

# FIELD PAPERS

## SOMALIA

Outline for a Workshop  
on  
Systems Approach to Planning

June 1986

### IEES

Improving the  
Efficiency of  
Educational  
Systems

Florida State University  
Howard University  
Institute for International Research  
State University of New York at Albany

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# SOMALIA

## Outline for a Workshop on Systems Approach to Planning

Frederick L. Dembowski

June 1986

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## TABLE OF CONTENTS

	Page No
Planning Workshop	
Introduction .....	iv
Tentative Outline for the Workshop .....	v
Introduction to Systems Theory.....	1
The Systems Approach to Management.....	2
Planning .....	6
Steps in the Planning Process .....	11
Goals and Objectives .....	14
Development of Strategies and Policies .....	15
Decisionmaking .....	16
Budgeting .....	18
Forecasting .....	19
Forecasting Using the Ordinary Least Squares Regression Technique.....	20
Forecasting Using Linear Regression .....	22
The Role of Diagnosis in Educational Planning .....	28

## PLANNING WORKSHOP

SOMALIA, JUNE, 1986

### Introduction:

This workshop is intended to give a broad overview of the planning techniques needed for efficient use of a computer based management information system. The conceptual base for this workshop is the premise that planning is but one of the processes required for the efficient management of an organization. Thus, a base of Systems Theory and general management theory will be given first, followed by an extensive treatment of planning techniques. Once the planning techniques have been covered, their application in a computer based management information system will be discussed. The advantages of the use of a data base system will be reviewed, and the procedures for the setup of a data base system using LOTUS 1-2-3 on the WANG microcomputer will be reviewed. The data base that is presently established in the Ministry of Education in Somalia will be examined, and ways to improve its efficiency of operation will be discussed. Finally, extensive treatment of forecasting techniques, including the cohort survival technique for forecasting enrollments, and the ordinary least squares regression technique will be discussed. Throughout the Workshop, practical applications using the five year plan already in place in Somalia, as well as the computerized data base on the WANG microcomputers will be emphasized.

## Tentative Outline for the Workshop

Date	Topic
June 3	Start of Workshop, Introduction to Systems Theory, Introduction to Management Theory
June 4	Management Theory Continued, Introduction to Planning.
June 5	Introduction to Planning, Continued
June 6	No Class
June 7	Planning and Control, Types of Plans
June 8	No Class
June 9	No Class
June 10	Steps in the Planning Process - the Systems Approach to Planning
June 11	Goal Setting, Management by Objectives
June 12	Review of Somalia Five Year Plan
June 13	No Class
June 14	Review of LOTUS 1-2-3 Data Base Management Commands.
June 15	Conversion of current Somalia lotus files into a data base management system
June 16	Principles of Questionnaire Design, and coding
June 17	Data Analysis Techniques and Statistics
June 18	Introduction to Forecasting Techniques
June 19	Application of Forecasting Techniques
June 20	No Class
June 21	Demographic Analysis
June 22	Demographic Analysis, Continued
June 23	Last Workshop Session, Review and Summary

## INTRODUCTION TO SYSTEMS THEORY

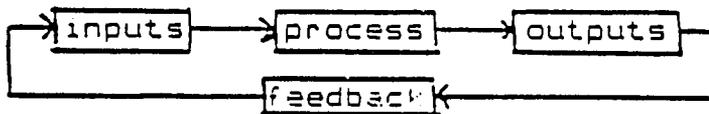
Systems theory provides a general way of visualizing how all the parts of an organization fit into a whole and interrelate with each other.

Definition of a system - a set of interconnected, interdependent things that form a complex whole.

A system may be physical, such as a train, biological, such as the human body, symbolic, such as a mathematical model, or theoretical, such as a set of concepts, principles, and techniques relating to a theory of management.

