# PLANNING - PROGRAMMING - BUDGETING SYSTEM

# ( P. P. B. S. )

## An Exploration into its theory and practice

JOAQUIN MARUY TASHIMA

# UNIVERSITY OF EDINBURGH

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# PLANNING-PROGRAMMING-BUDGETING SYSTEM

# (P.P.B.S.)

## An Exploration into its theory and practice

JOAQUIN MARUY TASHIMA

M.Phil. Thesis

Department of Urban Design and Regional Planning
Social Sciences
Edinburgh University
1974

To my son, Camilo, in the hope
that he will not be forced to
live in a 'Brave New World'.

# INTRODUCTION

## 1. Nature and Purpose of this Work

Take any group of people living together. They will have needs, whatever their situation and resources to satisfy these needs. In most cases, their needs will be greater than their resources. Thus, for the everyday business of living they may have to decide on the most beneficial use of their scarce resources.

Throughout the ages from the smallest households to the largest cities, it has always been possible to identify someone in any particular group whose ideas would very much influence the decision making activity relating to the use of resources. They are the elders, fortune tellers, priests, counsellors, professors, politicians and the like, whose acquaintance we have made through our books of history.

The nature of these people's ascendancy may have been different, but in the last analysis they have played, or they still play, the same role in society, viz. to influence with their thoughts and actions the decision-making process.

In the most economically "developed" societies, a new group of people who share (or compete for) the above mentioned role have emerged since World War II. They are known as the "systems analysts", and they claim that although they are neither "politicians" nor "kings", both kings and politicians must listen to their advice, for they speak in the name of science, rationality and common sense.(1)

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(1) See, for example, the definition of Operational Research provided by J.K.Friend and W.N.Jessop, "Local Government and Strategic Choice", p.xx. "Operational Research is.. the attack of modern science on problems of decision-making arising in the management of organizations". The meaning of "rationality" and "common sense" are discussed in chapter nine, section 1.3, of the present work.

The systems analysts have replaced the fortune tellers' cards with yet another set of tools, i.e. the computer, statistics, mathematical model and the scientific methodology. With these tools they are, as L. von Bertalanffy says, "at work creating a New World, brave or otherwise".(2)

The systems analysts in their work have developed new concepts like Linear Programming, Network Analysis, Theory of Games, etc., which allegedly help to understand and make easier the decision-making process. One of these concepts and probably the newest of them all is the so called Planning-Programming-Budgeting System (P.P.B.S.), the use of which, it is claimed, will assist any administration in the problem of allocation of scarce resources to decide "what to do, how much to do, and when to do it."(3)

The focus of this work is centred on the above mentioned concept. The aim is to provide a framework for the understanding of what the Planning-Programming-Budgeting System is, how it is used, and what is its practical value.

Planning-Programming-Budgeting System is the source of many controversies. Those who promote it allege that "P.P.B.S. is the most significant managerial innovation of the 1960s,"(4) and moreover "the most basic and logic planning tool which exists".(5) Those who criticise it think that "P.P.B.S. is the onslaught of certain types of intellectualism (econometrics, mathematics and

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(2) L. von Bertalanffy, "General System Theory", p.1.
(3) D. Novick, "Current Practice in Program Budgeting (PPBS)", p.12.
(4) D. Novick, Ibid, p.23.
(5) From the Proceedings of 91st Congress, First Session (U.S.A.) quoted by D. Novick, ibid.

engineering) upon public decision making"[6], and that the development of P.P.B.S. in social programmes - "programmes directed to helping people rather than destroying them"[7] - is enormously difficult.

One of the main hindrances to understanding P.P.B.S. is the existence of a complete mixture of terms and concepts coming from the different theories which have been developed around the problem of decision-making, and which have been incorporated within the P.P.B.S. framework. A preliminary survey on the subject showed that by and large most of the basic concepts can be grouped into four different but closely related categories of subjects as follows:[8]

(i) Systems Theory
(ii) Operational Research
(iii) Cost-Benefit Analysis
(iv) Programme and Performance Budgeting

It was felt that the acquisition of a basic understanding of the above mentioned subjects was very important to comprehend and evaluate the problems and possibilities of P.P.B.S. Consequently, the first part of this work has been devoted to the study of these basic subjects, which has provided the background knowledge used in the investigation of the concepts and application of P.P.B.S. in the second part of this work. The organization of the research is shown in graph 0-2. The summary of this work is presented in the succeeding section.

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(6) F. Mosher, "P.P.B.S. re-examined", in P.A.R., Vol.XXIX No.2, p.161.
(7) Ibid.
(8) As is shown in graph No.0-1, each one of the above mentioned headings comprehends a different number of theories and methods concerned with the decision-making process.

## 2. Abstract

The aim of this work is to appraise the problems and possibilities of P.P.B.S. as a decision-making tool. The work has been divided into two parts:

Part One - Theoretical antecedents of P.P.B.S.

Identification and critical appraisal of the basic concepts which have influenced the development of P.P.B.S. The aim of this part is to establish whether the conceptual foundations upon which P.P.B.S. has been built are solid or not. The concepts studied are:

1.1 - Systems Thinking: Two of the main theories which have contributed to the origin of studies of "systems" are "General Systems Theory" as proposed by L. von Bertalanffy, and "Cybernetics Theory" as formulated by N. Wiener. The main elements from both theories are presented, analysed and compared in the first chapter.

1.2 - Analysis of Systems: Operational Research. Chapter two provides a general idea and appraisal of the methods and techniques most commonly used in the analysis of systems. Special emphasis is given to the understanding of the Theory of Games, because of its importance for the formulation of strategic planning concepts.

1.3 - Cost-Benefit Analysis: This is one of the main analytical tools considered within the P.P.B.S. approach to decision-making. The main problems for the application of Cost-Benefit Analysis principles in the evaluation of alternative policies and programmes of action are presented in chapter three.

1.4 - Programme and Performance Budgeting: In chapter four the basic ideas of Programme and Performance Budgeting are presented and discussed since to some students of P.P.B.S. it is only an improved form of the budgetary concept known as Programme and Performance Budgeting.

1.5 - Conclusions to Part One: Part One is concluded by discussing the general pattern of relationships between the subjects appraised and the P.P.B.S. method of approach. Thus, chapter five serves as an introduction to the study of the principles of P.P.B.S.

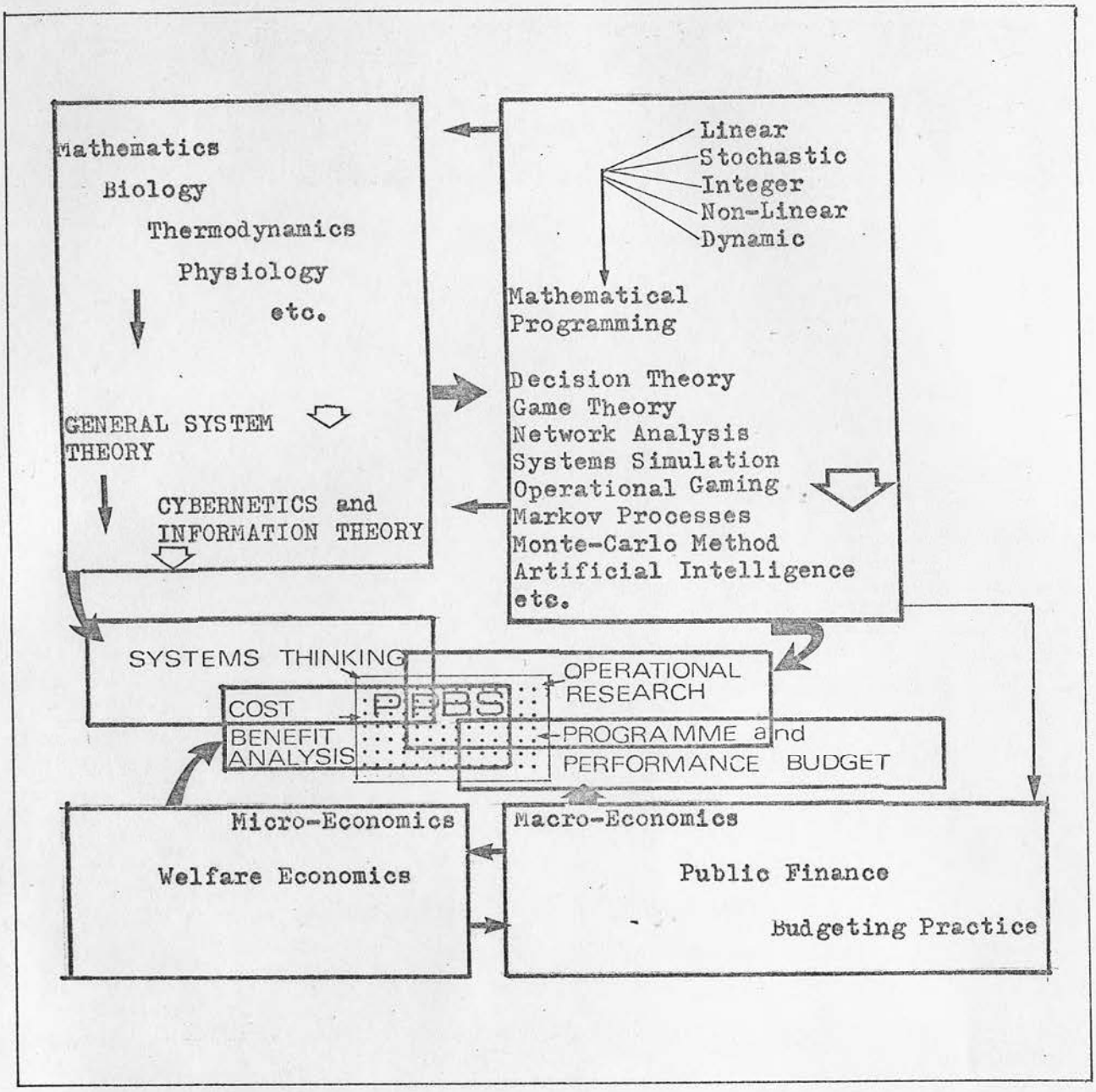
Part Two - Principles and Practice of P.P.B.S.

Study of the P.P.B.S. method of approach and appraisal of its use in the U.S.A. and the U.K. General discussion on the problems and possibilities of P.P.B.S. This study is presented in the succeeding order:

2.1 - Principles of P.P.B.S.: The main P.P.B.S. concepts and the connections between these concepts and those presented in Part One are shown, discussed and analysed in chapter six. In this chapter an attempt is made to establish whether P.P.B.S. is a general approach, i.e. a way of thinking, or if it is only a technique for the solution of problems of allocation of resources.

2.2 - Implementation of P.P.B.S.: The problems of implementation of P.P.B.S. in the U.S.A. at National Level (chapter seven), and in the U.K. at Local Level (chapter eight) are discussed. These two examples have been selected because in both cases, after a period of enthusiastic application, P.P.B.S. has been variously dismissed, downgraded and/or rejected as an aid in the process of decision-making. The reasons for this varied response by users of P.P.B.S. have been investigated.

2.3 - General Conclusions: A general discussion of whether P.P.B.S. can be considered a good approach for decision-making, and whether it can be improved or should simply be rejected, is contained in chapter nine. A short review is provided of the different working hypotheses which have given direction to the different parts of this study.

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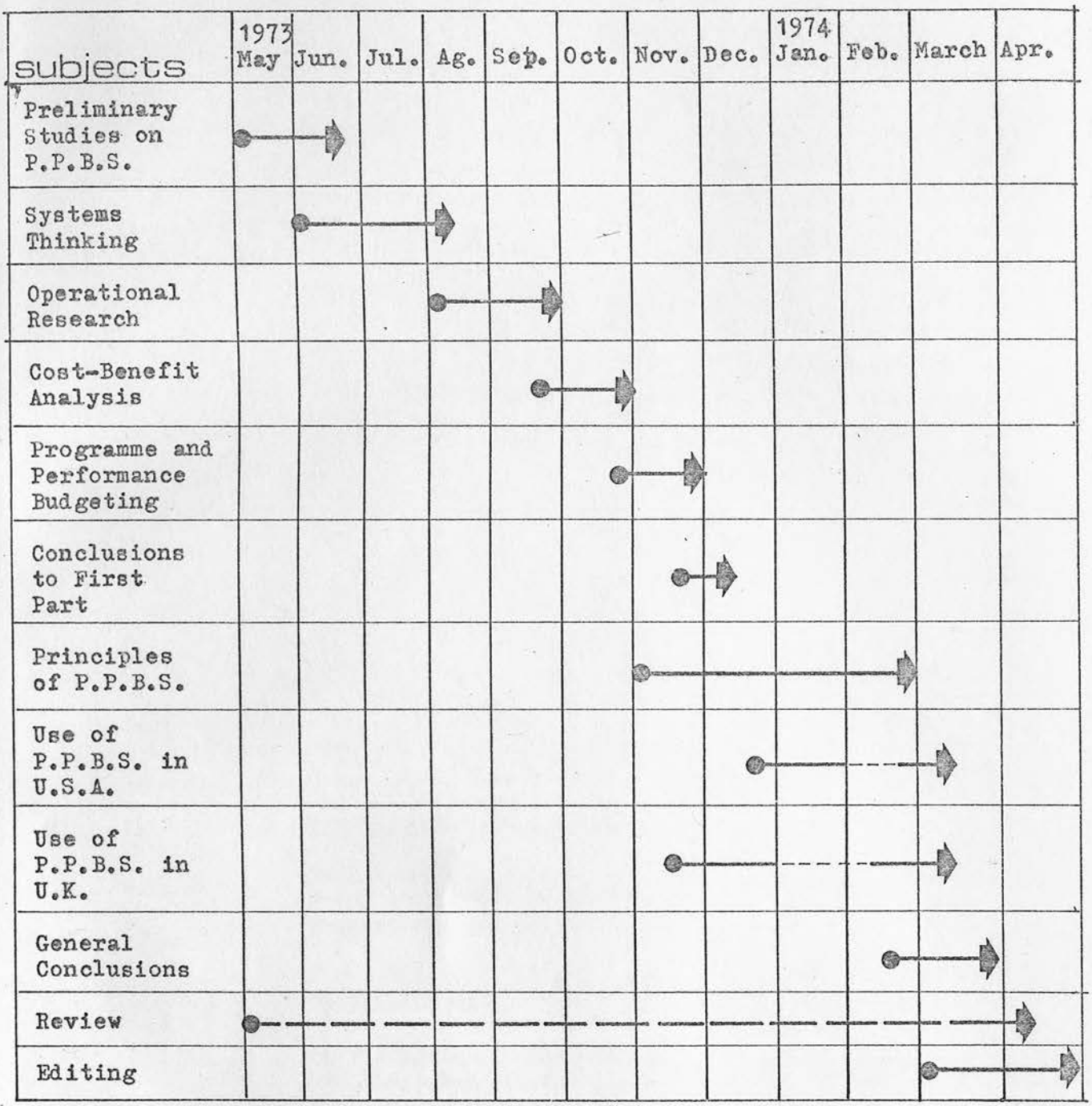


RESEARCH TIME-TABLE

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Joaquin Maruy Tashima

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# CHAPTER 1

## SYSTEMS THINKING

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# CHAPTER 1: SYSTEMS THINKING

## 1. Aims of this Chapter

A system can be defined as "a set of elements standing in interaction".(1) With this short and simple definition L. von Bertalanffy introduced the concept of "systems", which in time would generate what R. Ackoff calls "the most comprehensive effort to attain a synthesis of scientific knowledge yet made".(2)

> "The history of this concept includes many illustrious names. As natural philosophy we may trace it back to Leibniz; to Nicolas of Cusa with his coincidence of opposites; to the mystic medicine of Paracelsus; to Vico's and ibn-Khaldun's vision of history as a sequence of cultural entities or "systems"; to the dialectics of Marx and Hegel, to mention but a few names from a rich panoply of thinkers." (3)

The basic concept presented by L. von Bertalanffy was the idea of "generalization" in sciences:

> "... We need a simpler, more unified approach to scientific problems, we need men who practise science - not a particular science. In a word, we need scientific generalists..." (4)

In 1940 L. von Bertalanffy presented his theory of organisms as "open systems"(5). In this work von Bertalanffy formulates what he calls the "General Systems Principles".(6) At the same time, though from different disciplines, quite a number of novel developments dealing with the idea of systems emerged: Wiener's Cybernetics (1948); von Neuman and Morgenstern's Theory of Games (1944); Dantzig's Linear Programming (1947) etc.(7)

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(1) L. von Bertalanffy. "General System Theory", p.37.
(2) R. Ackoff. Quoted in ibid. p.7.
(3) Ibid p.9.
(4) From a paper entitled "The Education of Scientific Geneologists" (1949) published by a group of scientists including Bode, Mosteller, Tukey, Winsor. Quoted in Ibid, p.49.
(5) The paper was published with the title: "The Organism considered as Physical System". It is included in ibid, Chapter 5.
(6) In the following paper a description of these "principles" will be carried out.
(7) All these theories will be introduced presently in this work.

All these theories study the same basic problem - relationships between elements in interaction - but at different levels of analysis. By and large we could say that General System Theory and Cybernetics Theory focus their attention on the "conceptual" problems of "Systems Theory",(8) whereas the "operational" aspects of "Systems Theory" are studied through a series of methods gathered under the name of Operational Research.(9)

The understanding of both "conceptual" and "operational" aspects of "Systems Theory" is the basic aim of the first and second chapters of the present study.

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(8) As we will attempt to show, there is nothing definitive in Systems theory. Therefore the classification adopted in this work is somehow arbitrary. However, we thought that in this way a certain order may be established for developing our arguments.

(9) In U.K. these methods are known as "Operational Research". In the U.S.A. the trend is to call them "Operation Research", "Systems Analysis", "Systems Research", etc.

## 2. General System Theory

### 2.1 Introduction

The subject matter of General System theory is the formulation of principles that are valid for systems in general, "whatever the nature of their components and the relations or "forces" between them".[10] The main author of this theory, L. von Bertalanffy, writes:

> "General System theory is a general science of 'wholeness', which up till now was considered a vague, hazy, and semi-metaphysical concept. In elaborate form it would be a logico-mathematical concept, in itself purely formal but applicable to the various empirical sciences."(11)

Following an "empirico-intuitive approach"[12], and studying mainly biological systems, L. von Bertalanffy outlined a number of "Systems Principles". According to the above mentioned author the validity of these "Principles" has been corroborated by the works of several students in subjects as diverse as Engineering and Social Sciences.[13][14] What follows is a relation of these "Principles".

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(10) L. von Bertalanffy. op.cit. p.36.

(11) Ibid

(12) Ashby defines the empirico-intuitive approach in this way... He takes the world as we find it, examines the various systems that occur in it - zoological, physiological, and so on - and then draws up statements about the regularities that have been observed to hold. Quoted by L. von Bertalanffy, ibid. p.101.

(13) L. von Bertalanffy op.cit. p.102. The following researches are mentioned: Hall and Fagen, "General Definition of Systems", 1956; Keiger, "Types of Growth", 1951-1952; D.D. Hall, "Systems Engineering", 1962; Hedan, "Social Works", 1958.

(14) At the same time, von Bertalanffy mentions the differences existing between his theory and Wiener's (Cybernetics). We will come back to the issue after the presentation of the main ideas of Cybernetics.

## 2.2 Systems Principles

Systems are considered in two ways: "open", and "closed":(15)

> "An open system is not isolated from its environment and its materials or energy or information are exchanged with the environment in a regular manner. A system is closed if it operates without such interchange". (16)

The above definition has one problem: the idea that any system can be considered "open" or "closed" depending on the scale on which it is studied.(17) This idea has originated many conceptual problems in System theory:

> "Many of the earlier concepts of Social Sciences were closed systems views because they considered a given social system as sufficiently independent so that its problems could be analysed in terms of internal structure, tasks, and formal relationships - without reference to the external environment..." (18)(19).

In our opinion, the criteria to differentiate between "open" and "closed" systems should be based on the fact that the former systems are considered to be "open" not only in relation to the environment but also internally to themselves:

> "The open system adopts to its environment by changing the structure and processes of its internal components".(20)

With this criteria a nuclear reactor should be studied as a "closed" system whereas a human group should not.

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(15) Actually, the above is the most general classification of systems. There are, however, many other attempts to classify systems. The problem is not really solved. See G. Chadwick, "A Systems View of Planning", p.41.

(16) Ibid, p.45.

(17) Ibid: "We can choose to treat it (a system) as closed by regarding the environment as an additional element of a new complete closed system.

(18) F.E.Kast and J.E. Rosenzweg, "The Modern View: A Systems Approach" in "Systems Behaviour", ed.by J.Beishon and G.Peyers, p.18.

(19) Not only in the earlier times of social sciences, systems have been studied as "closed". What we attempt to show in this work is that some of the present P.P.B.S.models are very much based on the idea of "closed" systems.

(20) L. von Bertalanffy, p.38.

The work of L. von Bertalanffy is mainly concerned with the identification of certain processes[21] which are characteristics of all "open" systems. The most important of these processes are:

2.2.1 Negative Entropy

Entropy is a term originated in thermodynamics. It is defined as:

> "The tendency for any closed system to move toward a chaotic or random state in which there is no further potential for energy transformation or work." (22)

Closed systems are considered to be subject to the forces of entropy which increases until eventually the entire system stops. Open systems, however, can offset entropy by continually importing material, energy or information, transforming them and redistributing resources in the environment. This special ability of open systems is known as "capacity for importation of negative entropy. For this characteristic, open systems can maintain themselves in a steady state, can avoid the increase of entropy, and may even develop towards states of increased order and organization."[23][24]

2.2.2 Steady State

It is mentioned above that under certain conditions open systems can reach a steady state, i.e. a condition of dynamic equilibrium.

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(21) A complete list of these processes includes: growth, competition, wholeness, sum, mechanization, centralization, finality, equifinality, negative entropy, steady state.

(22) F.E.Kast and J.E. Rosenzweg. op.cit. p.18.

(23) L. von Bertalanffy, op.cit. p.40.

(24) Obviously, for biological systems, this process of negative entropy is not perfect; the organism lives and grows for a period of time but is subject to deterioration and death. About this point see: "Entropy in Cybernetics" in this chapter.

The relationship between negative entropy and the steady state for living organisms and social systems is suggested by Emery and Trist:

> "In contradistinction to physical objects, any living entity survives by importing into itself certain types of material from its environment, transforming these in accordance with its own systems characteristics, and exporting other types back into the environment. By this process the organism obtains the additional energy that renders it "negentropic". It becomes capable of attaining stability in a time-independent steady state - a necessary condition of adaptibility to environmental variance...." (25)

This concept means that any open system can adapt itself to changes in its environment, still maintaining its functions and performing effectively.(26)

The concept of "steady state" has been used to define the condition of dynamic equilibrium of different systems.(27)

In "planning", for instance, we would dare to say that the process of defining "planning goals" is rooted in the idea that a social system can reach a condition of steady state.(28)

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(25) Quoted by F.E.Kast and J.E. Rosenzweg, op.cit. p.21.

(26) In biological systems this state is known as "Homeostasis". This concept is presented in section 3.2.1 of this chapter.

(27) In G. Chadwick, op.cit. p.60, we see the following example:
> "The activity systems of a city literally feed upon those of the environment: the city converts food, energy, information, from the environment, as negative entropy, to offset the production of positive entropy within the city systems and provide for growth of the system, at the same time producing waste products which are returned to the regional environment. Such systems will survive, will maintain the internal order of their subsystems, so long as they are able to import more energy than they use in transformation and output; they will monitor their functioning by feed-back from the environment in order to maintain a steady state."

(28) We will refer to this point in our study of the principles of cost-benefit analysis (Chapter Three).

2.2.3 Equifinality

According to L. von Bertalanffy: "If a steady state is reached in an open system, it is independent of the initial conditions, and determined only by the system parameters".(29) This is called "Equifinality".

In a closed system there is a direct cause and effect relationship between the initial condition and the final state. The concept of "Equifinality" says that, in an open system, the final result may be achieved by different initial conditions and in different ways.

This concept is very important for planners, because it suggests that "goals" and "objectives"(30) can be reached through different ways. Therefore the planner's function should be not to seek for a rigid optimal solution (which may not exist) but to make available a variety of satisfactory solutions to be considered according to the circumstances.

2.2.4 Hierarchy

In Table No.1.1 we present Boulding's "Survey of Main Levels in the Hierarchy of Systems". L. von Bertalanffy uses this table to introduce his views of hierarchic order of the Universe, i.e. the Universe as a "tremendous hierarchy, from atoms to socio-cultural systems".(31) The definition of the

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(29) L. von Bertalanffy, op.cit. p.149.

(30) This idea constitutes one of the main concepts of the systems approach to planning. See J.B. McLoughlin, "Urban and Regional Planning - A Systems Approach", p.95. We will be mentioning it throughout our whole work.

(31) Quoted by L. von Bertalanffy, op.cit. p.25.

hierarchic relationships between the different elements of a system - or between systems - is one of the great pre-occupations among many students of systems.(32) In Social Sciences, for example, theories have been drawn about the "world" as a system;(33) the system of cities;(34) the hierarchy of relations between different zones within a city;(35) relationships between economic activities;(36) hierarchic structure of organisations,(37) etc. The issues involved, however, have proved very difficult to deal with and have been the source of many arguments.(38)

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(32) As a matter of fact, L. von Bertalanffy started his research on systems, guided by the idea that "Organisms are organised things, and, as biologists, we have to find out about it." ...L. von Bertalanffy, op.cit. p.95.

(33) See e.g.,P.B. Checkland, "A System Map of the Universe", in J. Beishon and G. Peters, ed. op.cit.

(34) See e.g.,R. Morrill, "The Spatial Organization of Society", Parts Three and Five.

(35) See e.g.,E. Howard, "Garden Cities of To-morrow".

(36) See e.g.,R.J. Chorley and P. Hagget, ed., "Socio-Economic Models in Geography", especially the chapter written by D.E.Keeble, "Models of Economic Development".

(37) See e.g., F.E. Emery (ed.) "Systems Thinking", part four, "Organisations as Systems".

(38) See, for instance, C. Alexander, "The City is not a Tree", in "Human Identity in the Urban Environment". He attempts to answer the following question:

> "What is the inner nature, the ordering principle, which distinguishes the artificial city from the natural city?" He writes, "I believe that a natural city has the organization of a 'semi-lattice'; but that when we organize a city artificially, we organize it as a 'tree'. Both the 'tree' and the semi-lattice are ways of thinking about how a large collection of many small systems goes to make up a large and complex system". p.403.

Table 1.1. An Informal Survey of Main Levels in the Hierarchy of Systems.

| Level | Description and Examples | Theory and Models |
|---|---|---|
| Static structures | Atoms, Molecules, crystals, biological structures from the electron-microscopic to the macroscopic level | e.g.structural formulas of chemistry;crystallography; anatomical descriptions |
| Clock works | Clocks, conventional machines in general, solar systems | Conventional physics such as laws of mechanics (Newtonian and Einsteinian) and others |
| Control mechanisms | Thermostat, servo-mechanisms, homeostatic mechanism in organisms | Cybernetics;feedback and information theory |
| Open systems | Flame, cells and organisms in general | (a) Expansion of physical theory to systems maintaining themselves in flow of matter(Metabolism) (b) Information storage in genetic code (DNA). Connection of (a) and (b) presently unclear |
| Lower organisms | 'Plant-like' organisms: Increasing differentiation of system (so-called 'division of labour' in the organism); distinction of reproduction and functional individual ('germ track and soma') | Theory and models almost lacking |
| Animals | Increasing importance of traffic in information (evolution of receptors, nervous systems);learning; beginnings of consciousness | Beginnings in automata theory (S-R relations), feedback (regulatory phenomena), autonomous behaviour (relaxation oscillations),etc. |
| Man | Symbolism; past and future, self and world, self-awareness, etc., as consequences; communication by language, etc. | Incipient theory of symbolism |
| Socio-cultural systems | Populations of organisms (human included); symbol-determined communities(cultures) in man only | Statistical and dynamic laws in population dynamics, sociology, economics, possibly history. Beginnings of a theory of cultural systems |
| Symbolic systems | Language, logic, mathematics, sciences, arts, morals, etc. | Algorithms of symbols (e.g. mathematics,grammar); 'rules of the game' such as in visual arts,music,etc. |

From: L. von Bertalanffy, op.cit.p.26.

2.2.5 Analogies and Homologies

General System Theory was drawn by L. von Bertalanffy, on the idea that "independent of each other, similar problems and conceptions have evolved in widely different fields of knowledge".(39) He explains that this "parallelism" of general conceptions (or even specific laws) in different fields is due to the fact that certain general principles apply to systems irrespective of their nature.(40)

Therefore, the above author argues that:

> "General System Theory could be, methodologically, an important means of controlling and instigating the transfer of principles from one field to another, and it will no longer be necessary to duplicate or triplicate the discovery of the same principles in the different fields isolated from each other".(41)

The limitations of this concept, however, could be shown by the study of the different approaches for the description of "phenomena".

General System Theory considers that there are three levels in the description of "phenomena":(42)

(a) Analogies - Superficial similarities of phenomena.

(b) Homologies - When the efficient factors are different, but the respective laws are formally identical. Such homologies are of considerable importance in science.

(c) Explanation - The statement of specific conditions and laws that are valid for an individual object or for a class of objects.

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(39) L. von Bertalanffy, op.cit. p.29.

(40) Ibid p.85.

(41) Ibid p.81.

(42) Ibid p.85.

It is obvious that General System Theory can not be interested in the establishment of easy analogies for they are "scientifically worthless".(43) "Homologies, in contrast, often present valuable models",(44) and as such they should be taken into consideration to reach the goal of "unity of science".(45) Moreover, L. von Bertalanffy thinks that one of the tasks of General System Theory should be to differentiate the analogies from the homologies, for in that way meaningless similarities will be avoided and meaningful models of the real world will be established.(46)

## 2.3 Critics of General System Theory

It is the same author of the theory who admits that General System Theory, in its present form, is one - and still very imperfect - model among others.(47) Its primary aim is the search for an explanation "in principle":(48)

> "explanation in principle, however, is better than none at all. If and when we are able to insert the necessary parameters, system-theoretical explanation 'in principle' becomes a theory, similar in structure to those of physics."

L. von Bertalanffy himself believes that the main drawback of his theory is the lack of "method" (rules to establish and to apply "systems principles").(49) For that reason, the application

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(43) Ibid
(44) Ibid
(45) The promotion of the unity of science is the main aim of General System Theory. L. von Bertalanffy, op.cit. p.48.
(46) Ibid p.86.
(47) Ibid. "The fact that 'system theory' by various authors looks rather different, is therefore no embarassment ... but a healthy development in a new and developing field", p.90.
(48) Ibid p.35.
(49) L. von Bertalanffy, "General System Theory. A Critical Review", in J. Beishon and G. Peters op.cit. p.38. We would count as an additional drawback the lack of order in the presentation of the "General System Theory" ideas. This problem makes difficult the understanding of many concepts.

of general systems principles in other fields of knowledge different from those from which these principles have been derived is somehow difficult.(50) For example, L. von Bertalanffy formulated his concepts of "negative entropy" and "self-regulation of open systems" based on the study of the metabolic processes of biological systems.(51) There are, however, no specific studies to identify the metabolic process of other than biological systems, e.g. social systems. For that, systems scientists(52) have adopted another view to study these types of systems. The present trend in the study of social systems is to view "self-regulation" not as a "metabolic" process but rather as a "thermodynamic" one. The concept of negative entropy of biological systems has been replaced by the concept of "feed-back mechanism". The latter concept - originated in electrical engineering and widely adopted in Cybernetics Theory(53) - has been proved easier to understand and for that it has been generalised as "assuming a monopoly suppressing other equally necessary and fruitful viewpoints".(54) L. von Bertalanffy thinks that this happened because -

> "The concept of feedback...appeals to a time when control engineering and automation are flourishing. Computers, servomechanism, etc. are in the centre of interest, and the model of the 'organism as servomechanism' appeals to the heart of a mechanized society." (55)

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(50) L. von Bertalanffy is basically a biologist. His papers on systems are by and large written with reference to biology. In addition to this field, he also underlines the use of his theory in social sciences: "The System Concept in the Sciences of Man"; and psychology and psychiatry "General System Theory in Psychology and Psychiatry" in "General System Theory", op.cit.

(51) See "Some Aspects of System Theory in Biology", in "General System Theory", op.cit.

(52) See e.g., J.B. McLoughlin "Control and Urban Planning".

(53) To be studied in this same Chapter.

(54) L. von Bertalanffy op.cit. p.169.

(55) Ibid.

Thus, we see that General System Theory is only one of the approaches to the study of systems. There are many others.(56)

The most well-known of them all is known as the "Cybernetics Theory". In the following sections this theory will be presented and compared to the General System Theory. The Chapter will be closed with some general conclusions on the conceptual problems of Systems theory.

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(56) A good idea of the different approaches to the study of systems is given in F.E. Emery, Ed. "Systems thinking". About the problem of having different viewpoints on systems, L. von Bertalanffy writes:

> "The various approaches enumerated are not, and should not be considered monopolistic... They are not mutually exclusive and are often combined in application."
>
> L. von Bertalanffy, op.cit.p.100.

## 3. Cybernetics

### 3.1 Introduction

> "Cybernetics attempts to find the common elements in the functioning of automatic machines and of the human nervous system, and to develop a theory which will cover the entire field of control and communication in machines and in living organisms." (57)

Cybernetics is a word invented to define a new field of science concerned with communication and control. The term was coined by Norbert Wiener (from the Greek word "kubernetes" steersman) who in 1948 published "Cybernetics".(58) The book was the outcome of a programme undertaken jointly for several years by Wiener and the physiologist Arturo Rosenblueth:

> "For many years we shared the conviction that the most fruitful areas for the growth of the sciences were those which have been neglected as no-man land between the various established fields. Dr Rosenblueth always insisted that a proper exploration of these blank spaces on the map of science could be made by a team of scientists, each a specialist but each possessing a thoroughly sound acquaintance with the field of the fellows..." (59)

The approach followed in this new field was clearly interdisciplinary. In his biography, Wiener provides an accurate account of the persons and ideas which influenced his own work on cybernetics. Quoting from Newton, he writes:

> "If I have seen further than other men, it is because I have stood on the shoulders of giants"(60)

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(57) N. Wiener. "Cybernetics", in Scientific American eds. "Mathematics in the Modern World", p.378.

(58) N. Wiener. "Cybernetics", John Wiley 1948.

(59) N. Wiener. "Cybernetics", in Scientific American eds. op.cit. p.378.

(60) N. Wiener, "I am a Mathematician", p.267.

The group of people with which Wiener and Rosenblueth discussed together problems of neurophysiology, communication and computers, includes:

> "the mathematician John van Neuman, the physiologists Warren McCulloch and Lorent de No: the anthropologists Gregory Bateson and Margaret Mead; the economist Oskar Morgenstern; the engineer Julian Bigelow; and others in psychology, sociology, anatomy, physics and so on.."(61)

The result of this interaction of people and ideas is described by Wiener in this way:

> "Very shortly we found that people working in all these fields were beginning to talk the same language, with a vocabulary containing expression from the communication man, the servomechanism man, the computing machine man and the neurophysiologist ... These meetings I must consider the birthplace of the new science of cybernetics, or the theory of communication and control in the machine and in the living organism.." (62)

The idea of relating the control mechanism of both machines and living organisms goes back to the days of World War II, when Wiener and Julian Bigelow discovered that there was a coincidence in the effects caused by the application of excessive control in servomechanic apparatus and in human beings: (i.e. an excess of feedback in servomechanic apparatus would generate a decrease rather than an increase in the degree of control of the apparatus. In human beings, that pathological stage is known as "purpose tremor". Its existence was confirmed by the work of A. Rosenblueth.)[63]

In this way, the common control element, in machines and

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(61) N. Wiener, "Cybernetics", in Scientific American eds. op.cit. p.379.
(62) N. Wiener, "I am a Mathematician", p.269.
(63) Ibid p.252. In this work the "Black Box" principle was applied, i.e. the knowledge of a machine through the measurement of its input and output characteristics. For further discussion see Section 3.3 of the present work.

living organisms, was identified as the "feed back process". In the next section, the concept of feedback will be related to other important cybernetics concepts such as "entropy" and "information".

## 3.2 Cybernetics Principles

### 3.2.1 Entropy

The existence of the process of "entropy" and the means to control it (in machines and in living organisms) are the main concern of cybernetics.

About entropy, Wiener writes:

> "We are swimming upstream against a great torrent of disorganization, which tends to reduce everything to the heat-death of equilibrium and sameness described in the second law of thermodynamics. The declaration of our own nature and the attempt to build up an enclave of organization in the face of nature's overwhelming tendency to disorder is an insolence against the gods, and the iron necessity they impose. Here lies tragedy, but here lies glory too...." (64)

Therefore, the knowledge of the second law of thermodynamics brings up the basic contradiction of life: living organisms hold themselves distinct and separate from their surroundings, and yet in a molecular scale they are in a state of constant interchange from their surroundings.

> "Thus although a living body maintains itself distinct from its surroundings, it does this by taking atoms and molecules from the surroundings and organising them into living shape.." (65)

This characteristic of life can be called "negative entropy":

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(64) N. Wiener, Ibid p.325.

(65) J. Young, "Cybernetics", Iliffe, London, 1969, p.15.

> "The entropy of any system increases as it becomes more disorganised, decreases as it becomes more organised. Living organisms all have the property of taking up randomly distributed matter and organising it into logical living shape. When this process of organisation ceases, the organism can no longer be said to be alive." (66)

The primary aim of life appears to be to maintain its state of organisation and to interchange atoms and molecules with its surroundings in the process.

The subject, as applied to the human body, was studied by Walter Cannon (1939) who coined a new concept, "homeostasis". In "The Wisdom of the Body"(67) Cannon writes:

> "Here then, is a striking phenomenon. Organisms, composed of material which is characterised by the utmost inconstancy and unsteadiness, have somehow learned the methods of maintaining constancy and keeping steady in the presence of conditions which might reasonably be expected to prove profoundly disturbing..."

Cannon goes on explaining that:

> "The perfection of the process of holding a stable state in spite of extensive shifts of outer circumstance is not a special gift bestowed upon the highest organisms but is the consequence of gradual evolution..." (68)

In other words, it is the result of a process of learning. Our bodies (higher vertebrades, bird and mammals) have learned how to maintain a steady state in the organism:

> "I have suggested a special designation to these states, HOMEOSTASIS. The word does not imply something set and immobile, a stagnation. It means a condition - a condition which may vary, but which is relatively constant." (69)

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(66) Ibid p.16.

(67) W. Cannon, "The Wisdom of the Body". Reprinted by J. Beishon and G. Peters op.cit. with the name of "Self Regulation of the Body", p.219.

(68) Ibid p.220.

(69) Ibid.

3.2.2 Feed-Back

Dwelling upon the concept of homeostasis, Wiener advances the idea that:

> "The apparent equilibrium of life is an active equilibrium, in which each deviation from the norm brings on a reaction in the opposite direction, which is of what we call Negative Feed-Back." (70)

As has been mentioned already, Wiener linked his own work on anti-craft control apparatus with the problem of control in human beings by the introduction of the concept of feed-back:

> "Through a Latin corruption of a Greek word, 'gubernator', came the term governor, which has been used for a long time to designate a certain type of control mechanism, and was the title of a brilliant study written by the Scottish physicist James Clerk Maxwell in 1868. The basic concept which both Maxwell and the investigators of cybernetics mean to describe by the choice of this term is that of feed-back mechanism, which is specially represented by the steering engine of a ship..." (71)

By the use of his homology, Wiener introduces an important new idea in nerve physiology. The central nervous system no longer appears to be a self-contained organ receiving signals from the senses and discharging into the muscles. On the contrary, some of its most characteristic activities are described in circular processes, travelling from the nervous system into the muscles and re-entering the nervous system through the sense organs.

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(70) N. Wiener, "I am a Mathematician", p.291.

(71) N. Wiener, "Cybernetics", in Scientific American eds. op.cit. p.378.

In the above mentioned way, the basic model of feed-back is introduced, i.e. a circular process where part of the output is monitored back, as information, into the input, thus making the system self-regulating; either in the sense of maintenance of certain variables or of steering towards a desired goal.

We see how, in this model, the term information substitutes the term "negative feed-back" originally given. And because the function of negative feed-back is to reduce entropy,(72) "information can be considered therefore as negative entropy".(73) In this way it is observed how there is a merge between Wiener's original ideas and what is known as "information theory".

### 3.2.3 Information

Information Theory in a strict senseis a branch of Probability Theory originating from a paper by Claude E. Shannon in the Bell System Technical Journal in 1948, in which a new mathematical model of communication systems was proposed and investigated.(74) The original concepts in the theory were the notions of entropy, channel capacity and coding; in a sense information theory may be considered as the study of these three principles and their interrelation either in an abstract mathematical context or in association with their application to physical systems. The central results of this

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(72) Refer to footnote 70.

(73) G. Chadwick, op.cit. p.54.

