness* decision criteria are also included. The criteria must be sufficiently specific and emphasize differences in order to permit decision. Technical, cost and schedule considerations as well as the recognition of overall strategy and policy should be included.

*Cost-effectiveness is a procedure used when benefits are difficult to measure or when those that are measurable are not commensurate with the costs. It is similar to cost benefit analysis except that benefit, instead of being expressed in monetary terms, is expressed in terms of results achieved, e.g. number of lives saved or number of days free from disease.

7. Select best schemes for delivery

In this process each of the project delivery schemes should be tested against criteria established for choice. It may not be possible to eliminate all but one scheme at this stage. In this case, the final decision will be made later when more precise information is available. In order to avoid undue efforts a final delivery scheme should be chosen as soon as the proper choice is clear. Operations research techniques may be useful.

B. Project phase

9. Select task/activity planning technique.

The suitable detailed planning technique should be chosen. The potential techniques include Gantt Charts, constrained Gantt Charts, critical path method, PERT, CERT cost and risk analysis. The simplest suitable technique must always be chosen.

9. Itemize activity list

Depending on the specific planning technique selected, the project should be broken down into individual activities. Care must be taken to include all activities which contribute to the project, including administrative, interface and control tasks.

10. Evaluate project objectives

It is important that the project objectives remain a realistic expression of the expected project accomplishments.

11. Select major milestones

The major technical milestones should be selected and fixed dates for accomplishment assigned, where required. It is expected that these milestones will be the major item for the technical review of the programme by higher management levels.

15. Establish technical project evaluation criteria

Criteria should be selected which will permit evaluation of project success. This could perhaps give adequate consideration to health, socio-economic and cost- benefit measures of project success. The main intention is not internal measurement of project success, as this is carried out elsewhere, but to provide comparative analysis of this project success compared to other approaches and to the uses of resources.

16. Construct network chart.

The activities result is assembled according to the rules of the specific planning selected.

17. Check and revise.

Re-planning is a dummy activity on the first pass through the planning process. On subsequent feedback activities, major milestones and resources must be used consistently with the activity network.

15. Estimate Requirements for each Activity

Estimates should be made of required resources to satisfy each activity. Manpower and financial resources should be identified. Manpower needs should be expressed in terms of skills levels, time requirements and funds.

16. Verify Resource Availability

The resource requirements should be summed up and time phased. The availability of resources should then be verified. If budgetary availability of personnel or other constraints exist which do not permit resources to be expanded as planned, it will be necessary to re-plan.

17. Management Plan

This is intended to identify totally the processes by which the project will be launched and managed. This planning is performed to enhance the likelihood of project approval and success. Where a project management system exists in a country, this plan will be relatively easy to produce and will follow established procedures to a large extent. In those countries where are no project management systems, development of this plan will probably be the first consideration of project management in the Ministry of Health for that country and will therefore be a much more difficult, extensive and time-consuming process. While many management activities are administrative in nature, the project management scheme will interfere with normal governmental practice; consequently, the operating procedures for the project must be clearly identified. Careful consideration of these aspects should go a long way towards removing hesitancy on the part of the officials to approve projects and could be a vital contribution by the planners.

17.1 Project Organization.

a) Internal: This element considers specifically the internal organization of the project, the preparation of the organization chart and the definitions of lines of authority.

b) External: This organization defines the position of the project as a part of the external world. It will define those individuals and agencies to which the project reports and will define formally both co-ordination and authority interfaces with the external world. Distinction must be made between functional authority, which is the traditional line authority path, and the project authority, which exists for the purpose of the project only.

17.2 Definition of Responsibility and Authority

This section will explicitly define the responsibility and authority of the project manager, clear definition of project authority is necessary in order to establish explicitly the rules under which he must operate. Recognition should be made that project management is essentially a management task and that the persons selected for management positions must be picked for their demonstrated management skills. Experience has demonstrated that human and conceptual management skills are as important as technical strengths in the area of the project. Sophisticated technical skills generally exist at the performance level and not necessarily at the level of management.