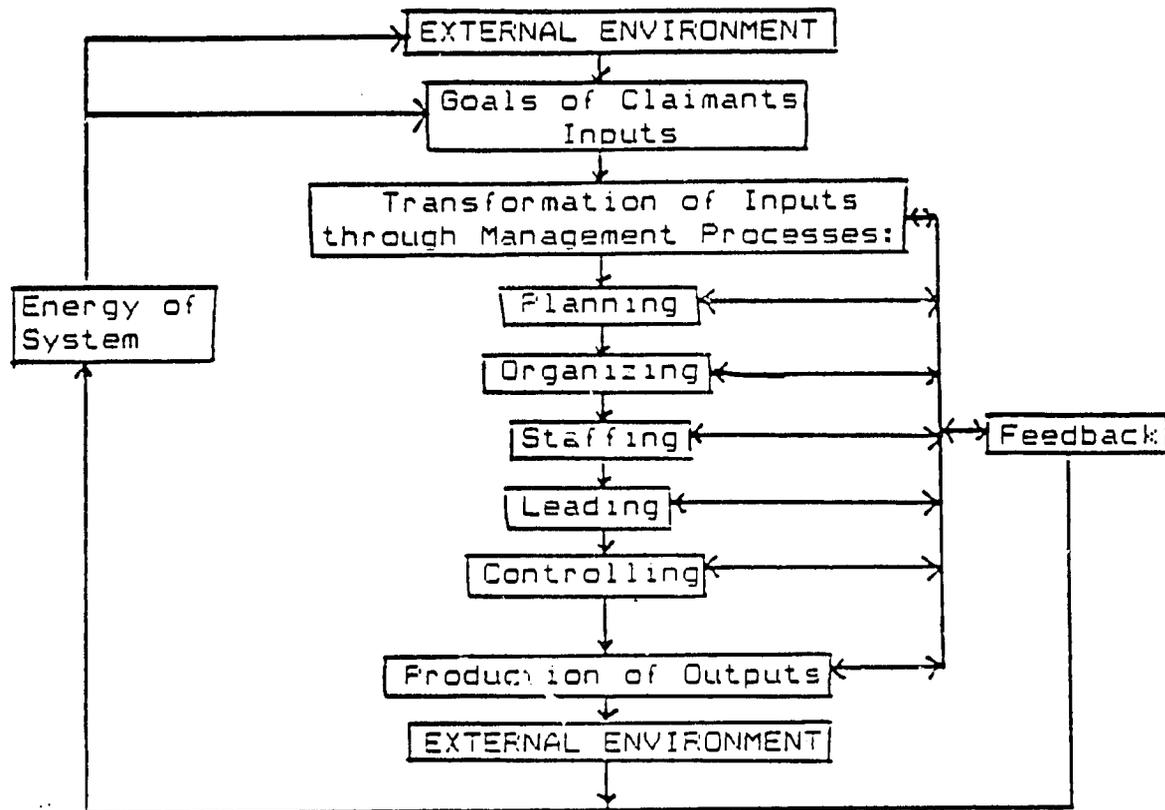
General Outline of a System:

1. systems have inputs, processes, and outputs  
inputs - what goes into the system  
process - what takes place in the system  
outputs - the result of the system
2. systems have boundaries that are defined by the user of the systems approach.
3. systems may be open or closed - all systems are open for most purposes.
4. all systems have "feedback loops", otherwise they would become nonfunctional.
5. the basic design of a system may be depicted as follows:



## THE SYSTEMS APPROACH TO MANAGEMENT

The systems approach to management may be viewed as follows:



### Discussion of the Systems Approach to Management

Organizations are dependent on their environments and are part of larger systems called society and the economy. Thus, the systems must be responsive to the needs and requirements of the economy and the society in which they exist or they will cease to be functional.

Claimants from the external environment - there are many different claimants in the environment. It is the managers job to reconcile all these claims, and transform them into the operations of the organization.

It is also the job of the manager to organize the inputs, processes and outputs of the organization in such a way that the claims of society are met in an efficient and effective manner.

## THE SYSTEMS APPROACH TO MANAGEMENT

### The Functions of Managers

In a systems approach to management, there are several primary functions of managers that are interconnected to form a viable management system. These functions are as follow.

1. Planning - is essentially decision making, selecting courses of action that the organization will follow. Planning involves an analysis of alternatives. Planning is deciding in advance what to do, when to do it, who to do it, where to do it, and how it will be done. Planning fills the gap between where the organization is at present in the process of fulfilling its goals and objectives, and where it wants to be at some point in the future.