(74) The paper was called "A Mathematical Theory of Communication". It was published in "Bell System Technical Journal", Vol.27 pages 379-423, July 1948. We have not read the paper but an appraisal of it by W. Weaver, "The Mathematics of Communication" in Scientific American eds. "Mathematical Thinking in Behavioural Science", p.47.

theory are expressed in the form of coding theorems for various channels, which, figuratively speaking, set bounds to the transmission capacity of these channels. However, a number of investigations has also been devoted to various modifications and generalisations of the notion of entropy and the concept of information derived from it.(75)

The relation between entropy and information is established as follows:

> "A system gaining in entropy is loosing information, for when the system has reached maximum entropy it is in fact dead, for it has no more information to give." (76)

Information Theory provides new views about the organization and function of nervous systems - both as communication system in which "messages" are encoded and transmitted and as control system regulating voluntary and involuntary activities. The theory has been adapted and used in many behavioural problems in economics, anthropology, planning, and so on.(77) The theory provides, as well, an insight into the problem of comparing the complexity of the systems, i.e. problems of "variety", which are considered to be fundamental in the problem of control of systems (a fact which, at the same time, is considered to be fundamental in the Planning process).(78)

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(75) From S. Kotz, "Recent Results in Information Theory", p.2.
(76) G. Chadwick, op.cit. p.54.
(77) See e.g., Scientific American ed. "Mathematical Thinking in the Behavioural Sciences".
(78) See e.g., J.B. McLoughlin, "Control and Urban Planning", passim.

About "variety" and "planning" we will quote from G. Chadwick:

> "Thus planning is vitally concerned with the conceptual framework which allows of the necessary process of regulation of variety." (79)

> "The main tool in understanding the ways in which systems are controlled is called 'The Law of Requisite Variety' and is stated by R.Ashby(80) in this way:
> 'Only variety can destroy variety'. (81)

> "In other words, to control a system of given variety we must match it with a controlling system of requisite variety". (82)

> "The lesson for planning is obvious: the mechanism for controlling the systems with which planning deals must be capable of generating requisite variety to match those real world systems at the level of variety which is appropriate to secure an adequate level of performance..."(83)

## 3.3 Critics of Cybernetics Theory

> "Cybernetics is a 'theory of machines', but it treats not things, but ways of behaving. It does not ask, 'What is this thing?' But,'What does it do?' ... Cybernetics is thus essentially functional and behaviouristic." (84)

The above quotation reveals the essential idea of the Cybernetics method: Systems can be defined by evaluating their output and input. This idea is known as "The Black Box Principle" and it is defined in the following way:

> " 'Black Box' is a system of whose structure we know nothing except that which can be deduced from its behaviour, its input and output characteristics."(85)

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(79) G. Chadwick. op.cit. p.71.
(80) About this Law see: W.R.Ashby, "An Introduction to Cybernetics", p.202.
(81) G. Chadwick, op.cit. p.71.
(82) Ibid
(83) Ibid p.72.
(84) W.R.Ashby, "An Introduction to Cybernetics", p.5.
(85) G. Chadwick, op.cit. p.43.

Thus, in Cybernetics, "systems" and/or "sub-systems" are regarded as 'black boxes' whose inputs and outputs are linked up by an interaction network known as "feedback mechanism":(86) i.e., Cybernetics is more interested in the performance rather than in the structure of a given system.(87) The approach, therefore, is from "outside" - as opposed to an approach from "within" - a system. This method has been widely accepted in many fields.(88) In Planning, for instance, social, economic and physical indicators are frequently used to characterise a given social group, e.g. the growth of the G.N.P. of a nation is supposed to provide some insights into the nation's welfare; the numbers of public libraries of a city as indication of the cultural level of the city's population, and so on. We will not quarrel with those who regard this method as a great help for the understanding of the planning problems. Yet we still think like P. Geddes that it is the understanding of the records, spirit, qualities and defects of a place(89) which will allow the planner to accomplish his fundamental role: "to leave the place... the richer, not the poorer, for our presence". We believe that this fundamental task cannot be reached through the sole manipulation of the input-output variables of a "black box". This work attempts to prove the above mentioned argument.

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(86) See Section 3.2.2 of this chapter.
(87) This is one of the main characteristics of the so-called Behavioural Sciences. For discussion about the issues see: R. Ackoff "The Meaning, Scope, and Method of Operations Research" in "Progress in Operations Research", R.Ackoff (ed.) p.26.
(88) For examples of application of "Black Box" theory, see W.R.Ashby, op.cit. p.86.
(89) P. Geddes, "Cities in Evolution", p.317.

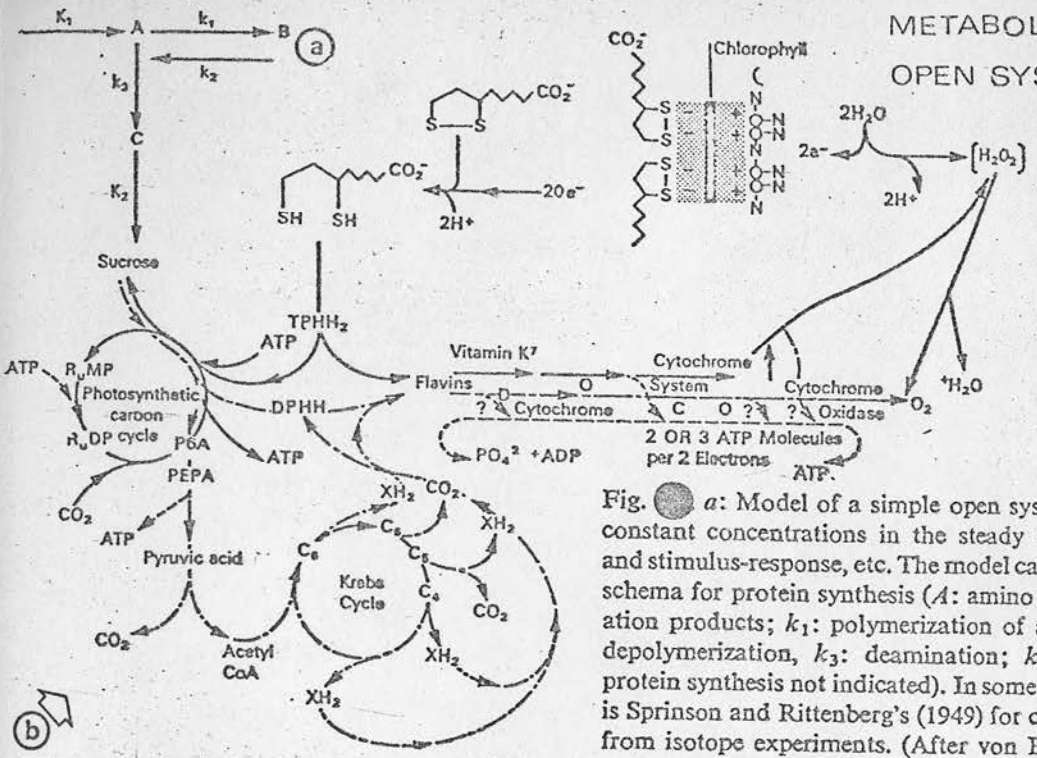
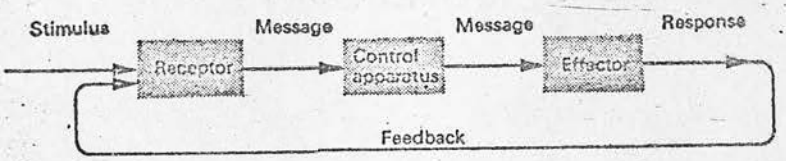


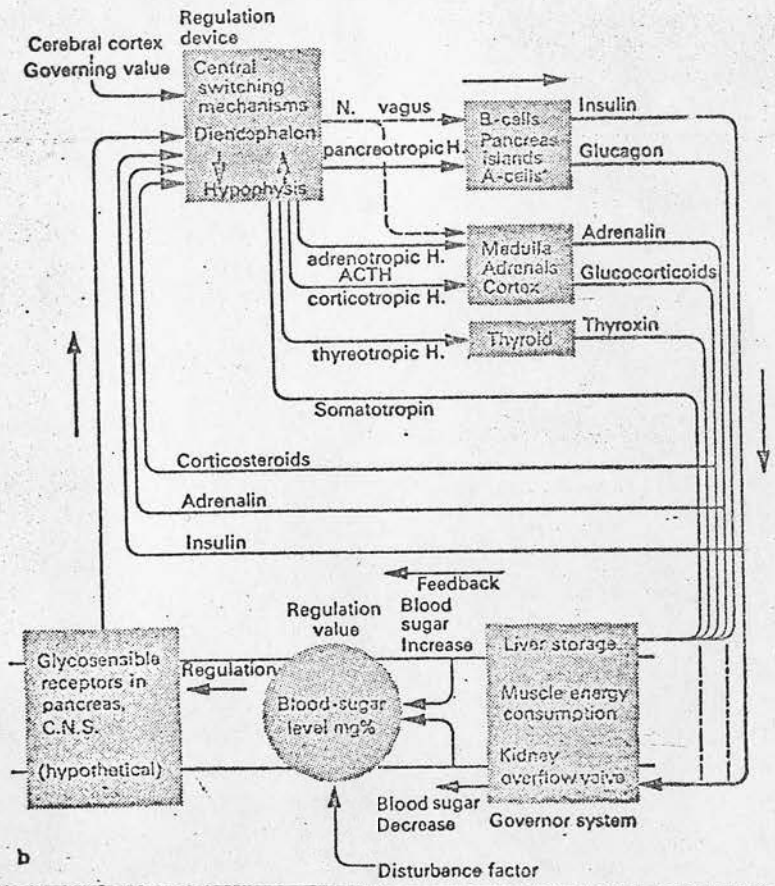

Fig. *a*: Model of a simple open system, showing maintenance of constant concentrations in the steady state, equifinality, adaptation and stimulus-response, etc. The model can be interpreted as a simplified schema for protein synthesis (*A*: amino acids, *B*: protein, *C*: deamination products; $k_1$: polymerization of amino acids into protein, $k_2$: depolymerization, $k_3$: deamination; $k_2 \ll k_1$, energy supply for protein synthesis not indicated). In somewhat modified form, the model is Sprinson and Rittenberg's (1949) for calculation of protein turnover from isotope experiments. (After von Bertalanffy, 1953a).

*b*: The open system of reaction cycles of photosynthesis in algae. (After Bradley and Calvin, 1957).

Simple feedback scheme




Homeostatic regulation of the blood sugar level




FEEDBACK CONTROL SYSTEMS

b

OPEN and CLOSED SYSTEMS 1-1

Ref. L. von Bertalanffy, op. cit. pp. 166 - 171

## 4. Cybernetics and General System Theory: Conclusions

From what has been studied so far, it can be said that the General System Theory model is a "metabolic" one. It is based on the dynamic interaction of the elements of a system. The Cybernetic model, on the other hand, is based on information and feed-back. "It has no metabolism". (90) i.e.,

> "Feed-back regulation is based upon pre-established arrangements (structures in the broad sense--in contrast to regulations of a 'dynamic' nature resulting from free interplay of forces and mutual interaction between components and tending towards equilibrium and steady state." (91)

This point is very important for the application of "Systems thinking" in planning. The question is: How should we study society? As an open system? As a cybernetic one?

G. Chadwick - in one of the most complete works on systems ideas(92) - after establishing a difference between "social" systems and "engineering" systems, reaches the conclusion that "The idea of 'steering' a social system, in the way that engineering systems can be controlled, is thus not possible."(93)

However, this is not the only opinion of the problem, and there are many writers whose views of society are very near to what can be called "a cybernetic model".(94)(95)

The existence of different approaches to the study of systems should not be a discouraging fact, because it is only as the result of the amount of interest that the idea of "systems" has generated into the different scientific fields.

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(90) L. von Bertalanffy, p.170.
(91) Ibid. 170
(92) G. Chadwick, op.cit.
(93) Ibid. p.366
(94) See for instance J. Brian McLoughlin "Control & Urban Planning".
(95) It is important to note that not even the author of Cybernetics thought of the world as a clockwork mechanism. In "I am a Mathematician"Wiener writes: "From the point of view of cybernetics, the world is an organism, neither so tightly jointed that it cannot be changed in some aspects, nor so loosely jointed that any one thing can happen as readily as any other thing". p.327.

It indicates, as well, that Systems Theory is a science in its infancy which will develop by solving its present contradictions. There are some evidences that many of these contradictions may be elucidated in the near future; writers like M. Maruyama[96] think that the present development of mathematics[97] will help to study in a better way the phenomena of "dynamic interaction of elements" and that due to this fact an integration between Cybernetics and General System Theory - which M. Maruyama calls "The Second Cybernetics"[98] is very likely to occur.

We have seen, as well, that some planning concepts such as: goal formulation; feed-back and information; interdisciplinary approach to planning; planning as a continuous process; etc. are to be found within the original formulations of the authors of General System Theory and Cybernetics. This is a clear indication of the impact of systems ideas into the planning field. It is not surprising, therefore, that one of the most modern planning methods, P.P.B.S., claims the incorporation of systems ideas into a single and unified planning framework. The aim of this work is to test the validity of the assumption. For reaching this aim, it is necessary first to explore another dimension of the systems theory: The Operational Research approach. This is the subject of our next chapter.

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(96) M. Maruyama, "Cybernetics", in "P.P.B., A Systems Approach to Management", F. Lyden and E. Miller (eds.) P.330.
(97) The author refers to the mathematical method of research known as"Multivariate Analysis", in Ibid p.334.
(98) Ibid.

CHAPTER 2

# OPERATIONAL RESEARCH - THE ANALYSIS OF SYSTEMS

1. Aims of this Chapter

2. Operational Research - Introduction.

3. Development of Operational Research.
   - 3.1 Earlier Works
   - 3.2 Theory of Programming
   - 3.3 Present Trends

4. The Mechanics of Operational Research.
   - 4.1 Definition
   - 4.2 Models
   - 4.3 Problems-solving models:
     - 4.3.1 "Allocation" Problems
     - 4.3.2 "Sequencing" Problems
     - 4.3.3 "Queueing" Problems
     - 4.3.4 "Simulation" Problems
     - 4.3.5 "Inventory" Problems
     - 4.3.6 "Replacement Problems
     - 4.3.7 "Competition" Problems
     - 4.3.8 "Search" Problems
   - 4.4 Game Theory Model
     - 4.4.1 Introduction
     - 4.4.2 Principles

5. Conclusions.

# CHAPTER 2: OPERATIONAL RESEARCH - THE ANALYSIS OF SYSTEMS

## 1. Aims of this chapter

The aim of this chapter is to provide a framework for the understanding of the main concepts involved when systems thinking is applied to analyse real life situations.

In general, the many techniques and methods which are concerned with the above referred activity are grouped under the "umbrella" name of Operational Research (O.R.).* In this chapter we are going to study its origins, development, concepts and methods, to draw some conclusions at the end about this activity and its connections with P.P.B.S.

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* The term "Operational Research" is the one used in the U.K. In the U.S.A. this activity is known by a variety of names: "Operations Research", "Operations Analysis", "Systems Analysis", "Systems Evaluation", and "Management Science". Quoted from R. Ackoff, "Operations Research", in "International Encyclopedia of the Social Sciences", D. Sills(ed.) Vol. II, p.291.

## 2. Operational Research - Introduction

Operational research came into being in Great Britain in the early years of World War II, when research groups, made up by scholars representing various disciplines,(1) were set up to work out scientific methods of logistics and military operations. It is not surprising, therefore, that one of the earlier works on Operational Research,(2) includes in its contents items such as: aircraft search for submarines; distribution of flying escorts; air to air combats; etc. All these problems involved maximising the realisation of an end or minimising the outlay of means. At that time Operational Research was defined as "the art of winning wars without actually fighting".(3)

After the war new types of management problems, created by the nationalization of industries and the need to rebuild large segments of the nation's industrial facilities, called for a new approach in Britain. "This call was answered by the Operational Research workers who had moved in to work on governmental and industrial problems. Management consulting, which had never been popular in Britain, caught on because British managers were willing to try a new approach to raise productivity and profits - Operational Research".(4)

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(1) Actually, starting from 1937 British scientists were increasingly asked to help the military learn how to use the newly developed Radar in locating enemy aircraft. The scientists, working on different aspects of this problem, were brought together in September 1939, at H.Q. Fighter Command (R.A.F.). This group is considered to be the nucleus of the first O.R. Group. Quoted from R. Thierauf and P. Grosse, "Decision Making through O.R.",p.4.

(2) The book referred to is by P.Morse and G.Kimball, "Methods of Operations Research". The Technology Press of M.I.T. and John Wiley & Sons, Inc., New York, 1950.

(3) From E. Duckworth, "A Guide to Operational Research", p.14.

(4) R. Thierauf and R.Grosse, op.cit. p.5.

## 3. The Development of the Operational Research method.

### 3.1 Earlier works

From one of the first books on O.R.[5] we get some ideas about the purpose and method of the first O.R. workers. These ideas are:

1.1 Object: To assist in finding means of improving the efficiency of operations in progress or planned for the future.

1.2 Steps: For accomplishing the abovementioned objective it is required to follow the succeeding steps:-

(a) Past operations are studied to determine the facts.
(b) Theories are elaborated to explain the facts.
(c) Facts and theories are used to make predictions about future operations.

1.3 Tools: O.R. uses the following tools:-

(a) Mathematical tools. Mainly probability and statistical methods.
(b) Analytical models. Mainly theory of tactics and strategies. Presented in this chapter with the name of Game theory.
(c) Interdisciplinary approach to the problems of O.R.

1.4 Personnel: The O.R. worker does not need to be a specialist in any particular branch of science. He does, however, need to be a person with considerable experience in research of a scientific nature, whether he is a biologist, a physicist, a mathematician or a worker in some other sciences. The important requisite is impersonal curiosity concerning new subjects. That is the very essence of research ability.

1.5 Problems: The main problems which an O.R. worker should find are:-

(a) To find the problem.
(b) To find sensitive parameters to define a problem.
(c) To create a mutual understanding between administrator and scientist and among the scientists themselves.
(d) To present quantitative aspects of the problem in intelligible form.

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(5) P. Morse and G. Kimball, op.cit.passim.

## 3.2 The introduction of the theory of Programming

As presented in the last section, the first works on O.R. were based upon statistical methods. However, the need to solve different types of problems gave origin to a new and interesting discipline: Programming.

A special case of O.R. problems was to find the best location for warehouses intended to store food and war supplies. A location close to the theatre of hostilities facilitated rapid delivery of supplies to the place of destination but exposed the stores to a greater danger of destruction by enemy action. A similar problem involved the choice between a dense network of small warehouses and a scattered network of large ones. These are problems in optimization: the techniques used in solving these have since been applied in peace-time to economic activities with the name of Theory of Programming.(6)

The first works on the field are due to the Soviet mathematician Kantorivich who in 1939 published his "Mathematical Methods of Production, Planning and Organization".(7) In this book he presents his basic idea of the theory of Programming in relation to problems of organization and transport. Hitchcock in 1941 and Koopmans in 1947(8) studied the problem of shipping quantities of a product from several origins to several destinations. G. Dantzig in 1947(9) discovered the Simplex Method as a systematic procedure to solve a Linear Programming problem.

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(6) A good discussion about the origins of the Theory of Programming can be found in O. Lange "Optimal Decisions - Principles of Programming", pp.5 to 6.

(7) Ibid p.6.

(8) P.G.Moore and S.D.Hodges, "Programming for Optimal Decisions",p.8.

(9) During 1947 George Dantzig (with Marshall Wood and their associates) was involved in a project for the U.S.A. Air Force. The essence of the research lay in viewing interrelations between activities of a large organization as linear programming model and determining the optimizing programme by minimizing a linear objective function. - Quoted from R. Thierauf and R. Grosse, op.cit. p.223.

Thus, in the 1950s, Linear Programming (combined with the use of electronic computers) gave to Operational Research a major boost. Ever since, some type of O.R. operation is used in industry, business, and public and private administration. In Britain, for instance, "it is difficult to conceive any single type of industry where O.R. is not used". ... "In the U.S.A. the number of persons engaged in O.R. work has increased from a handful in the early 1940s to approximately 6,000 in 1970."(10)

## 3.3 Present Trends

S. Beer mentions three main lessons to be learned from the early O.R. experiences:(11)

(a) Management problems concern situations about which information is essentially incomplete. We have to assess the cost of obtaining more information, and to propose ways (not yet described) of wringing the maximum understanding out of the minimum data.

(b) Since no one knows which branches of science will prove to be useful in tackling a particular problem, an O.R. team must represent as many scientific disciplines as possible.

(c) The strategies which the manager employs are at least as important as the facilities at their disposal. These strategies are ways of exploiting the entire system under the manager's command, taking account of what possibilities lie ahead, as a whole.

That is, the characteristics of O.R. are:

Inference from incomplete information, interdisciplinary approach to the problems, and a concern for the studies of "systems".

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(10) R. Thierauf and R. Grosse, op.cit. p.7.

(11) S. Beer, "Management Science", p.27.

R. Ackoff[12] after a discussion of the meaning of O.R., arrives at the following conclusion:

> "In discussions of the general characteristics of O.R.'s methodology three characteristics consistently appear:
>
> (a) the use of mathematical models,
> (b) the interdisciplinary team,
> (c) the 'holistic' approach to the problem."

So, in the above quotation, the term "mathematical model" has replaced the term "inference from incomplete information" from the former quotation by Beer.

Although there is no basic discrepancy between the two terms, in practice, mathematic model-building techniques have developed so much that they are "often written about as if they constitute management science."[13]

The preoccupation for this problem can be reflected in the work by J. Singh[14]:

> "In operational research, the danger of applying unwarily the wrong procedure or method is great, because it is quite likely that the assumptions underlying the methods do not hold in the case of the problem under study. The general safeguard against such misapplication is a general understanding of the ideas underlying operational research methods."

and H. Kendall[15]:

> "Operational research may be regarded as a branch of philosophy; as an attitude of mind towards the relation between man and environment; as a body of methods for the solution of problems which arise in that relationship.."

and S. Beer[16]:

> "...No one would confuse the pharmaceutical chemist's prescription with the practice of medicine. Yet there is to-day a widespread attempt in many industrial companies, and to some extent in the government, to make use of the powerful tools of the O.R. trade without undertaking the empirical science on which their application should alone be based.."

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(12) R. Ackoff, "The Meaning, Scope and Method of Operations Research", in "Progress in O.R.", R.Ackoff ed. p.18.
(13) S. Beer, op.cit. p.26.
(14) J. Singh, "Operations Research", p.21.
(15) Quoted by R. Ackoff, op.cit. p.4.
(16) S. Beer, op.cit. p.26.

In spite of these warnings, we notice that a very substantial number of papers on O.R. are more concerned with the technical problems of the design and use of statistical-mathematical models than with the development of a "philosophy" of thinking about systems problems. This is what we attempt to demonstrate in the following sections of this chapter.

## 4. The Mechanics of O.R.

### 4.1 Definition of O.R.

In the last section, the arguments about the concepts around O.R. have been introduced. Because there are different points of view about the scopes of O.R., there are, consequently, different definitions of the subject. However, we will not make an issue of this point. We will select a definition of O.R. which is well accepted and which shows what O.R. represents for the O.R. people at the present moment. A change in direction of O.R. will deserve a new definition.(17)

The Operations Research Society(18) defines O.R. as:

> "The attack of modern science arising in the direction and management of large systems of men, machines, material and money in industry, government, business 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 outcomes of alternative decision, strategies or controls. The purpose is to help management determine its policy and actions scientifically."

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(17) The idea that O.R. should be reoriented is given by R.Ackoff, when he writes: "We have created operational analysis, now we must begin to create operational synthesis." R.Ackoff, op.cit. p.21.

(18) Quoted from W. Bane, "Operational Research, Models and Government, p.5.

Broadly, five stages are identified in the use of O.R. These are:[19]

1. Study of the system to elicit the major variables and how they interact.
2. Collection of data to quantify the interaction.
3. Construction of model and its validation.
4. Manipulation of model, i.e. carrying out experiments upon it.
5. Implementation of the experimental results.

From what has been presented so far, it is clear that the core of the O.R. work method is the abstraction of the reality in a representation of it. That is: research upon a model that represents reality. Thus, for our study, it is necessary to understand the concept of "model" in O.R. This we will do in the next section.

## 4.2 Models in O.R.

From S. Beer we learn that:[20]

> "O.R., as all empirical science, deals less in analysis and deduction, and more in experiment and induction. Given all the facts, a certain answer can be deduced; given only some of the facts, we have to find new ways of inferring a conclusion."

In O.R., experiments are conducted not on the actual systems but on models of them. The reason is obvious: "large systems (whether solar, corporate, or governmental) cannot be brought into laboratory nor can experiments be conducted on them as a whole in their natural environment."[21]

According to G. Chadwick,[22] a model of a system is a representation of that system by another system". A more descriptive

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(19) Quoted from W. Bane, "Operational Research, Models and Government, p.3.
(20) S. Beer, op.cit. p.24.
(21) R. Ackoff, "A concept of Corporate Planning," p.10.
(22) G. Chadwick, "A Systems View of Planning", p.182.

definition is given by R. Thierauf and R. Grosse:[23]

> "A model is a representation or abstraction of an actual object or situation. It shows the relationships (direct and indirect) and the interrelationships of action and reaction in terms of cause and effect. Since a model is an abstraction of reality, it may appear to be less complex than reality itself..."

Models may be physical representations (such as model airplanes in wind tunnels or model ships in tow tanks), graphic representations (such as diagrams and graphs), or symbolic representations (such as mathematical equations).[24]

The development of models in O.R. is connected with the types of problems that the operational research workers have dealt with. The study of managerial and industrial problems through O.R. methods shows that "despite the fact that two problems are never exactly alike in contents, most problems fall into one or a combination of a small number of basic types."[25] These basic types of problems are characterized in the following way:

(a) "Allocation" problems
(b) "Sequencing" problems
(c) "Routing" problems
(d) "Queueing" problems
(e) "Simulation" problems
(f) "Inventory" problems
(g) "Replacement"problems
(h) "Competition"problems
(i) "Search" problems.

Each one of these problems has been studied through the use of a distinctive method or model. These models are the subject of the next section.

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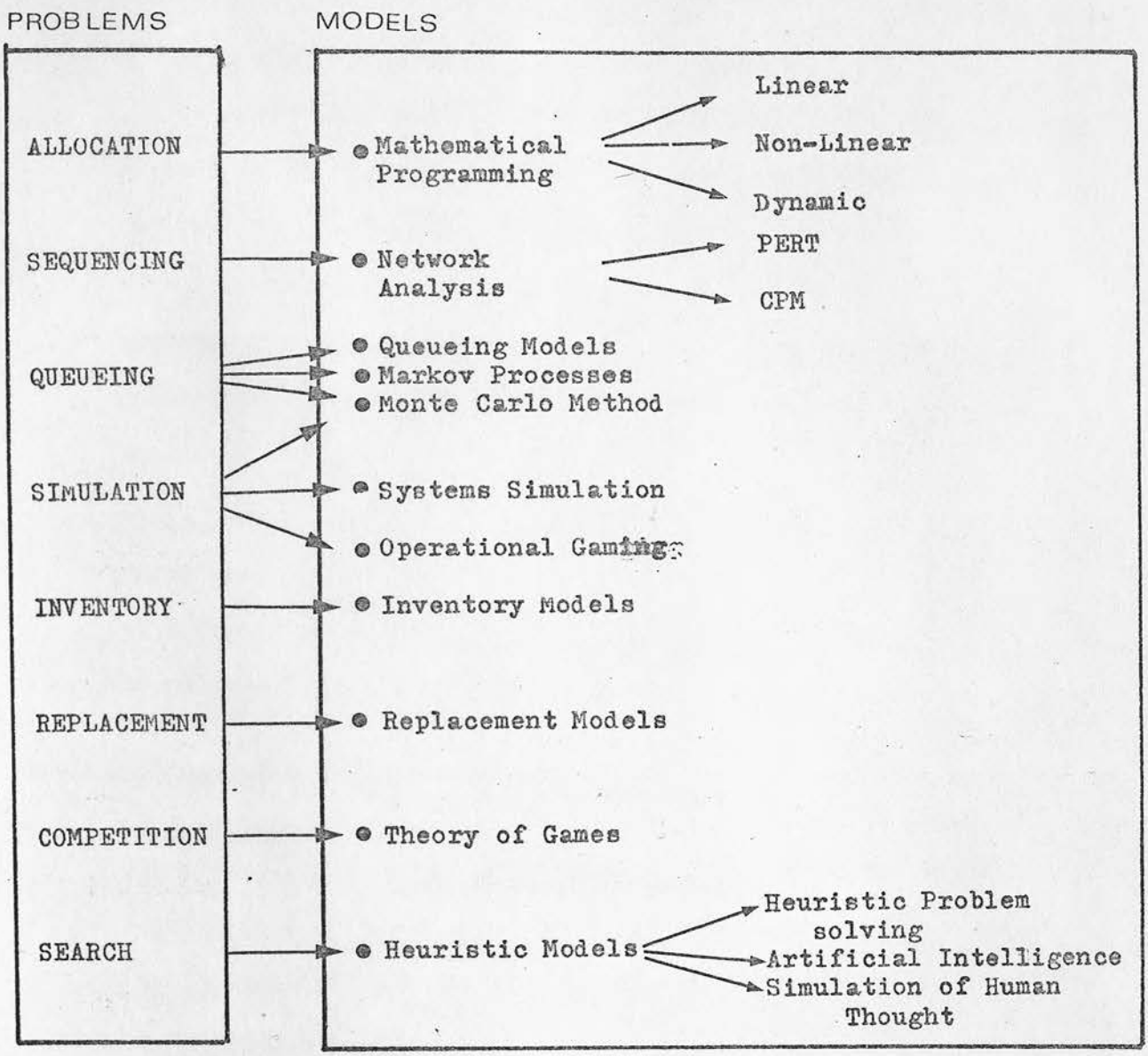
(23) R. Thierauf and R. Grosse, op.cit. p.14.

(24) R. Ackoff, op.cit. p.10.

(25) R. Ackoff, "Operations Research", in "International Encyclopedia of Social Sciences", D. Sills (ed.) Vol.II p.293.


PROBLEMS
MODELS
ALLOCATION
SEQUENCING
QUEUEING
SIMULATION
INVENTORY
REPLACEMENT
COMPETITION
SEARCH
Mathematical Programming
Linear
Non-Linear
Dynamic
Network Analysis
PERT
CPM
Queueing Models
Markov Processes
Monte Carlo Method
Systems Simulation
Operational Gaming
Inventory Models
Replacement Models
Theory of Games
Heuristic Models
Heuristic Problem solving
Artificial Intelligence
Simulation of Human Thought

## 4.3 Problems-solving models

Prior to the introduction of the subject, we must make the following remark:

The distinction between the type of problems shown above is an artificial one, "for it is commonplace to find that a problem of one type can be cast into the form of another type",[26] and inversely the type of method designed to deal with a given problem can be perfectly used to deal with other problems.[27] However, for the purposes of presentation the above classification of problems will be maintained. Moreover, due to the limitations of time and knowledge, we will include in this survey only the basic models. The variations on this field are such that to follow all types of combinations and applications of the different O.R. models would constitute a thesis by itself.

### 4.3.1 Allocation Problems

#### 4.3.1.1 Description

When there is a number of activities to be performed, alternative ways of doing them, and limited resources or facilities for performing each activity in the most effective way:[28]

#### 4.3.1.2 Model most commonly used

A - MATHEMATICAL PROGRAMMING. The objective of this model is to combine activities and resources in an optimal manner so that overall efficiency is maximized, i.e. profit is maximised and cost is minimised.

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(26) R. Ackoff, "The Meaning, Scope and Method of O.R." op.cit.p.19.
(27) A very good example of this argument can be found in J.E.Mulligan, "Basic Optimization Techniques - a Brief Survey", in "Programming for Optimal Decisions", P.G. Moore and S.D. Hodges (eds.)
(28) R. Ackoff, "Operations Research", in "International Encyclopedia of the Social Sciences", D.Sills(ed.) Vol.II, p.294.

The types of Mathematical Programming models are classified, according to the kind of data they can handle and the assumptions that are made, in the following way:

$A_1$ - LINEAR PROGRAMMING. Used in allocation problems when the following conditions are met:

(a) The objective (i.e. cost, profit, etc.) can be expressed as a linear function in terms of the activities, i.e. fixed costs or profit, etc. per unit of activity, can be given to each of the activities.

(b) The objective function described in (a) is limited by a set of constraints which can be expressed as linear equations or inequations in terms of the activities. (29)

The general Linear Programming problem is described by Hadley as follows: "Given a set of 'm' linear inequalities or equations in 'r' variables, we are to find non-negative values of these variables which will satisfy the constraints and maximise or minimise some linear function of the variables."(30)

In industrial management the typical Linear Programming problems could be:

Distribution of products from a set of origin points to a number of destinations; multiple plant location studies; allocation of limited raw materials used in a variety of products; allocation of production facilities where alternative routings are available; blending problems; maximising material utilization etc.(31)

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(29) From K. Williams et al. "Allocation", in "Operational Research", ed. by B. Houlden, p.4.
(30) Quoted from E. Buffa, "Operations Management, Problems and Models", p.300.
(31) Ibid p.291.

There are basically three methods for the solution of linear programming problems: Graphic solution, the Simplex technique, and the Distribution method.(32)

Linear programming is specially used in very complex large-scale operations. The difficulty is a computational one, that is, the number of man-hours required to develop a solution. The digital computer has been the answer to this problem, and library programs for linear programming models are commonly available.(33)

Special cases of linear programming such as: STOCHASTIC LINEAR PROGRAMMING and CHANCE-CONSTRAINT LINEAR PROGRAMMING, are designed to deal with problems of linear programming under conditions of uncertainty.(34)

The INTEGER PROGRAMMING is actually the same as a linear programming problem except that the variables appearing in the final solution must be non-negative whole numbers. The usefulness of the integer programming should be obvious since many resources are indivisible, such as machinery, trucks, etc. The restriction imposed by the integer programming is difficult to handle mathematically. However, some progress has been made in developing solution procedures.(35)

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(32) These are well-known methods of Linear Programming. The most commonly used is the Simplex Method (discovered by G.Dantzia in 1950) described by F. Hillier and G. Lieberman in "Introduction to Operational Research", as 'an algebraic procedure which progressively approaches the optimal solution through a well-defined iterative process until optimality is finally reached.'

(33) E. Buffa, op.cit. p.329.

(34) F. Hillier and G. Lieberman, p.530.

(35) Ibid, p.553.

$A_2$ - NON-LINEAR PROGRAMMING.

Non-linear or Curvilinear Programming deals with non-linear relationships where the "constraints" and the "objective functions" can assume almost any mathematical form.

Actually, there is no general overall approach for solving Non-Linear Programming problems. However, some special types can be solved.(36)

Many Non-Linear Programming problems are solved by the use of the Approximation method. This technique is utilized in conjunction with the Simplex method of Linear Programming. Other non-linear programs which have been studied are QUADRATIC PROGRAMMING and CONVEX PROGRAMMING.(37)

$A_3$ - DYNAMIC PROGRAMMING.

Linear Programming problems are statics, i.e. the problems are stated and solved (by one of the methods shown previously) in terms of a specific situation occurring at a certain moment. When a problem is considered with reference to its variations over time, a different approach should be used - that is Dynamic Programming.

Dynamic Programming was developed by R.Bellman and G. Dantzig.(38) This method may be defined as "mathematical technique which solves for a series of sequential decisions"(39) A sequence of decisions must be made with each one affecting future decisions.

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(36) Ibid. p.553.
(37) Ibid.
(38) Ibid.
(39) From R. Thierauf and R.Grosse, "Decision Making Through Operations Research", p.356.

Dynamic Programming is based on the Bellman's "principle of optimality" which says that "An optimal policy has the property that whatever the initial state and initial decisions are, the remaining decisions must constitute an optimal policy with regard to the state resulting from the first decision."(40) For example, if wrong decisions have been made for the first and second weeks, this does not prevent one from making the right decisions in the future - third week, and remaining weeks. Dynamic Programming enables one to arrive at optimal decisions for the periods or stages that still lie ahead despite the bad decisions made in the past.(41)

The basic logic and the mathematics of Dynamic Programming are directly related to the theory of servomechanism, the feedback controls that, for example, enable an autopilot to sense variations in an airplane flight and bring it back on course.(42)

Bellman's theory is one of the newer tools of operational researchers. It promises application in business, economics, biology and statistics, as well as in engineering. However, the computational difficulties are formidable, and very high mathematics are necessary in most Dynamic Programming problems.(43)

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(40) From M.G.Simpson, C.Smith, H.Bass, J. Kirby. "Dynamic Programming", in "Operational Research" ed.by B.Houlden, p.61.
(41) R. Thierauf and R. Grosse, op.cit. p.357.
(42) G. Boehm, "Decision Theory and Program Scheduling", in "Managerial Economics and Operations Research", ed. by E. Mansfield, p.176.
(43) Ibid.

4.3.2 Sequencing Problems

4.3.2.1 Description

To determine the order in which a set of tasks should be performed in a multi-stage facility so as to minimise costs associated with the performance of the tasks and delays in completing them. A variation of this problem is that of ROUTING, i.e., to determine which path or route through a network of points or locations is shortest (or longest), or is least (or most) costly to traverse subject to certain limitations on the paths or routes that are permissible.(44)

4.3.2.2 Models used

A - NETWORK ANALYSIS

The methods of Network Analysis are a part of a more general discipline called "Graph Theory".(45)

Network Analysis is the generic term for the whole range of "Network Techniques" designed for the planning of complex projects in a logical way, by analysing them into component parts and recording them as a network, model or diagram.(46) These techniques assist in controlling the inter-related activities of a project from initiation to completion.(47) The types of problems in which Network Analysis is used are:

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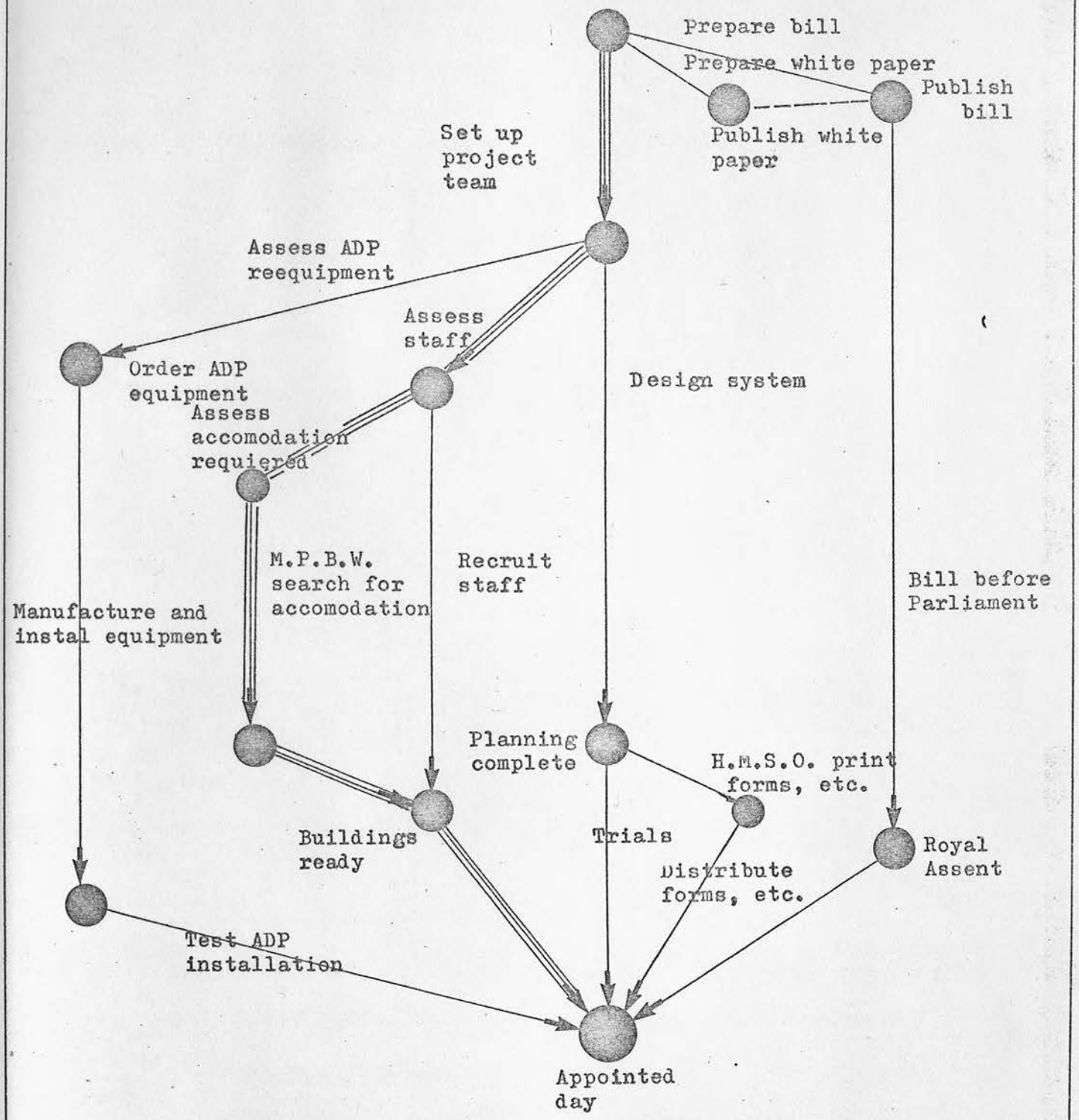
(44) R. Ackoff, "Operations Research", in "International Encyclopedia of the Social Sciences", op.cit. p.294.

(45) Graph Theory is a branch of mathematics which belongs in part to Topology and more closely in subject matter and methods of proof to Combinatorial analysis. The beginnings of Topology, and simultaneously of Graph theory, date from the celebrated Konisberg bridge problem. The problem was to find a way of walking across each of the seven bridges exactly once and returning to the same point. From McGraw-Hill "Encyclopedia of Science and Technology", Vol.6. p.284.