17.3 Major Milestone Schedules

Major milestone are extracted from the detailed activity network (see 13) and are included in the management plan to highlight the significant events of the project.

17.4 Project Control Plan

Depending upon the size of the project, project control may be incidental to the manager's own day to day management or may require detailed definition of procedures and techniques. Control techniques include frequent reporting against established schedule network, recording of weekly financial expenditures, internal project status meetings, formal proof of technical performance, maintaining the schedule etc.

17.5 External project review plan

This plan will identify the process for review of the project by higher authorities. Typically this review includes frequent reporting by the project manager to his supervisor in a normal organizational mode. The schedule for review may be picked by important milestones rather than on a scheduled calendar basis.

17.6 External interface control and co-ordination

The organizational chart referred to above will identify this external interface, and plans must be made to co-operate with these bodies. If these co-ordination functions are specifically considered, it is much more likely that they will be successfully performed.

17.7 Project information system

Where no project information system exists, it may be necessary to design one.

17.8 Reports and Documentation

The contents of the report should be explicitly considered particularly when external funding agency is involved.

17.9 Risk Management

Risk may be of technical nature (i.e unknown or uncertain likelihood of success), schedule (uncertainty whether the job can be accomplished in time), or of a financial nature (uncertainty as to the total cost). PERT is one of the analytical techniques used for appraising these problems. Explicit recognition beforehand and identification of the plan for the management of risk will enhance the likelihood of success.

17.10 Corrective Action and Re-planning

As every project will at some time or another in its execution deviate from the plan initially prepared, consideration must be given to the mechanics for re-planning and to the procedures which management plans to take for corrective action when progress deviates from the plan.

17.11 Staffing Plan

This plan will identify the requirements for differing technical disciplines and the schedule of their need. If recruitment is necessary, the plan must take into account the recruitment process and the delays associated with recruitment. Failure to consider these aspects has resulted in the lack of performance of many projects, particularly in the international sphere.

17.12 Material and Logistics Plan

This is necessary in projects where hardware components are involved.

17.13 Promotion Plan

The plan for promotion of the project (consumer acceptance) should be considered explicitly where necessary.

17.14 Management Resource Requirements

The resources for management of the project, in contrast to the technical delivery, should be specifically identified.

17.15 Pre-approval Promotion Plan

Specific identification of the overall plan for project initiation should be made. This element will identify the total approval cycle for the project; the governmental and potential multi-national approval authorities will be defined, and the approval by each will be scheduled. The activities necessary to secure approval together with the individuals responsible for its achievement will be defined.

18. Financial Plan

It is important that preparation be made for sufficient financial support and for control of the financial resources under the control of the project.

18.1 Resource Requirement

These resource requirements should be scheduled according to the category (manpower supplies consultants, capital investment, sub-contract) requirements of the funding agency.

18.2 Planned Sources of Resources

The resource requirements should be allocated to the sources. Sources will include government bodies, overhead items, international funding, contributions etc. Different requirements will likely exist for each source of funds and must be considered in planning the total availability of resources.

18.3 Project Accounting System

If necessary the cost accounting system for the project should be described.

18.4 Financial Control Plan

Specific techniques should be set aside for the control of finances of the project and the financial authority for each project manager defined. If government regulations are the control, suitable reference should be made; otherwise, controls must be designed specifically for the project.

18.5 Budget Plan

The schedule and definition of responsibility for securing continuous funding should be identified. This will include planning for the requirements or corresponding to government budgetary cycles, loan applications, correspondence with international agency budgetary cycles etc. The person responsible for these processes should be identified.

19. Write-up of Plan Formulated

All such plans must be written for use in securing approval and later in the management of the project. The completion of these plans will present to the government (decision-makers) a complete package for execution of a project; only approval is necessary. Naturally the effort required is greater than in current practice, but the enhanced likelihood of approval and project success will make this effort worthwhile.