2. Organizing - organizations are simply groups of people working together to achieve common goals. These people all have roles to fulfill, each with their own unique sets of goals and objectives. The functions of the manger in organizing are:

- a. determining what organizational activities are required,
- b. grouping organizational activities into departments or programs,
- c. assignment of activities to managers,
- d. delegation of authority,
- e. providing for coordination of activities, authority, and communication links within the organization.

3. Staffing - filling and keeping filled positions in the organizational structure, setting requirements for activities to be accomplished, determining compensation levels, providing for training programs, recruitment of qualified personnel, and the evaluation of employees.

4. Leadership - influencing people so that they will strive willingly to achieve the goals of the organization. Leadership involves motivation of employees, adoption of a leadership style, approaches to leadership, and establishment of communication links with employees.

5. Controlling - the measurement and correction of the activities of subordinates to ensure that events that take place within an organization conform to plans. The manager measures performance against the goals and objectives of the organization, pointing out where problem areas lie for corrective action, and shows where excellent performance is taking place for recognition. Plans are not self achieving; they need controls to be effective. Some control mechanisms are:

- a. budgets - expense controls,
  - b. inventories - supply and equipment controls,
  - c. inspection records - activity controls,
  - d. performance evaluation - personnel controls.
- Outcomes of the organization are controlled through the monitoring and adjustments of the input mix and processes of the organization.

6. Coordination - the feedback mechanism of the organization. Is involved in determining how well the goals of the organization are being met and the communication of this information throughout the organization through continual coordination of activities across organizational structural lines.

## Definition of efficiency and effectiveness:

There are two kinds of efficiency - technical and allocative

Effectiveness is meeting the goals set for the organization. Thus, an organization may be effective, but not efficient.

## CHARACTERISTICS OF SUCCESSFUL ORGANIZATIONS

1. were action oriented
2. knowledge of the needs of their clients
3. promoted managerial autonomy
4. promoted productivity by recognizing the needs of their workers.
5. had a positive organizational philosophy
6. focused on business they knew best
7. had a simple organizational structure
8. were both centralized and decentralized

Management is an art and a science. The practice of management is an art, the theory and concepts of management are the science.

Parkinson's Law - work tends to expand to fill the time available. Question - is the time being spent efficiently and effectively?

Management principles are descriptive, not prescriptive. For example, the law of gravity tells us that we will fall if we jump off of a building, it does not tell us to jump!!

Henci Fayol - the father of modern management:

1. authority and responsibility are related, with responsibility rising from authority
2. unity of command - employees should receive orders from only one superior.
3. chain of superiors - from highest to lowest - should be departed from only when absolutely necessary
4. esprit de corps - teamwork is important as well as a sense of mission.

Elton Mayo - Hawthorne Studies - people work better when they are paid some attention; that is the manager's job!

## PLANNING

### Introduction

A manager's most essential task is to see that everyone in the organization understands the goals and objectives of the organization and is working towards their attainment. If the organization is to be effective, then the members of the organization must know what the purposes of the organization are. This is the function of planning.

Definition of planning: the selection of the future courses of action from among all the alternatives available to the organization. It requires the selection of the organization's overall objectives, the departmental goals, and determination of the methods used to achieve them. These goals and objectives are both short and long range.

The plans provide a rational approach to preselected objectives. Planning bridges the gap between where we are and where we want to go with the organization.

The difference between planning and forecasting is that the planner does not want to leave the future to chance but wants to affect future events. The forecaster simply wants to see what the future events may look like, but does not necessarily want to effect them. Forecasting, however, is an essential part of the planning process.

### The Nature of Planning:

Planning has four major features in it's nature.

1. its contribution to the goals and objectives
2. its primacy among the manager's tasks
3. its pervasiveness in the organization.
4. the efficiency of the resulting plans.