(46) See example in graph 2-2.

(47) See example in graph 2-2.




Times shown in months viz.(6)
Minimum Time Path ⟹
HMSO Her Majesty's Stationery Office
MPBW Ministry of Public Buildings and Works.

The chart corresponds to the first approach of one of the early applications of network analysis to an administrative project in Whitehall - The planning and establishment of the Land Commission. Further information on this project is to be found in :
Ryan W. "Network Analysis in Forming a New Organization". CAS Occasional Papers, H.M.S.O., London, 1967

(a) The computation of optimal routes. -
One of the most common questions associated with graphs is that of optimal routes. Optimal may be defined as shortest, longest, safest, etc.

(b) The computation of optimal networks. -
Very often, not only the optimal route between two certain nodes of a graph is asked for, but all the optimal routes between each pair of nodes are required. A network of graph, the edges of which represent the shortest route between all the nodes, will be called "optimal network".

(c) Flow in graphs. -
The problem is defined in the following way:(48)

"The maximum flow problem is to determine the feasible steady-state pattern of flows through the network which maximises the total flow from the source to the sink."

Actually the problem can be formulated in terms of linear programming problem. However, the solution by the use of network analysis is more efficient than the Simplex solution (Linear Programming). (49)

The best known network analysis models are:

$A_1$ Programme Evaluation and Review Technique (P.E.R.T.), and Critical Path Method (C.P.M.).

These two models have been developed in the U.S.A.; P.E.R.T. by the Navy Office of Special Projects (Polaris Project-1957), and C.P.M. by the Du Pont company in concert with the Univac Division of the Remington Rand Corporation (1957).(50)

The two models (which differ from each other only in a few details) are methods of minimising trouble spots - production bottlenecks, delays and interruptions, by determining critical activities before they occur so that various parts of the overall project can be co-ordinated.(51)

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(48)See example in graph 2-3.
(49)See "Linear Programming" in section 4.3.1.2 of this chapter.
(50)From R. Company's "Planificacion de projectos", 1968, p.5.
(51)A. Boehm, "Decision Theory and Program Scheduling", op.cit.p.166.

Network Planning in the context of P.E.R.T. reduces to three phases:(52)

(a) Activity Analysis.(53)
The first step is to analyse all the work that must be done, break it down into individual tasks, and then estimate how long each will probably take and how much it will cost.

(b) Arrow Diagramming.
The above mentioned information is then diagrammed as a network of activities or "arrow diagram". The arrow diagram attempts to show the inter-relationships between activities.

(c) Node Numbering.
The construction of a logical relationship of an arrow diagram to prevent the occurrence of close loops.(54)

The output of this work is a diagram showing the required activities, the precedents relationships, and the estimated activity time. At the same time, there will be a clear idea about the slack time and critical path of the project. The "slack" for an event is the difference between its latest time and earliest time; thus the "slack" indicates how much delay in reaching the event can be tolerated without delaying the project completion. A "critical path" for the project may be defined as a path through the network such that the events on this path have zero slack,(55) i.e. the sequence of jobs in which any slowdown will delay the completion of the entire project.

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(52) From F. Hillier and G. Lieberman, op.cit. p.228.

(53) In P.E.R.T. terminology a project is defined as a collection of interrelated activities, connected by events and leading to the accomplishment of the project. From ibid.

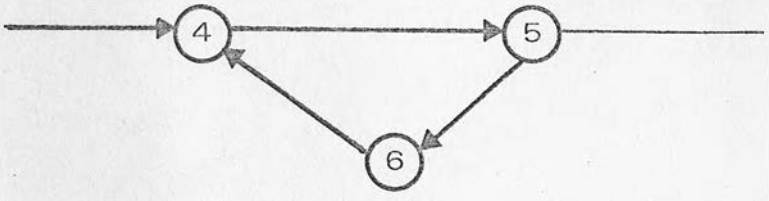
(54) See example in graph 2-3.

(55) From F. Hillier and G. Lieberman, op.cit. p.228.

Although drawing a PERT network demands nothing more than an understanding of the inherent logic of the operation in question one must nevertheless guard against two logical errors that sometime occur when drawing very complicated networks. They are known as "looping" and "dangling".

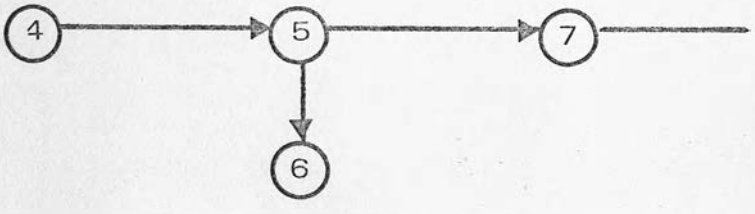
## Looping:

Is the ocurrence of a loop somewhere in the network. In PERT such a relationship between events is impossible. For if event occurs after event 4 and event 6 in turn after event 5, then event 6 must necessarily occur after event 4 and not before, as the network suggests.

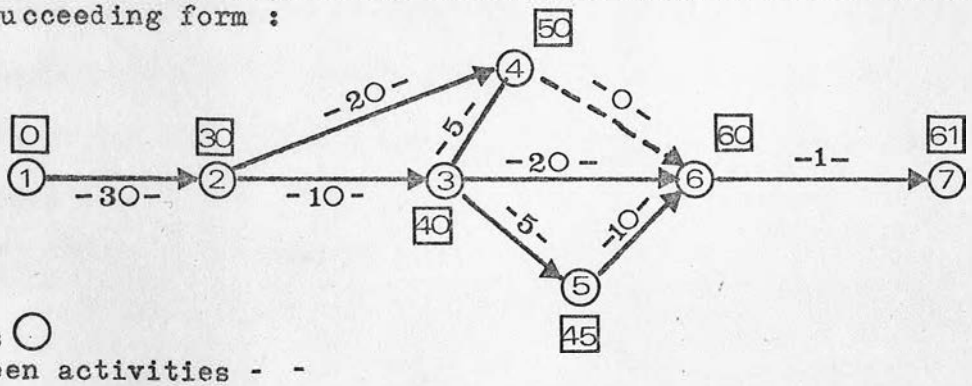



## Dangling:

Occurs when an intermediate activity dangles in mid-air. Obviously the activity represented by the dangling arrow 5-6 is at fault as it is undertaken with no result.




Dangling arrows can be avoided by following two rules: i - all events except the first and last must have at least one activity entering and one activity leaving them, ii - all activities must start and finish with an event. When the abovementioned errors are avoided a PERT network will have the succeeding form :




activities ○
time between activities - -
earliest time an activity will occur □

From:J. Singh, "Operations Research" p.92

The use of P.E.R.T., C.P.M. and related techniques is linked with the extensive use of computers, as it is clearly specified by M.G.Kendal[56] when referring to the basic issues of Network Analysis.

" (a) identify the limitations imposed by the fundamental nature of the job itself, or of the basic methods to be used in tackling the job, and diagram these limitations;

(b) then work out the limitations of time as determined by the individual tasks and the resources you are prepared to allot to each one ...

(c) then determine the limitations imposed by resources...

(d) and re-examine, if you must.

And, above all, decide the level of control you wish to exercise on the project or enterprise, and be guided thereafter in your analysis accordingly;

(e) And exploit the computer to the full! "

The development in both theory and application of Network Analysis Techniques has generated other types of models such as EDP-System (Norway),[57] and LUNET (Holland.[58] All these models are basically adaptations of the PERT and CPM models to the particular needs of an industry of a Country.

Network Analysis is now applied in all kinds of industrial, managerial and governmental problems. A good illustration of the Network Analysis Applications can be found in the references quoted below.

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(56) M.G.Kendall "Introductory Address", in "Applications of Critical Path Techniques", ed. by J. Brennan. The English University Press, London, 1968. p.4.

(57) H. Anderson et al. "A Network Model for Resource Allocation and Time Scheduling specially constructed for Repetitive Processes in the Building Industry", in "Applications of Critical Path Techniques,"ed. J. Brennan, p.7.

(58) S. Sotthewes, "Top Management Control". Ibid p.42.

### 4.3.3 Queueing Problems

#### 4.3.3.1 Description

To determine the amount of service facilities required, or how to schedule arrival of tasks at service facilities, so that losses associated with idle facilities, waiting and turned-away tasks are minimal.(59)

#### 4.3.3.2 Model used

A - QUEUEING MODELS

These are mathematical formulations which enable the O.R. workers to calculate, for any given situation, what kind of queue will result, and how long the items will have to wait before service.

The first Queueing Model was introduced by A.Erland(1909)(60) to study the problem of congestion of telephone traffic.

At the end of World War II, the Queueing Model was extended to the study of other general problems involving queues or waiting lines.

By employing this method, a manager is able to assess the probable efficiency of a system in terms of its service-providing capacity, to estimate the likely bottlenecks and plan to eliminate them, and, if queues are inevitable, to calculate their likely lengths so that he can make provisions for storing the items while they are waiting for services.(61)

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(59) R. Ackoff, "Operations Research", in "Encyclopedia of Social Sciences", op.cit. p.294.

(60) A. Erland published in 1917 his book "Solutions of some problems in the theory of probabilities of significance in Automatic Telephone Exchanges", quoted from R. Thierauf and R. Grosse, op.cit. p.430.

(61) From E. Duckworth, "A Guide to Operational Research", p.34.

Queueing theory is based on Probability Theory and Calculus. There are, though, other ways of dealing with waiting lines problems, viz. Simulation (Monte Carlo Method) (to be studied in the next section), and the use of the concepts of the Markov Processes.

B - MARKOV PROCESSES (62)

A Markov Process is a model of a probalistic system that is characterized by a sequence of trials or experiments in which the results of a trial are dependent upon the immediately preceding trial.

Fundamental concepts of a Markov Process are the state of a system at a point in time and the transition from one state to another; and a fundamental assumption is that there is a finite number of mutually exclusive states. The process reveals the behaviour of the system as it moves from one time period to another and the conditions under which the process stabilizes, if it does stabilize.

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(62) The concepts are quoted entirely from R. Meir et al. "Simulation in Business and Economics", p.57.

## 4.3.4 Simulation Problems

### 4.3.4.1 Description

When it is necessary to represent the reality through the use of a model or other device which will react in the same manner of reality under a given set of conditions.

> "To 'simulate' means to duplicate the essence of the system or activity without actually attaining reality itself." (63)

### 4.3.4.2 Models used

In the broadest sense, any mathematics or analytic formulation of a problem is a simulation. However, in O.R. the term is used when referring to the following basic models:

A - MONTE CARLO METHOD(64)

The Monte Carlo Method, in general, is used to solve problems which in some important way depend on probability - problems where physical experimentation is impracticable and the creation of an exact formula impossible. Essentially Monte Carlo Method is simulation by sampling technique (Probability Theory), that is, instead of drawing samples from a real population, they are obtained from a theoretical counterpart of the actual population. The method presents some operational complications, because "one is always faced with the unhappy choice of either inaccurate results or a very large amount of calculations".(65) However, Monte

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(63) G. Morgenthaler. "The Theory and Application of Simulation in Operations Research", in "Progress in O.R." ed. Russell Ackoff, New York, 1961, p.367.

(64) The description is based on D. McCracken, "The Monte Carlo Method", in "Mathematical Thinking in Behavioural Sciences", ed. by Scientific American, 1968, p.32.

(65) Ibid.

Carlo is able to give at least approximate answers to many questions where other mathematical techniques fail.

Work areas for Monte Carlo method are: Waiting line problems, inventory levels, flow of city traffic, utilization of airports, runways, etc.

B - SYSTEM SIMULATION METHOD

The method is a derivation from the "sampling" techniques of statistics.(66) It is described as "The process in which information, useful in the analysis of a complete problem, is processed through the operation of a model."(67) The simulation model is a reproduction of the operating environment. Its characteristics allow the observer to analyse the response of the environment to alternative planning decisions. This method differs from the Monte Carlo approach in that System Simulation draws samples from a real population and uses this information in a mathematical model which can be analytically solved to assist an individual in reaching a decision.(68) This type of approach is used in a variety of forms, i.e. System Simulation for Regional Analysis,(60) for city planning,(70) for scenario studies,(71) etc.

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(66) G. Morgenthaler. Op.cit. p.370.
(67) R. Thierauf and R. Grosse. Op.cit. p.473.
(68) Ibid
(69) H. Hamilton et al. "System Simulation for Regional Analyses".
(70) Jay Forrester "City Dynamics".
(71) H. Kahr and A. Wiener, "The Year 2000".

C - OPERATIONAL GAMING METHOD

Thomas and Deemer[72] have distinguished Operational Gaming by the idea of play. "Operational Gaming may, by simulation, put people into realistic situations in order to derive what assumptions to make about human behaviour;"[73] i.e., in Operational Gaming the human element in decision-making is brought in and studied.

The two most widely used forms of operational gaming are business management games and military games. The business games are designed to imitate competitive situations in industry and to observe the performance of the men who take the roles of Managing Directors, Sales Managers, and so on, in the imaginary companies which are set up.[74] The aim of this type of games is basically educational (to make generalists out of specialists).[75] The same principles could basically be applied to the military games.[76]

Operational Gaming is not to be confused with the theory of games which is a mathematical method of obtaining solutions to competitive situations.[77]

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(72) Quoted by G. Morgenthaler, op.cit. p.371.
(73) Ibid
(74) E.Duckworth, "A Guide to Operational Research", op.cit. p.87.
(75) G. Morgenthaler, op.cit. p.375.
(76) C. Thomas, "Military Games", in "Progress in O.R." ed. R. Ackloff, p.423.
(77) See Game Theory, at the end of this chapter.

## 4.3.5 Inventory Problems

### 4.3.5.1 Description

To determine the amount of resources to be acquired or the frequency of acquisition when there is a penalty for having either too much or too little.

### 4.3.5.2 Models used

A - INVENTORY CONTROL MODELS

An Inventory is defined as a stock of goods which is held for the purpose of future production or sale.(78) Since inventories constitute an alternative to production, or purchase in the future, the choice among policies depends upon their relative "Profitability". Some of the costs that determine this Profitability are:

(a) The costs of ordering or manufacturing.
(b) Holding or storage costs.
(c) Unsatisfied demand or shortage penalty costs.
(d) Revenues.
(e) Salvage costs.
(f) Discount rates.

The Inventory Control Model is used as a tool to help the decision-maker in the design of policies and decision rules which view inventories in a "system" context so that the aforementioned costs are minimised.(79)

Inventory Models are based on statistical probability theory and can be solved using graphics, algebraics, or calculus approach.(80) The cornerstone of inventory works is the determining of economical purchase quantities and reorder points quantities.(81)

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(78) F. Hillier and G. Lieberman. op.cit. p.357.
(79) E. Buffa. op.cit. p.229.
(80) R. Thierauf and R. Grosse. op.cit. p.188.
(81) T. Whitin. "Introduction to the lot-size Formula", in "Managerial Economics and Operations Research", ed. E. Mansfield, p.255.

The basic formula for determining economical purchase quantities was developed in the 1920s[82] (several authors independently arrived at the same conclusion).

The formula involves a simple application of elementary differential calculus to inventory control. Based on this first model, more complicated and sophisticated approaches have been developed.[83]

### 4.3.6 Replacement Problem

#### 4.3.6.1 Description

To determine when to replace instruments, tools or facilities, so that acquisition, maintenance, and operating and failure costs are minimised.

#### 4.3.6.2 Models used

The Models have been developed according to two basic types of problems.[84]

(a) Problem involving items that degenerate over a period of time, i.e. Firm's fixed assets such as machinery, trucks, buildings, equipment. Solutions to this type of problem are obtained by use of calculus and dynamic programming. (85)

(b) Problem involving items that fail after a certain amount of time, e.g. vacuum tubes, tyres, tubes, etc. The models in this type of problem consider:

(b.1) replacing items as they fail;

(b.2) replacing all items at specified intervals;

(b.3) a combination of these. Statistical theory and probability theory are used for this study.

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(82) T. Whitin, "Introduction to the lot-size Formula", in "Managerial Economics and Operations Research", ed.E.Mansfield, p.255.

(83) A good reference about the Systems Approach to Inventory Control can be found in E. Buffa, op.cit.

(84) This section is based on R. Thierauf and R. Grosse, op.cit. p.25.

(85) See Dynamic Programming in this same chapter.

4.3.7 Competition Problems

4.3.7.1 Description

To determine the rules to be followed by a decision-maker that yields the best results when the outcome of his decision depends in part on decisions made by others.

Models used in this type of problem are derived from the model presented by von Neuman and Morgenstern - Theory of Games - which because of its importance will be studied in a separate section in this chapter.

4.3.8 Search Problems

4.3.8.1 Description

To determine the amount of resources to employ and how to allocate them in seeking information to be used for a particular purpose so as to minimise the costs associated with the search and with the errors that can result from the use of incorrect information.(86)

4.3.8.2 Model Used

A - HEURISTICS MODELS(87)

In recent years increasing attention has been given to problems solving techniques and procedures, usually computerised, which are similar to, or which simulate, those that might be employed by intelligent problem solvers. The name "heuristic" has often been employed to describe methods of this type.

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(86) R. Ackoff, "Operations Research", in "Encyclopedia of Social Sciences", op.cit. p.294.

(87) The section is based on the work of R. Meir et al. op.cit. pp.147 to 173.

Heuristic programming is defined by H. Simon as:-

> "A point of view in the design of programmes for complex information processing tasks. This point of view is that programmes should not be limited to numerical processes, or even to orderly systematic non-numerical algorithms of the kind familiar from the more traditional uses of computers, but that ideas should be borrowed also from less systematic, more selective processes that humans use in handling those many problems that have not been reduced to algorithm".(88)

Different students think differently about the concepts and scopes of the heuristic methods.(89) However, a useful compromise has been reached by R. Meier et al.(90)

> "It is useful to think of heuristic methods as a master set containing three subsets...; we define the three subsets as follows:
>
> Heuristic problem solving: Problem oriented use of heuristics to achieve a reduction of search in the attainment of satisfactory solution.
>
> Artificial intelligence: The use of computer-oriented heuristics in programmes that may accomplish one or more of the following:
>
> (a) Search - The systematic investigation of the solution space.
>
> (b) Pattern recognition - The acceptance of certain groupings of elementary units as identifiable entities.
>
> (c) Organisation planning - The breaking down of a complex problem into subproblems, the sequencing of analysis according to priorities and recombination into a solution of the higher level problem.
>
> (d) Learning - Programme modification resulting from experience.
>
> (e) Inductive inference - Generalization for the purposes of prediction and decision making.
>
> Simulation of human thought: The use of a heuristic computer programme to replicate thought process of a human decision maker."

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(88) H. Simon and A. Newell, "Simulation of human thinking", in "Management and the Computer of the Future", Martin Greenberger ed. New York, J. Wiley & Sons, Inc., 1962. p.113 - Quoted by R. Meier, op.cit. p.148.

(89) In fact there are three main approaches to heuristic methods: a) problem solving, b)computer oriented, c) human thought. This difference in scope can be explained by the fact that concepts were tailored to the specific application of heuristics by different authors. Ibid p.149.

(90) Ibid. pp.149, 150.

## 4.4 Game Theory Model

In section 4.3.7 of the present chapter we mentioned that "competition" problems are studied through the use of concepts provided by the "Theory of Games". In our opinion this is one of the most important theories in Operational Research, and its understanding will help us very much for the further development of our work. For that reason, the "Theory of Games" is included in this separate section.

### 4.4.1 Introduction

Based on Set Theory, Linear Geometry and Group Theory, John von Neuman constructed the "Theory of Games" in the 1920s. The subject achieved real prominence after the publication, in 1944, of the classic "Theory of Games and Economic Behaviour" by von Neuman and the economist, Oskar Morgenstern.(91) The theory has been the cornerstone upon which different ideas about analysis of systems have been built. In fact, Linear Programming, Network Analysis, Cost-Benefit Analysis and the like count as one of their antecedents the ideas of "Game Theory". In this sense, we could say that the concepts of "Game Theory" paved the way for the introduction of quantitative analysis into planning.

In the work before mentioned, it is stated that the purpose of the "Theory of Games" is:

> "To find the mathematically complete principles which define 'rational behaviour' for the participants in a social economy, and to derive from them the general characteristics of that behaviour. And while the principles ought to be perfectly general - i.e. valid in all situations - we may be satisfied if we can find solutions, for the moment, only in some characteristic special case". (92)

(91) J. von Neuman and O. Morgenstern, "Theory of Games and Economic Behaviour", Princeton University Press, Princeton 1953.
(92) Ibid. p.31.

As a branch of economics, "Game Theory" is concerned with economic decisions, but, unlike most conventional economics, the theory emphasises not merely the set of strategies available to the single decision-maker, but considers him in a situation in which other decision-makers are acting also. "What is more, each of these individuals' behaviour is seen to influence directly all others. In other words, each player does not find himself in a fixed environment or a deterministic universe... the emphasis is placed on strategic interdependence... in which.. the outcome of each person's actions depends explicitly on the action of other people." (93)
The situation presented above could represent either a real life situation or a game of strategy, e.g. chess. This is the starting point of the "Theory of Games":

> "When they are examined by the methods of modern mathematics, it becomes evident that many forms of economic and social behaviour are strictly identical with — not merely analogous to —games of strategy. Thus the mathematical studies of games offers the possibility of new insights and precision in the study of economics." (94)

Thus, the game model is adopted here as one of the many schemes within which the human behaviour has tried to be formalised, and "whether or not the phenomena studied by games theorists are thought to be intrinsically serious, the subject itself is very much so, being neither technically nor conceptually easy or superficial."(95)

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(93) M. Peston and A. Coddington, "The Elementary Ideas of Game Theory", p.4.
(94) O. Morgenstern, "The Theory of Games", in "Mathematical Thinking in Behavioural Sciences", Scientific American (ed.) p.86.
(95) M. Peston and A. Coddington. op.cit. p.3.

4.4.2 Principles of the Theory of Games

As presented before, the theory deals with situations of inter-dependent decision making, i.e. cases in which the decision-makers are faced with choices between alternatives in which the best alternative for one decision-maker depends on the choice made by the other. The common theoretical framework for the analysis of inter-dependent decision-making problems would be as follows:(96)

1 - Decision makers faced with
2 - choices which jointly lead to
3 - outcomes among which each decision-maker has
4 - preferences.

In game theory the decision-maker is called "player", the choices are called "strategies", and the preferences of the players are represented by utilities or pay-off.

The application of the Theory of Games to the situation described above would generate a plausible set of rules for each decision-maker which would tell him how to behave in every situation, i.e. a strategy will be drawn. Strategy is defined as:(97)

> "A plan which specifies what choices he (the decision-maker) will make in every possible situation, for every possible actual information which he may possess at that moment in conformity with the pattern of information which the rules of the game provide for him for that case."

There are two points to be mentioned about strategies:(98)

1. The rules of behaviour even in a perfectly rational community must provide for a great variety of situations - some of which will be very far from optimum.
2. The rules of rational behaviour must provide definitely for the possibility of irrational conduct on the part of others.

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(96) Ibid. p.7.
(97) J. von Neuman and O. Morgenstern. op.cit. p.79.
(98) Ibid. p.32.

Perhaps the key principle of Game Theory is that the 'optimal' solution of a conflict is the establishment of an equilibrium among the parties concerned, i.e. there would be a situation in which each participant should try to minimise the maximum harm (minimax outcome).(99) If this outcome is the same for both individuals, then both individuals should use the strategy that leads to this outcome since the use of any other strategy can only improve the other's outcome and reduce one's own. This minimax outcome is called a saddle-point. The "Minimax Theorem" of von Neuman proves that such an equilibrium exists in all game-conflict. Von Neuman formulates his theorem in the following:

> "If the set of possible strategies of the players is extended beyond the pure strategies, there is always some mixed strategy for player 1 whose minimum pay-off is larger than any other, and there is always a mixed strategy for player 2 whose maximum pay-off is smaller than any other, amd these two pay-offs are equal in value." (100)

The demonstration of this theorem goes beyond the scope of this work. However, it is necessary to point out the fact that to apply the theorem it is always necessary to have some measure of the preferences of the individual players among possible outcomes. In some situations preference could be measured in money terms (in a game of poker) - the situation becomes conflictive, when "satisfaction" or other abstract outcome is attempted to be measured.

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(99) In other words "each participant will choose the better of a set of worse alternatives". This solution is always prescribed no matter how many alternatives there are, provided that the gains of one are the losses of the other, and provided that what is the "best of the worst" for one is also the "best of the worst" for the other. From A. Rapport, "The use and misuse of game theory", ed. by Scientific American op.cit. p.98.

(100) M. Peston and A. Coddington, op.cit. p.15.

The authors of the theory faced the abovementioned problem in this way:

> "In Chapter I our primary concern lay in economics. It was only after having convinced ourselves of the impossibility of making progress in that field without a previous fundamental understanding of the games that we gradually approached the formulations and questions that are partial to that subject... From this Chapter II on, however, we shall have to treat the games as games... of course, most of the main concepts are still those familiar from the discussion of economic literature, but the details will often be altogether alien to it - and details, as usual, may dominate the exposition and overshadow the guiding principles". (101)

In other words, the authors of the "Theory of Games" did not attempt to discuss - as main issues - problems of "utility" or preference; adopting - "a mainly opportunistic point of view in relation to these issues". (102)

For the purposes of simplification they assumed that "the aim of all participants in the economic system - consumers as well as entrepreneurs - is money, or equivalent by a single monetary commodity. This is supposed to be unrestrictedly divisible and substitutable, freely transferable and identical, even in the quantitative sense, with whatever 'satisfaction' or utility is desired by each participant."(103) We have brought up this issue because further development of "Game Theory" proved that "details, as usual, may dominate the exposition and overshadow the guiding principles",(104), i.e. the complicated mathematics

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(101) J. von Neuman and O. Morgenstern, op.cit. p.46.
(102) Ibid p.8.
(103) Ibid.
(104) Ibid. Mentioned in footnote 101 above.

of the Theory of Games are constantly used for the study of conflict situations[105] regardless of the fact that it is not always true that "the aim of all participants in the economic system...is money or equivalent." [106]

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(105)"Planning" is regarded as a game in which the opponent is nature, and according to G. Chadwick:

> "We may say that - in principle - game theory might provide a way of representing a decision model for the planning process; its attributes are that it can deal with uncertainty, it is anticipatory, and it attempts optimisation - the best outcome".
> From G.Chadwick, op.cit. p.304.

(106) See note 103 in this chapter.

## 5. Conclusions

From the general view of the "Operational Research" processes presented in this chapter, the following conclusion can be drawn:

Operational Research came into being as an imaginative, interdisciplinary, empirical approach towards the understanding of systems problems. Its development, however, shows that, somehow, the above mentioned characteristics are attempted to be replaced by a "display of technical devices"(107) i.e. at the present moment "Operational Research" has become less "an attitude of mind towards the relation of man and environment,"(108) and more a "group of techniques to deal with problems of organization of largely complex organisations and activities".(109)
We ought not to hide our preoccupation for the development of the late "Operational Research" trends, for we think that the vital activity in "Operational Research" must be to understand "what makes things tick,"(110) and that this task can be accomplished with or without the use of computational techniques. We do not argue against the use of these techniques, for they are very useful tools for facing the complex problems involved with the investigation of systems. But we must keep in mind that if our understanding of the system under study is defective, we will have defective answers regardless of the type of sophisticated technique used.

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(107) The term belongs to S. Beer, op.cit. p.28. He thinks that in O.R. sometimes "means" are confused with the end itself.
(108) For reference see footnote 15 in this chapter.
(109) The definition belongs to: The Committee on Operations Research of The National Research Council. Quoted from R. Thierauf and R. Grosse, op.cit. p.13.
(110) S. Beer, op.cit. p.26.

We will come back once more to the above issue when discussing the problems of implementation of P.P.B.S. For (advancing our ideas) we think that some of the difficulties in the use of P.P.B.S. spring from an exaggerated belief in technical tools as opposed to empirical research, understanding and imagination. However, before attempting to deal with the P.P.B.S. issue we must study the way in which systems ideas have influenced the theory and practice of governmental decision-making. This we will present in the next two chapters of this work.

# CHAPTER 3

## COST-BENEFIT ANALYSIS

1. Aims of this Chapter.
2. Introduction
3. Development of Cost-Benefit Analysis.
4. Welfare Economics and Cost-Benefit Analysis.
5. Principles.
   - 5.1 Enumeration of Costs and Benefits.
   - 5.2 Valuation of Costs and Benefits.
   - 5.3 Choice of an interest Rate of Discount.
6. Synthesis: Investment Criteria.
7. Role of the "Analyst".
8. Conclusions.

# CHAPTER 3. COST-BENEFIT ANALYSIS

## 1. Aims of this chapter.

In this chapter we will attempt to identify and appraise the main concepts of the decision-making method of approach, known as Cost-Benefit Analysis.

> "One can view Cost-Benefit Analysis as anything, from an infallible means of reaching the new Utopia to a waste of resources in attempting to measure the immeasurable." (1)

As can be seen from the above quotation, this method is very controversial. However, so much has this method influenced the P.P.B.S. theory that, for some authors,(2) P.P.B.S. is only another form of Cost-Benefit Analysis, and hence our interest in the understanding of the subject.

## 2. Introduction

In Chapter 2 of this work, the function of "evaluation" has been identified as a central element of the planning process; i.e. in accordance with the ideas of Operational Research, Planning can be described as "a list of tests which have to be carried out: tests which determine whether or not fundamental criteria are satisfied."(3) The best known criterion for the evaluation of alternative development projects, in the public sector, is probably the Cost-Benefit Analysis Method.

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(1) A. Prest and R. Turvey, "Cost-Benefit Analysis - a Survey", in "Surveys of Economic Theory", Vol.III, edited by the American Economic Association and the Royal Economic Society, p.200.
(2) See, for instance, C. Schultze, "Why Benefit-Cost Analysis", in H.Hinrichs and G. Taylor (eds.) "Program Budgeting and Benefit-Cost Analysis" passim.
(3) G.Chadwick, op.cit. p.258.

Cost-Benefit Analysis is defined as:

> "a practical way of assessing the desirability of projects, where it is important to take a long view (in the sense of looking at repercussions in the further, as well as the nearest, future) and a wide view (in the sense of allowing for side effects of many kinds, on many persons, industries, regions, etc.) i.e. implies the enumeration and evaluation of all relevant costs and benefits." (4)

In doing so, Cost-Benefit Analysis draws on different aspects of the theory of Economics - Public Finance, Resources Economics, and especially on Welfare Economics - using, too, the analytic tools of Operational Research, attempting to weld all these components into a coherent whole. The output: Cost-Benefit Analysis: is a subject for argument:-

> "Thus C.B.A. is derived directly from the theory of the firm in economic theory, where the firm has the single goal of maximising its profits, and the profitability of alternative investments is considered by deriving estimates of costs and revenues and relating these to the capital invested. The maximising of private profits in this way, within an economy of pure competition, is supposed to lead to optimal welfare of the community, according to Welfare Economics. When translated into the public sector, it is unlikely that circumstances are analogous to those of the private firm.... The market view upon which the theory of the firm is based cannot be applied meaningfully to the public sector... Moreover, the single goal focus of the firm is fundamentally different from the multiple goals of public welfare... and there is the further problem that certain goals are of a qualitative nature which makes qualification either difficult or impossible." (5)

There are not many conceptual, practical or philosophical issues of the C.B.A. method in which a common agreement exists among the students of the subject.(6) Yet the method is applied

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(4) A. Prest and R. Turvey, op.cit. p.155
(5) G. Chadwick, op.cit. p.263.
(6) D. Pearce, "Cost-Benefit Analysis", p.8.

in projects all over the world. In the following pages we will try to identify the main sources of disagreement and controversy in the theory of C.B.A., to have, in this way, a better idea of its possibilities and limitations.

## 3. Development of Cost-Benefit Analysis

"On the Measurement of the Utility of Public Works", published in 1844 by J. Dupuit[7], is considered to be the starting point of the idea of measuring the net advantages of capital investment projects. However, Dupuit's ideas were only applied in the first half of this century when the U.S.A. Flood Control Act of 1936 authorised federal participation in flood control schemes "if the benefits to whomsoever they may accrue are in excess of the estimated costs".[8] Soon this type of analysis was used in other U.S.A. agencies concerned with water development projects.

In 1950, an inter-agency committee produced a Green Book of Cost-Benefit Analysis.[9] This book is well-known because it used for the first time the language of Welfare Economics, thus merging into a whole the so far separated developments of "Practical Project Analysis" and Welfare Economics.

The above mentioned document, and a second one (Budget circular A-47),[10] talked of social gains in terms of National Product,

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(7) In this work the notion of consumers' surplus is presented, i.e. the excess of consumers' willingness to pay for an item or service over and above its market price, as a measure of the net welfare gain of a project. Refinements to this concept are due to Marshall, Hotelling and Hicks, from A. Dasgupta and D. Pearce, "Cost-Benefit Analysis - Theory and Practice", p.11.

(8) Quoted from T.Newton, "Cost-Benefit Analysis in Administration",p.29.

(9) The agency above mentioned is the Federal Inter-Agency River Basin Committee's Sub-Committee on Benefits and Costs.

(10) U.S. Government Bureau of the Budget, "Budget Circular A-47", Washington, 1952, mentioned in A.Dasgupta and D.Pearce,op.cit.p.254.

"ignoring the fact that some social gains and losses are not expressible in terms of recorded National Product, and that the government might have aims other than maximising gains to the National Product".(11) At the end of the 1950s, a number of publications about the subject appeared attempting to develop an integrated theory of Cost-Benefit Analysis, with costs and benefits being related more clearly to welfare losses and gains so that the substantial body of Welfare Theory could be brought to bear on the issue.(12)

Ever since, C.B.A. has been used for the evaluation of projects, not only in the U.S.A. where it was originated but in different parts of the world. In the U.K. for instance, the first application of C.B.A. was in the M 1 (Britain's first motorway).(13) Other C.B.A. exercises in the U.K. include: road bridge over the Rivers Tay and Severn; the withdrawal of railway services; and the proposed third London Airport.(14) In many developing countries, C.B.A. has been used to evaluate the desirability of irrigation, hydro-electrical and transport projects.(15)

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(11) Ibid, p.12.

(12) The most important of these publications are: The work of O. Eckstein, "The Economics of Project Evaluation", Cambridge, 1958; R. McKean, "Efficiency in Government through Systems Analysis with Emphasis on Water Resource Development", New York, 1958; and J. Krutilla and O. Eckstein, "Multiple Purpose River Development: Studies in Applied Economics", Baltimore, 1958. Quoted from Ibid.

(13) The study was made by M.Beesley et al, and published under the name of "The London/Birmingham Motorway: Traffic and Economics", H.M.S.O. 1960. Quoted from T.Newton, op.cit. p.29.

(14) The study of the Third London Airport has become the classical example of the application of C.B.A. techniques and as such it is quoted in most of the British books on the subject.

(15) Application of C.B.A. in underdeveloped countries has been studied in M.Little and J.Mirrlees "Manual of Industrial Project Analysis", Vol.II, OECD, Paris, 1969.

It is tempting to think that after twenty years of development C.B.A. "must have reached the stage where a clear consensus of opinion exists about the proper procedure to be followed."(16) However, as we have already pointed out, this is not the case, and there are still many problems to be sorted out. The first of these problems we will call: the use of Welfare Economics Concepts in Cost-Benefit Analysis.

4. Welfare Economics and C.B.A.

From the work by A. Dasgupta and D. Pearce,(17) the basic idea of C.B.A. has been identified:

> "To decide on the worth of a project involving public expenditure (or more extensively, public policy) it is necessary to weigh up the advantages and disadvantages. The province of C.B.A. is usually confined to public projects because the advantages and disadvantages are defined in terms of social gains or losses. It is assumed that most private decisions are not concerned with the wider social effects, but with effects on profits, sales or producer status." (18)

It is the reference to "social gains and losses" of the aforementioned quotation which links C.B.A. to Welfare Economics. Modern Economic theory draws a distinction between Positive Economics, which explains the working of an economic system, and Welfare Economics, which prescribes policy.(19) In this

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(16) A. Dasgupta and D. Pearce, op.cit. p.14.
(17) Ibid
(18) Ibid p.19.
(19) The subject of Welfare Economics is very controversial. M.Dobb in "Welfare Economics and the Economics of Socialism",p.3,writes:
> "It has become fashionable among economists to assume that no answers about welfare are possible without resort to so-called 'value judgements' and that everything involving these must fall outside the boundaries of economics treated as positive science."

context, we could say that Welfare Economics is the part of Economic theory which attempts to supply the economist - and the politician - with some standards by which they can appraise and on the basis of which they can formulate policy.(20)

Most of the conventional theory of Welfare Economics (especially in its application to C.B.A.) rests on the assumed value judgement that if one person is better off, and no one is worse off, the total welfare has been increased. This situation is known as the Pareto Improvement.(21)

> "A Pareto Improvement is defined as a change in economic organization that makes everyone better off, or, more precisely, that makes one or more numbers of society better off without making anyone worse off." (22)

A further refinement to this formulation was introduced by Kaldor and Hicks under the name of the "Compensation Principle".

> "A social state 'y' is 'socially preferable' to an existing social state 'x' if those who gain from the move to 'y' can compensate those who lose, and still have some gain." (23)

The acceptance of the above mentioned "principle" is the condition "sine qua non" for accepting the Cost-Benefit Analysis theory, for the latter is based on this "principle" for arguing that -

> "If the monetary value of benefits exceeds the monetary value of the costs, then the gainers (those who receive the benefits) can hypothetically compensate the losers (those who bear the costs) and still have some gains left over. The excess of gains over required compensation is equal to 'net benefits' to society." (24)

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(20) T. Scitovsky, "Papers on Welfare Economics", p.174.
(21) Named after V. Pareto (1848-1923), an Italian engineer. Succeeded Leon Walras to the Chair of Economics in the Faculty of Law at Lausanne University in 1892, and continued the study of Marginal Utility theory started by his predecessor. From G. Bannock et al, "The Penguin Dictionary of Economics", p.310.
(22) E. Mishan, "Elements of Cost-Benefit Analysis", p.14.
(23) A. Dasgupta and D. Pearce, op.cit. p.57.
(24) Ibid p.57.

In our opinion there are many reasons for not accepting the above formulation. One of these reasons (but not the only one)[25] is referred to as "the equity problem", which states that the Potential Pareto Improvement test clearly ignores the resulting change in the distribution of income.

> "Not only is it true that not every one is made better off, but it is also possible that those in the community who are made worse off are to be found largely among the lower income groups... A cost-benefit calculation may indeed be accompanied by observations on the resulting distribution, and even by recommendations in this respect. But the quantitative outcome of a Cost-Benefit calculation itself carries no distributional weight, it shows that the total of gains exceeds the total of losses, no more." (26)

Moreover, to ignore distributional changes is to accept the initial distribution of income of being socially preferred,[27] i.e., that there is a socio-economic equilibrium within the society; obviously this idea we cannot accept.

But the "Compensation Principle" is not the only source of argument in the C.B.A. theory. The use of the notion of "Consumer Surplus" generates controversy too. A. Marshall defined the idea of "Consumer Surplus" as:

> "The maximum sum of money a consumer would be willing to pay for a given amount of the goods less the amount he actually pays" (28)

That is,[29] if we were to ask an individual consumer to tell us the maximum amount he would be prepared to pay rather than go without some quantity of a particular article, we should

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(25) See section 5.1 of this chapter.
(26) From E. Mishan, op.cit. p.15. The author himself does not criticise the method but provides some examples of the kind of critics most commonly found.
(27) A.Dasgupta and D. Pearce, op.cit. p.62.
(28) Quoted from E. Mishan, op.cit. p.26.
(29) From G. Bannock et al, op.cit. p.81.

generally find that this exceeds the amount of money he actually does pay. This is explained in terms of the existence of a surplus of satisfaction or utility from the consumption of the article which is not completely swallowed up by the total expenditure of the article. The money value of this "surplus" satisfaction is the "Consumer Surplus". A rigorous analysis of the nature of Consumer Surplus was first put forward by A. Marshall. Its existence stems essentially from the tendency for "Marginal Utility",(30) to diminish as consumption of an article is increased. The sum of total expenditure on an article, and the Consumer Surplus derived from it, will give a money measure of the total utility derived from its consumption. Thus C.B.A. uses the Consumer Surplus as an indicator of welfare change, when benefits are defined in terms of willingness to pay.

The following reasons are brandished to criticise the use of Consumer Surplus in C.B.A.:

(a) There are practical difficulties in measuring Consumer Surplus. "In practice", D. Pearce writes, "some Cost-Benefit Analyses dispense altogether with the attempt to measure 'Consumer Surplus', mainly on grounds of impracticability." (31)

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(30) Marginal Utility. The increase in total utility of consumption of an article which results from increasing the quantity of the goods consumed by one unit. From ibid, p.272.

(31) D. Pearce, op.cit. p.22.

(b) Many writers[32] oppose the use of this concept on the grounds that the demand curve is only partial and fails to take account of the effect of the investment on the prices of all other goods, i.e. there may be changes in surplus elsewhere which are not accounted for by the analysis of the project in question.

(c) Arguments for the retention of the Consumer Surplus concept as a practical measure have largely rested upon the view that investment policies rarely cause significant price changes. The practice - and specially in developing countries - has shown us that major projects are very able to provoke a radical change in prices.

To end this section, we would say that the 'Compensation Principle" and the "Consumer Surplus" notion are two of the main concepts upon which the theory of C.B.A. has been built. Therefore the doubts about the usefulness of either concept are doubts about the validity of C.B.A. The issue remains one of controversy.

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(32) For instance, M. Little, who writes "Consumer Surplus is no more than a totally useless theoretical toy". Quoted from Ibid.

## 5. Cost-Benefit Analysis Principles

The word "principles" will be used, in this section, in the sense of "guiding rules". Thus, this section is concerned with the general rules concerning the application of the C.B.A. method. By and large three main stages are identified for the application of this method:

1. Enumeration of costs and benefits.
2. Valuation of costs and benefits.
3. Choice of interest rate.

The well-known "Survey" by A.R.Prest and R. Turvey[33] provides a thorough list of concepts used in each one of the stages above referred to. These concepts are:

1. Enumeration of costs and benefits:
   - 1.1 definition of a project
   - 1.2 externalities
   - 1.3 secondary benefits
   - 1.4 project life
2. Valuation of costs and benefits:
   - 2.1 the relevant prices
   - 2.2 non-marginal changes
   - 2.3 market imperfections
   - 2.4 taxes and control
   - 2.5 unemployment
   - 2.6 collective goods
   - 2.7 intangibles
3. Choice of interest rate:
   - 3.1 the social time preference rate
   - 3.2 the social opportunity costs rate
   - 3.3 adjustment for uncertainty
   - 3.4 the need for an interest rate
   - 3.5 principles v. practice

It is not our intention to review all the concepts listed above, but rather to point out some important issues in relation to the acceptance and use of these concepts.

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(33)A. Prest and R. Turvey, Op.cit.passim.

## 5.1 Enumeration of Costs and Benefits

According to A. Dasgupta and D. Pearce, the difference between C.B.A. and any "commercial" appraisal of a project or policy is that C.B.A. attempts to embrace "all costs and benefits, whether they accrue to the investing social agency or not".(34) In other words: C.B.A. is the only method of analysis which tries to identify the "external" effects of the investment or policy. This task is one of the most difficult ones to be reached in the C.B.A. method. In this section we will cover some ground on the above mentioned problem.

An external effect will be said to exist whenever:

(a) an economic activity in the form of production and consumption, affects the production or utility levels of other producers and consumers;

and

(b) the effect is unpriced or uncompensated.(35)

The first condition is called the "Interdependence" condition, the second one the "Non-price" condition. Both conditions must be obtained for an "externality" to exist. If "Interdependence" exists but the effect is priced, then the "externality" is said to be "internalised". External effects may be either "External Benefits" (economies) or "External Costs" (diseconomies); and they are supposed to be originated by either "Technological" or "Pecuniary" effects:

> "Technological externalities exist when the technical possibilities of transforming input into outputs are changed because of the action of the "externality-creating" agent, and when this change in transformation possibilities goes unpriced." (36)

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(34) A. Dasgupta and D. Pearce, op.cit. p.118
(35) Ibid
(36) Ibid p.120.

On the other hand, a "Pecuniary" externality is said to exist in the following condition:

> "A pecuniary externality relates to a change in the output or utility of a third party due to changes in the level of demand. Thus, pecuniary effects show up in changed prices and profits, but do not alter the possibilities of production." (37)

The above distinction between "technological" and "pecuniary" externalities is established because in the opinion of many students(38) only "technological" externalities should be considered in the appraisal of a public investment project. The reason given is that the "technological" externalities reflect real gaines and losses, whereas "pecuniary" effects reflect only transfers from one section of the community to another section, via changes in relative prices. Thus, to add "pecuniary" and "technological" effects would be double-count.(39) As a general guiding principle it is therefore accepted that:

> "costs and benefits are measured on the assumption of a given set of prices, and the incidental and consequential price changes of goods and factors of production should be ignored." (40)

The first problem for the acceptance of this rule is that the distinction between "technological" and "pecuniary" externality may not be so obvious and that some "externalities" will be the result of investments which are partly technological, partly pecuniary.

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(37) Ibid.
(38) For instance, see R. McKean, "Efficiency in Government through System Analysis", quoted by A. Prest and R.Turvey, op.cit.p.160.
(39) A. Dasgupta and D. Pearce, op.cit. p.121.
(40) A. Prest and R. Turvey, op.cit. p.160.

The second problem is that the view of the society used in the analysis is a static one, i.e. it is not considered that "external" effects can affect in different ways the different income groups of the population(the "Equity" problem again),[41] and that future generations are excluded from the analysis.[42] The latter point is a very important one because, by and large, C.B.A. tends to limit society to present generations or assumes that future generations will have a want structure very much like the existing one. This argument can be proved by the fact that hitherto "little effort has been made to consider the ecological effect of major investments",[43] an issue which is very important because "Ecological" externalities, in general, take on the attribute of "irreversibility", i.e. they produce effects which cannot be reverted. If this is true - and we have no reason to think otherwise - we are defining a basic restriction for the indiscriminate use of the C.B.A. method: that to-day's interest can destroy to-morrow's resources in a situation in which there are no possibilities of "disinvesting" in such a way as to restore the "status quo".

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(41) Discussed in section 4 of this chapter.

(42) According to D. Pearce, op.cit. p.9, "Almost by definition the Pareto criterion precludes consideration of future generations."

(43) A. Dasgupta and D. Pearce, op.cit. p.129.

## 5.2 The Valuation of Costs and Benefits

The enumeration of all relevant costs and benefits is but the first problem to be faced in the C.B.A. The second problem is the reduction of all costs and benefits to a "common denominator" so that they are comparable with one another, i.e. to obtain an idea of the aggregate benefits and costs associated with a project, and to compare these for different projects whose costs and benefits are measured in different physical dimensions or none at all, it is helpful to reduce all magnitudes to some common "unit of account".(44) Since the "Unit of account" most commonly used is "money", this "generally becomes the problem of valuing costs and benefits in monetary terms."(45) To do so, it is required that the prices attached to the physical benefits and costs reflect society's "valuations" of the final goods and resources involved. Two questions immediately arise:

(a) If markets do exist, to what extent will observed market prices reflect social valuations?

(b) If markets do not exist, how are surrogated prices to be derived, which, in turn, reflect social valuation? (46)

What is asked, then, in both cases, is how to define a price which would reflect the "true" social value of goods and

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(44) From G. Bannock et al. op.cit. p.89
(45) Ibid
(46) D. Pearce, op.cit. p.52.

services.[47] In C.B.A. this type of price is defined as a "shadow price"[48] and it may or may not be the actual amount to be paid for goods and services to which it refers. Its existence is based on the hypothesis that "technically, once a physical unit exists it must also be possible to find a shadow price, the willingness to pay of society for those units."[49]

In "Marginal Economic" theory, when a situation of perfect competition exists, the marginal cost[50] of any final output reflects the appropriate "shadow price". And because, in the same conditions of perfect competition, market prices are equal to marginal costs, we could therefore assume that "market prices are themselves adequate shadow prices".[51] In a real life situation, however, there are several factors which will twist the aforementioned perfect competition condition. These factors are as follows:[52]

(a) Imperfect competition
(b) Non-marginal changes in prices
(c) Increasing returns
(d) Taxation
(e) Multiplier effect
(f) External effects
(g) Public goods

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(47) E. Mishan, op.cit. p.69.
(48) A. Dasgupta and D.Pearce explain this concept in the following way: "Given that resources are limited, the use in one project will entail an opportunity cost - the benefit they would have yielded in an alternative use. Whatever the objective function, then, there will be a cost involved in meeting that objective by the use of resources in one project rather than in another. The ration of the two "willingness to pay" for these alternative uses is given the term of "shadow" or "accounting price"; from op.cit. p.97.
(49) Ibid, p.113
(50) Marginal Cost. The change in total costs of production which results when output is varied by one unit or the available costs of producing an additional unit of output. From G.Bannock et al. op.cit. p.261.
(51) D. Pearce, op.cit. p.53
(52) From A. Dasgupta and D. Pearce, op.cit. p.105.

It will be beyond the scope of this work to follow up all the arguments around the relative importance of each one of these factors in the building of the "shadow price" notion. However, to cut a long story short we would say that, by and large, it is considered that due to the existence of these factors "market prices will rarely coincide with the shadow prices which are theoretically necessary to value costs and benefits".(53) This argument puts the analyst of costs and benefits in a difficult situation for:

(a) In situations in which a perfect competition condition does not exist, there are no well-developed procedures for finding these "shadow prices". Moreover, it is said that any existing procedure hitherto has an element of arbitrariety ascribed to it. (54)

(b) On the other hand, to be consistent with the C.B.A. theory, it is not possible to ignore gains and losses simply because they cannot be measured.

We could illustrate the above situation with the following example: A new airport is to be built. It will save time and bring trade. But it will inflict noise and air pollution on the community. If the community recognises that their peace, tranquillity and the purity of their environment have infinite value, how is the analyst going to estimate the trade-off involved? Which price is the analyst going to allocate for the inconvenience which the new airport is

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(53) Ibid.

(54) The problem of "arbitrariety" will be discussed in section 7 of this chapter.

going to create to the community? Moreover, let us say that the new airport will occupy fine land suitable for agriculture. How will the permanent destruction of this land be valued? By which arguments could the analyst prove that "agriculture land" or "tourist spot" or "community tranquillity" are less important than "saving time" and "trade"?

Let us put ourselves in the place of the analyst. We could say that in the interest of the majority a new airport must be built in that given place. Probably the majority of the people who live beyond the radius of disturbance of the new airport will agree with us. However, what about the minority who will be directly affected? What about future generations? Will they agree with us too? Technically, we have not found any meaningful answer to all these questions. In our opinion, if any answer is to be found, it is a political and not a technical one. Therefore, we think that the estimation of costs and benefits still remains, as a source of great controversy.(55)

However, if a certain answer could be found, we must consider the problem all but finished, for we have to face the stage of selection of interest rate. This stage we will discuss in the next section.

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(55) See, for instance, A.Dasgupta and D. Pearce, op.cit. p.115.

## 5.3 Choice of an Interest Rate of Discount

To "discount" is to try to find the present value or present worth of a future sum of money. This is done, because to the individual (or the society), the value of a specific sum of money depends precisely on when it is received, i.e. "the community values benefits and costs falling at different times differently".(56) In other words, it is everybody's knowledge that £100 to-day will be worth only £90 after one year. Based on this fact, C.B.A. recognises that:

(a) Society expresses a preference for the present over the future (57), and that

(b) The sacrifice of present consumption would not be worth while unless gains in future consumption are greater.(58)

Although the above line of reasoning is accepted by the C.B.A. students, there is no universally accepted view concerning the choice of discount rate, even in principle. This fact is reflected in the "widely differing magnitudes of discount rates suggested by various schools of economists as suitable for discounting the returns from actual public projects." (59)

A. Williams(60) summarises the problem in the following way: In classical Micro-Economics the equilibrium rate of interest is the outcome of two distinct influences:

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(56) A. Williams, "Output Budgeting and the contribution of Micro-Economics to efficiency in Government", p.12.
(57) D. Pearce, op.cit. p.34.
(58) A. Dasgupta and D. Pearce, op.cit. p.136.
(59) H. Walsh and A. Williams, "Current Issues in Cost-Benefit Analysis", p.12.
(60) A. Williams, op.cit. p.12.

(a) The Marginal Social Rate of Time Preference for Consumption (also called: Social Time Preference Rate, or STPR), i.e. the rate to which the community is willing to give up present consumption for future consumption.

(b) The Marginal Social Opportunity Cost of Capital (also called: Social Opportunity Cost Rate or SOCR), i.e. the rate at which the community can actually transform present resources into future resources, which clearly depends upon the marginal productivity of capital.

The issue is still more confusing because:

(a) There are several conceptual disagreements within the representatives of the same school of thought.

(b) There are some economists who favour using both rates of discount (the synthetic approach).

(c) There are still others who would use neither.(61)

A. Williams's opinion on this problem is as follows:

"Attempts to estimate the theoretically correct rate have not so far been conspicuously successful, and the only way out at present appears to be the pragmatic one of applying some standard set of alternative rates (say 4%: 8%: and 12%) to see if the outcome is sensitive to such variations, and if it is, to make the critical "break-even" rate clear to the sponsors, but if not so much the better." (62)

Again, with the selection of some rate of discount the problem of the C.B.A. analyst is not yet finished, for he must make some allowances for the presence of "Risk" and "Uncertainty". In C.B.A. the concepts of "Risk" and "Uncertainty" have the following meaning:

Risk: A risk situation exists when the value of a variable (the benefit flow, discount rate, costs) is not known but its probability distribution is known.

Uncertainty: Pertains to a situation in which the probability distribution is not known at all.

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(61) H. Walsh and A. Williams, op.cit. p.13.
(62) A. Williams, op.cit. p.12.

Clearly, there are variations between these two extremes. But in general it is said that a situation of "Uncertainty" means that "the outcome (consequences) of policy (or project) are not uniquely determined"(63) because of these two reasons:

(a) The outcomes in any time-period depend not only on the policy adopted but on other circumstances too.

(b) The exact knowledge about the time pattern of relevant states of nature over the life of a project is lacking for the analysis.

At present, several methods for allowing for "Risk" and "Uncertainty" have been studied. However, they are so difficult to be applied that in practice what is done is to apply certain rules of thumb. These rules are summarised by Prest and Turvey in the following manner:(64)

In a project, allowances because of "Uncertainty" can be introduced in:

(a) The assessment of annual levels of benefits and costs;

or (b) The assumption about the length of life of a given physical structure

or (c) The discount rate.

These allowances are selected according to the succeeding criteria:

(i) The (a) type of allowance will be most appropriate if the risk of dispersion of outcomes (or inputs) is irregular, rather than regular, and distributed with time.

(ii) The second type of adjustment (type b) is needed when the main risk is that there may be a sudden day of reckoning when benefits disappear and costs soar.

(iii) The third type of correction (type c), a premium in the discount rate, is appropriate where "Uncertainty" is a strictly corresponding function of time.

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(63) A. Dasgupta and D. Pearce, op.cit. p.175.
(64) A. Prest and R. Turvey, op.cit. p.171.

A. Dasgupta and D. Pearce sum up the problem of "Risk" and "Uncertainty" in C.B.A. in the following way:

> "The use of rough adjustments such as these (shown above) can be understood as a reflection of the forces of inertia in management practices rather than a reasoned attempt to adjust for risk and uncertainty. Their replacement by methods with a firm foundation in economic theory can confidently be predicted as C.B.A. gets under way.." (65)

## 6. Synthesis: Investment Criteria

Assuming that: all relevant costs and benefits of a number of alternative projects have been a) identified, b) measured in monetary terms, c) discounted for time, and d) adjusted for uncertainty - which, all in all is a very big assumption - we still have to define an investment criteria which, using the available information, will allow us to rank all the alternatives in terms of "social profitability" for selecting a preferred one.(66)

In this problem, the analyst has the following possibilities:(67)

(a) Select all projects where the present value of benefits exceeds the present value of costs.

(b) Select all projects where the ratio of the present value of benefits to the present value of costs exceeds the unity.

(c) Select all projects where the constant annuity with the same present value as benefits exceeds the constant annuity (of the same duration) with the same present value as costs.

(d) Select all projects where the internal rate of return exceeds the chosen rate of discount.

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(65) A. Dasgupta and D. Pearce, op.cit. p.197.
(66) From T. Newton, op.cit. p.27.
(67) A. Prest and R. Turvey, op.cit. p.175.

From the above alternatives, (a) and (b) are the most commonly used. Alternative (a), i.e. to select the project which offers the highest net present value of benefits, in A. Dasgupta and D. Pearce's opinion is "the correct criterion" to be used.(68) However, T. Newton points out the fact that "many studies have ignored this criterion in favour of the benefit/cost ratio", (alternative (b) ).(69) The reason given is that the latter alternative "can be used in cases in which benefits and costs, although quantifiable in numerical terms, cannot be measured in monetary terms".(70) In this case, alternative (a), by definition, cannot be used. It is interesting to note that, according to the criterion adopted, a given project may or may not be considered to be the most convenient for implementation, i.e. a situation could exist in which a particular project will be considered "feasible" according to alternative (a), but "unfeasible" according to other criteria. For this reason it is recommended that the final presentation of the results of the analysis must be supplemented with a clear statement of the social costs and benefits considered in the project. In this way, the decision-maker will be able to make a value judgement based on the evidences available.

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(68) A. Dasgupta and D. Pearce, op.cit. p.173.
(69) T. Newton, op.cit. p.27.
(70) Ibid.

7. The role of the "Analyst"

C.B.A. is about choices. And, as we have already discussed, it is not only about the choice of a project (or policy), but also about the choice of the analytical concepts to be used in the application of the method. That is, so many are the arguments about each one of the C.B.A. concepts, that the first decision any C.B.A. "analyst" must make is about the type of approach he will use. This first decision will influence tremendously the results of his analysis.

What we are saying here, therefore, is that the C.B.A."analyst" is making decisions IN EACH STAGE OF THE PROCESS, and that this is done in spite of the fact that the "analyst" is not supposed to make any decision but to leave this to the "decision-makers". The question is: to what extent is the "analyst" influencing the analysis with his own value judgements?

R. Turvey says: "In some cases the Cost-Benefit 'analyst' may reject some alternatives even though he is not the decision-maker, because he is able to predict that the decision-maker himself would reject them".(71) If this is accepted, then, why have decision-makers? However, if this is not accepted, it will be actually impossible for the "analyst" to work, for he must select, discriminate, classify, evaluate all kinds of information, and in this process he is, by force, choosing.

The problem goes back to the initial formulations of Welfare Economics and all the doubts about its validity. T. Scitovsky,

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(71) R. Turvey, "On the Development of Cost-Benefit Analysis", in M. Kendall (ed.) "Cost-Benefit Analyses", p.5.

in the first lines of "The State of Welfare Economics" (72) argues that -

> "without welfare economics, however, economic theory would be a collection of techniques and the economist would be little more than a technician, a politician's handy man, who has to wait for the latter to state his aims and can merely advise him on how to go about achieving those aims".

In other words, to the above mentioned author, Welfare Economics is about ethical judgements. K. Arrow reinforces this opinion, when he claims that his "Impossibility Theorem" shows that "the explicit introduction of ethical judgements into C.B.A. appears inevitable."(73) The arguments on this problem go on "ad infinitum".(74) We have brought this matter into the discussion, not for insisting on the idea that the boundaries between the roles of the "analyst" and the "decision-maker" should be defined, but for making clear that the problem exists and it must be taken into consideration by the "analyst", the "decision-maker", and "the public".

In our opinion, only if the analyst knows the limitations of his methods, the decision-maker is conscious of this situation, and the public is aware of all these problems, can a process of questioning and response, i.e. a real process of learning, be established.

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(72) T. Scitovsky, "The State of Welfare Economics", in T.Scitovsky(ed.) "Papers on Welfare and Growth", p.174.

(73) Quoted in A. Dasgupta and D. Pearce, op.cit. p.90.

(74) See, for instance, Ibid. Chapter three.

## 8. Conclusions

C.B.A. is based on the simple idea that to know the value of a project (or policy) it is necessary to identify all relevant costs and benefits, to give them a value at a given point in time, and to compare them.

To do this, the analyst must answer the following questions:

Which costs and benefits are to be included?

How are they going to be valuated and compared?

In our study we have come to know that these are difficult questions to deal with. The wide divergency of views about the correct way of answering them has been sketched in this chapter. In our opinion there is not a right answer to all the C.B.A. problems. Yet it does not mean that the method cannot be used. We think that, if its limitations are clearly stated, the method is a useful tool in problems of decision making, not because this method would provide complete answers to the problems of allocation of resources among competing claims, but because a framework of discussion about the consequences derived from making alternative decisions will be established. And in our opinion, a platform for discussion is a first stage in the process of learning about planning.

# CHAPTER 4

## PROGRAMME AND PERFORMANCE BUDGETING

1. Aims of this Chapter

2. Introduction

3. Development of "Programme and Performance Budgeting"

4. Characteristics
   - 4.1 Definition
   - 4.2 Classification by "Programmes"
   - 4.3 The "Financial Management System"
     - 4.3.1 Financial Plan
     - 4.3.2 Accounting Problem
   - 4.4 Measurement of Physical Performance

5. Use of "Programme and Performance Budgeting"

6. Conclusions

# CHAPTER 4: PROGRAMME AND PERFORMANCE BUDGETING

## 1. Aims of this chapter

Planning-Programming and Budgeting System is viewed as the result of half a century of evolutionary process in budgeting practice.(1) Before its introduction, the highest step on the evolutionary ladder was occupied by the budgetary system known as "Programme and Performance Budgeting". It is on this system that the first works on P.P.B.S. were based. Thus, we think that the understanding of the concepts of "Programme and Performance Budgeting" will help us to understand P.P.B.S. This chapter is drawn with that aim.

## 2. Introduction

Although the word "budget" has different connotations,(2) it is usually used to indicate -

> "a financial and/or quantitative statement prepared prior to a definitive period of time, of the policy to be pursued during that time for the purpose of attaining a given objective." (3)

According to A. Schick(4) every budget system, even rudimentary ones, comprises planning, management and control processes, i.e. in the context of budgeting:

> "PLANNING involves the determination of objectives, the evaluation of alternative courses of action, and the authorization of selected programs."

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(1) A. Schick, "The Road to P.P.B.: The Stages of Budget Reform", in F. Lyden and E. Hiller (eds.) "Planning-Programming-Budgeting: a systems approach to management", p.27.

(2) "The word 'budget' is used of many kinds of statements of future plans and expectations, varying enormously in their form and contact, the uses to which they are put, and even their very names" - R.S. Edwards et al, "Budgeting in Public Authorities", p.15

(3) Ibid, p.16.

(4) A.Schick, op.cit. p.28.

> "MANAGEMENT involves the programming of approved goals into specific projects and activities, the design of organizational units to carry out approved programmes, and the staffing of these units and the procurement of necessary resources."
>
> "CONTROL refers to the process of binding operating officials to the policies and plans set by the administration."

The above mentioned author thinks that these three elements have tended to be competing processes in budgeting "with no net division of functions among the participants". His thesis is about the fact that the history of budgeting[5] can be differentiated into three stages of budgeting reform. These stages would correspond to the influence that each one of the above mentioned elements has had upon the budget process. Thus, there can be distinguished:

(a) A "control" oriented budget: the so called "Traditional Budget".

(b) A "management" oriented budget: the "Programme and Performance Budget":

and

(c) A "planning" oriented budget: P.P.B.S.

This chapter is devoted to the study of the second type of system. In doing so we attempt to settle the bases for a better understanding of the "planning" oriented budget (P.P.B.S.)

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(5) Ibid, p.30.

3. Development of "Programme and Performance Budgeting"

> "Without some system of book-keeping, orderly management of the king's great household would have been impossible; and therefore clerks and scribes, equipped with writing materials, are found in paintings dating to early times." (6)

The author's description corresponds to the kingdom of King Menes in Egypt some three thousand four hundred years before the Christian Era. Thus financial and budgeting problems of nations, cities and households are as old as the history of mankind.

The word "budget" which we use to-day is derived from the old French "bougette", meaning a small bag or pouch.(7) It was first used in England to describe the white leather bag that held the seal of the mediaeval Court of the Exchequer:

> "Later the Minister's bag containing his proposals for financing government expenditure likewise became known as his 'budget'. When he presented his proposals to Parliament he was therefore said to 'open his budget' - a phrase first used in about 1733 ....." (8)

However, in England, budgeting practice as it is now understood can be found as early as 1217 when "it was declared in Magna Charta that no scutage or aid shall be imposed in the Kingdom unless by the common council of the realm"; (9) i.e., the English national budget system came into being as a means of asserting Parliamentary control over the Executive.

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(6) C.J. Bullock, "Politics, Finance, and Consequences", p.5.
(7) R.S.Edwards et al, op.cit. p.13.
(8) Ibid
(9) Ibid

From its earlier beginning until the 1930s the budget served two purposes:[10]

(a) It was designed to aid in the formulation and execution of government expenditure and financial programmes.

(b) It was designed to enable the Parliament to control and supervise the financial operations of the government.

These are the characteristics of the so-called "traditional budget". From the 1930s onwards an entirely new approach was opened by the Keynesian school of economic thought.[11] They drew attention to the so far unrecognised possibilities of using fiscal measures to regulate the level of employment and economic activity. They emphasised the role of the budget as an instrument of economic planning - a means of assessing probable developments in the national economy and of regulating the volume of taxation and government expenditure to offset threats of inflation or economic recession; i.e., Budgeting practice was considered to be not only an instrument for the control of expenditure but mainly a management tool of the national government's economic policy. These new ideas, amalgamated with the new conceptions of Cost-Benefit analysis, reviewed in chapter three of this work, provided the basic framework upon which the "Programme and Performance Budget" concept was coined.

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(10) G. Colm, "The Government Budget and the Nation's Economic Budget", in American Economic Association (ed.) "Readings in Fiscal Policy", p.387.

(11) The Keynesian attack on the classical principles of budgeting and public finance was a logical extension of the Keynesian attack on the view that economy tends to equilibrium at full employment. Keynes himself, however, did not elaborate the role of fiscal policy in the maintenance of full employment. This remained for Alvin Hansen and the Keynesian. For information about this issue, see J. Burkhead, "The Balanced Budget", ibid in special part II.

Cost-Benefit analysis stressed the importance of measuring the output side of the budget, i.e. in the "traditional" form of budget the contribution of the government to the national economy was measured by its inputs and not by its outputs. The reason, as A.Williams says, is because "on the whole no market exists for the output of the sector, the only readily accessible items being inputs of one kind or another";(12) i.e., data was available for inputs and not for outputs.

Moreover, it was noticed that the classification of expenditures (by inputs) in the budget did not enable the identification of programmes or projects, and, furthermore, it was not related to the cost of major inputs or the work performed. In other words: "The system of budgeting did not provide information on what a government was actually doing and what it got for the money spent".(13) "Programme and Performance Budget" was developed as an attempt to correct the above mentioned situation. In the U.S.A., the "Commission on Organization of the Executive Branch of the Government" (known as the first Hoover Commission 1947-49) recommended that:

> "the budget document be completely recast along the lines of work, programs and functions. Such a document - a performance budget - would analyze the work of government departments and agencies according to their major functions, activities, and projects. It would thus concentrate attention on the work to be done or service to be produced rather than on things to be acquired." (14)

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(12) A. Williams, "Output Budgeting and the Contribution of Micro-economics to efficiency in Government", p.14.
(13) United Nations, "A Manual for Programme and Performance Budgeting", p.8.
(14) Quoted from H.A. Hovey, "The Planning-Programming-Budgeting Approach to Government decision-making", p.77.

As G. Moss writes,

> "The idea behind this movement was absurdly simple: namely, that any government agency should know what it has done, is doing, or wants to do with the inputs it uses.." (15)

As we will see in chapter five, P.P.B.S. borrowed the same idea, which, although simple, has proved very difficult to put into practice.

## 4. Characteristics

### 4.1 Definition

The definition of Programme and Performance budget usually adopted is:

> "A Programme and Performance Budget is one which presents the purposes and objectives for which funds are requested, the cost of the programmes proposed for achieving these objectives,and quantitative data measuring the accomplishments and work performed under each programme". (16)

The Programme and Performance Budget is based on three sets of interrelated considerations:-

CLASSIFICATION OF PROGRAMMES

(a) Meaningful programmes and activities are established for each function entrusted to an organization or an agency in order to show precisely the work objectives of various agencies.

FINANCIAL MANAGEMENT SYSTEM

(b) The system of accounts and financial management are brought into line with this classification.

MEASUREMENT OF PHYSICAL PERFORMANCE

(c) Under each programme and for its operational subdivisions, action is taken to establish programmes and work measures that are useful for evaluation of performance.

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(15) G. Moss, "The New Systems Budgeting", in P.A.R. Vol.29, No.2, p.119.

(16) United Nations, op.cit. p.2.

In the following sections we will study these three considerations. The need for doing so is because we find that the structure of the Planning and Performance Budget presented above has striking similarities with the structure of P.P.B.S. (to be presented in the following chapters).

## 4.2 Classification by Programmes

Basic to a "Programme and Performance Budget" is the establishment of "programmes" and "activities" that group work operations according to the way in which they contribute to the end products produced by government organizations. The classification structure for a Programme and Performance Budget involves the identification of:(17)

(a) Functions
Broad grouping of operations that are directed towards accomplishing a major purpose of government, e.g. Education, Health or Agriculture.

(b) Programmes
Broad categories within a function that identify the end products of major organizations, e.g. Construction Programme, University Programme.

(c) Activities
Segments of a programme that identify homogeneous types of work carried out by subsidiary organizations to produce the end product of a programme; e.g. within a construction programme, items such as: irrigation, building, river control and drainage, etc., are considered to be activities.

The aim of this type of classification is to establish a clearly defined pattern of organizational responsibilities inside the government machinery, contributing in such a way to the overall purposes of budgeting by improving executive and legislative review and decision-making, and, further, by facilitating effective internal financial administration. Examples are shown in Tables 4.1 and 4.2.

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(17) Ibid, p.5.

Table 4.1: Functional Classification of Government Transactions in Central America.

The Central American Workshop in Programme and Performance Budgeting held in Costa Rica in 1963 recommended the development of a standard functional classification for Central American Countries, along the following lines:

| | |
|---|---|
| General Services: | (a) General Administration<br>(b) Justice and Police<br>(c) General Research and Scientific Services |
| Defense: | |
| Social and Community Services: | (a) Education<br>(b) Health<br>(c) Social Security and Special Welfare Services<br>(d) Community Services |
| Economic Services: | (a) Agriculture and Non-Mineral Resources<br>(b) Fuel and Power<br>(c) Other Mineral Resources, Manufacturing and Construction<br>(d) Other Economic Services<br>(e) Multi-Purpose Projects |
| Unallocable Expenditure | |

From: U.N. "Manual of Programme and Performance Budgeting", p.6.

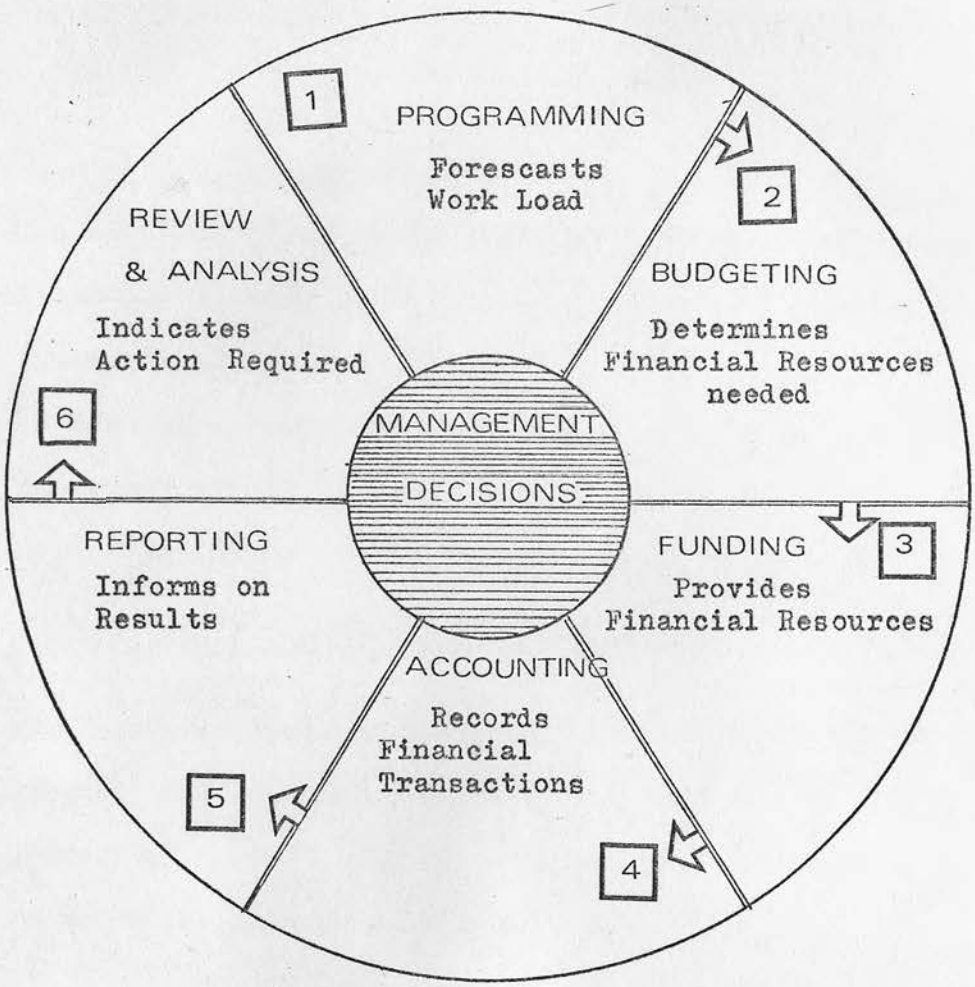
Table 4.2: U.S.Department of Agriculture - Forest Service Programme by Activities

1. FOREST LAND MANAGEMENT:
   - (a) National Forest Protection and Management
   - (b) Fighting Forest Fires
   - (c) Insect and Disease Control
   - (d) Acquisition of Lands

2. FOREST RESEARCH
   - (a) Forest and Range Management
   - (b) Forest Protection
   - (c) Forest Products Utilization
   - (d) Forest Resources
   - (e) Forest Research Construction

3. STATE AND PRIVATE FORESTRY CO-OPERATION
   - (a) Forest Fire Control
   - (b) Forest Tree Planting
   - (c) Forest Management and Processing
   - (d) General Forestry Assistance

From: U.N. "Manual of Programme and Performance Budgeting, p.98.




from: U.N., "A Manual for Programme and Performance Budgeting" p.29

About "Classification by Programmes", two points should be noticed:

(a) Conceptually, "Classification by Programmes" draws on the ideas of "Hierarchy"(18), and "Black Boxes"(19) discussed in chapter one of this work. The importance and meaning of this fact will be discussed in our next chapter.

(b) As we shall see in chapter six of the present study, the idea of "Classification by Programmes" has been adopted within the P.P.B.S. framework.

## 4.3 The Financial Management System

The second basic consideration in the "Programme and Performance Budgeting" approach is to bring the system of accounting and financial management in line with the budget classification. In this way a direct relationship could be established between programmes and their costs:

> "The purpose of doing something and the cost of doing it are the twin considerations which are indivisible and indispensable to the most effective system of management.." (20)

The financial management function is described in the U.N. "Manual of Programme and Performance Budgeting"(21) as a continuous cycle of related operations that contribute to necessary management decisions". (See Graph 4-1).

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(18) See chapter one, section 224, of this work.

(19) Black Boxes have been discussed in chapter one, section 3.3, of this work. In the above structure of programmes the "activities" constitute "Black Boxes", i.e. elements treated as units, without any consideration of its internal composition or structure, so that attention is directed solely to the character of the outputs which result from identified inputs.

(20) Ibid p.2.

(21) Ibid p.2.

According to the same "Manual", the application of Programme and Performance Budgeting, in relation to that cycle, raises the following questions:(22)

(a) Kinds of classifications needed for the various operations.

(b) The best methods for relating one operation to another.

(c) The accounting basis and the kind of financial data to be developed.

(d) The most appropriate financing, report and control practice.

All these questions are concerned with two aims of the "Programme and Performance Budget": a) the introduction of a Financial Plan, and b) the improvement of Accounting Methods.

4.3.1 The Financial Plan

The "Programme and Performance Budget" approach introduces the idea of long-range programming in government works.(23) Consequently the budget system was designed so as to provide a programming framework for the development of detailed agency plans that can be related to long term objectives and goals. "The underlying technique that gives fiscal substance to this relationship is the Financial Plan."(24)

> "A Financial Plan is the technique that correlates objectives, authorities, responsibilities and resources - in a way that keeps management at the various levels better informed on budget proposals and performance in the attainment of approved goals, thus providing an improved basis for decision-making throughout the budget process." (25)

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(22) Ibid, page 22.
(23) Ibid, page 23
(24) Ibid.
(25) Ibid.

In the 1940s V.O. Key[26] called the attention to the lack of a "Budgetary theory" to reach the above mentioned objectives. Professor Key argued that since the problem of budgeting is a problem of applied economics(allocation of resources among competing demands), the budget question should be explored from the point of view of economic theory. V. Lewis[27] believed and proposed an economic theory of the budget based on the principles of Cost-Benefit Analysis. Thus, as we have already discussed, "Budgeting" and Cost-Benefit Analysis were linked in a single framework: "The Programme and Performance Budgeting". The development of this relationship gave as a result what is known as P.P.B.S.[28]

4.3.2 The Accounting Problem

Given an appropriate management structure, "the application of Programme and Performance Budgeting" directs attention to the type of financial information that will be most useful for management purposes".[29] Accounting practices can vary from a relatively simple "cash basis"[30] of accounting

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(26) See V. Lewis "Towards a Theory of Budgeting", in P.A.R., Vol.XII, p.42.
(27) Ibid
(28) To be studied in chapter six of this work.
(29) United Nations, op.cit. p.23.
(30) In government, accounting has traditionally been maintained on a "cash" basis - one that recognizes the availability of resources upon receipt of cash, and the use of such resources at the time that payments (disbursements) are made. Under this type of system, management and control information are developed in terms of disbursements - or, as they are often called, in terms of expenditures. From Ibid, p.23.

to a refined "accrual basis" that produces costs per unit of work or programme accomplishment.(31) The problem of accountancy is very much related to a third important concept in "Programme and Performance Budgeting": The measurement of physical performance. This we will present in the next section.

## 4.4 Measurement of Physical Performance

As discussed in chapter three of this work, the use of Cost-Benefit Analysis requires the identification of inputs and outputs of a given set of projects in order to evaluate and compare them. The same idea is used in Programme and Performance Budgeting. Here the measurement of physical progress and performance has as specific objectives:(32)

(a) To obtain physical measures of work effort and results.

(b) To establish a pertinent relationship with the use of resources, so as to provide data that will help in developing and presenting budget proposals.

(c) To assign personnel and allocate funds to responsible organizations for the conduct of approved plans.

(d) To review progress in the attainment of policy objectives and programme and work goals.

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(31) In general an "accrual system" in a government agency reflects the funds, inventories, and other resources available, the receipt of goods and services, the use of available resources in relation to work performed in a given time period, and the liabilities of the agency. It incorporates monetary property records and establishes financial controls that are consistent with assigned management responsibilities. Thus, the system provides for full disclosure, reflecting not only the availability and states of funds, but also showing all resources on hand and the actual use of such resources. From Ibid, p.24.

(32) Ibid, p.48.

To attain these objectives, "Programme and Performance Budgeting uses some Operational Research models such as P.E.R.T., CPM, Linear Programming.(33) In our opinion, these models can help but not solve the problem of finding suitable indicators of public works output. As we have already seen in chapter three of this work, the issue (as any other issue concerning Cost-Benefit Analysis) is very controversial. However, as we will see in chapter six of this work, the idea of measurement and comparison of the output of public works has been somehow adopted in P.P.B.S.

5. Use of Programme and Performance Budgeting

Programme and Performance Budgeting has been used not only in the U.S.A. but in many countries of the world. In fact, one of the actions of the United Nations during the so called "Development Decade"(34) was to sponsor the introduction of the system to a great number of "developing countries".(35)

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(33) See chapter two of this work.

(34) The period between 1960-1970 was called the "Development Decade" by the U.N. However, a general air of disillusionment exists about this period, e.g., H. Singa complained in FAO's Ceres for May-June 1968 that the development decade of the 1960s is frequently referred to as a "decade of frustration"; from A. Waterson, "An Operational Approach to Development Planning", in H.M.Faber and D. Seers (eds.) "The Crisis in Planning", Vol.I, p.81.

(35) The term "Developing Countries" is an English term. In Spanish we use the term "Undeveloped Countries". In our opinion neither of these two terms is accurate. They are used to gather under a special heading a group of countries exploited in different degrees by imperialism. We are not going to make an issue on the correct terminology to be used. As P. Jalee says: "The expression is short, practical, and everyone knows pretty well what sort of country it refers to". P.Jalee, "The Pillage of the Third World", p.3.

In doing so the U.N. was aiming at:[36]

(a) The development of new types of information on the public sector essential for drawing up long-term development plans.

(b) The change of concepts and procedures in government budgeting required to make the annual budget an effective instrument for implementing the development plans and policies.

During the 1960s "Programme and Performance Budgeting" systems were established in countries such as: The Philippines, Thailand, Iran, Costa Rica, Honduras, Nicaragua, Panama, Guatemala, Bolivia, Colombia, Venezuela, Peru, etc.[37] Reviewing the problems of implementation of the new system, A. Waterson concludes:

> "attractive though they are in theory, performance budgeting techniques which require unit cost measurement of all government functions, programmes, projects and activities are much too advanced for application in most less developed countries..."(38)

For two reasons the above opinion should not be accepted:

(a) Mr Waterson assumes that "Programme and Performance Budgeting" is efficiently used in some "developed" countries.