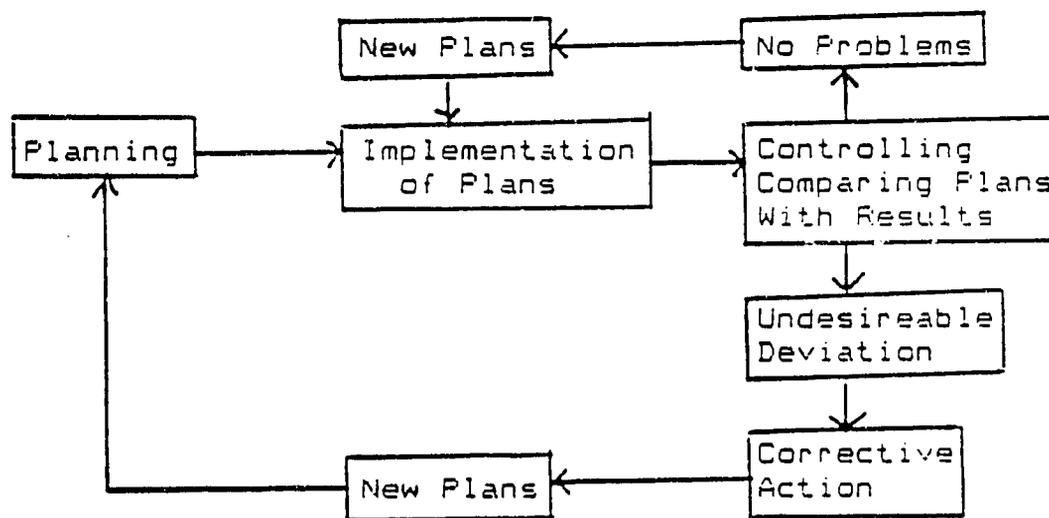
The Contribution of Planning to Goals and Objectives - the purpose of the planning process is to contribute to the accomplishment of the organization's purpose. An organization is in existence in order to accomplish a group purpose through deliberate cooperation.

Primacy of planning - planning precedes all of the other managerial functions and activities of the organization. Planning and Controlling are inseparable managerial activities. Unplanned action cannot be controlled, for control means keeping activities on planned courses of action. Plans, through the articulation of the organizational goals and objectives, if properly devised, provides the standards of control.

Pervasiveness of planning - planning is a function of all levels of management within an organization, and unless all levels of supervision within the organization have some planning responsibilities, they cannot be called managers. Some people make a distinction between a manager and an administrator, as a manager is more of a policy maker because he has a greater degree of planning within his job tasks. However, all managers plan, and the degree to which managers are successful, is the amount of planning that they do. In fact, studies have shown, that if managers and supervisors are not involved in planning, they are not as effective or as satisfied with their work on the job.

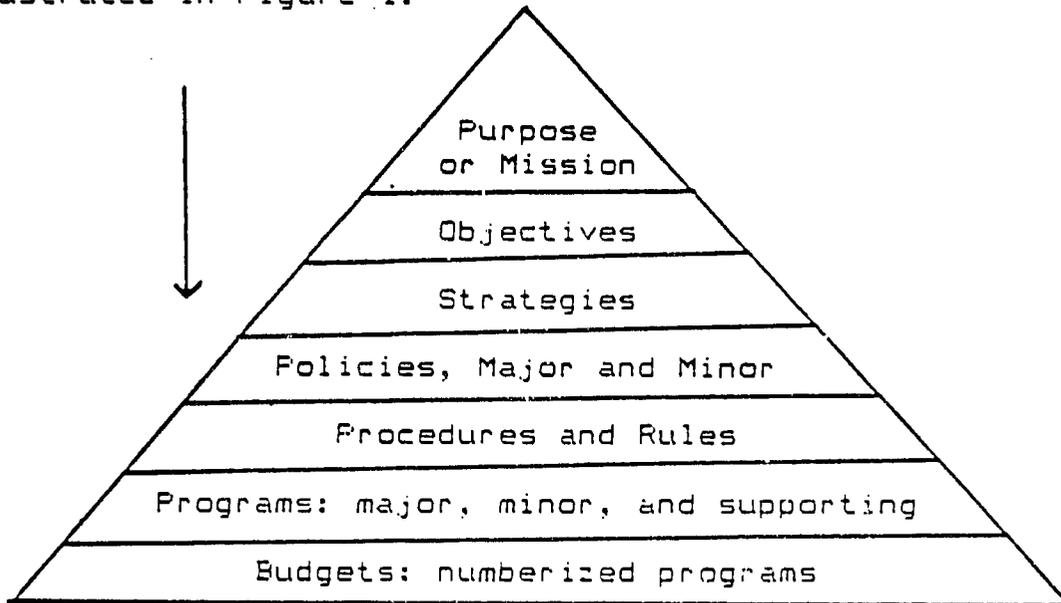
Efficiency of Plans - a plan is efficient to the extent that it contributes to the accomplishment of the organization's goals and objectives., offset by the costs and other factors required to formulate and operate it. A plan is inefficient if it attains the goals and objectives of the organization but at an unnecessarily high cost. Costs are measured not only in monetary terms, but also in worker satisfaction terms, both individual and group, as well as meeting the needs of its clients.