As far as we know this has not happened even in the U.S.A. In fact, I. Galnoor and B. Gross, who wrote one of the few papers appraising the use of the new system in the U.S.A. qualify it as "conceptually unfinished".[39]

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(36) United Nations, op.cit. p.111.
(37) Regional workshops were established to discuss the new system in Asia, Africa and Latin America. The result of these meetings has been published under the name of "A Manual for Programme and Performance Budgeting" in 1965 by U.N.
(38) Quoted from I. Galnoor and B.Gross, "The New System Budgeting and the Developing Nations", in Int.Soc.Sci. Vol.XXI, p.34.
(39) Ibid

They point out the fact that in practice there were tremendous problems for the identification of outputs and costs which could provide a reliable basis for evaluating the efficiency of governments' programmes.(40) We draw the attention to this problem in our chapter on Cost-Benefit Analysis.(41) Yet we now learn that Cost-Benefit Analysis has been adopted with all its conceptual unsolved problems within the "Programme and Performance Budgeting" framework. If this is so, it is not surprising that the same problems, found for applying Cost-Benefit Analysis techniques, come up once again for the case of the new system.

(b) Mr Waterson assumes that the success or failure of "Programme and Performance Budgeting" depends on the technological development of the country concerned. This is a dangerous assumption because Mr Waterson does not consider the idea that "Programme and Performance Budgeting" may not be suitable - and "ergo" non applicable - in countries different to those in which the system was conceived. For, after all, why should a system used with doubtful success in the management of the American government machinery be imported to Peru,

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(40) In another paper, B.Gross "The New System Budgeting", op.cit., presents a long list of defects of "Programme and Performance Budgeting", among them: Government Budgeteers have failed to focus on the problem of intangible outputs - that is, services involving information and control rather than the processing of raw material. Costing has been incomplete and clumsy, large capital costs are neglected in many areas, with overly compulsive attention fixed on allocations of overhead labour time, p.120.

(41) See chapter three, section 5.1 of this work.

Colombia or Iran? In our opinion, the problem is not that the system is "too advanced for application in most developing countries", as Mr Waterson believes,(42) but that the system has not proved its value, either in the "developed" or in the "developing" countries. Moreover, we believe that even if the system had been successfully tested in the U.S.A. this would not mean immediate success in other countries, e.g. Keynesian macro-economics has been referred to as one of the most important intellectual antecedents of "Programme and Performance Budgeting".(43)

However, the use of J.M. Keynes's economic policies in developing countries is severely criticised by many economists.(44) For instance, referring to the use of the Keynesian-type real income multiplier in Latin America, A.A. Montenegro writes:

> "the economic policy of Latin American countries in the years after 1925 was guided by the Keynesian formula of stimulation of investment and employment by means of huge governmental programmes of work and services. The deficient financing of these created in the Latin American economies a severe inflation, a monetary devaluation and disequilibrium in the balance of payment." (45)

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(42) See footnote 38 of this chapter.
(43) See section 3 of this chapter.
(44) See for instance: V. Rao, "Investment, Income and the Multiplier in an underdeveloped Economy", in A. Agarwald and P.S.Singh (eds.) "The Economics of Underdevelopment". See also, Joan Robinson, "Economic Philosophy": "Keynes theory has little to say, directly, to the underdeveloped world, for it was framed entirely in the context of an advanced industrial economy with highly developed financial institutions and a sophisticated business class"...p.112.
(45) A.A.Montenegro, "Teoria y Politica del Desarrollo Latino-Americano", p.132.

Thus, the failure of the above mentioned economic doctrine in Latin America cannot be attributed to the fact that its methods were "too advanced to be applied in developing countries", but to the differences in economic and political conditions existing between Latin America and the U.S.A. or Great Britain.

Having said so, we cannot deny the fact that the application of the new system in the different countries of the world brought up many important changes in the theory of planning. To start with, "planning", which was a taboo concept in many countries,(46) became "respectable" after the introduction of "Programme and Performance Budgeting" by the U.N. during the 1960s. However, the introduction of a system which emphasises the measurement of all sorts of inputs and outputs gave origin to a developing planning theory with "an appalling reliance on national income account."(47) That is:

> "The economy is regarded as a kind of balloon, which bulges in one place when pressure is applied somewhere else, or which can be blown up or let down at will; or even as a flow of water from a tap which can be regulated as desired by using general instruments of economic policy...." (48)

About the same problem, I. Galnoor and B. Gross say:

> "National plans in many developing countries revolve around a 'number magic' of such and such annual increase in G.N.P., or a certain decrease in the balance of payment gap." (49)

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(46) For instance, the history of "planning" in Latin America shows that, by and large, the existing national planning agencies (in all the Latin American Countries) have been created at the beginning of the 1960s. Before that period (and speaking from our experience in Peru), "planning" was too "revolutionary" to be accepted.

(47) I. Galnoor and B.Gross, op.cit. p.36.

(48) A. Burstedt et al, "Social Goals in National Planning", p.13.

(49) I. Galnoor and B. Gross, op.cit. p.36.

The above quoted "number magic" is probably referred to Rostow's "take off" theory,(50) which recommends "a rise in the productivity investment of over 10% of national income"... to "transform the economy and society in such a way that a steady rate of growth can thereafter be regularly sustained". Many if not all developing countries were out for the 10% growth. Well, at the present moment Japan and Brazil touch the figure. The question is - are they better off because of that? (51)

To conclude this section we would say that, in our opinion, the system known as "Programme and Performance Budgeting" has over-emphasised the usefulness of economic statistics, and in consequence has promoted an approach to life based on the principle of using monetary units as the common denominator of "all that is important in human life."(52) In our succeeding chapters we will appraise the impact that these ideas had in the formulation of P.P.B.S.

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(50) See W.W. Rostow, "The Take Off into Self-Sustained Growth", in A.Agarwala and S.P.Singh (eds.) op.cit. p.164.

(51) In economic terms Japan is the new giant (and Brazil the future one). However, the social, political and ecological problems of these countries increase in direct relation with their G.N.P. growth.

(52) I. Galnoor and B.Gross, op.cit. p.36.

## 6. Conclusion

The "Programme and Performance Budgeting" is a budgeting system designed to provide better information about what a government is actually doing and what it gets for the money it spends.

Conceptually, "Programme and Performance Budgeting" draws on Keynesian macro-economics and Cost-Benefit Analysis theories, using at the same time some of the operational tools included in the study of Operational Research.

Because of its intellectual relationship with Cost-Benefit Analysis, the new system insists very much on the idea that inputs and outputs of governmental works can be measured and evaluated in monetary terms. In practice, the idea has not been completely successful and therefore some authors qualify the system as "conceptually unfinished". In our opinion, this fact paved the way for the introduction of another budgeting reform and the introduction of a new system for the evaluation of government activities. This is the system known as P.P.B.S., which we will study in the following chapters.

# CHAPTER 5.

## CONCLUSIONS TO THE FIRST PART OF THE WORK

1. Aims of this chapter.

2. Conclusions - A Framework for Decision-Making.

1. Aims of this Chapter

The aim of this chapter is to provide an introduction for the study of P.P.B.S., and with that end in view some general relationships between the theories and methods presented hitherto and P.P.B.S.will be discussed.

2. Conclusion - A Framework for Decision-Making

As a result of the adoption of the ideas provided by General System Theory, Cybernetics Theory, Operational Research, Cost-Benefit Analysis, Programme and Performance Budgeting and the like,(1) a new method of approach for problems of decision-making has emerged: the Systems Approach. In general this approach seeks for:

1. The determination of objectives to be met.
2. Formulation of alternative ways to reach these objectives.
3. Choice of a preferred alternative based on some evaluation criteria.
4. Continuous assessment of actual performance of preferred alternative.

i.e., implicit in this method of approach is the idea that "planning" is not an act but a process, "a process that has no natural conclusion or end point".(2) Based on that some authors define "planning" as:

> "the process of preparing a set of decisions in the future directed at achieving goals by optimal means and learning from the outcome about possible sets of decisions and new goals to be achieved..." (3)

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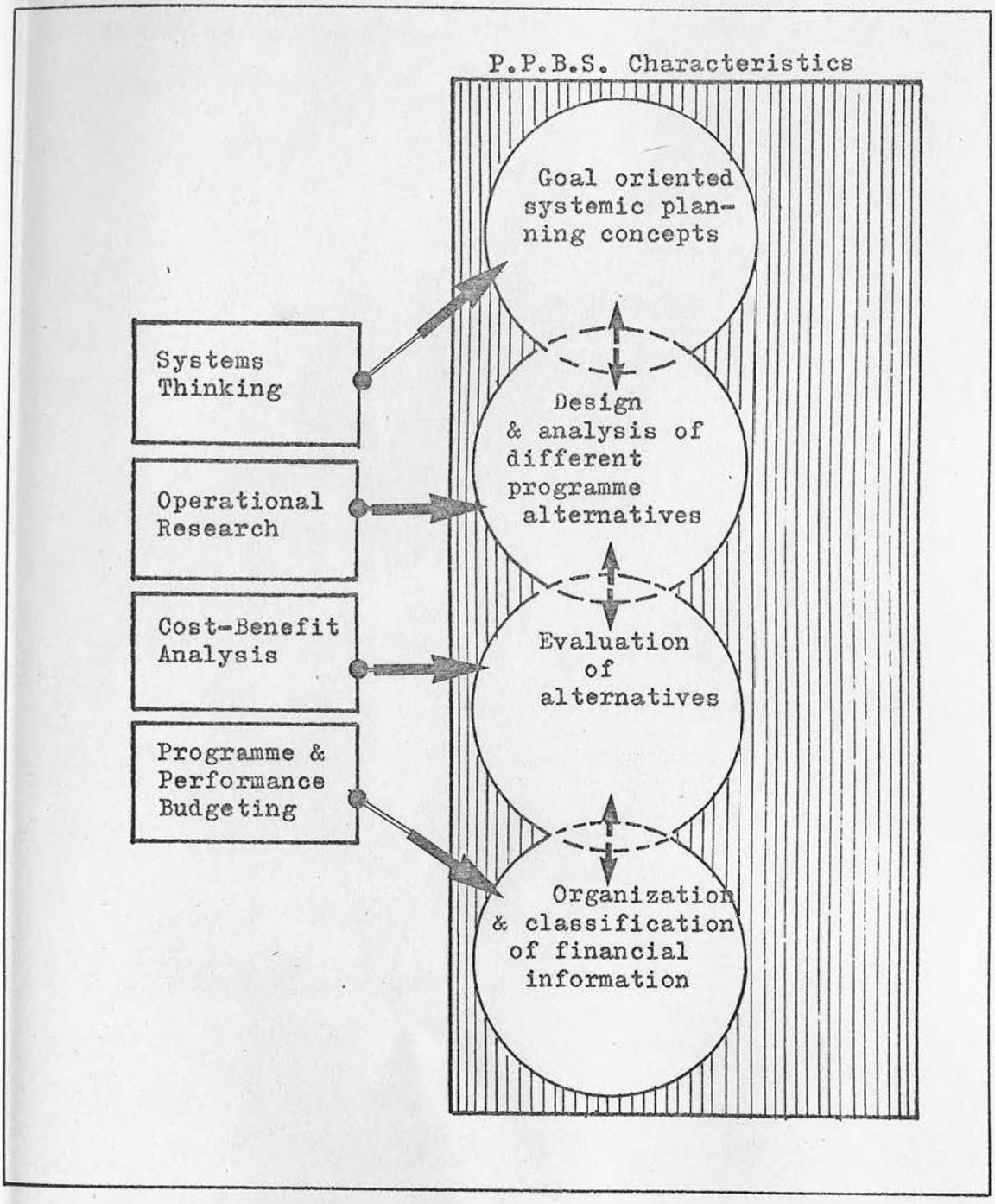
(1) We are aware of the fact that what we have studied in the first part of this work does not cover the whole field of the theory of systems. However, we must remember that the aim of this part of the work was to provide the conceptual basis for the understanding of P.P.B.S., and not to present a comprehensive survey of all the theories and methods involved with the idea of "systems".
(2) R. Ackoff, "A Concept of Corporate Planning", p.3.
(3) T. Eddison, op.cit. p.12.

Relationships between the subjects studied in the first part of this work and the concepts of Planning-Programming and Budgeting System.



Planning-Programming and Budgeting System (P.P.B.S.) uses the aforementioned method of approach, attempting to incorporate all the theories studied in the first part of this work within a single conceptual structure. The way in which this is done will be the subject of our next chapter. A first idea on the relationships between the theories studied hitherto and P.P.B.S. is shown in graph 5-1. What we mean with this graphic is that the theory of P.P.B.S is based on the theories studied so far, and consequently its validity is dependent on the validity of General System Theory, Cybernetics, etc. On this point we want to make two important considerations:

1. We have seen that there are many blank spaces of unresolved conceptual problems in almost all the theories explored hitherto. In our opinion, this is not a main difficulty, for - according to the idea of "process"(4) that rests behind the systems approach - all theory should be considered as perfectible. However, what we see as a main difficulty is that sometimes some concepts which have been drawn only as "operational assumptions"(5) are so attractive that they are accepted, generalised and used, regardless of the fact that the validity of the assumptions has not been proved, i.e. J. von Neuman and O. Morgenstern in their "Theory of Games" used the operational assumption that "satisfaction" can be measured in monetary (or equivalent) terms. They did not prove the point. However, we have seen that "Cost-Benefit

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(4) See Chapter 1 of this work.
(5) i.e. assumptions which have not been proved.

Analysis" techniques use the same concept when attempting to enumerate and evaluate all relevant costs and benefits of government works.(6) Moreover, because "Programme and Performance Budgeting" draws on "Cost-Benefit Analysis" concepts, it, too, accepts as a main concept the possibility of comparing in monetary terms the "satisfaction" derived from undertaking different government programmes.(7) Thus we observe that whole conceptual structures are built upon foundations which may not prove to be valid. Moreover, when these structures are presented with the dressing of very elegant mathematical formulations there has been some tendency to forget that the conceptual model used has to be correct for the technique to be useful.

The problem mentioned in this section, namely, the unthorough acceptance of basic concepts, has been pointed out by several students of the Systems Approach. For instance, in "Management Science" S. Beer(8) writes that:

> "no one would confuse the pharmaceutical chemist's dispensing of a prescription with the practice of medicine. Yet there is to-day a widespread attempt ... to use the powerful tools of the O.R. trade without undertaking the empirical science on which their application should alone be based."

In the same issue, B.Gross in his contribution to the 1969 P.P.B.S. "Symposium" argued that,

> " 'system', 'output', 'planning' and 'programming' have become 'fad words', used with a false sophistication that often masks narrow-minded naivete. In fact, there seems to be an unspoken 'gentleman's agreement' that basic terms need never be defined" (9)

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(6) See Chapter 3, section 5.2 of this work.
(7) See Chapter 4, section 4.4 of this work.
(8) S. Beer, op.cit. p.26.
(9) B. Gross, "The New Systems Budgeting" in P.A.R. Vol.XXIX No.2 March/April 1969, p.115.

It is obvious, the importance, for our study, of finding out whether or not this "gentleman's agreement" has been observed by the people who promoted P.P.B.S. An affirmative answer to that question will only mean that no substantial conceptual improvement has been introduced in the P.P.B.S. approach. If the answer is negative, then it will signify that the authors of P.P.B.S. have attempted to clarify many of the ambiguous concepts pointed out in the first part of this work.(10) We hope to know more about this issue after having studied the theory and practice of P.P.B.S. in the second part of this work.

2. The need for facts and measurement is well recognised in all the theories and methods studied so far. About this need, which we do not deny, it is important to make the following remark: Planning is about the future. It is anticipatory decision-making. To evaluate the impact of present actions in the future, Operational Research and Cost-Benefit Analysis techniques have been developed. These are tools designed to help the planner in the deduction, from present facts, of what will happen in the future.

Based on what we have studied hitherto, we could say that the above mentioned techniques are mainly based on the study of statistical possibilities, that is, in the study of "quantified chance."(11) The elements of "risk" and "uncertainty"(12) are

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(10) To define whether the society can be studied as an "open" or a "closed" system. See Chapter 5 section 4 of this work.
(11) See Chapter 3, section 5.3, of this work.
(12) See Chapter 3, section 5.3, of this work.

what the planner attempts to reduce through the use of the technical tools referred to above. However, as we have discussed in the sections concerned,(13) the planner is not yet in a condition to say that these elements have been eliminated from his calculations. That is, in the final analysis the planner can only guess. Moreover, we argue that the planner's guesses are based on his own particular experience, i.e. he would guess based on the facts he is familiar with. He would use what he thinks is useful. He would lay aside many other facts whose usefulness he cannot comprehend. In this process of selection, the planner's own particular background would play a very significant role.

Therefore, what we think is that in spite of the apparent objectivity of facts and figures, these are used in a process in which subjective elements play an important role.

Furthermore, we would have thought that not even facts and figures should be considered to be completely objective; for these have been collected, arranged, classified, interpreted, and published by people who are limited by their own particular experience. In that sense, we would say that cool facts and figures are biased by the personal background of the people who collected them all.

To illustrate our arguments, we will refer to chapter four of this work, in which the use of "Programme and Performance Budgeting" in developing countries has been discussed. In that

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(13) Ibid

chapter it was pointed out that, due to the influence of certain economic doctrines, the problem of the development of these countries has been mainly viewed as a problem of macro-economic development, i.e. "development" was (and still is) mainly related to certain variations in the annual figures shown in the national accounts, e.g. the change in the G.N.P. rate of growth.(14) Thus, in this case, a group of people with a particular background in macro-economics influenced so much the theory of development that only what was referred to their discipline was considered to be significant for the analysis of a problem, which, in our opinion, should be studied beyond the professional boundaries.

We do not say that macro-economic figures do not reveal certain aspects of the economy of the country concerned; we do not even discuss the fact that through the use of these figures certain aspects of the socio-political structure of the country can be derived. However, we do strongly believe that these figures cannot be used as a device to comprehend all aspects of the problem of development of the developing countries. This is what we mean when we refer to the existence of a "background bias" in the collection, processing and interpretation of facts and figures. It is not that these figures are inaccurate, but that their accuracy is conditioned by what the investigator is interested in finding. In this sense, we argue that these figures will reveal only very partial aspects of a problem, or,

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(14) See Chapter 4, section 5, of this work.

even worse, they will set "red herrings" which will confuse furthermore the issues involved.(15)

In summary:

The general conclusion of this part of the work is that despite the ingenuity of the technical and conceptual tools at his disposal, the planner is bound to make "educated" guesses on a considerable number of issues, such as: the validity of the concepts he uses; the accuracy of his methods of evaluation and projection of problems; the real meaning of the facts and figures he comes across; in general, he is guessing every time he makes a decision. The Systems Approach's answer to this situation is to view planning as a learning process carried out as an inter-disciplinary activity. "What is required", says T.Eddison, " is a process of planning which seeks to set in motion a decision-making machinery affecting the future based on changing information about both present and future."(16)

With this last consideration, the scene is set for P.P.B.S., which attempts "to weave into its conceptual fabric"(17) the different theories and methods sketched in the foregoing pages. What follows is an appraisal of this attempt.

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(15) On this issue, see G. Mirdal, "The Challenge of World Poverty", p.266. "In the field of production and income this uncritical attitude has made it possible to 'measure' and compare the rate of development of individual underdeveloped countries from year to year down to a fraction of a per cent. Such accuracy is unwarranted. It is not less when these figures are dressed in impressive looking econometric models. The models represent loose thinking presented as particularly rigorous analyses."
(16) T. Eddison, op.cit. p.13.
(17) A. Williams, op.cit. p.8.

CHAPTER 6

NATURE AND PURPOSE OF P.P.B.S.

1. Introduction.

2. The Problem of Defining the new System.

3. Description of P.P.B.S.

4. "Programme Structure".
   - 4.1 Definition and Design Principles
   - 4.2 Analysis of Programmes
     - 4.2.1 Basic Ideas
     - 4.2.2 Level of Analysis
     - 4.2.3 Goals, Objectives and Criteria for Evaluation.
     - 4.2.4 Review and Feed-Back

5. The "Programme Memoranda" and the "Programme and Financial Plan"
   - 5.1 "Programme Memoranda"
   - 5.2 "Programme and Financial Plan"

6. Conclusions.

## CHAPTER 6: NATURE AND PURPOSE OF P.P.B.S.

### 1. Introduction

Planning-Programme and Budgeting System was first introduced in the U.S. (Department of Defense) in 1961.(1) Its objective was "to consider the 'worth' of a weapon system as a whole, and to relate longer-range planning to Annual Budget". The groundwork for this work was developed essentially by D. Novick of the Rand Corporation in a book called "Efficiency and Economy in Government through New Budgeting Process".(2) This book is a systematic exposition on how the new system of "Programme and Performance Budget" (introduced by the Hoover Commission)(3) could be applied effectively to military spending. This first study was followed by the work of Hitch and McKean, "The Economics of Defense in the Nuclear Age"(4), and D. Novick "New Tools for Planners and Programmes".

In 1963, P.P.B.S. was fully applied in the Department of Defense of the U.S.A., and its application to civilian affairs was recommended. In A. Wildavsky's opinion the latter step was too hasty.(5)

> "We would be in a much stronger position to predict the consequences of program budgeting if we knew (a) how far toward a genuine program budget the Defense Department has gone, and (b) whether the program budget has fulfilled its promise. To the best of my knowledge, not a single study of this important experiement was undertaken (or at least published) before the decision was made to spread it around the land."

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(1) D. Novick, "Program Budgeting", p.xxi, brings to our attention the fact that the U.S.Army in 1941 used a primitive P.P.B.S. known as "Production Requirements Plan".
(2) Quoted by D. Novick in Ibid. p.xxv.
(3) Studied in chapter four of the present work.
(4) Quoted by D. Novick in op.cit. p.xxv.
(5) A. Wildavsky, "The Political Economy of Efficiency: Cost-Benefit Analysis, Systems Analysis and Program Budgeting" in"P.P.B. - A Systems Approach to Management", ed.F.Lyden and E.Miller, p.391.

In 1965, the former President of the U.S.A., L.B. Johnson, introduced the new system to the Federal Government, labelling it as"a new and revolutionary system which... will help us to find new ways to do jobs faster, to do jobs better, and to do jobs less expensively... It will make our decision-making process as up to date, I think, as our space-exploring programs".(6)

This enthusiastic presentation of P.P.B.S. was followed by different arguments in favour or against the new system. About this point, let us quote C.Schultze:(7)

> "Much has been published on P.P.B. Learned articles have treated it sometimes as the greatest thing since the invention of the wheel. Other articles attack it, either as a naive attempt to quantify and computerize the impossible, or as an arrogant effort on the part of latter-day technocrats to usurp the decision-making function in political democracy."

C. Schultze's opinion is that:

> "P.P.B. is neither. It is a means of helping responsible officials to make decisions. It is not a mechanical substitute for the good judgment, political wisdom and leadership of those officials."

Whether this opinion is accurate or not is the whole point of our work, and we hope that at the end of it we will have more clear ideas about the issue.

However, we should mention that since 1965 P.P.B.S. has been in the focus of attention of planners not only in the U.S.A. but throughout the world. The system has been introduced in Canada(8)

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(6) D. Novick, op.cit. p.xix.
(7) C. Schultze, "Why Benefit-Cost Analysis" in "Program budgeting and Benefit-Cost Analysis", ed.by H.Hinrichs and G.Taylor, p.1.
(8) A. Johnson, "P.P.B. in Canada", article in Public Administration Review, January/February, 1973, pp.23 to 31.

Japan,[9] Norway,[10] Israel,[11] France[12] the U.K.[13], etc. Moreover, there are some papers on the use of P.P.B.S. in the so-called developing countries.[14]

Being a synthesis of very controversial ideas (Cost-Benefit Analysis; Systems Thinking, Systems Analysis; Programme and Performance Budgeting) - the P.P.B.S. has become a still more controversial subject, to such an extreme that although applying the P.P.B.S. framework, people tend to avoid the name itself.

> "Whatever the new system was to be it would better not be called P.P.B.S. The perception of P.P.B.S. in some key quarters includes informal knowledge of some of its failures, and ranges all the way to heel-digging resistance to any change in the budget process whatsoever." (15)

In the rest of this chapter we will describe the basic P.P.B.S. framework as first presented in the U.S.A. This will provide a basis for further analysis of this system.

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(9) M. Ohkawa, "P.P.B.S. in Japan", in "Public Finance", Vol.XXVII No.2, 1972, pp.212 to 217.

(10) O. Saetersdal, "Norwegian Experiences in the Application of New Budgetary Methods", Ibid. pp.217 to 222.

(11) D.Wainshal, "Planning and Budgeting in Israel", in Ibid, pp. 196 to 205.

(12) P. Huet, "Contribution a L'etude de relation entre l'analyse cout - Advantages et le budget de programmes" in Ibid, pp.110 to 123.

(13) See W. Hirsch, "Program Budgeting in U.K.", in Public Administration Review, March/April 1973, pp.120 to 127.

(14) See, for example, I. Galnoor and B. Grosse: "The New Systems Budgeting and the Developing Nations", in International Social Sciences Journal, Vol.21 - No.1,1969.

(15) T. Eddison, "Local Government: Management and Corporate Planning", p.190.

## 2. The Problem of defining the new system

The task of defining P.P.B.S. is very complicated, simply because P.P.B.S. seems to mean different things to different people; i.e, there are different definitions of the subject. We have broadly gathered these definitions into the following groups.

### 2.1 Very general definitions of P.P.B.S.

(a) "P.P.B.S. is a system for assisting choice related to the use of resources. It does not make choices. It does not even reduce decision to the selection of one clearly correct course of action. Quite the contrary, it has the built-in objective of expanding available alternatives. It does, however, have the faculty of making the ingredients of choice and the probable consequences of alternatives extraordinarily clear. Central to this process of illuminating choice is the necessity of a program budget." (16)

### 2.2 Cost- Benefit oriented definitions

(a) "The essence of the new system (P.P.B.S.) is more explicit and logically organized information on effects (direct and indirect benefits or disbenefits) of specific programmes likely to result from certain types, quantities and qualities of outputs and activities (tangible or intangible), made possible by the use of inputs whose costs are realistically estimated". (17)

(b) "P.P.B.S. is a formal procedure by which alternative ways of achieving objectives are listed, costed, and compared for efficiency.". (18)

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(16) C. Wright, "The Concept of a Program Budget", in H.Hinrichs and G.Taylor, op.cit. p.23.

(17) I. Galnoor and B.Gross, op.cit. p.30.

(18) G.Chadwick, op.cit. p.380.

2.3 Definitions with emphasis on "systems" concepts

(a) "P.P.B.S. is an approach to mission-oriented, purpose goal oriented management". (19)

(b) "P.P.B.S. is the process by which objectives and resources, and the interrelationship among them, are taken into account to achieve a coherent and comprehensive program of action for the government or agency as a whole."(20)

2.4 Definitions in which the tools of Operational Research are included

(a) "P.P.B.S. is a term now commonly used to describe a family of budgetary techniques which includes accountable management, management by objectives, output budgeting, cost-benefit analysis, linear programming and econometric modelling... Vital to the concept of P.P.B.S. is the setting of objectives and the development of plans by which they can be achieved with the minimum use of resources." (21)

2.5 Budget oriented definitions

(a) "P.P.B.S. is the first budget system designed to accommodate the multiple functions of budgeting." (22)

2.6 Definitions in which P.P.B.S. is described as a "way of thinking" (rather than a particular technique)

(a) "P.P.B.S. is essentially an approach to decision-making. It is not a technique but a way of presenting information in a systematic way so as to expose policy choices, making as explicit as possible the costs and consequences of these choices." (23)

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(19) Murray Weidenbaum, "Program Budgeting - Applying Economic Analysis to government expenditure decisions", in F. Lyden and E. Miller, ed. op.cit. p.172.
(20) A. Smithies, "Conceptual framework for the Program Budget", in "Program Budgeting", ed. by D. Novack, op.cit. p.24.
(21) Ann Robinson, "Prosepcts for P.P.B.S. Some Macro-Political Variables examined for U.S.A., Canada and Britain", in PAC Bulletin No.12, June 1972, p.2.
(22) Allen Schick, "The Road to PPB: The Stages of Budget Reform", in F. Lyden and E. Miller, ed. op.cit. p.27.
(23) T. Eddison, op.cit. p.43.

(b) "Output budgeting is in fact a general approach rather than a particular technique. Its specific contribution is to bring together the objectives of a particular service and resource being devoted to them, and to provide a framework within which the costs and advantages of possible policy choices are examined side by side. An output budgeting system is a policy tool, and as such is naturally concerned mainly with future expenditure." (24)

(c) "P.P.B.S. is one of the more recent attempts to achieve a more systematic and rational approach to decision making in respect to Government programs. It undertakes to assess costs of achieving objectives against the benefits to be expected therefrom, and in this way makes possible a more intelligent use of resources by the public sector." (25)

(d) "Despite its elaborate terminology, P.P.B.S. seems to me a simply commonsense approach to decision making." (26)

2.7

In our opinion, the existence of different definitions of P.P.B.S. is the consequence of its multi-disciplinary nature. Each individual writer concerned attempts to define the new system with concepts and ideas from his own discipline.

However, because there is not a clear understanding of the potentials and limitations of the use of P.P.B.S., each one of the writers expresses in his definition not only what he knows about P.P.B.S., but also what he hopes the new system will be able to do.

In this situation, we have chosen to keep the issue open, i.e. after having studied more about the structure and application of P.P.B.S. This will be done in the following sections.

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(24) In many British books P.P.B.S. is presented as Output Budgeting, as in: Department of Education and Science, "Output Budgeting for the Department of Education and Science", p.3.

(25) The Sub-Committee on Economy in Government of the Joint Economic Committee, Congress of the U.S., "The P.P.B.S. - progress and potential", in H.Hinrichs and G.Taylor, op.cit. p.372.

(26) A.Rivlin, "Systematic thinking for social action", p.3.

## 3. Description of P.P.B.S.

When P.P.B.S. was introduced to the U.S. government agencies in 1965, the U.S. Bureau of the Budget issued some "bulletins" containing instructions for the establishment of the new system. Two of the most important of these "bulletins" are No.66-3 and No.68-2.(27) As a first stage in our work, we will describe the new system as it is done in these "bulletins". This will serve two purposes:

(a) A general idea of P.P.B.S. - as first used in the U.S.A. - will be provided.

(b) A platform for a discussion of the most important P.P.B.S. concepts will be established.

### 3.1 Bulletin No.66-3

P.P.B.S. is introduced in this bulletin in the following way.

3.1.1 The new P.P.B.S. is based on three concepts:(28)

(a) The existence in each agency of an "Analytic" capability which carries out continuing-in-depth analyses by permanent specialized staffs of the agency's objectives and its various programmes to meet these objectives.

(b) The existence of a multi-year "Planning and Programming" process which incorporates and uses an information system to present data in meaningful categories to the making of major decisions by "agency heads" and by "the President".

(c) The existence of a budgeting process which can take broad programme decisions, translate them into more refined decisions in a budget context, and present the appropriate programme and financial data for Presidential and Congressional action.

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(27) Executive Office of the President, "Bureau of the Budget", Bulletin 66-3 (Oct.12, 1965): Bulletin 66-3 (Feb.21, 1966) Bulletin 68-2 (July 18,1967). Reproduced in F. Lyden and E. Miller, "P.P.B., a Systems Approach to Management".

(28) Ibid, p.406.

3.1.2 Essential to the system are:(29)

(a) An out-put oriented (this term is used interchangeably with mission oriented or objective oriented) Programme Structure (sometimes also called a Programme Format) which presents data on all the operations and activities of the agency's end purposes or objectives.

(b) Analyses of possible alternative objectives of the agency and of alternative programmes for meeting these objectives. Many different techniques of analysis will be appropriate, but central should be the carrying out of broad system analyses in which alternative programmes will be compared with respect to both their costs and their objectives.

(c) Adherence to a time cycle within which well considered information and recommendations will be produced at the times needed for decision-making and for the development of the President's budget and legislative programme.

(d) Acceptance by line officials (from operating levels up to the agency head) with appropriate staff support, of responsibility for the establishment and effective use of the system.

3.1.3 The products of the system will include:(30)

(a) A comprehensive multi-year "Programme and Financial Plan" systematically updated.

(b) Analyses, including Programme Memoranda, prepared annually and used in the budget preview, special studies in depth from time to time, and other information which will contribute to the annual budget process.

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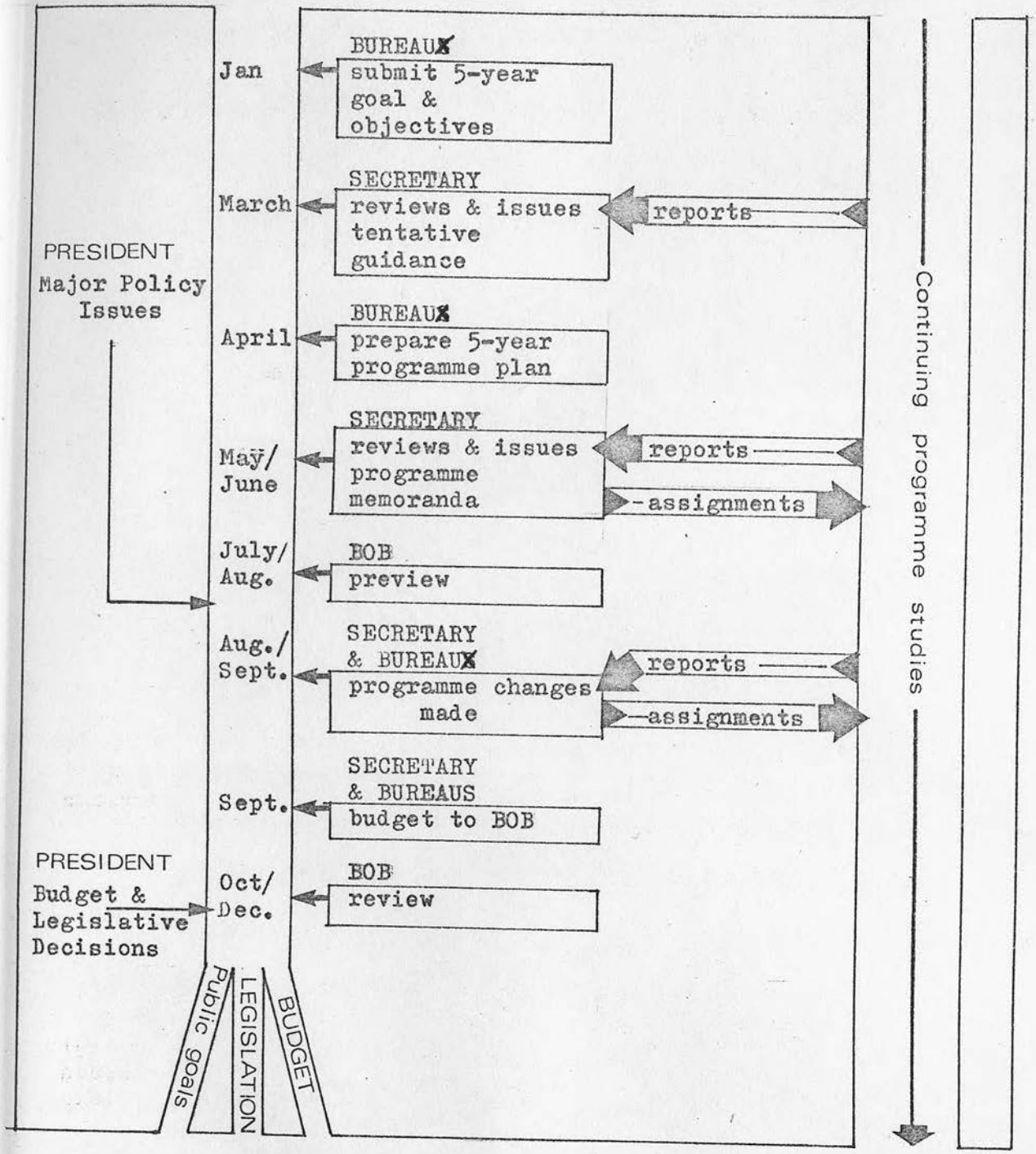
(29) Ibid, p.407.

(30) Ibid.

The Federal Budget Annual Cycle




BOB = Bureau of the Budget

From: M. Weidenbaum, "Program Budgeting Applying Economic Analysis to Government Expenditure Decisions", in F. Lyden and E. Miller (eds), op. cit. p.169

U.S.A. P.P.B.S. CYCLE 6-1

3.2 Bulletin 68-2 (31)

This bulletin is important because it describes the basic documents to be used in P.P.B.S. These documents are:

(a) Programme Memoranda (PM) which succinctly presents the agency head's major programmes recommendations to the President within a framework of agency objectives, identifying the alternatives considered and supporting the decision taken on the basis of their contribution to the achievement of these objectives.

(b) A comprehensive multi-year "Programme and Financial Plan"(PFP) which is periodically updated and presents in tabular form a complete and authoritative summary of agency programmes in terms of their outputs and costs.

(c) Special Analytic Studies (SAS) which provide the analytic groundwork for decisions reported in Programme Memoranda.

(d) The Programme Memoranda and the Programme and Financial Plan are organised around a Programme Structure which groups the activities of an agency into a set of programme categories which will facilitate analytic comparisons of the "costs" and "effectiveness" of alternative programmes.

3.3. Summary and Conclusion

From the study of the information provided by the above mentioned "bulletins", some basic ideas about P.P.B.S. can be drawn. We will present these ideas in the following way:

3.3.1 P.P.B.S.is based on the assumption that:(32)

(a) Decisions are likely to be better if we know what it is we are trying to achieve.

(b) Decisions are likely to be better if information is available about how resources are being deployed as between objectives rather than between a department or committee responsible for implementation.

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(31) Ibid p.408.

(32) T. Eddison, op.cit. p.35.

(c) Decisions are likely to be better if effectiveness of current programmes, policies and projects is evaluated.

(d) Decisions are likely to be better if alternative ways of achieving an objective are considered and analysed.

3.3.2 By and large, five steps are basically identified in the P.P.B. process:

(a) To identify goals.
(b) To relate goals to specific programmes.
(c) To relate programmes to resource requirements.
(d) To relate resources to budget.
(e) To measure the impact of the implementation of programmes.

3.3.3 The above information is presented in three basic documents:

(a) Programme Memoranda (PM): Summary of agency plans.

(b) Multi-year Programme and Financial Plan (PFP): Summary of agency programmes in form of outputs and costs.

(c) Special analytic studies (SAS): Analytic groundwork for the decisions reflected in the former documents.

All these documents (and consequently most of the P.P.B.S. process) are referred to the issues involved with the design, organization, functioning, analysis, and evaluation of the so called Programme Structure, which appears to be a very important element in the whole conceptual structure of P.P.B.S. For this reason, we are going to continue this chapter with the study of the meaning of the Programme Structure concept.(33)

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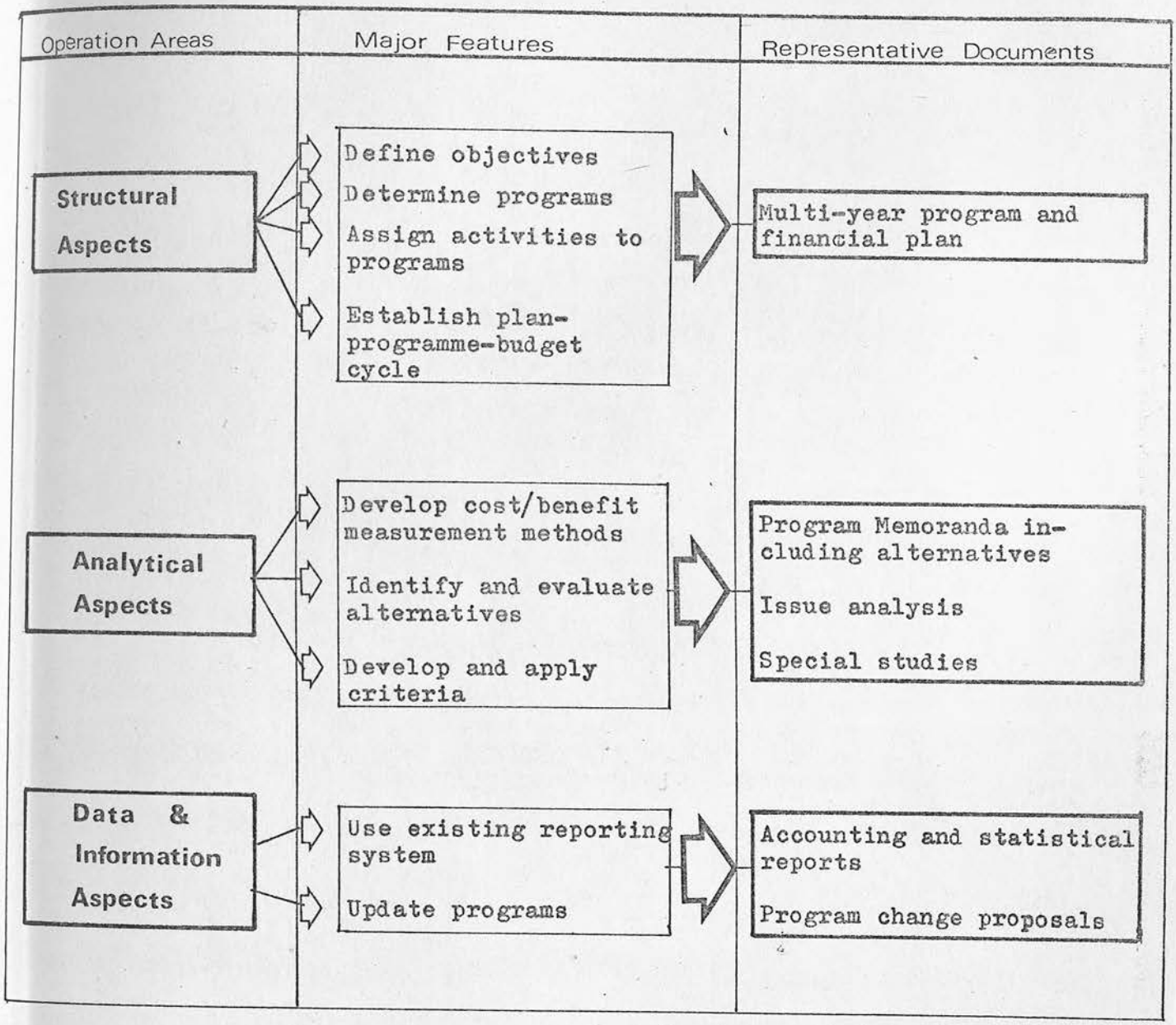
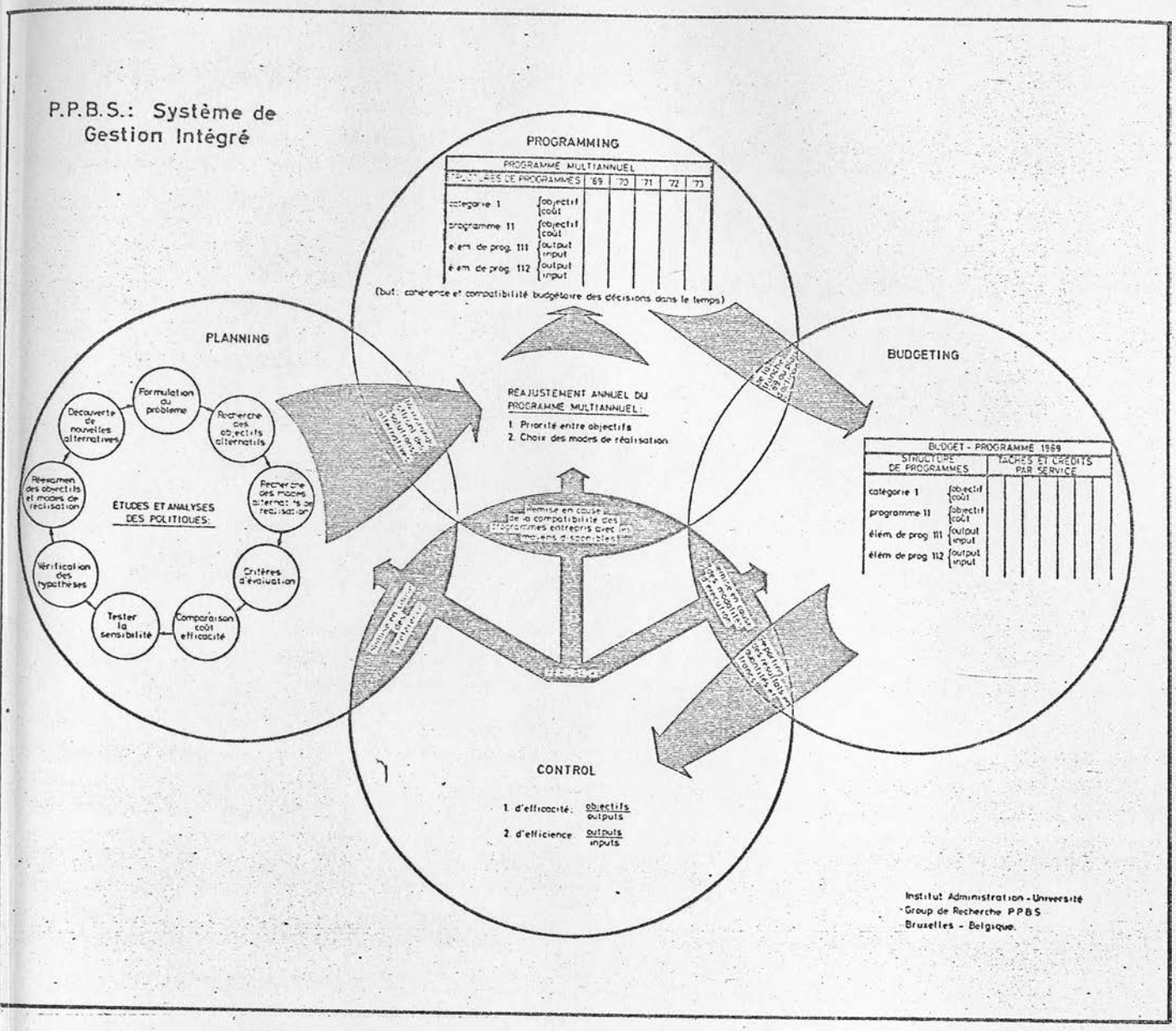
(33) These documents are referred to the American P.P.B.S. In other countries, other types of documents are used. See, for instance, "The P.P.B.S. of Liverpool Corporation", in chapter eight of this work.




Based on a sketch of Program Budgeting provided by D.Novick "What Program Budgeting Is and Is Not", in D. Novick (ed), "Current Practice in Program Budgeting (PPBS)", p.11




Source : L. Morissens, "Problèmes de coordination entre l'analyse coûts-advantages et la programation budgétary". Public Finance, Vol. 27, No. 2, 1972. p.126

## 4. The Programme Structure

### 4.1 Definition and Design Principles

General System Theory and Cybernetics Theory point out the existence of a structure of relationships among the several components of a system.(34) Based on this basic concept, Programme and Performance Budgeting proposes to organise government activities by "grouping work operations according to the way they contribute to the end product produced by government organisations".(35) The same basic idea is once again used in the P.P.B.S. Programme Structure concept. Programme Structure is defined as:

> "a hierarchical way of arranging 'goals', 'objectives', sub-objectives, and 'activities' which gives expression to what a government authority sees as its current needs and problems and the variety of choices open to it to meet these needs." (36)

The aim of a Programme Structure is to "relate 'activities' to 'goals' and 'objectives' regardless of the pattern of departmental and committee responsibilities within the authority".(37) According to the Department of Education and Science of the U.K.(38) the design of a Programme Structure comprehends the following steps:

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(34) See chapter one, section 2.2.4 of this work.

(35) See chapter four, section 4.2 of this work.

(36) T.Eddison, op.cit. p.44.

(37) Ibid.

(38) Department of Education and Science, "Output Budgeting for the Department of Education and Science", p.5.

(a) The first step is a general survey of the areas of activities and the identification of the relevant objectives. These objectives should, as far as possible, be ends and not means, e.g. health and not "cancer research". (39)

(b) The next step is the analysis of the existing activities of government, local authority, etc., in order to identify their contribution to the various objectives.

(c) A hierarchy of programmes can then be defined.

In Bulletin No.68-2[40] programmes are organised hierarchically along the following lines:

(a) Programme Categories: Groupings of agency programmes (or activities, or operations) which serve the same broad objective or which have generally similar objectives. Succinct captions or headings describing the objective should be applied to each grouping.

(b) Programme Sub-Categories: These are subdivisions which should be established within each programme category, combining agency programmes (or activities, or operations) on the basis of narrower objectives contributing directly to the broad objectives for the Programme Category as a whole.

(c) Programme Elements: These are usually sub-divisions of Programme Sub-Categories and comprise the specific products (i.e. the goods and services) that contribute to the agency's objectives. Each Programme Element is an integrated activity which combines personnel, other services, equipment and facilities.

The above mentioned Programme Elements would have the following

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(39) There is no unique approach to the identification of objectives. However, two chief considerations should guide the way in which they are stated:
(a) They should be meaningful in terms of policy purposes, i.e. they should be drawn up in a way which makes policy options clear.
(b) They should regard what is practicable in terms of the allocation of inputs and the assessment of outputs. From Ibid.

(40) Bulletin 68-2 Bureau of the Budget, in F. Lyden and E. Miller, op.cit. p.408.

specific characteristics:

(a) They should produce clearly definable outputs, which are quantified wherever possible.

(b) Wherever feasible, the output of a Programme Element should be an agency end product - not an intermediate product that supports another element.

(c) The inputs of a Programme Element should vary with changes in the level of outputs, but not necessarily proportionally.

In other words, the Programme Element is the "Black Box" of P.P.B.S.(40[1]). An example of this type of classification is provided in graph 6-4.

According to the Institute of Municipal Treasurers and Accountants(41), a good Programme Structure must fulfil the following conditions:

(a) Clear statement of objectives, free from ambiguity.

(b) Opportunity of choice between alternative means whereby the purpose of an immediate superior level may be observed.

(c) The avoidance where possible of gaps and overlaps between and within objectives/programmes.

(d) The expression of programmes and activities in terms of assessable output and impact wherever possible, in order to monitor the efficiency and effectiveness of each alternative.

(e) The lowest level in a structure being that below which output, effectiveness or costs cease to be significant to authority.

There is a considerable number of problems in the design of a Programme Structure; goals are not always clear; or organizations would have more than one goal; goals can be divided into different numbers of objectives; or into different kinds

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(40[1]) See Chapter one section 3.3 of this work.

(41) T. Eddison, op.cit. p.44.

of objectives; it would not always be easy to differentiate means from ends; etc. A good comment about these problems is provided by G. Taylor:(42)

> "Reasonable men of good judgement can be expected to hold legitimate differences of opinion on the optimal design. Rather than indulge in interminable philosophic discussions about the proper dimensional classification of sub-categories, or the choice of sub-categories to which a particular program element belongs, the design team's efforts should be directed towards achieving a logical and reasonably consistent whole."

In other words, the idea of process should guide the design of the Programme Structure. By having a basic Programme Structure it will be possible to analyse information in a more meaningful way and in this process the structure of programs should be modified according to the additional information.

Moreover, G.Taylor insists on the need of using the Programme Structure "analytically". He thinks that "the mere act of recasting an agency's budget in Programme Structure terms has not intrinsic virtue." The virtue is in the use of the Programme Structure as "an orderly array to trigger systematic thinking about planning". (43) Thus, this idea leads us to the next issue of this chapter: the analysis of programmes within the P.P.B.S. framework.

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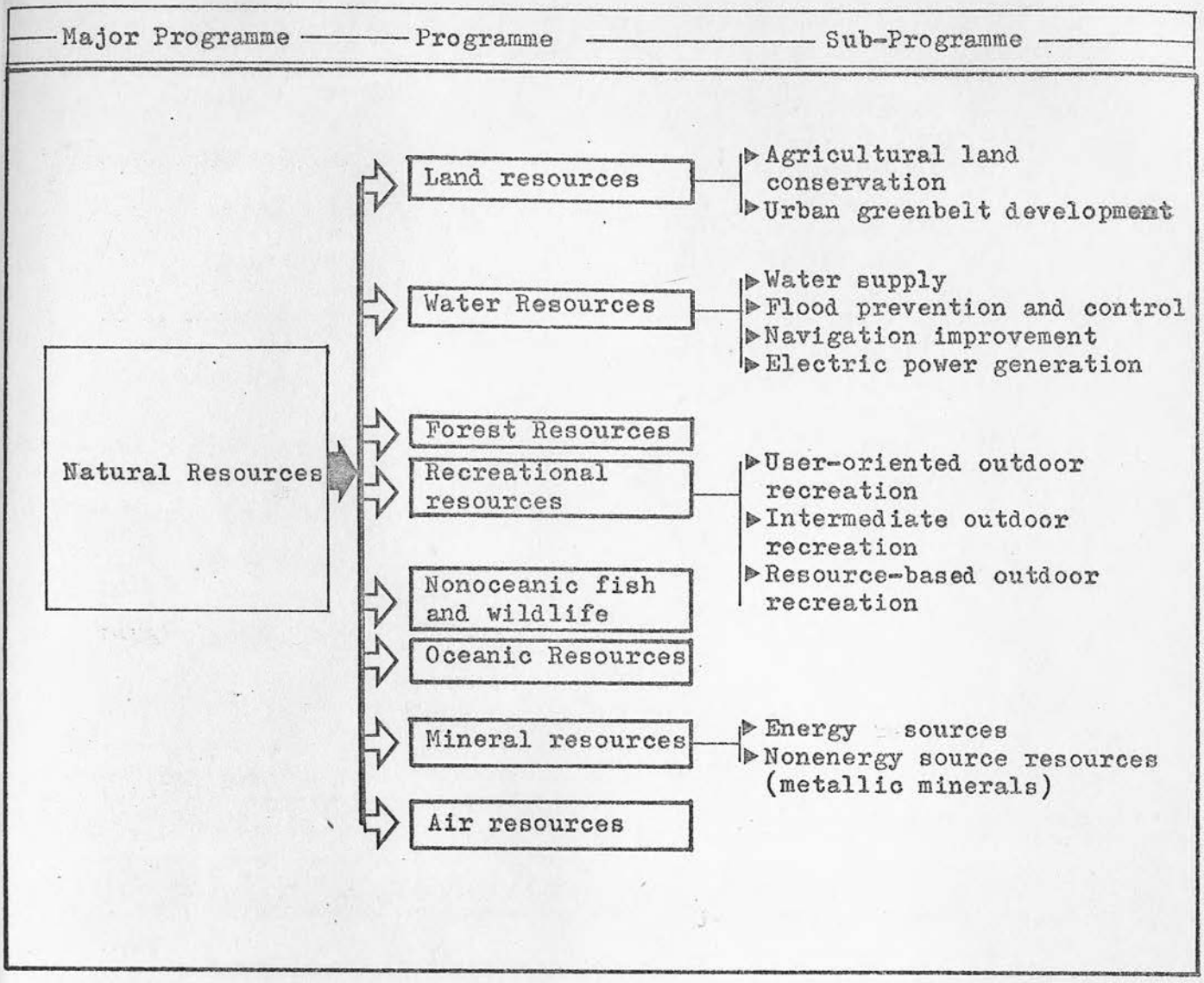
(42) G. Taylor, "Designing the Programme Structure", in H. Hinrichs and G. Taylor (eds.), "Programme Budgeting and Benefit-Cost Analysis", p.44.

(43) Ibid, p.45.




Suggested Federal Natural Resources Activities Programme, from, W. Hirsch, "Program Budget for Natural Resources Activities", in D. Novick (ed), "Program Budgeting", p. 263

example
PROGRAMME STRUCTURE 6-4

## 4.2 Analysis of Programmes

In the last section we advanced the idea that the organization of government activities into a structure of programmes will only be meaningful when these programmes are constantly analysed. The corollary of the above enunciation should be that: systematic analysis of government activities is the condition "sine qua non" of P.P.B.S.

In this section we will attempt to present the basic ideas, the problems and the possibilities concerned with this activity.

### 4.2.1 Basic ideas

> "Probably the most important component of the P.P.B. System, the most difficult to initiate, and the most difficult to gain acceptance of in the government, is systematic analysis of government programmes." (44)

It is in this stage of the P.P.B.S. process that the theories and techniques described as "System Thinking" (chapter one), "Operational Research Methods"(chapter two), and"Cost-Benefit Analysis Principles"(chapter three) are meant to be used for the systematic analysis of programmes to be included in the Multiyear Plan.

In brief, it could be said that programmes are analysed to establish:(45)

(a) What a department is aiming to achieve - what its objectives are - in the areas of policy for which it is responsible;

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(44) J. Haldi, "The Role of Analysis", in Ibid p.151.
(45) Department of Education and Science, op.cit. p.3.

(b) Which activities are contributing to these objectives;
(c) What resources, or inputs, are being devoted to these activities;
(d) What is actually being achieved, or what the output is;
(e) What type of adjustments should be included in the future.

In the conclusion of the first part of this work[46], the idea was introduced that, by and large, the general approach followed for the analysis of systems comprehended:

(a) Determination of objectives to be met.
(b) Formulation of alternatives to reach these objectives.
(c) Choice of a preferred alternative based on some evaluation criteria.
(d) Continuous assessment of actual performance of preferred alternative.

In the jargon of P.P.B.S. the above mentioned approach is described in the following way:

P.P.B.S. proceeds by:[47]

(a) Breaking down broad programmes (health, education,etc.) into detailed sub-programmes.
(b) Devising methods of measuring the level of output of the sub-programmes, and of evaluating the resources required to provide this output.
(c) Clarifying the objectives laid down by the policy-makers in respect to the broad programmes, and possible sub-programmes.
(d) Finding the least-cost ways of meeting these objectives.
(e) Clarifying the opportunity costs[48] of these objectives and thus in turn helping to formulate future policy objectives.

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(46) See chapter five of this work.
(47) G. Bannock et al, "The Penguin Dictionary of Economics", p.332.
(48) About the concept of "opportunity cost". The principle of opportunity cost involves asking what is actually foregone by choosing a particular alternative. This concept is preferred by economists, because it leads to a more rational process of decision-making against which the returns from an alternative are compared to the real cost involved in undertaking it. From Ibid p.88.

This approach is presented in different forms by the different students of the P.P.B.S. process, but the pattern is basically the same. Moreover, as we discussed in the first part of this work, there are not any "cooking recipes" which can be used indiscriminately for the analyses of all types of planning problems. About this point A. Wildavsky writes:(49)

> "The good systems analyst is a... 'wise man', with overtones of a 'wise guy'. His forte is creativity.. Since no one knows how to teach creativity, daring and nerve, it is not surprising that no one can define what systems analysis is or how it should be practised.

E.S. Quade says:(49[1])

> "It is still largely a form of art".... in which it is not possible to lay down "fixed rules which need only be followed with exactness." He examined systems studies to determine ideas and principles common to the good ones, but discovered that "no universally accepted set of ideas exists. It is even difficult to decide which studies should be called good."

At the present moment, there are in existence some works on the application of the systems analysis ideas to the physical planning process.(50) Their basic concepts have been presented in the first part of this work.(51) Therefore, in this section the discussion will be aimed specifically to the problems and possibilities of systems analysis within the P.P.B.S. framework.

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(49) A. Wildavsky, "The Political Economy of Efficiency", in Ibid p.380

(49[1]) E.S.Quade is the compiler of the Rand Corporation lectures on Systems Analysis. He published them in the book "Analysis for Military Decisions". Quoted by A. Wildavsky in Ibid.

(50) For example: I. Robinson (ed), "Decision-Making in Urban Planning - An Introduction to New Methodologies", A.Catanese and A. Steiss "Systemic Planning: Theory and Application"; J.B. McLoughlin, "Urban and Regional Planning: A Systems Approach"; and especially G. Chadwick, "A Systems View of Planning".

(51) Chapters one, two and three of this work.

4.2.2 Level of Analysis

On the subject of systematic analysis, one of the most important arguments is referred to the level of analysis to which a given job should be carried out, i.e. to decide upon the extent to which quantitative elements are to be used for purposes of analysis. J. Haldy argues that the word "analyse" does not have the same meaning as the word "quantity" or "measure", "although analysis often includes measure".(52)

We have already seen, however, that no universal agreement exists on the subject.(53) Writing about this problem, H. Hatry(54) distinguishes two levels of analysis: the "less rigorous" and the "in-depth".

(a) The less rigorous analysis:

> The emphasis lies on the dialogue - the questioning and response - among the decision makers, the proposal makers and the programme analysts. In fact, "much of the relevant analytical work done so far in Government PPB systems has resulted not from very sophisticated, technical analyses, but from penetrating questioning and the improved perspective obtained on the issues by applying this level of analysis". (55)

(b) The in-depth analysis:

> When the studies draw upon the tolls of the professional disciplines, including mathematics, economics, operational research, engineering, computer sciences, etc. The aim is to identify to the extent possible, the cost and benefit implications of the range of feasible alternative.(56)

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(52) J. Haldy, op.cit. p.151.
(53) See section 4.1 of this chapter.
(54) H. Hatry, "Criteria for Evaluation in Planning State and Local Programs", in H. Hinrichs and G. Taylor(eds) op.cit. 97.
(55) Ibid.
(56) Ibid.

In our opinion, the above mentioned levels of analysis are not mutually exclusive but complementary. We base this opinion on our own understanding of the limitations of the Cost-Benefit Analysis methods. In chapter three, we reached the conclusion that this method can seldom provide a complete answer to problems of public policy decision-making,(57) but that this information can be useful to sharpen the judgement of the decision-makers. In consequence, a process of questioning and response could be worthwhile as the melting pot in which different kinds of information are brought to the discussion, to: question the objectives, consider the alternatives, and gauge the necessary efforts for the implementation of plans. This is not an easy process and probably most of the criticisms to the process of analysis in P.P.B.S.(58) are the result of an uneven use of either level of analysis.

4.2.3 Goals, objectives and criteria for evaluation

The theoretical antecedents for the concept of goal/objective formulation can be found in the discussions about: Systems Thinking (chapter one)(59); Operational Research (chapter two;(60) and Cost-Benefit Analysis (chapter three).(61)

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(57) See section 8 in chapter three of this work.
(58) See chapter nine of this work.
(59) Chapter one of this work, in special section 2.5: "systems" principles.
(60) Chapter two of this work, in special section 4, "The Mechanics of Operational Research", and section 4.4, "The Theory of Games".
(61) Chapter three of this work, in special section 5.1, "Enumeration of Costs and Benefits", and section 5.2, "The Valuation of Costs and Benefits".

Although some authors use the terms: goals, aims, purpose, objective mission or function, indiscriminately, we will adopt the terminology most currently used in Britain, in which -

Goals - are "that which one wishes to obtain"(62).

> ... "they are ideals over a horizon which will never be attained, since progress towards them over time implies their reformulation in yet higher ideals". (63)

Objectives - are seen as "specific steps towards the attainment of a goal, and thus although an end it intself, also as a means of achieving a more distant goal". (64)

It has been said that the purpose of the process of analysis in P.P.B.S. is "to derive goals and objectives from needs existing and perceived in the community, and then to decide how to deploy limited resources to meet those objectives most effectively." (65)

Thus, goal and objective formulation assumes a very important role in P.P.B.S., because -

> "If the purpose of a programme cannot be identified clearly, alternatives to achieve that purpose cannot be formulated. Likewise, performance cannot be measured unless a standard for measurement exists."(66)

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(62) R. Bigwood, "Goal Formulation", discussion paper presented to the students of the Department of Urban Design and Regional Planning, Edinburgh University, p.1.
(63) T.Eddison, op.cit. p.26.
(64) Ibid.
(65) Ibid.
(66) H. Hovey, "The Planning-Programming-Budgeting Approach to Government Decision-Making", p.17.

From the above discussion we could say that to identify needs and to set community goals and objectives certain standards for comparison will be required. In the P.P.B.S. literature these standards are known as "evaluation criteria".(67)

About the use of this new element, let us quote H. Hatry:

> "The need for evaluation criteria arises because funds and physical resources are scarce; there are not enough available to satisfy all needs and proposals.. Thus the problem of choice arises, and evaluation of proposals is needed to make the best use of available resources. To perform this evaluation, it is necessary to identify specific criteria that can be used to evaluate performance against the government objectives... The selection of criteria depends upon the objectives that are formulated. Also the process of selecting the criteria will often suggest the need for the revision of objectives. Thus the establishment of objectives and criteria are interacting processes.."(68)

For illustration purposes, we have included in this chapter an appendix containing examples on how "goals", "objectives", and "evaluation criteria" are related.(69)

In P.P.B.S. the evaluation process it not only concerned with the measurement of the effectiveness of ongoing programmes (as in the above discussion) but also with the probing of issues in which different alternatives are considered, e.g. the decision to commence a new programme; or to modify the structure elements of a programme; or different problems of strategic choice, etc. At the present moment, there are in

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(67) The use of this "evaluation criteria" is a direct consequence of the application of the "Black Box" idea to planning. See chapter one, section 3.3, "critics of Cybernetics", of this work.
(68) H. Hatry, op.cit. p.98.
(69) See Table 6.1 at the end of this chapter.

existence different evaluation techniques which, by and large, use extended concepts of the principles underlying Cost-Benefit Analysis. The enumeration and appraisal of all these methods constitute a dissertation by itself. Nevertheless, we should mention that the best known methods used in physical planning[70] are:

(a) The "Balance Sheet of Development", by N. Lichfield. (71)

(b) The "Goals-Achievement Matrix for evaluating Alternative Plans", by M. Hill. (72)

(c) "The Community Structure and Value Approach", by C. Schimpeler and W. Grecco. (73)

4.2.4 Review and Feed-Back

> "A plan prepared to-day will be inferior to one prepared to-morrow because our information will be more complete by then. The lesson is obvious. We have a plan to-day based on to-day's data. To-morrow we have a different plan, based on to-morrow's data, and so on. We cannot ignore new information. If our plan is thereby shown to be weak, it must be changed." (74)

The above quotation underlies the process oriented nature of P.P.B.S. That is, in P.P.B.S. "as the problem unfolds through analysis, the desired solution or "objective function" may "undergo a series of redefinitions of the basis of new information brought to light". The "process approach", writes R. Bigwood, "accepts as inherent to the system the feedback from implementation to reformulation of goals; the

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(70) See J.B. McLoughlin, "Urban and Regional Planning - A Systems Approach", Chapter 10.

(71) To be found in N. Lichfield, "Economics of Planned Development", p.263.

(72) To be found in M. Hill, "A Goals-Achievement Matrix for evaluating alternative Plans", in I. Robinson (ed.), op.cit. p.185.

(73) C. Schimpeler and W.Grecco, "Systems Evaluation; An Approach based on community structure and value", in Ibid p.241.

(74) T. Eddison, op.cit. p.13.

re-evaluation of plan-components, including objectives and priorities as needs arise: an extremely fluid, ambiguous and indeterminate network of information flows".(75)

In planning, "feedback" means "information",(76) but not any kind of it. J.B. McLoughlin warns us about the "misunderstanding and unimaginative.. tendency towards collecting information for its own sake, unselective and uncritical wallowing in facts and figures, impressions and maps, charts and diagrams, trends and influences".(77) This overflow of information has been, unfortunately, a characteristic of the practice of P.P.B.S. in many cases in the U.S.A., in which,

> "the flood of PPB paper-work clogging the channels of government communication, has in some cases threatened the very capability for rational action that it was supposed to enhance..." (78) (79)

The problem is really twofold:

(a) How to collect good information(80)

(b) How to use it(81)

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(75) R. Bigwood, "Aspects of an Integrated Planning Process", p.1.

(76) See chapter one of this work, section 3.2.

(77) J.B. McLoughlin, op.cit. p.125.

(78) B.Gross, "The New Systems Budgeting", in P.A.R.Vol.XXIX,No.2,p.115.

(79) According to the above mentioned author, "The spread of the new budgeting system in U.S.A. has been accompanied by mounting confusion..ritualization, over-formalization and over-documentation"; Ibid.

(80) Being from a so called "underdeveloped country", I was under the impression that one of the great difficulties for planning in our Countries (as opposed to planning in a Western European Country) was our lack of information. After two years in Scotland I now can say that the mountain of facts and figures which the European planners have about their countries can hardly be called "information". In the language of the "information theory", these facts and figures can be called "noise".

(81) Again, "noise" only became "information" after a process of decoding". Systems Analysis in planning is used for that purpose: for transforming "noise" into useful "information".

P.P.B.S. attempts to deal with these problems through the use of the Programme Memoranda (PM) and the Programme and Financial Plan (PFP). These elements will be studied in the next section.

## 5. The Programme Memoranda and the Programme and Financial Plan

At the beginning of this chapter we presented the definitions and purposes of these documents as stated by the U.S.A. Bureau of the Budget.(82) Except for this source, not very much information exists on the subject. What follows attempts to summarise the ideas discussed in one of the few papers on the subject.(83)

### 5.1 The Programme Memoranda (PM)(84)

Objectives:

(a) Describe the programmes recommended by the agency head for the multiyear time period being considered; show how these programmes meet the needs of the community; show the total costs of recommended programmes, and show the specific ways in which they differ from current programmes and those of the past several years;

(b) Describe programme objectives, insofar as possible in quantitative physical terms;

(c) Describe programme objectives and expected accomplishments and costs for several years in the future.

(d) Compare the effectiveness and the cost of alternative objectives, of alternative programmes that achieve the same or comparable objectives, and of the different levels of quantity within any given programme category; this comparison should show past experience, the alternatives that are believed to be worthy of consideration, early differing recommendations, early cost and performance estimates, and the reasons for changing these estimates;

(e) Make explicit the assumptions and criteria that support recommended programmes; and

(f) Identify and analyse the main uncertainties in the assumptions and in the programme effectiveness or costs, and show the sensitivity of recommendations to these uncertainties.

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(82) See section 6.3. of this chapter.

(83) D. Page, "The Federal Planning-Programming-Budgeting System", in Journal of American Institute of Planning, Vol.33,No.4, p.257.

(84) Ibid.

The Programme Memoranda are intended to be analytic, quantitative documents that describe needs, define objectives in precise terms, analyse cost and effectiveness, and state explicit priorities.

5.2 The Programme and Financial Plan (PFP)[85]

The Programme and Financial Plan of each agency is to be a quantitative statement, largely in tabular form, of the agency programmes, organized according to the various functions it performs. Data should be shown for the current year and for as far into the future as it is useful to project.

The PFP should express objectives and planned accomplishments, wherever possible, in quantitative physical (or output) terms and financial (or input) terms. For some programmes, it may not be possible to obtain or develop quantitative physical measures; but for them, objectives and performance should be described in as specific terms as possible.

Associated with the physical output data will be financial data to show the cost of carrying out the activity. Cost data should be expressed in system terms. All costs - research and development, loans and grants, and current costs of operations (including maintenance) - that are associated with a programme element, should be assigned to that element.

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(85) Ibid.

The PFP will serve the following functions:

(a) It will reveal future implications of current budget decisions.

(b) It will group programmes in a way to facilitate comparison among those with similar purposes.

(c) It will provide important data for decision-making, helping at the same time to force choices among programmes.

The PFP is not fixed. As circumstances change, the PFP should be changed. An example of this document is to be found in Table 6.2. at the end of this chapter.

In summary, it can be said that the above mentioned documents attempt to provide a framework for the search, analysis and presentation of information to be used in a continuous process of decision-making.

## 6. Conclusion

Planning-Programming and Budgeting System is a planning and management tool, which uses concepts from Systems Thinking, Operational Research, Cost-Benefit Analysis and Programme and Performance Budgeting, for the analysis of government activities. The intention is twofold:

(a) To provide a general approach towards decision-making.

(b) To provide a framework for the search, analysis, and discussion of information needed in the decision-making process.

To fulfil these objectives the "systems approach" has been adopted, government programmes of action are identified according to community goals and all relevant information is analysed and condensed for discussion into two documents: the Programme Memoranda and the Programme and Financial Plan.(86)

The value of P.P.B.S. is relative. If properly utilised it will help to sharpen the judgement of the decision-makers in the difficult problem of linking up "policy-planning" and resource allocation. If wrongly used it will mean only another burden on the shoulders of the tax payers. In no case (despite the large use of "quantification") will the system provide complete answers to policy questions, i.e. the system cannot replace "human judgement".

The way in which the system has been used will be the subject of our next two chapters.

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(86) As we will see in the study of the P.P.B.S. of Liverpool Corporation these documents are not the only ones considered in the P.P.B.S. process. See chapter eight of this work.

Table No.6.1: Evaluation Criteria - An Illustration:

The example is referred to section 4.2.3, "Goals, Objectives and Criteria for Evaluation".

Intending to encompass the great majority of the activities of government jurisdiction in the U.S.A., H. Hatry identifies seven "major programme areas";

(a) Personal safety.
(b) Health.
(c) Intellectual development.
(d) Satisfactory home and community environment.
(e) Economic satisfaction and satisfactory work opportunities.
(f) Satisfactory leisure-time opportunities.
(g) Transportation - communication - location.

Each of these programmes has a general goal. Each goal is defined by some objectives. Each objective is defined by some evaluation criteria: e.g., the programme -

(d) SATISFACTORY HOME AND COMMUNITY ENVIRONMENT

is defined by the goal:

To provide opportunity for satisfactory living conditions.

This goal is characterised by a series of objectives, such as:

A. Satisfactory homes

B. Maintenance of a satisfactory water supply.

C. ..... etc.

The objective "A" - Satisfactory Home is defined as:

> To provide opportunities for satisfactory homes for all the citizenry, including provision of a choice, at prices they can afford, of decent, safe, and sanitary dwellings in pleasant surroundings.

This objective should be evaluated through the use of some of the following criteria:

1. Number and percent of "substandard" dwelling units. More information would be provided by identifying more levels than just two. In any case, "substandard" should be fully defined; the definition should include consideration of crowding, physical deterioration, unsatisfactory sanitation, etc.

2. Number and percent of substandard units eliminated or prevented from becoming substandard. (This is essentially another form of 1.)

3. Acres of blighted areas eliminated and other areas prevented from becoming blighted areas.

4. Total number and percent of persons and families living in substandard dwelling units.

5. Number and percent of persons and families upgraded from one level of housing (for example, "substandard") to a higher level (for example, "standard"), or prevented from degrading to a lower level. This is essentially another form of 4.

6. Measure of neighborhood physical attractiveness. Perhaps (a) as indicated by the number of negative conditions estimated by neighborhood inspectors, including adverse physical appearance, excessive noise, lack of cleanliness, offensive odours, excessive traffic, etc.; or (b) an index based upon a public-opinion poll of persons passing through the neighborhood and/or experts.

7. Measure of neighborhood psychological attractiveness. Perhaps an index based upon a public-opinion survey of persons living in the neighborhood and/or experts.

8. Average, and distribution of, property values adjusted for price level changes. Expected changes, from year to year, in property values might also be used as a criterion.

9. Number of fires, other accidents, deaths, and injuries resulting from housing deficiencies.

Notes

(a) Important secondary effects (such as change in crime and juvenile delinquency rates, in health conditions, in fire problems and in job opportunities) are likely to result from changes in housing conditions and urban redevelopment. Criteria relating to these effects are included under the other major program areas.

(b) It will frequently be appropriate to distinguish target groups by such characteristics as family income, race, family size, and location.

(c) Criteria 1 through 5 aim at provision of housing, with 4 and 5 probably the most important, since they directly evaluate effects on people rather than things. Criteria 3 and 6 and probably 7 evaluate the physical attractiveness of the neighborhood. Criteria 7 and 8 are attempts at evaluating the overall quality of the housing and living conditions. Criterion 8 is included here rather than under major program area V, economic satisfaction, as a measure of the overall quality of the neighborhood; that is, property values are used as a proxy for the many features contributing to the attractiveness of the property. Criterion 9 measures the safeness of housing.

Table No.6.2: Example of a Programme and Financial Plan (PFP)

| GLOUCESTERSHIRE COUNTY COUNCIL<br>PLANNING PROGRAMMING BUDGETING SYSTEM | PROGRAMME SUMMARY |
|---|---|
| 1971-1972 BUDGET | TRANSPORTATION |

OVERALL OBJECTIVE: To facilitate the transportation by road of goods and people in the County, to the maximum extent compatible with safety and preservation of the environment, having regard to the existence of other forms of transport.

| COST SUMMARY<br>Capital and Revenue Expenditure (excluding debt charges) and expenditure by other Depts. | 1970-71 Estimate | 1971-72 Estimate | 1972-73 Forecast | 1973-74 Forecast |
|---|---|---|---|---|
| PROGRAMME: | | | | |
| A. To promote expeditious and economic transport of goods and people | 4,337,300 | 5,924,545 | | |
| B. To preserve the environment | 82,000 | 139,340 | | |
| C. To reduce accidents | 298,850 | 402,630 | | |
| D. General administration and support | 355,800 | 489,195 | | |
| Transportation Programme Total £ | 5,073,950 | 6,955,710 | | |
| Deduct Capital Expenditure £ | 1,097,400 | 2,189,800 | | |
| Deduct Expenditure by other Departments £ | 121,305 | 142,290 | | |
| Deduct Income £ | 1,513,120 | 1,875,750 | | |
| Add Debt Charges £ | 181,230 | 254,130 | | |
| Net Expenditure to be met from Revenue £ | 2,523,355 | 3,002,000 | 3,092,000 | |

DESCRIPTION:

A The Highways Department is responsible for the provision of new routes to meet traffic demands and the maintenance and improvement of the existing road system. The free flow of traffic is assisted by control of parking, segregation of road users, provision of direction signs and other aids to movement, aided by police action in enforcement and control.

B The Department assists in preservation of the environment by landscaping of roads, grass cutting and street sweeping. Careful consideration is given to the design and location of new roads or improvements to harmonise with existing features.

C Several sub-programmes are devoted to the reduction of accidents. The Department is responsible for street lighting, providing protection for pedestrians, dealing with temporary hazards and minor improvements aimed at reducing accident blackspots.
The Police are responsible for enforcement of any restrictions imposed, collecting accident data and co-operate with the Education Department's Road Safety Organiser for general road safety publicity, schools, education and training programme.
The Weights and Measures Department carries out tasks to ensure the road-worthiness of vehicles particulary heavy goods vehicles.

D Some expenses cannot readily be allocated under individual activities, for example administrative salaries, central charges and recoverable costs are included on this programme.

From: T. Eddison, Op.cit. p.76.

# CHAPTER 7

## IMPLEMENTATION OF P.P.B.S.

1. Aims of this Chapter.
2. The Discouraging American Experience.
3. The Contradictory Nature of P.P.B.S. in the U.S.A.
4. The Fate of the P.P.B.S. Defence Model.
5. Lessons from the Experience.

# CHAPTER 7: IMPLEMENTATION OF P.P.B.S.

## 1. Aims of this Chapter

Hitherto we have been discussing the basic principles of P.P.B.S. Now the time has come to study how all this theory has been put into practice. We are going to discuss two experiences:

(a) P.P.B.S. in the Domestic Agencies of U.S.A.

(b) P.P.B.S. in local government. - The case of the Liverpool Corporation.

The reasons for having selected these cases are:

(a) In both cases the P.P.B.S. work has been very advanced.

(b) In both cases P.P.B.S. has been downgraded.

Thus our interest in these cases, because we will be able to follow the whole cycle from the birth to the death of P.P.B.S. In doing so we hope to learn from the experience.

## 2. The Discouraging American Experience

When P.P.B.S. was introduced in the U.S.A. Domestic Agencies by presidential directive in 1965, the type of comments made about the new system implied that it worked near miracles.(1) Six years after, on June 21st 1971, the following words were issued by the U.S.A. Office of Management and Budget (OMB):

> "Agencies are no longer required to submit with their budget submissions the multiyear program and financial plans, program memoranda and special analytical studies.. or the.. schedules.. that reconcile information classified according to their program and appreciation structure." (2)

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(1) For instance, see V.J. Moore in "Integrated P.P.B.S.: Breakthrough on Burocracy", in V.Curtis (ed.) "P.P.B.S.", p.1 ... "Integrated P.P.B.S. presents a radical new development in American administration which has the potential to provide one of the simple most important breakthroughs in comprehensive planning in the history of the movement in America..."

(2) Quoted from A. Schick, "A Death in Burocracy: The Demise of Federal PPB", in PAR, March/April, 1973, p.146.

"By these words, PPB became an unthing. No publicity or press release; only an erasure from the administration records.."(3)

In this chapter the attempt will be made to provide an insight into the performance of P.P.B.S. in the domestic agencies in the U.S.A. The aim of this work is to identify the reasons why it is said that P.P.B.S. failed in these agencies.

3. The contradictory nature of Planning-Programming-Budgeting System in the U.S.A.

The way in which P.P.B.S. was introduced in the U.S.A. was against the nature of the new system. Former Secretary of Commerce, J.T.Connor, described the introduction of Cabinet Members to P.P.B.S.:

> "The cabinet members were called together early one morning without any prior preparation, and after a brief summary by Budget Director Schultze, ordered to put it into effect promptly. There was no meaningful discussion on whether or not it would be applicable throughout the Federal Government, even if successfully applied in Defense". (4)

That is, a system which claims to be useful only when it is adopted as a learning process - with emphasis on the virtues of analysis, discussion, feed-back, consideration of alternatives, and evaluation - was introduced at the national level from the top down, without any discussion.

Moreover, it is said that "in issuing his sweeping across-the-board order to implement P.P.B.S., President Johnson acted against the wishes of some Budget Bureau officials who favoured slow and careful development of P.P.B.'s conceptual tools."(5)

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(3) Ibid
(4) Quoted from S. Botner, "Four Years of PPBS; An Appraisal", PAR, July/August 1970, p.425.
(5) Ibid.

In doing so, Mr Johnson imposed on all the departments in the U.S.A. the so-called "Defence model" of P.P.B.S. .."including most of its procedures and terminology,and directed the civilian departments to fall into line".(6) Therefore, what was introduced was not P.P.B.S.as a general approach to the problems of decision-making, but the cooking recipe created and used (with doubtful success)(7) in the Department of Defense in the U.S.A.

The problem is expressed in the following terms:

> "The departments did not have the opportunity to design their own systems or procedures, nor were they able to relate PPB to their established practices..." (8)

Not only this, but in many cases the departments were forced to abandon their own analytic efforts. The most notorious of these cases is referred to as the "everyone loses"(9) struggle between the State Department and the Bureau of the Budget in which the State fought for its own Comprehensive Country Programming System (CCPS) and Budget insisted that P.P.B.S. should be adopted. Thus a foreign system, alien to the preferences and problems of individual departments, was introduced. The consequence was that,

> "faced with an imposed system which they neither designed nor understood, many departments reacted by divorcing the PPB system from budgeting." (10)

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(6) A. Schick, op.cit. (in this chapter) p.147.
(7) See section 4 of this chapter.
(8) A. Schick, op.cit. (in this chapter) p.147.
(9) Ibid.
(10) Ibid.

But, in one way or another, P.P.B.S. was adopted in the U.S.A. in:(11)

(a) Hundreds of bureaus and divisions throughout the federal government;

(b) the Comptroller General as a tool in trying to modernize the General Accounting Office;

(c) Congressional committees in appraising executive programme proposals and writing legislative prescriptions for future programme review.

(d) Many Governors, Majors, and State and local agencies.(12)

To the extent of our knowledge, the only systematic field research appraising the use of P.P.B.S. in the U.S.A. civil agencies is the one undertaken by the Bureau of the Budget in 1968.(13)

The study was carried out in sixteen major domestic Federal Agencies. The aim of the study was to identify the problems of implementation of P.P.B.S.(14)

The main conclusions of the study could be presented in the following way.

1. Main Findings.(15)

(a) Policy analysis in most agencies had not been performed much differently to what it was before the advent of P.P.B.S.

(b) Agencies varied widely in the rate at which they elected to emphasize analytic capability or the process for integrating analytic output.

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(11) B. Gross, op.cit. p.114.
(12) For information on this issue see F. Mosher "Limitations of PPBS in the States" and S. Mushking "PPB in Cities", in PAR, Vol.XXIX No.2, March/April 1969.
(13) The study was undertaken by E. Harper et al, and published as "Implementation and Use of PPB in sixteen Federal Agencies", in PAR, Vol.XXIX, No.6, November/December, 1969.
(14) "The study attempted to ascertain how these sources had dealt with a requirement that potentially involved basic changes in their policy decision-making processes. These changes would involve the eventual integration of the planning, programme analysis, and budget functions, into a single decision-making process". From Ibid, p.623.
(15) Ibid.

(c) The most important factor determining the relative effectiveness of an agency's P.P.B.S. efforts was the active support and use of P.P.B.S. by the agency head.

(d) There was uncertainty within the agencies as to whether P.P.B.S. was intended to be an agency management tool or primarily to fulfil the requirements of the Bureau of the Budget.

2. The Agencies that did make substantial progress towards the implementing of systematic planning and analysis were characterized by the following factors:(16)

(a) A sufficient number of analysts were assigned to both bureau and agency level staff.

(b) The analysts were well qualified.

(c) The analytic effort had access through the formal organization structure to the heads of the agencies and bureaus, to programme managers, and to lateral, particularly budget, staffs.

(d) The informal relationships between analytic staffs and agency heads, programme managers, and lateral staffs supported the analytic effort.

(e) Agency head strongly supported the development and use of analytic outputs.

(f) The general attitude in the agency was that the analytic effort is primarily for the benefit of the agency rather than for the Bureau of the Budget.

The relations between these factors and the agencies involved are shown in Table 7.1. Agencies are classified in five groups according to the relative use of the outputs of the analytic efforts.

These five groups are:(17)

A. Agencies that have made substantial progress in integrating PPBS outputs into their decision-making process:
USDA = United States Department of Agriculture.
HEW = Health, Education and Welfare.
OEO = Office of Economic Opportunity.

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(16) Ibid p.624.
(17) Ibid.

Table 7.1: Summary of Development of Six Factors affecting the Integration of PPBS in Sixteen U.S.Federal Agencies

| Categories / Agency / Factors | 1<br>HEW<br>USDA<br>OEO | 2<br>AEC<br>Corps of Engineers | 3<br>VA<br>GSA | 4<br>Interior<br>Labor,<br>Treasury | 5<br>NASA, Commerce<br>Justice, Post<br>Office, HUD,<br>DOT. |
|---|---|---|---|---|---|
| Number of Analysts sufficient | X | X | X | X | X |
| Analysts are qualified | X | X | X | | |
| Formal organization promotes integration | X | X | X | | |
| Informal relations promote integration | X | X | X | | |
| Agency Heads support and use PPB outputs | X | X | | | |
| Purpose of analytic effort perceived to be agency use | X | | | | |

X Group conforms to factors.

From: E.Harper et al,
op. cit. p.625.

B. Agencies that have for a long time used sophisticated analytic tools although not necessarily in the PPBS framework:
Corps of Engineers - Civil Works.
Atomic Energy Commission (AEC)

C. Agencies in which rudimentarly policy analysis within the PPBS process occurs at lower organizational levels, but top management tends to use analysis irregularly in decision-making.
VA = The Veteran's Administration.
GSA = General Services Administration.

D. Agencies in which the PPBS output is not used extensively by decision-makers:
Interior.
Labour.
Treasury.

E. Agencies in which analysis plays a small role in an agency's wide decision-making because systematic planning efforts have been fragmented by relatively strong bureaus and other disintegrative factors.
Commerce.
Justice.
Transportation. (DOT)
NASA
Post Office
Housing and Urban Development. (HUD)

It is noticeable that the study deals only with the problem of integration of P.P.B.S. within the decision-making structure. The study does not attempt to assess the quality of the analytic output. The study was drawn under the basic assumption that:

> "Competent analytic staffs of sufficient size working in the environment favourable for the use of analysis would produce analytic materials that would contribute positively to the agency decision-making process." (18)

The above assumption has not been proved. As far as we know, no major study has been undertaken in the U.S.A. to know whether or not P.P.B.S. enabled the Federal Agencies to do "jobs faster, to DO JOBS BETTER, and to do jobs less expensively",(19)

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(18) Ibid, p.624.
(19) See chapter six section 1 of this work.

as Mr Johnson boasted it would do. Most of the papers written on P.P.B.S. are by and large subjective speculations on its virtues or its defects.(20) But if the proof of the pudding is in the eating, we have very little evidence to know whether the pudding tastes wonderful or not.(21)

Very often, it is possible to read in the various P.P.B.S. papers that "the use of P.P.B. in civilian departments never reached the status it attained in Defense".(22) This is probably true, but again, the words are carefully chosen and are referred to the "status" of P.P.B.S. rather than to the effectiveness of its use. We will attempt to make clear the point in the next section.

4. The Fate of the P.P.B.S. Defense Model

When Mr Robert MacNamara became President Kennedy's Secretary of Defense early in 1961, one of his first actions was to appoint C. Hitch, formerly Head of the Economic Division of the Rand Corporation,(23) as Comptroller, with the task of making a five-years Defense Budget. This was the beginning of the Planning-Programming-Budgeting system of the Defense Department.

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(20) But as F. Mosher says, "There has been little objective and evaluative analysis of what PPBS has accomplished or failed to accomplish in any area - even the Department of Defense". F. Mosher, "Limitations and Problems of PPBS in the States", IN PAR, Vol.XXIX No.2 March/April 1969, p.160.

(21) As referred to this point we will say that this lack of evaluation studies is strange in the application of PPBS, especially because the P.P.B.S'ers stress analysis and evolution of outputs.

(22) See, for instance, A. Schick, "A Death in Burocracy", op.cit. p.147.

(23) From R. Clarke, in the Books Review Setion of "The Political Quarterly", Vol.42 No.4, p.449.

The fundamental ideas behind the new development were:[24]

(a) Decision-making should be based on explicit criteria of the national interest in Defense programmes, as opposed to decision-making by compromise between the various interests in the Defense Department.

(b) Consideration of military needs and costs together.

(c) Explicit consideration of alternatives at the top decision level.

(d) Active use of analytical staff at the top level, notably the system analysis office.

(e) Plan considering both forces and costs which projected into the future the foreseeable implications of current decisions.

(f) Open and explicit analysis, to be made available to all interested parties.

The elements included within the new Planning-Programming-Budgeting structure were:[25]

(a) A programme structure in terms of missions, forces and weapon to support systems. (26)

(b) The analytical comparisons of alternatives.

(c) A continually up-dated five-years force structure and financial programme.

(d) Related year-round decision-making on new programmes and changes.

(e) Progress reporting to test the validity and administration of the plan.

The aim of the work was "improved planning through the designation of major programmes, and of programme elements within them, as the unit for planning and programming of forces, dollar costs, and manpower".[27][28] The idea was that a comprehensive system

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(24) Ibid.
(25) D. Novick, "The Department of Defense", in D.Novick (ed.) "Program Budgeting", p.89.
(26) See Table 7.2 at the end of this chapter.
(27) Ibid, p.91.
(28) See Table 7.2: Major Programmes in the Department of Defense.

The idea was that a comprehensive system for the continued programming of forces, manpower, and dollars could be created.(29) Table 7.2 shows the major programmes in the Department of Defense. By and large the publications issued on this model fell into two types:

(a) How the new ideas were brought into being,(30) or
(b) How these ideas were applied to a number of specific issues. (31)

As far as we know, no general appraisal on the results of the use of P.P.B.S. in the Defense Department has been published.(32) However, if we adopt one of the P.P.B.S. principles, and the effectiveness of the system is appraised according to its outputs,(33) the logical argument should be that in the most important involvement of the Department of Defense (The Vietnam War) the performance of the system was disastrous.

A. Enthoven, who was Deputy Comptroller and later Assistant Secretary of Defense for Systems Analysis from 1961-1969, writes about this issue in the following terms:

> "When McNamara was at the height of his influence and power, the new methods were strongly to the fore; but as the situation changed from peace-time world-wide defense to the war in Viet-Nam, the authority of the military grew and the power of MacNamara and the civilian defense officials fell, and with them the new techniques." (34)

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(29) D. Novick, op.cit. p.91.
(30) Like the paper of D. Novick, "The Department of Defense", op.cit.
(31) Like the paper of G. Fisher, "Illustrative example of Cost-Utility considerations in a military context", in D.Novick (ed.)
(32) Probably the book by A. Enthoven and K.Wayne Smith "How much is enough: Shaping the Defense Programme 1961-1969", will fulfil this gap. However, we must admit that we have not read the book but a review of it.
(33) i.e. the idea of "Black Box" which we discussed in chapter one, section 3.3
(34) Quoted from B. Clarke, op.cit. p.452.

What Mr Enthoven attempts to say is that their organisation (The Systems Analysis Office of the Defense Department) had very little to do with the planning and problems of the Viet-Nam war and consequently "their methods cannot be regarded as having been discredited by the failures of the Viet-Nam War."(35) Assuming that this is what actually happened, it will still mean that Mr MacNamara (and all the talented people around him) did not succeed in "getting them accepted as integral and indispensable parts of all defense decision-making, more critical and important in the fact of war than in peace, as the problem of the most economical use and allocation of resources and the direction of effort must be".(36) If this is the case, could we still speak about P.P.B.S. as having proved useful for Defense?

5. Lessons from the experience

> "The most important factor determining the relative effectiveness of an agency's P.P.B.S. efforts was the active support and use of P.P.B.S. by the agency head." (37)

As we have already seen, this is one of the conclusions drawn by the Bureau of the Budget, from the study of the problems of implementation of P.P.B.S. in some civil agencies.(38) The same conclusion can be applied to the case of the Department of Defense. We have seen, in the last section, how the acceptance of P.P.B.S. in Defense was a reflection of the acceptance of Mr MacNamara within Kennedy's administration. What was then accepted was Mr MacNamara and "his" P.P.B.S. but not P.P.B.S. by itself.

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(35) Ibid.
(36) Ibid.
(37) See section 2.1 of this chapter.
(38) E. Harper et al. op.cit.

In this case, as in the case of the introduction of P.P.B.S. into the American Civil Agencies, we notice that P.P.B.S. was imposed and maintained by the men on top. This is probably the way in which an administrative innovation should be introduced into a private firm.(39) But the experience shows that this was not the way for introducing the new system into the public administration machinery. A. Schick thinks that although those who pioneered P.P.B.S were experts in economics and systems analysis, they knew little about public administration. That is, they knew little about the system that they were supposed to help to guide.

About this point the above mentioned writer says:

> "P.P.B.S. died because new men of power were arrogantly insensitive to budgetary traditions, institutional loyalties, and personal relationships." (40)

Probably the above quotation comprehends in a single sentence the main lesson to be learnt from the American P.P.B.S. experience: That the first element to be considered in any planning system is the human one. If this element is neglected, the system - despite its technical sophistication - will hardly come through. This is what happened in the U.S.A. But, as we will see in our next chapter, not in the U.S.A. only.

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(39) This fact shows, too, that the P.P.B.S.'ers did not make any difference between a private business and the business of government.

(40) A. Schick, op.cit. (in this chapter), p.148.

Table No.7.2: Major Programs in the Department of Defense Program-Budget Structure

PROGRAM I

Strategic Retaliatory Forces: the forces that are designed to carry out the long-range strategic mission and to carry the main burden of battle in general. They include the long-range bombers, the air-to-ground and decoy missiles, and the refueling tankers; the land-based and submarine-based strategic missiles; and the systems for their command and control.

PROGRAM II

Continental Air and Missile Defense Forces: those weapon systems, warning and communications networks and ancillary equipment required to detect, identify, track, and destroy unfriendly forces approaching the North American continent.

PROGRAM III

General Purpose Forces: the forces relied upon to perform the entire range of combat operations short of general nuclear war. These include most of the Army's combat and combat support units, virtually all Navy units, all Marine Corps units, and the tactical units of the Air Force.

PROGRAM IV

Airlift and Sealift Forces: those airlift and sealift forces required to move troops and cargo promptly to wherever they might be needed. Included in the airlift forces are both the MATS transports and the Air Force Tactical Air Command troop carrier aircraft. The sealift forces include the troop ships, cargo ships, and tankers operated by MSTS and the "forward Floating Bases".

PROGRAM V

Reserve and National Guard Forces: equipment, training, and administration of the Reserve and National Guard personnel of the several services.

PROGRAM VI

Research and Development: all research and development effort not directly identified with elements of other programs (i.e., where there has been no decision to produce for inventory).

PROGRAM VII

General Support: support activities of the several services and the agencies that serve the entire Department of Defense. It constitutes an "all-other" or residual category of activities or programs and includes all costs not capable of being directly or meaningfully allocated to the other major programs.

PROGRAM VIII

Military Assistance: equipment, training, and related services provided for armed forces of allied and friendly nations.

PROGRAM IX

Civil Defense: federal assistance for fallout shelters, warning and radiological monitoring systems, training and education for emergency preparedness, etc.

From D. Novick, "Program Budgeting", p.92.

# CHAPTER 8

## P.P.B.S. in Liverpool

1. Background

2. The P.P.B.S. of the Liverpool Corporation.
   - 2.1 First Operation: Programme Definition Statement
   - 2.2 Second Operation: Guidelines from Policy and Finance Committee.
   - 2.3 Third Operation: Preparation of Programme Plans and Budget.
   - 2.4 Fourth Operation: Issue Analyses

3. Summary of basic characteristics.

4. Problems of implementation.
   - 4.1 Integration of Programmes.
   - 4.2 Functioning of the Policy and Finance Committee.
   - 4.3 The Council's Reaction.
   - 4.4 Use of Standards

5. Conclusion.

# CHAPTER 8: P.P.B.S. IN LIVERPOOL

## 1. Background

It is true to say that any city government in the world faces the ever increasing problem of knowing how to allocate its scarce resources for the creation of an environment "in which the citizens can live and work comfortably and conveniently in health and safety".(1) In this chapter we will study the mechanism developed in the city of Liverpool for the tackling of the above mentioned problem.

> "In Liverpool... not only do rising standards create increasing or competing demands for its scarce resources from each of the services it provides, but Liverpool's mixture of population and ambitious programmes for development of the physical structure of the city impose even greater demands." (2)

The Liverpool Corporation, faced with the problem of resource allocation, alongside with the pre-occupation of the value that was being obtained for public expenditure, asked a private consultant(3) to undertake a study to -

1. Achieve cost-reductions.
2. Improve the decision-making processes of the Corporation.
3. Strengthen the organization.

A preliminary study of the problem convinced the consultants that:

> "by focussing the attention on the Corporation decision-making processes and organization structure, they could improve its ability to make the key decisions that ultimately determine standards and costs of services, and help it to manage its resources more effectively." (4)

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(1) P. Geddes, "Cities in Evolution".
(2) McKinsey and Cia, Inc. "A New Management System for Liverpool Corporation", p. i.
(3) The consultant was McKinsey and Cia.Inc. (an American firm).
(4) McKinsey and Cia. Inc. op.cit. p. ii.

In other words, the consultants' opinion was that the problem of cost-reduction must be solved through the improvement of the decision-making processes and the organizational structure of Liverpool Corporation.(5)

In their Report, "A new management system for the Liverpool Corporation", the consultants present the following conclusions and recommendations:

> The Corporation anticipates spending some £1,000 million in revenue expenditure during the next 10 years in discharging its great and continuing responsibility for providing a wide range of services that deeply affect the lives of the 650,000 people in Liverpool. Although Government policies and sanctions circumscribe its actions, the Corporation still has the important responsibilities of initiating proposals for improving, extending and maintaining its services, establishing priorities, ensuring value for money, and managing the city's enormous assets.
>
> The consultants believe that the framework of the Corporation's present organization and system of management is not adequate for a management task of this magnitude. The organization does not provide for adequate coordination of direction either of committee or of permanent staff departments. It divides responsibilities for carrying out the Corporation's task among too many departments, often with overlap between departments. Finally, while control is exercised over the amount of spending, no effective control is exercised over the results of expenditure and its impact on the services provided to the public. Thus the existing framework inhibits the Council's effectiveness in setting priorities and ensuring that departments carry out their duties efficiently.
>
> To strengthen the organization and management processes of the Corporation the following major changes have been recommended.

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(5) Ibid.

1.1 Assign responsibility for direct services to the public to seven committees under the Policy and Finance Committee as follows:

(a) Education
(b) Housing
(c) Environment Health and Protection
(d) Personal Health and Social Services ) To have the
(e) Children's ) same membership
(f) Transportation and Basic Services
(g) Recreation and Open Spaces

1.2 Group departments into six programme administrations, each under a Programme Director to match the committee structure.

1.3 Appoint a Chief Executive to be head of the Corporation's permanent staff and free him from day-to-day administrative duties.

1.4 Strengthen administrative and other internal services by:

(a) Appointing a Director of Administrative Services.

(b) Appointing a Director of Land and Property Services.

(c) Giving the Personnel Committee a more positive role as the sole 'employing' committee.

1.5 Adopt a new system of planning and control activities and allocating resources.

In this new system,

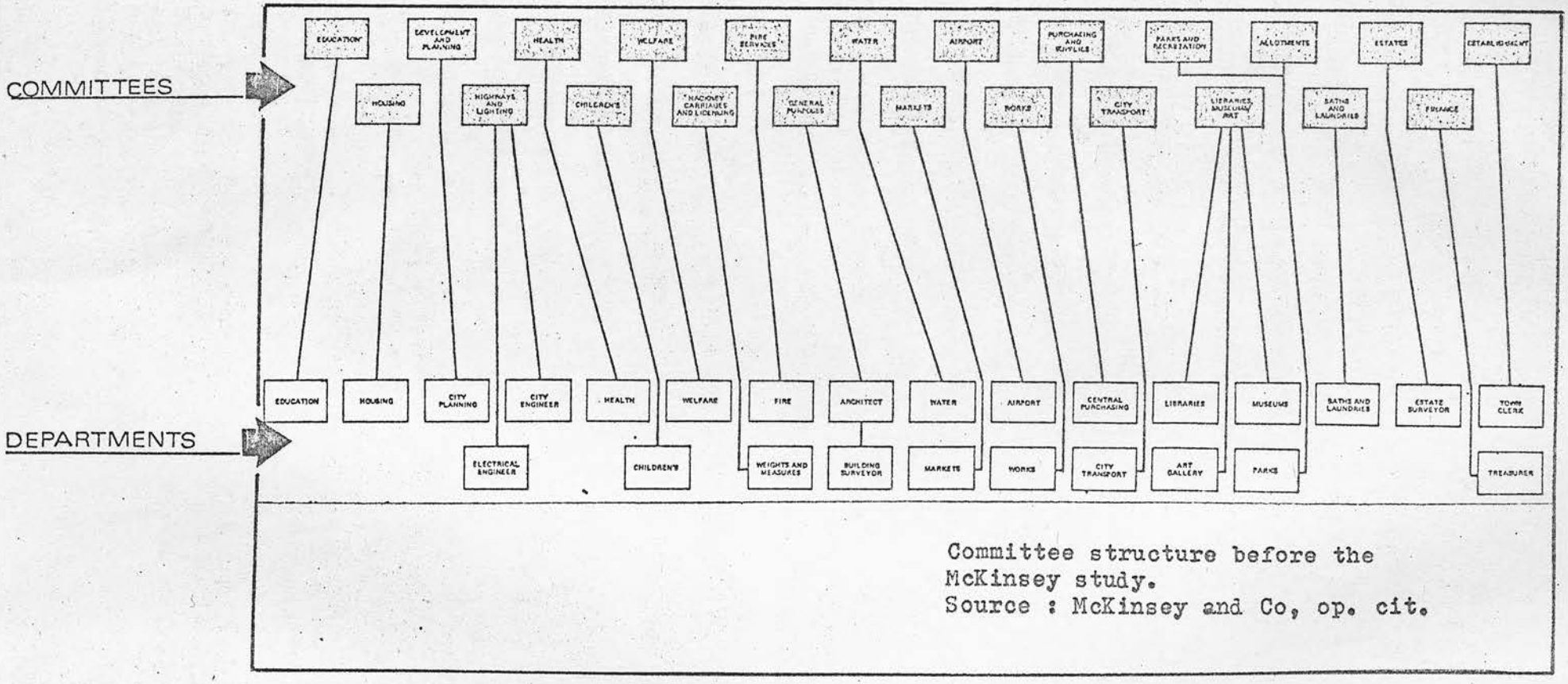
(a) Objectives and measures of performance will be established for each service provided by the Council.

(b) The issues surrounding each service will be explicitly identified and analysed.

(c) Performance of committees and departments in meeting objectives within cost targets will be monitored.

1.6 It is important to point out the fact that the consultants do not claim that the changes proposed will automatically solve the issues facing the Corporation, but that they will merely provide the framework in which the Corporation's current and future problems can be more effectively handled.

In summary, according to the consultants, a solution of the combined problem resource allocation/improved effectiveness of work must be based on:




Committee structure before the McKinsey study.
Source : McKinsey and Co, op. cit.

(a) A change of the organizational structure of the Corporation.

(b) The introduction of a new system of planning and control.

The above mentioned new planning system is introduced by the consultants under the name of "Programme Planning". In the following sections of this chapter we will attempt to provide the basic characteristics of this system.

## 2. The P.P.B.S. of Liverpool Corporation

The basic characteristics of this system are found in the "Manual of Programme Planning" drawn by McKinsey and Cia.Inc.(6) According to this document, the planning process set out in it "is designed to provide a framework within which important decisions on future services can be made well in advance, their timing and impact made explicit, and proper analytical effort applied for effective decision-making".(7) The new system is based on the idea that the budget is the financial representation of the planning and priorities setting-process. Thus, "Programme Planning" - as the new system is called(8) - attempts to integrate the function of "planning" with that of "budgeting" into what is known as a "planning cycle".(9) This cycle is described as a set of procedures by which the various stages in the process are performed in a regular sequence at set times of

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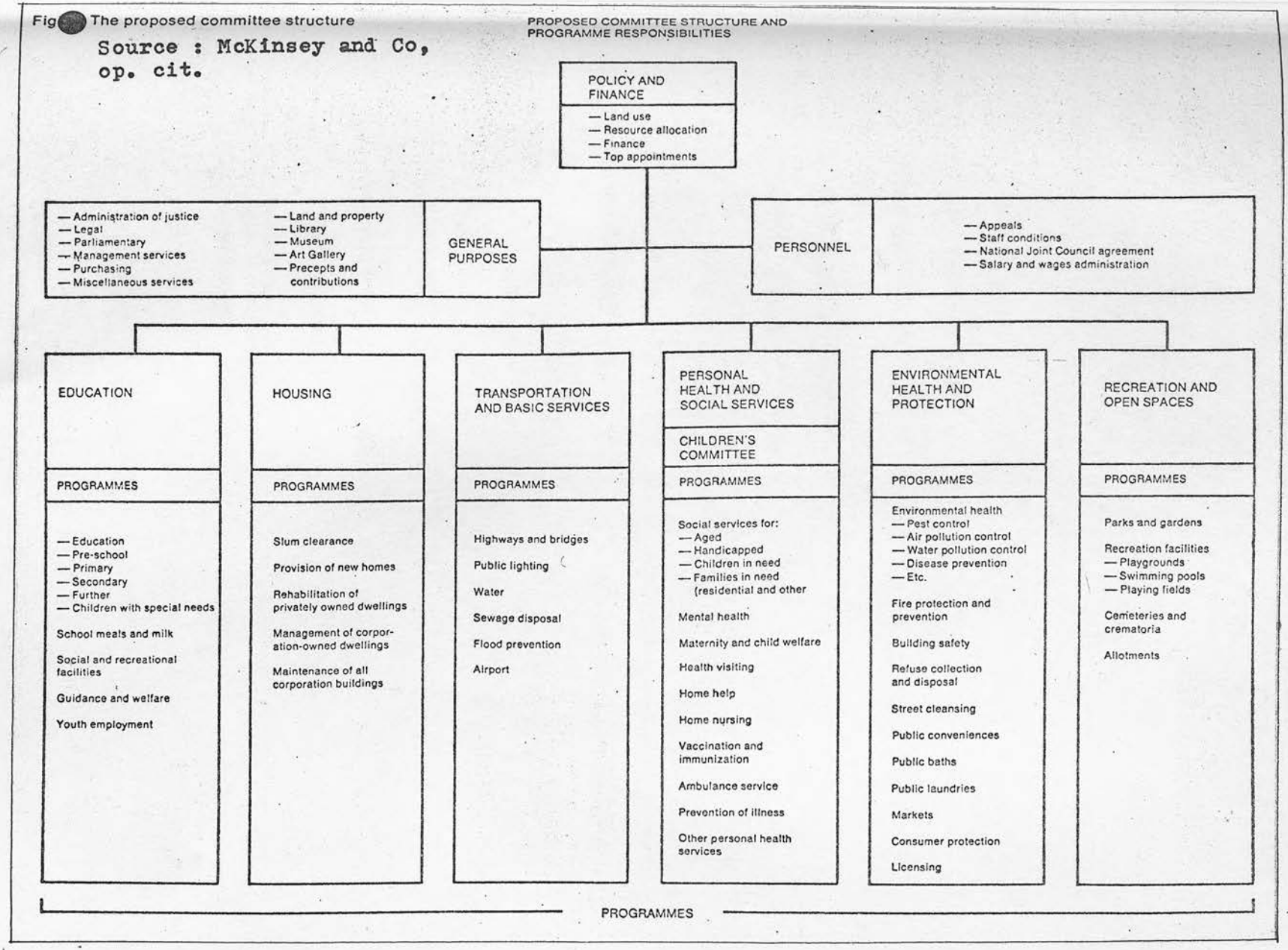
(6) McKinsey and Cia.Inc. "Manual of Programme Planning - City of Liverpool".
(7) Ibid p.1-1.
(8) As we have already seen, "Planning-Programming-Budgeting System" is known under several names: Output Budgeting, Programme Budgeting, etc. In this case it is called "Programming-Planning and Budgeting system".
(9) McKinsey and Cia. Inc. "Manual of Programme Planning - City of Liverpool", p.1-3.

Fig The proposed committee structure

Source : McKinsey and Co, op. cit.




Liverpool Corporation
PROPOSED COMMITTEE STRUCTURE

the year. This is a continuous process, though for its description it has a beginning and an end. In this sense, a complete "Programme-Planning and Budgeting Cycle" is supposed to be integrated by the following operations:

1. Programme Definition Statement.
2. Guidelines from Policy and Finance Committee.
3. Preparation of Programme Plans and Budget.
4. Analysis of Issues.

The relations between these operations are shown in graph 8-3. In the following pages we will briefly describe each one of these operations.

## 2.1 First Operation: Programme Definition Statement

Purpose: To define the scopes of programmes through which the Corporation provides services to the public, and to identify systematically the gaps and shortcomings in the service.

To fulfil these purposes, the following steps are recommended to be followed:

A. Describe Programmes

In chapter six[10] of the present work, the process of describing P.P.B.S. programmes has been discussed. The difference between the Liverpool Corporation process and the one discussed before is that in the latter the structure of programmes is built upon goals and objectives previously defined, whereas in the former, programmes are recommended to be defined before defining goals and objectives.[11] The recommended structure of programmes of Liverpool Corporation is shown in graph 8-2.

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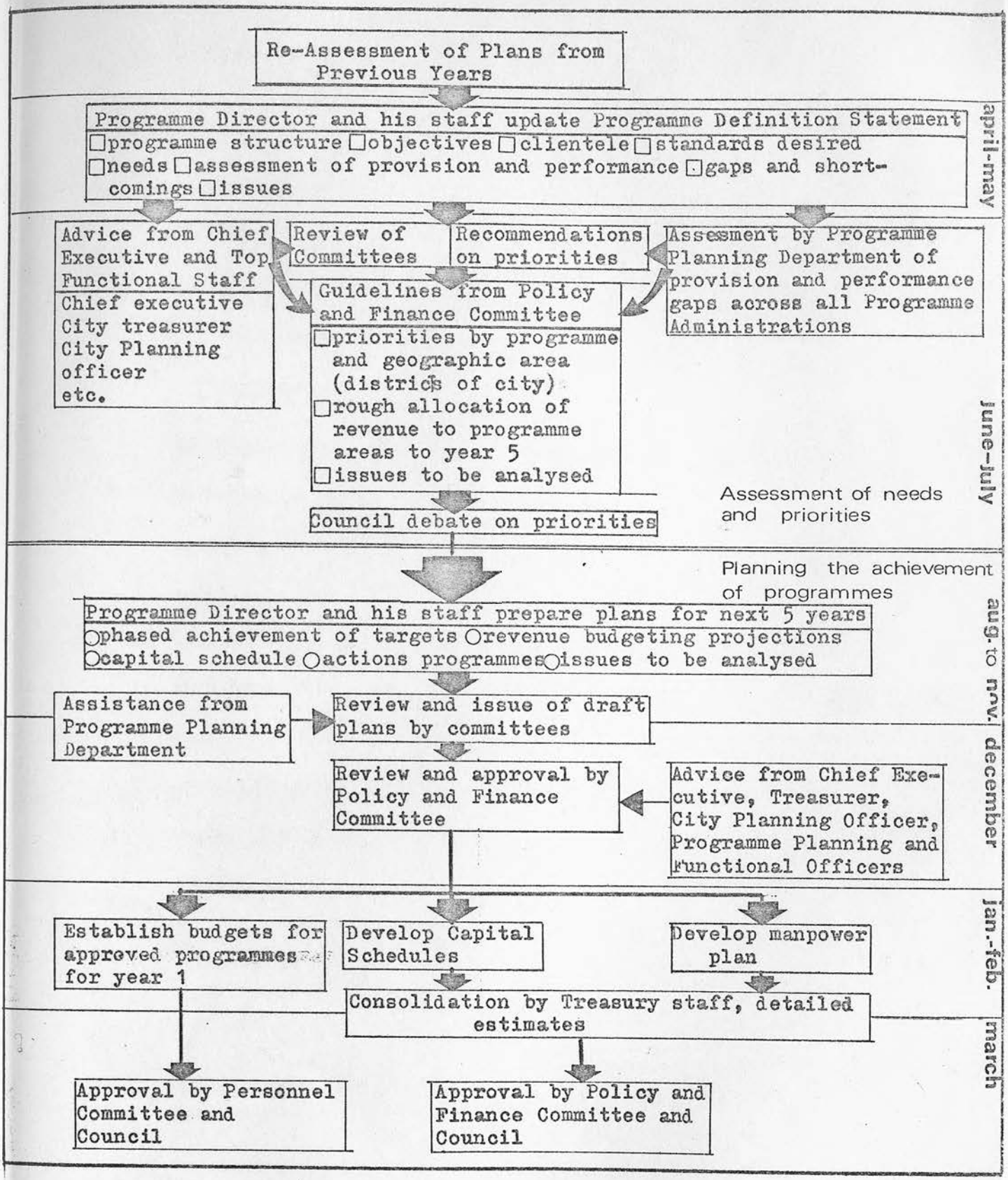
(10) See chapter six, section 4 of this work.
(11) Probably because of that reason, the system in Liverpool is named "Programme-Planning-Budgeting System", i.e. first programmes are defined and after that plans are drawn.




The P.P.B. cycle - Liverpool

Ref. McKinsey & Company, Inc.
op. cit. (exhibit iv)

B. To determine Programme Objectives

Once the structure is established, the objectives of each major programme should be determined.(12) According to the Consultants' "Manual", a complete definition of the objectives of a service must contain each one of the following elements:

(a) Activities: The authority conducts certain activities

(b) Clientele: For the benefit of a specific Clientele.

(c) Purpose: For a defined Purpose.

The relationships between these elements are shown in the following example:

In the case of the Children's Service, the programme provides services, viz. 1) Child care officers; 2) Senior child care officers; 3) Residential homes; 4) Reception centres; 5) Foster Homes; 6) Adoption services, etc.

These are for the benefit of a clientele consisting of children in need - i.e. children from broken homes; children beyond parental control, etc. - and their families. Their purpose is to:

1. Identify the needs for assistance;
2. Assist families to provide a satisfactory home environment for their children;
3. Care for children when family environment is no longer adequate.

C Assess Needs for Services provided for the Corporation.

This step requires:

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(12) McKinsey and Cia Inc. "Manual of Programme Planning - City of Liverpool", p.2.2

(a) To determine the standards of provision required.
(b) To determine the size of the clientele or the extent of the field of action. (13)
(c) To quantify the needs applying the standards of provision to the number of clientele, or the size of the field of action.

D. Evaluate Performance of the Existing Provision of Services against the needs previously determined

In this step it will be necessary:

(a) To assess the gaps in provision of services, i.e. theoretical needs less the actual provision at present time.
(b) To measure the impact of programmes, i.e. the extent to which programmes are fulfilling the underlying purpose of the activity and expenditure.(14)

## 2.2 Second Operation: Guidelines from Policy and Finance Committee

The Policy and Finance Committee(15) is the organism which will issue the overall planning guidelines of the Corporation every year.

These "guidelines" are referred to:

A. Indication of priorities between programme areas, within programme areas and by geographic areas of the city.

Purpose: The establishing of priorities between the conflicting claims for resources, to achieve a balance of services between the various sectors of the population, while meeting most urgent needs. This task will be accomplished by:

(a) Using the information provided in the Programme Definition Statements.(16)
(b) In coordination with the Chief Executive(17) who will report on:

---

(13) It is often the case that no specific sector or district can be identified as being the prime beneficiaries of a given programme, i.e. the clientele is the population of the city as a whole (e.g. highway programmes). In this case, it is necessary to define the size and scope of the field of action in order to determine the needs. This means, the miles of roads, or the number of factories, shops and offices requiring inspection. From Ibid, p.2.3.
(14) See example in Table 8.2.
(15) See role of Policy and Finance Committee in graph 8.3.
(16) See section 2.1 of this chapter.
(17) See graph 8-3.

Table 8.1 Assessment of Needs - Examples

| Programme Element | Clientele/Field of Action | Standard | Need |
|---|---|---|---|
| Public Bath | Number of dwellings lacking hot water system or fixed bath:<br>1969/70 = 33,500<br>1973/74 = 23,000<br>Number of occupants<br>1969/70 = 125,000<br>1973/74 = 15,000 | Theorectical=1 unit per user per week. (Unit is 35-minute period) Subject to confirmation by actual utilization figures.<br>Catchment Area= $\frac{1}{2}$ mile | Theoretical=1550 units.<br>Access must be within $\frac{1}{2}$ mile of needy home. |
| Provision of Parks (Landscape) Open space | Total population:<br>1969/70 = 680,000<br>1973/74 = 620,000 | 1 acre per 1000 population.<br>Catchment Area = 1 mile | 680 acres 1964/70<br>620 acres 1973/74<br>(distributed so that each household is within 1 mile of open space) |
| Housing - clearance of unfit dwellings | Total of non council owned dwellings in city = 130,000 | 6-point standard of unfitness | 1969/70 = 16,000 houses.<br>1980/81 = 56,000 houses (unless other action taken to upgrade between now and then) |

From: McKinsey & Co.Inc.
"Manual of Programme Planning".
(Exhibit IX)

Table 8.2: Illustration of Use of Measures to assess Programme Performance

| ASSESSMENT OF PROVISION | ASSESSMENT OF IMPACT |
|---|---|
| SWIMMING | SWIMMING |
| 1. Twenty five per cent. of the City's population live further than three quarters of a mile from a swimming pool. | 1. Attendance at public swimming pools is only 25 per cent. of capacity during present opening hours. However, all demands from clubs cannot be accommodated, and in 10 out of 13 pools lack of changing facilities limits real capacity at peak period. |
| 2. Five out of 13 pools are affected by development plans and will be demolished within 10 years. | 2. Only 27 per cent of users are over 15 years old and the overwhelming proportion of these adult users is male. |
| 3. Ten out of 13 pools are over 60 years old and are unsatisfactory by modern standards. | 3. Older pools with less attractive facilities attract an even lower proportion of the total population in their catchment area. |
| PRIVATE BATHS | PRIVATE BATHS |
| 1. Fifteen establishments cover all areas with houses lacking hot water and fixed bath, using half a mile as an effective catchment area. | 1. Only 5.4 per cent of people lacking baths and hot water systems in their own homes currently use the private baths provided by the Council. |
| 2. Capacity of 28,700 users per week relates to potential demand(for weekly use by all people lacking fixed bath in their own home) of 125,000 users per week. But utilization figures show that potential demand is far in excess of acutal. | 2. Facilities provided are only 24 per cent utilized. |

From: McKinsey & Co.Inc.
"Manual of Programme Planning",
(Exhibit XII)

(i) Economic Requirements: Problems of employment; industrial location; port authorities, etc. In this task the Chief Executive will be advised by the City Planning Officer.

(ii) "Foreign Policy" aspects of the city: comprehending the demands and action of National Government, neighbouring authorities and other outside agencies that impact the city's ability to control its own expenditure patterns and other activities.

(c) Keeping in mind the priorities for redevelopment and the pursuit of the city's Structure Plan, reported by the City Planning Officer.

(d) Within the financial limits established by the City Treasurer.

B. A rough allocation of revenue expenditure for the next 5-years' period to each programme area.

With the information gathered in the aforementioned step, the Policy and Finance Committee will establish its priorities and express them in terms of revenue expenditure between programmes, or at least programme areas, for the next five years. Once the Policy and Finance Committee completes its "guidelines" these should be debated in Council.

2.3. Third Operation: Preparation of Programme Plans and Budget

Drawing from the Policy and Finance Committee "guidelines", the programme directors and heads of departments will proceed with the preparation of their plans and budget for the next five years.

This process comprehends:

A. Planned Performance Goals.

To establish the goals of each service so that actions can be taken to reach them over a period of years. Performance goals (18) are set, for each service, under three headings:

(a) Standards of Provision
(b) Impact
(c) Output and Cost

Examples are shown in Tables 8.3, and 8.4

(18) See example in Table 8.3.

B. Revenue Expenditure Projections

This is a capital expenditure schedule showing the revenue implications of that capital expenditure relating it to the revenue implications of other proposals and activities. A five years' projection of revenue expenditure is expected to be calculated.

Examples are shown in Table 8.5.

C. Action Programmes

The programming of the steps required to achieve the change and to bring about benefits and improvements in the services to the public. According to the consultants' Manual, action programmes should be drawn up for all improvement projects, including reorganization and redeployment of personnel, cost reduction activities, and for making major changes in procedures like paperwork, filing etc.

The method suggested is shown in Graph 8-4.

D. Programme Budget

The first year of the above mentioned "revenue expenditure projections" is known as the "programme budget". It shows, by programme headings, the pattern of expenditure for which the administration will be responsible, i.e. it is assumed that the "programme budget" will provide all the information needed for committees to consider expenditure in their programme.

Example is shown in Table 8.6.

E. The Capital Schedule

The "Capital Schedule" is an abstract of the capital proposals for each programme, showing the total cost to completion and planned expenditure in each year. It also indicates for those projects under way, the estimated performance against time and cost deadlines of each project. This document is considered to be useful for planning resource acquisition.

Example is shown in Table 8.7.

F. The Manpower Plan

The plan is a summary of the manpower requirements of each administration and section of the Corporation. The plan will be submitted to the Personnel Office and Personnel Committee for translation into programmes to fill the manpower needs of the Corporation.

See Table 8.8.

Table 8.3: Example of Utilization of Performance Measures

RECREATION AREA

Programme - Swimming.

Objectives: To provide swimming facilities within reach of every citizen and to encourage their use for recreation.

Programme Activities:

1. Design and constrction of facilities.
2. Maintenance.
3. Operation of plant and boilers.
4. Supervision
5. Ancillary facilities (coffee bars, etc.)
6. Pricing

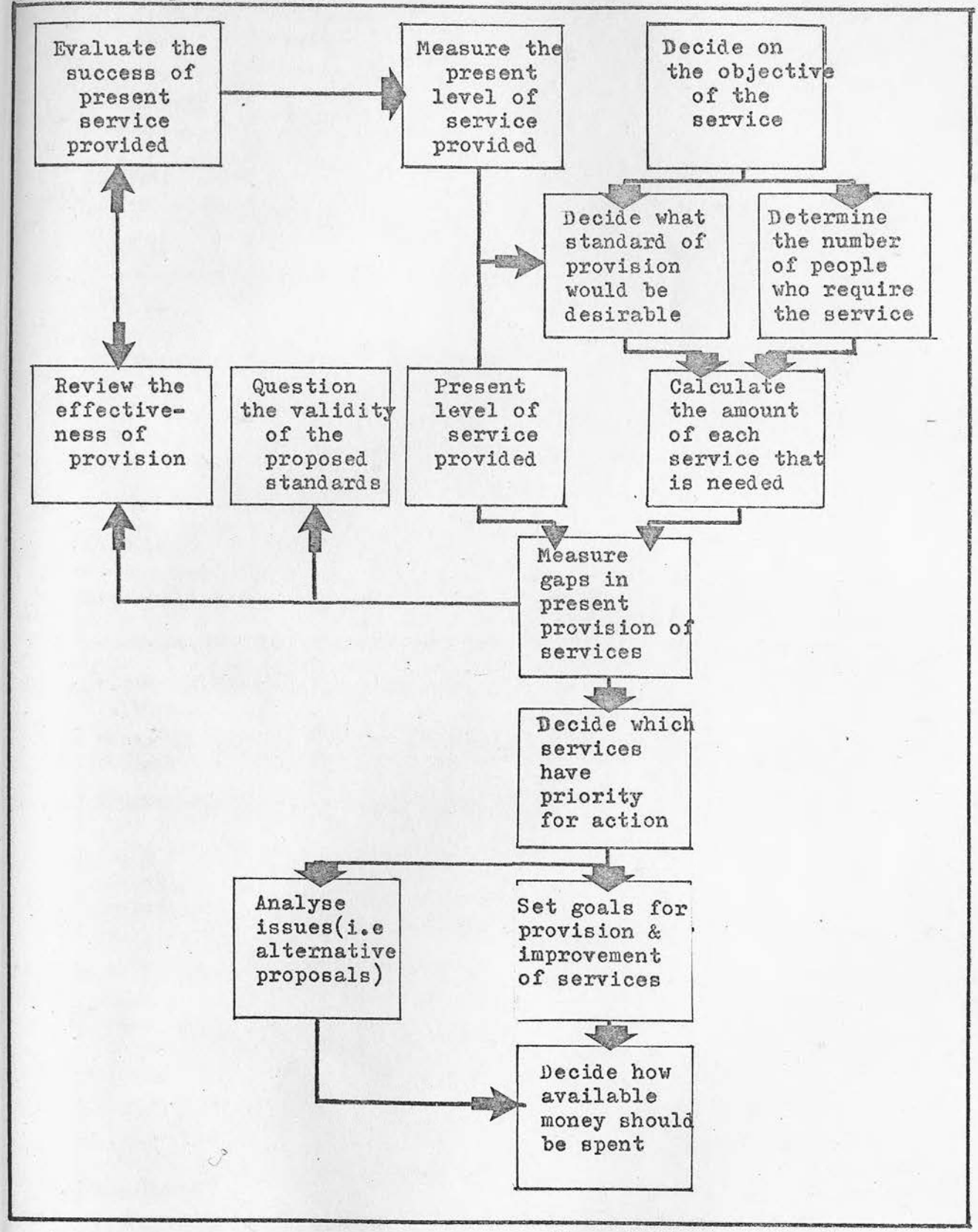
Performance Measures:

1. Provision
   (a) Number of people in catchment area per standard area (36 square feet) of swimming pool capacity, compared to national average peak-hour utilization.
   (b) Combined facility measure per group of enumeration districts.
   (c) Number of swimming instructions.
   (d) Number of teaching pools.

2. Impact
   (a) Number of users and age/sex classification.
   (b) Number of users at normal peak hours related to national trends of usage.
   (c) Number of people taking swimming instruction and passing swimming tests.

From: McKinsey & Co.Inc.
"A New Management System for the Liverpool Corporation"
(Exhibit X-1)

The Process of Deciding the Action Needed to Improve Services




From: McKinsey & Co.,Inc.
"Manual of Programme Planning",
Exhibit 1

Table 8.4: Performance Analysis Document

| | Name of Programme | | | |
|---|---|---|---|---|
| Performance Factors | Previous years | Current year | Trend over 5 years | Explanation of performance and other remarks |
| Provision | | | | |
| Impact | | | | |
| Output | | | | |
| Costs | | | | |

From: McKinsey & Co.Inc.
"Manual of Programme Planning"
Exhibit XIII.

Table 8.5: Revenue Expenditure Budget

| Programme Area | Planned 1969/70 | Estimated Actual 1969/70 | Planned | Net Change £ | Net Change % | Analyses net change | Brief comments and explanations |
|---|---|---|---|---|---|---|---|
| 1-(Name of Programme.)<br>-Salaries and wages.<br>-Superannuation and other running expenses<br>-Supplies and services<br>-Establishment expenses(direct)<br>-etc.<br>Debt charge.<br>Total controllable<br>-General establish- expenses (allocated)<br>Sub-total<br>Less:Total Revenue | | | | | | | |
| Total Net Revenue Expenditure | | | | | | | |

From: McKinsey & Co.Inc.
"Manual of Programme Planning",
Exhibit XVII.

Table 8.6: Example of Programme Structure and Budget

CHILDREN WITH SPECIAL NEEDS

| Elements | Activities | Costs |
|---|---|---|
| | | £000 |
| 1. ESN Children | 1.1 Day pupils in special schools | 533 |
| | 1.2 Resident pupils in special schools | 143 |
| | 1.3 Remedial teachers | 32 |
| | | 708 |
| 2. Children with physical handicaps and maladjusted | 2.1 Day pupils in special schools | 239 |
| | 2.2 Resident pupils in special schools | 108 |
| | | 421 |
| 3. Invalid Children | 3.1 LEA hospital schools | 16 |
| | 3.2 Teaching in other hospitals | 22 |
| | 3.3 Home teaching | 12 |
| | | 50 |
| 4. Mentally retarded children | 4.1 Junior training centre | 79 |
| 5. Delinquent children | 5.1 Remand homes | 29 |
| | 5.2 Approved schools | 140 |
| | | 169 |
| 6. Children with other needs | 6.1 Gian Alyn schools | 104 |
| | 6.2 Reception centre | 34 |
| | 6.3 Other boarding education | 4 |
| | | 142 |
| Programme Cost | | 1575 |

From: McKinsey & Co.Inc.
"A New Management System for Liverpool Corporation"
Exhibit XIV.

Table 8.7: The Capital Budget Document

| CAPITAL BUDGET SUMMARY<br>.....PROGRAMME ADMINISTRATION | | | | Programme Area | |
|---|---|---|---|---|---|
| CAPITAL PROJECTS | | A | B | C | |
| Approved figures | Total cost to completion | | | | |
| | Total cost borne by programme | | | | |
| 1969/70 | Planned expenditure | | | | |
| | Estimated actual | | | | |
| Total expended by programme at the end of 1969/70 | | | | | |
| Planned expenditure | 1970/71 | | | | |
| | 1971/72 | | | | |
| | Future years | | | | |
| Completion schedule 1970/71 | Indicated over-run (under-run by completion | | | | |
| | Original date | | | | |
| | Present Estimate | | | | |
| | | | | | Total £ |

From: McKinsey & Co.Inc.
"Manual of Programme Planning"
Exhibit XVIII.

Table 8.8: The Manpower Plan Document

| Manpower Plan<br>Transportation and Basic Services Programme Administration | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Staff | Planned | Actual | Allocation of major programme | | | | | Planned level 1970/71 | Planned changes | Pro-grammes affected | Method of achieving change |
| | | | 1 | 2 | 3 | 4 | 5 | | | | |
| Managerial | | | | | | | | | | | |
| Sub-Total | | | | | | | | | | | |
| Professional<br>Engineers:<br>Civil<br>Electrical<br>Mechanical<br>Trainee<br>Water<br>etc. | | | | | | | | | | | |
| Sub-Total | | | | | | | | | | | |
| Administra-tive support<br>Accounting staff<br>Clerical<br>Designers<br>Draughtsmen<br>Typists | | | | | | | | | | | |
| Sub-Total | | | | | | | | | | | |
| Direct Labour<br>Drivers<br>Mechanics | | | | | | | | | | | |
| Sub-Total | | | | | | | | | | | |
| TOTAL | | | | | | | | | | | |

From: McKinsey & Co. Inc.
"Manual of Programme Planning"
Exhibit XIX.

## 2.4 Fourth Operation: Issue Analysis

"Issue" is defined as: any aspect of any service for which more than one alternative exists.(19) Issues such as:

> What system of maintenance should the Corporation adopt for its housing stock?
>
> Should the Corporation build further civic laundries?
>
> Should the Corporation adopt frozen food for school meals?
>
> etc.

arise in all areas of the Corporation's services. The consultants' proposal is that the Corporation should build into its system of management the meahcnism for the explicit identification of issues and adopt a standard approach to their analysis. The approach proposed (see Fig.8-5) follows the same pattern (identification of alternative courses of action - evaluation against criteria derived from objectives of the programme in which the issue arises) previously discussed in chapter six of the present work.(20)

According to the Consultants, the "issue analysis process" is the key to better value for money in Liverpool. "The imagination and determination with which the analysis of issues is pursued by the new programme directors and their staff is the single most important factor that will affect the authority's performance in the future." (21)

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(19) In McKinsey and Cia.Inc., "A New Management System for Liverpool Corporation", p.4-5.
(20) See chapter six, section 4 of this work.
(21) McKinsey and Cia,Inc., "Manual of Programme Planning - City of Liverpool", p.5.

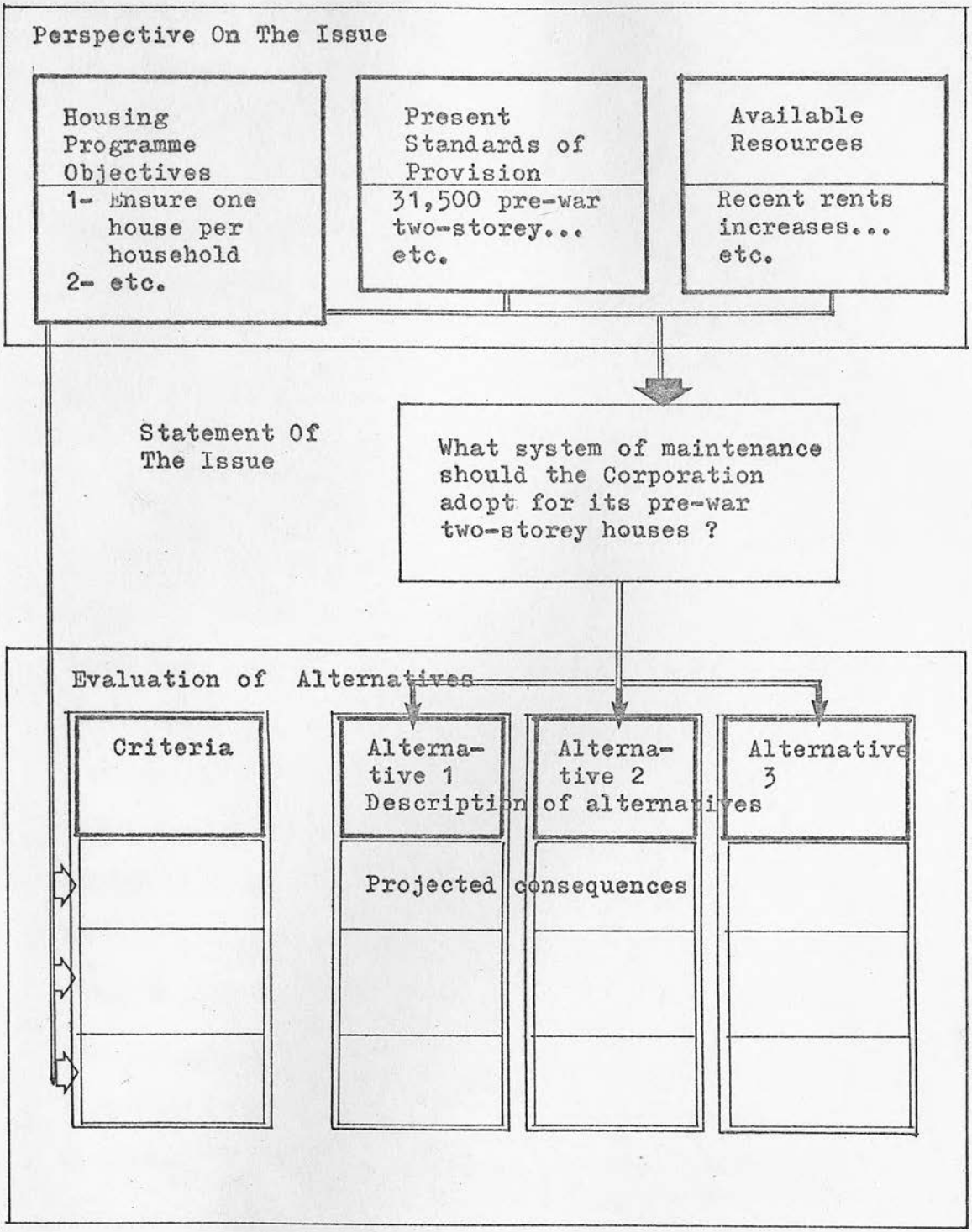


Illustration of the Process of Analysing An Issue.
From: McKinsey & Co., Inc.
" A New Management System for the Liverpool Corporation", Exhibit 11

3. Summary of Basic Characteristics

The Liverpool Corporation P.P.B.S. is a system for the planning and control of the Corporation activities. The system attempts to integrate the functions of policy-planning with those of budgeting into a continuous cycle of events: the planning cycle. This cycle starts with the process of Programme Definition Statement, in which programmes are selected and their objectives identified. In this stage of the "cycle" the following information is produced:

(a) The programme structure
(b) Statement of programme objectives
(c) Performance analysis
(d) Statement of standards, clientele and needs
(e) Gap analysis
(f) Narrative support and necessary analysis and exhibits. (22)

Based on the above mentioned information - and advised by the Chief Executive, the City Planning Officer, and the City Treasurer - the Policy and Finance Committee will draw some guidelines on priorities between programme areas, within programme areas and by geographic areas of the city. In addition, this "Committee" will provide a rough estimate of the next 5-years budget of the Corporation.

This information will provide the framework upon which the different programmes and departments of the Corporation will draw their plans of action and their budget. The cycle is repeated every year.

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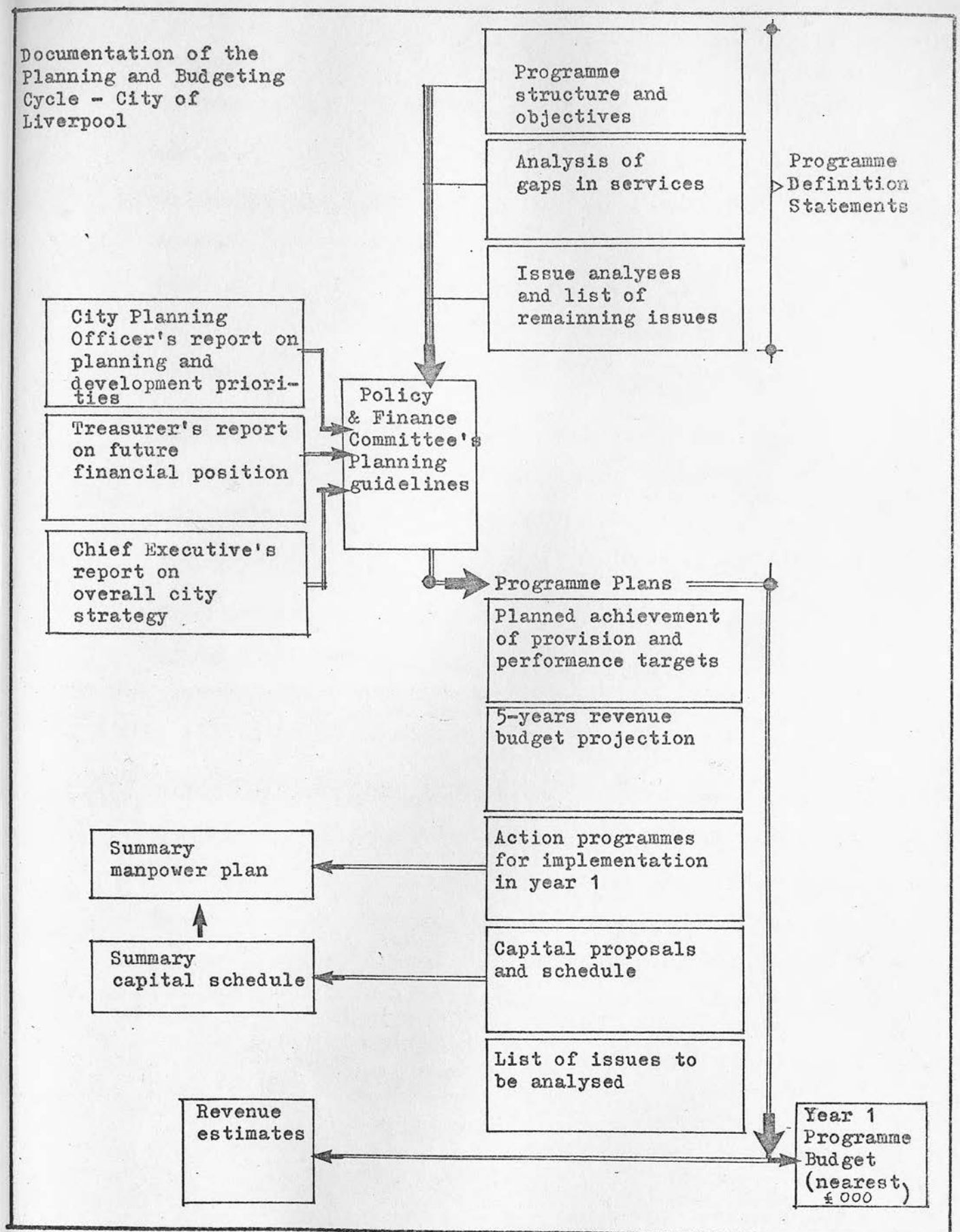
(22) See Graph 8-6.




From: McKinsey and Co.
"Manual of Programme Plan", exhibit 5.

## 4. Problems of Implementation

The Liverpool Corporation P.P.B.S. is probably the best known case of the application of systems ideas in local government in the U.K.[23] However, in our visit to the Corporation in November, 1973, we came to know that the system had never been fully implemented and moreover that the system is not used, at the present moment. Based on the information gathered in Liverpool,[24] we will try to explain why this has happened.

### 4.1 Problems of Integrations of Programmes

In spite of the huge work of reorganization of the Corporation's administrative structure - or probably because of it[25] - a real interdepartmental co-operation was never achieved.

The impression in Liverpool is that "McKinsey stopped short in offering proposals for inter-departmental machinery, so there was little formal corporate machinery available for planning."[26] Our own view of the problem is that, almost regardless of the type of administrative structure used, real team work - even among the members of the same department, not to speak of inter-departmental works - is a difficult goal to reach. Probably the answer (if any) to this problem is to be found, not in a change of the administrative structure of the departments, but in a

---

(23) In addition to Liverpool, P.P.B.S. has been applied by the London, Stockport, and Coventry local authorities.

(24) And on this point, we must express our gratitude for the help provided by Mr Alan Chape from the Liverpool Planning Department.

(25) In Liverpool they think that, before the reorganization, the task of interdepartmental coordination was easier to accomplish. The reason given is that the coordination between smaller units is always easier. At the present moment this coordination is more difficult because "the departments are presumed to be self-sufficient in research, policy formulation and execution". A. Wright, "Practical Implications of Corporate Planning", p.1.

(26) Ibid.

change of attitudes of the people working them. Our own experience in Edinburgh is that real team work can be achieved only after a slow and somehow painful process of education in which extra-mural contacts play one of the most important roles.(27)

4.2 Problems of Functioning of the "Policy and Finance Committee"

In our opinion, the cornerstone of the Liverpool Corporation P.P.B.S. was in the correct functioning of the "Policy and Finance Committee". The reason is obvious: this was the committee in charge of setting priorities between the different programmes of the Corporation. In other words, this was the place in which policy decisions were supposed to be made.
In the structure of government set out by McKinsey and Cia. the "Policy and Finance Committee" had the triple role of a) studying all the information provided by the departments and programmes of the Corporation, in order to b) set budgetary priorities between programmes. And in that sense, the Committee would have worked as a c) bridge between the technical staff and the politicians.
What actually happened was that it was found extremely difficult to develop a view on priorities between programmes, and because of that reason an "incremental" rather than a "zero base" view of the budget was adopted, i.e. rather than organizing the next year's budget according to the importance of different

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(27) As students at Edinburgh University, we have for two years participated in some project-works. At the beginning of that period, team work was almost non-existent among the members of our group. We needed two years of hard work to transform a bunch of individuals into a team. In this process, friendship, more than anything else, played the most important role.

programmes, the view adopted was to increase the budget of all individual programmes in a given percentage of past year's figures. In that way conflicts between programmes were thought to be avoided. However, we must point out that the problems of priorities between programmes - which were the reason of the whole P.P.B.S. exercise - were not solved. Moreoever, because it was understood that the same solution could have been reached without the use of P.P.B.S., the question in Liverpool was: what was the whole paraphernalia of P.P.B.S. about?(28)

4.3 The Council's Reaction

We must remember that one of the objectives of bringing McKinsey and Cia. to Liverpool was to achieve cost reduction.(29) However, what the use of the system showed to the Council was that more money had to be spent if existing gaps in services were to be filled. This fact created a climate of irritation among the Council members.(30) In addition, this irritation was increased because the Council

> "felt threatened by the complexity and opacity of the system, which they felt enabled the officers to blind them with pseudo-science." (31)

At the same time, the Council being a political entity, they were willing to keep a given amount of flexibility for political action.(32) To commit themselves - even in

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(28) The problems of forming an efficient "Policy and Finance Committee" are discussed in: F. Amos, "Systematic Local Government.
(29) See section 1 of this chapter.
(30) From A. Wright, op.cit. p.4.
(31) Ibid.
(32) Especially in Liverpool, P.P.B.S. has become a very controversial political issue. The reason is that the system was introduced when the Conservative Party was in power. Then it was reluctantly accepted by the Labour Party in its turn in power and, at present, is somehow rejected by the new group in power, the Liberals.

principle - five years in advance was not really kindly appreciated by the Council's members.(33) Furthermore, even if they had wanted to engage themselves in a five years' policy of action they would not have had the necessary financial information for doing so, because in practice it proved very difficult to get a good insight into the future financial possibilities of the Corporation. All these problems contributed to arouse great doubts about the usefulness of the whole system.

4.4 Problems of the use of standards

The process recommended(34) - to set standards; to calculate needs; to point out gaps in services - required, almost by definition, a wide use of a great variety of standards. Within the Corporation (especially among the Council members) there was the feeling that -

> "the use of standards of provision can institutionalise present action and stifle creative thinking about new ways of tackling problems." (35)

Again, we could say that in spite of the years that have passed since the von Neuman's "measure of satisfaction"(36) and despite all the studies of cost-benefit analysis,(37) the problem of the correct use, identification and quantification of standards of satisfaction is one of the greatest sources of controvery among planners.

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(33) Especially in the light of the proposed reorganization of local authorities in the U.K.
(34) See section 2 of this chapter.
(35) From A. Wright, op.cit. p. 4.
(36) See chapter 2, section 4.4 of this work.
(37) See chapter three of this work.

## 5. Conclusion

In our opinion, the use of P.P.B.S. in the Liverpool Corporation should have been based on the study of three different though inter-related types of systems:

(a) The city as a system: the relationships among the elements which make up the city of Liverpool, i.e. the knowledge of the "spirit of the city".

(b) The decision-making structure of the Corporation: the study of the formal and informal structure of relationships existent within the Liverpool Corporation.

(c) The system of planning and management to be used: the conceptual and technical characteristics of the Liverpool Corporation P.P.B.S.

We would have thought that a basic understanding of these three types of systems - and the relations among them - would have been the first move to be made towards the introduction of P.P.B.S. in Liverpool. However, we think that the people who introduced it focussed their attention only on two aspects of the whole problem. These aspects are:

(a) The "technical characteristics of P.P.B.S.

(b) Some aspects of the "formal" administrative structure of the Corporation.

Other important issues involved, such as: the "communication" problem between "analysts" and "politicians"; the introduction of a "philosophy" of systems thinking; the direct participation of the people in the decision-making process; the use of the "informal" channels of relations in the Corporation; etc. - have been completely neglected. The consideration of these

(and more) issues, would have helped to define a feasible system of planning and management for the Liverpool Corporation. However, as we have seen in our study, this was not done, and, in consequence, a system alien to the basic characteristics of the Liverpool Corporation was introduced. Therefore, the several conflicts generated by this action are not surprising.

# CHAPTER 9

## GENERAL CONCLUSIONS

1. The Problem: P.P.B.S.- A Closed System View of Society.
   - 1.1 P.P.B.S. centralises the decision-making process.
   - 1.2 Elements of a system viewed as "Black Boxes".
   - 1.3 P.P.B.S. offers an oversimplified view of the world.
   - 1.4 Summary.
   - 1.5 Corollary.

2. The Lesson: To open the closed system.

3. Epilogue: The Working Hypotheses of this work.

1. The Problem: P.P.B.S. a Closed System View of Society

Reference has already been made to the fact that when P.P.B.S. was introduced in the U.S.A. government agencies by former U.S.A. President, Mr Johnson, he expressed the opinion that the new system would make the decision-making process "as up to date as our space exploratory programmes".(1) In our opinion, this was a very unfortunate "analogy",(2) because the problems of putting a satellite into orbit cannot be equated with the problems of making decisions in, let us say, the government of the city of New York.

> "Putting a satellite into space is primarily an exercise in the well disciplined physical sciences". (3)

whereas

> "developing a city and supplying its services involves the adjustment of a people's undisciplined emotions, hopes, and dreams to the limited resources that reality permits". (4)

In other words, the former problem is mainly(5) concerned with the control of closed "mechanical" systems, whilst the latter is mainly referred to the understanding and guidance of open "biological" systems. It is important to make clear this difference, because, in our opinion, there are some shades of Huxley's "Brave New World"(6) in which people are considered to be elements of a gigantic electronic machine - in the view of society as a closed system.

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(1) See chapter six, section 1, of this work.
(2) See chapter one, section 2.2.5 of this work.
(3) Quoted from W. Ross, "Some Perspective on Federal P.P.B.S." in "Planning 1967", American Society of Planning Officials, p.87.
(4) Ibid.
(5) See chapter one, sections 2.2; 3.2.2; 4; of this work.
(6) A. Huxley, "Brave New World", Penguin Modern Classics.

The point is that, in this study, we have come across some evidences which make us think that the model of society considered in P.P.B.S. tends to be more "closed" than "open". The most important of these evidences are the following.

1.1 P.P.B.S. centralises the decision-making process in very few hands.

i.e. the organization most suitable for using P.P.B.S. is the one in which decisions are made by the individual (or committee) who sits on top of its hierarchical structure.(7) This individual (or committee) is supposed to receive information from all the other components of the system (i.e. a feed-back process will be established) to decide upon issues which will affect the system as a whole. As opposed to the above described process, it is assumed that in an open system, decisions are made on all levels of the system and that these decisions will enhance and promote the "self-organizing" properties of the system.(8)

1.2 In P.P.B.S. the elements of the system are viewed as "Black Boxes"

According to the "Black Box" theory,(9) the input and output characteristics of a given system will provide enough information so as to enable the analyst to control it. Thus, "Black Box" theory is neither concerned with the internal characteristics

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(7) See chapter six, section 3; chapter seven, section 5; and chapter eight, section 2.2 of this work. For more information let us quote R. MacNamara (who directed the introduction of P.P.B.S. in the U.S.Department of Defense): "Vital decision-making, particularly in policy matters, must remain at the top. This is partly, though not completely, what the top is for". Quoted by T. Roszak, "The Making of a Counter Culture", p.12.

(8) See chapter one, section 2.2. of this work.

(9) See chapter one, section 3,3, and chapter four, section 5, of this work.

of the system nor with the processes through which inputs are converted into outputs. It is our opinion that P.P.B.S. follows exactly the above described theory. In P.P.B.S., organizations are viewed as "Black Boxes" whose input/output characteristics (called "indicators") are studied by the analyst in order to increase their efficiency (i.e. to control them). Thus, if the main objective of government planning is the control of society, then a system of planning and control like P.P.B.S. must be used. However, we think that the planner's main task should not be concerned with the "control" of society, but with the understanding of its basic characteristics to enhance its own self-development possibilities. In other words, we think that the "planner", the "analyst", or the "politician" exist to serve and not to be the masters of society. P. Geddes used to say that our quest as planners "cannot be attained without participating in the active life of citizenship".(10) This is a very simple statement, but it is full of meaning, for it makes us remember that if we are planning for human groups (as opposed to controlling human groups) we must study these groups from within,(11) and must not consider them as "Black Boxes" whose only important characteristics are their inputs and outputs. For us it is very sad to read, for example, what R. Ackoff writes:

> "the characteristics of human beings which are of concern are usually no different from those of a machine which could perform the same task". (12)

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(10) P. Geddes, "Cities in Evolution", p.318.
(11) Or, as P. Geddes says: "Still more we must take our share in the life and work of the community if we would make this estimate an active one" Ibid.
(12) R. Ackoff, "The Meaning, Scope, and Methods of Operations Resources" in "Progress in Operations Resources", Vol.I. R Ackoff(ed) p.26.

This is the type of opinion which makes us oppose the use of a closed system oriented P.P.B.S., because to accept R.Ackoff's kind of opinion is to forget that the subject matter of planning is not facts and figures or incentive machines, but people, just like ourselves.

1.3 P.P.B.S. offers an oversimplified view of the world

P.P.B.S. is sometimes referred to as the "common sense approach to decision-making".(13) The problem is that we do not know whose common sense they are talking about.

"Common-sense" is one of these catch-words which the widespread usage has rendered completely meaningless. The Oxford Dictionary of Current English defines the word as the "practical good sense gained by experience of life, not by special studies",(14) i.e. it is "experience" which dictates the common-sense, and because "experiences of life" differ from period to period, people to people, city to city or nation to nation, we must realistically assume that the "practical good sense" will differ accordingly. Nonetheless, to some P.P.B.S. writers, "common-sense" seems to be synonymous with "the agreed way of doing the right thing, or thinking about different issues", and not with "the particular point of view of a given group of people on how things must be done".

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(13) See e.g. A. Rivlin, "Systematic Thinking for Social Action", p.3. See as well A. Enthoven, "The Systems Analysis Approach", in "Program Budgeting and Benefit-Cost Analyses", H. Hinrichs and G.Taylor (eds.) p.159.

(14) The Oxford Dictionary of Current English, p.190.

We have brought this point to the discussion, for we think that the roots of many conceptual problems of P.P.B.S. can be found in the exaggerated belief that a common consent may exist in all types of society's issues, and that "common sense men" will soon arrive at this universal agreement.(15) We tend to agree with the view that in a world in which universal agreement was an easy thing to be reached, the function of budgeting would have been a problem of common sense choice and not, as it is now, a process in which "bargaining, negotiation, compromise, creative integration, changing conditions, pressure, control and regulations"(16) are involved.

It is our opinion that only in the hypothetical world of "universal agreement" could it have been accepted without doubt that -

"satisfaction","happiness", and "well-being" could be described and furthermore "measured".

trade-off could be established in situations in which society's "gains" and "losses" could be identified, quantified and valuated.

"Gainers" could compensate the "losers" without political conflicts.

"Government programmes of action could be created, integrated, disintegrated, monitored and suppressed without any significant problem.

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(15) e.g. R. McNamara writes, "As paradoxical as it may sound, the real threat to democracy comes, not from overmanagement, but from undermanagement. To undermanage reality is not to keep free. It is simply to let some force other than reason shape reality. That force may be unbridled emotion... it may be ignorance, it may be inertia, it may be anything other than reason. But whatever it is, if it is not reason that rules man, then man falls short of his potential." Quoted by Roszak, "The Making of a Counter Culture", p.12.

(16) From I. Galnoor and B.Gross, op.cit. p.24.

> "Top" men (e.g. analysts, planners, managers and politicians) could discuss and decide upon issues which may affect the society as a whole.
>
> In a word, it is only in the world of "universal common sense" that a system like the P.P.B. could efficiently be implemented.

However, probably because resources are scarce, or maybe because everybody's common sense tends to be biased towards their own interests, or simply because people have been moulded by different experiences, we are aware that few are the society's issues in which a certain form of common consent exists. We must remember that in the name of "common sense" wars have been fought, cities have been destroyed, nature has been polluted, P.P.B.S. has not been accepted in several places, etc., and probably in all these situations one group of human beings has always wondered why "the others" do not have the "common sense" to understand the rationality of their arguments.

We are not here to make a value judgement on what kind of world we would have preferred to be born into, but simply to show that the view of the world presented in P.P.B.S. means an oversimplification of a reality which is richer, more complex and in consequence more conflictive than the somehow "mechanical" world of P.P.B.S.

1.4 Summary

In this section, the opinion has been given that the main problem of P.P.B.S. is that it is based on a closed system view of society. This opinion has been attempted to be

justified by means of the following arguments:

(a) P.P.B.S. considers the existence of a strong hierarchy of social organization.

(b) The method of approach in P.P.B.S. is based on the "black box" thesis which is aimed at the control of social groups rather than at the promotion of the self-development possibilities of society.

(c) P.P.B.S. offers a somehow simplistic "mechanical" view of the world.

1.5 Corollary

If the problems of P.P.B.S. are said to be the consequence of its closed system view of society, then we must look for the way of transforming this "closed" into an "open" system. This is the issue we attempt to discuss in the last section of this work.

2. Lesson: To open the closed systems

P.P.B.S. came into being as the response for the demand for a method of government decision-making to be used in the problem of allocation of scarce resources among competing claims.

The above mentioned problem is a very difficult one indeed, for - which could be the "technical" way to justify that in a country roads are more useful than open spaces, houses than industry, education than food, or military weapons than hospitals?

In our estimation, in a world of conflicting interests, "budgeting means politics",(17) i.e. the "right way" is

(17) Ibid p.25

only a matter of opinion, and what is "optimal" for the "gainers" will not be the same for the "losers". In this context, we consider that the "technical" opinion should be considered just as such, i.e. the particular point of view of an articulate group of people, with an academic background, and who have been moulded in a given way by their theoretical and practical experience. They should not be given, however, the last word in the discussion of the issue. It could be argued that because analysts and planners have more and better information about society's problems, their opinion must be considered decisive in the matter to be discussed. We tend to view the problem from a different angle. We think that the way to know more about the problems of society is with society itself participating in the discussion, i.e. the cornerstone of a good system of planning is an efficient system of people's participation.

We will attempt to present our views on the subject of public participation - and its connection with P.P.B.S. - by using the following illustration:

Let us put ourselves into the situation of having to select a job among several employment opportunities. The question is: which kind of criteria will guide our decision?

Our personal view in the matter is that, although the salary involved is a useful element to be considered, it does not cover the whole range of criteria needed for making a decision, i.e. the "salary" criterion will not tell us whether we are going to enjoy the job or not. Therefore considerations such

as the nature of the job offered, its degree of interest, the people we will work with, the social projections of our work, the overall working environment, our possibilities for learning, etc., ought to be included in the analysis too. The job selected will reflect our personal appreciation of the type of employment we think we will like best. This job will probably not be the one which offers the highest monetary remuneration. If this view is accepted, let us go one step further in our analysis, by talking about the nature of the above mentioned criteria of selection. Among these criteria, a difference could be established between the "salary" and the other type of criteria listed:

> The "salary" criterion could be viewed as the measurable indication of the degree of satisfaction we expect to get from the job, i.e. the "salary" can be considered as our personal "quantifiable" output from the job.
>
> The other type of criteria could be seen as the qualitative information of the satisfaction we expect to obtain in the process of working, i.e. they will provide most of the information on whether we are going to enjoy our work or not, and although they are very "subjective" and very difficult to quantify, they constitute a main argument to be considered in the process of decision-making.

Linking this illustration with the P.P.B.S. method of approach, we may say that, by and large, the criteria for decision-making used in P.P.B.S. are akin to the salary-type of criteria presented above, i.e. they are: a) mainly quantifiable, and b) referred to the input/output characteristics of a process and not to the process itself.(18)

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(18) See chapter six, section 4.2.3. of this work.

In our illustration, we advanced the hypothesis that the use of the "salary" as the only criterion for selection of a given job will not provide the full image of the satisfaction we are supposed to obtain in the process of working.

This hypothesis, applied to the case of P.P.B.S., reads in the following way: the use of the present set of input/output criteria in P.P.B.S. is not enough to provide a full image of the problems and possibilities involved in the social process of living. What is implicit in the above formulation is that P.P.B.S. should be directed not towards an increase in the number of input/output indicators, but towards a change in the quality of information considered in the analysis. This information should be referred rather to the study of the problems and possibilities involved in the process of living than to the enumeration and quantification of the final outputs.

By and large, this new type of required information may have the following characteristics:

(a) They may be referred to "subjective" human manifestations, like: "intuition", "feelings", sensitivity", "love", "joy", etc.

(b) It is difficult to define and even more difficult to quantify, let alone be evaluated in monetary terms.

Considering the special characteristics of the above mentioned type of information, the obvious question should be: if this information is so difficult of even being defined, how will the planner be aware of its relative importance?

In our opinion, the best witness of people's feelings and emotions is the people themselves. Therefore, a planning process which attempts to take into consideration the above referred type of information will require, almost by definition, the direct participation of the people in the process of decision-making. Thus, from the above argument, the following conclusion could be drawn:

Real citizen-participation in the decision-making process is the necessary condition to open the hitherto "closed" P.P.B. System of planning.

This conclusion may be complemented with the following ideas:

> Real "citizen-participation" means, in our opinion, not only people's consultation, but a real transfer of power from professionals (planners, analysts, city managers) and politicians to the people, who in the last analysis are those directly affected by government policies and programmes of action. (19)
>
> We do not believe that citizen-participation will make the decision-making process easier but better, i.e. more in agreement with the very complex human reality of the citizen concerned.
>
> We are aware of the fact that, like most things in planning, "democracy by participation" (20) may be a difficult goal to reach.(21) However, we must admit that in spite of all the difficulties which we could meet up with, our particular "emotions", "feelings", and "common sense", are all for a system of people's control upon the planning process rather than for a system of planning which attempts to control the people.

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(19) J.B. Cullingworth, "Problems of an Urban Society", Vol.2, "The Social Content of Planning", p.160.
(20) Ibid.
(21) Probably the first problem to be studied in the issue of Public Participation is that of deciding "who are the people", or, as J.B. Cullingworth says, that of answering the crucial question, "Who decides who gets the goodies". From ibid, p.161.

## Epilogue: The Working Hypotheses of this Work

The different working hypotheses on the meaning and value of P.P.B.S. considered during the development of this work will be presented in this section.

This work was initiated with the following idea about P.P.B.S.:

> P.P.B.S. is a planning and management tool which can assist any administration in the problem of allocation of resources, to decide what to do, how much to do, and when to do it. (22)

Thus, in the first stages of this work, we considered P.P.B.S. as a planning technique like Linear Programming, P.E.R.T., etc., and consequently we devoted a great deal of attention to the study of the above mentioned types of techniques.(23)

However, this opinion about P.P.B.S. suffered a first modification after having studied the Cost-Benefit Analysis Principles, for we found Cost-Benefit Analysis so controversial that any planning concept which, like P.P.B.S., was based on it, could never have been used in a straightforward manner.(24) Based on this idea, we drew a second hypothesis about P.P.B.S.:

> P.P.B.S. is rather a general approach than a particular technique. Its value in planning is in direct relationship with the grasp of its basic principles rather than with the slavish adherence to the letter of any P.P.B.S. manual. (25)

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(22) See the Introduction of this work.

(23) See chapter two of this work.

(24) See chapter three of this work.

(25) By and large, this is the conclusion put forward in chapter six of this work.

We studied the problems of implementation of P.P.B.S. in the U.S.A. and the U.K., attempting to corroborate the above mentioned hypothesis. From the study of the American experience the following conclusion was reached:

> The unsuccessful application of P.P.B.S. in some U.S. Government Agencies can be attributed to the fact that these agencies gave more importance to the letter rather than to the basic principles of P.P.B.S. (26)

On the whole, this conclusion is in agreement with the aforementioned second hypothesis about P.P.B.S.

However, the study of the Liverpool Corporation experience with P.P.B.S. provided new insights(27) from which a third hypothesis about the new system has been drawn. This is as follows:

> The fact that P.P.B.S. is based on a "closed" and oversimplified view of society constitutes one of the main reasons which makes difficult the acceptance and use of some of the P.P.B.S. basic principles. (28)

This hypothesis has been presented as one of the main conclusions of this work, and in this chapter we have attempted to explain and justify it. We must say, nevertheless, that this conclusion should be considered as yet another hypothesis, and, as such, possible of being modified or rejected with the addition of new information about P.P.B.S., i.e. the P.P.B.S. issue is still open for discussion and learning.

Joaquin Maruy Tashima,
Edinburgh, 19.2.74.

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(26) See chapter seven of this work.
(27) See chapter eight of this work.
(28) See section 1 of the present chapter.

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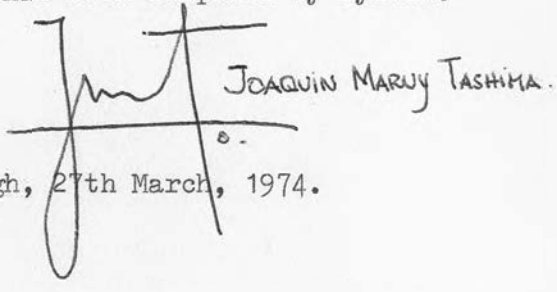
Regulation 2.4.15 for Postgraduate Study.

DECLARATION

I hereby declare that this Thesis embodies the results of my own special work, and that it has been composed by myself.




Edinburgh, 27th March, 1974.