Relationship of Plans to Controlling:



## Types of Plans:

There is a hierarchy of types of plans, as illustrated in Figure 1.



THE HIERARCHY OF PLANS  
Figure 1.

**Purpose or Mission** - the basic function or task of the organization, often stated in conjunction with an organizational philosophy.

**Goals** - the ends towards which the organization is striving stated in a general manner.

**Objectives** - specific ends towards which the processes of the organization are striving to attain, stated in behavioral terms that may be evaluated.

**Strategies** - the grand plans that reflect the broad programmatic aims of the organization; usually stated by three definitions.

1. general programs of action and deployment of resources to attain comprehensive objectives,
2. the program of objectives of an organization, resources used to attain these objectives, and the policies governing the acquisition, use, and disposition of these resources, and

3. the determination of the basic long term objectives of an enterprise and the adoption of courses of action and allocation of resources necessary to achieve these goals.

**Policies** - general statements or understandings which guide or channel thinking and actions in decision making. Policies define an area in which decisions will be made and ensure that the decision will be consistent with, and contribute to, the attainment of an objective. Policies help decide issues before they become problems, and make it unnecessary to reanalyze the same issue everytime it comes up. Policies should exist at all levels of the organization. Since policies are to be used as guides to decision making, they should leave some discretion to the decision maker, otherwise, they become rules.

**Procedures** - plans that establish a required method of handling future activities, or guides to actions, rather than to thinking. They are typically a chronologically sequenced series of required actions. Procedures may be nothing more than formalized standards of performance, or the way things have always been done, except now in writing. The lower in the organization, the more exacting and specific the procedures should be, with less discretionary leeway. Procedures should be established to put policies into practice.

**Rules** - spell out specific required action or nonaction, allowing no discretion. This is the simplest type of plan. Rules are unlike policies or procedures because they follow no time sequence, but are always in force.

**Programs** - complexes of goals, policies, procedures, rules, tasks, assignments and steps to be taken, resources to be employed, and other elements necessary to carry out a given course of action. They are ordinarily supported by their own budgets. A primary program may call for many supporting sub-programs.

**Budgets** - a statement of expected results expressed in numerical terms. It may be in financial terms, stating the financial resources to be used, or a program budget stating the other non-financial resources to be used as well as the financial, and it usually states the anticipated results in numerical terms. Budgets are primarily control devices, but may be used as planning devices also. There are many ways to build budgets, including serial budgets, program budgets, and zero-based budgets. Program budgets and zero-based budgets are primarily used as change agents.

## Discussion of the Steps in the Planning Process:

1. Being Aware of Opportunities - although not strictly a part of the planning process per se, this step should precede planning. Involves an examination of the strengths and weaknesses in our organization; what is it doing well? What are its problem areas? What are our priorities? Definition of the "GAP" - where are we now? Where do we want to be?

2. Establishing Goals and Objectives - establish a philosophy of operation for the entire organization, then general goals for the overall operation of major programs, and the specific measurable objectives for particular aspects of each program. This is necessary in order for the rest of the management process to function in setting strategies, policies, procedures, rules, budgets and programs.

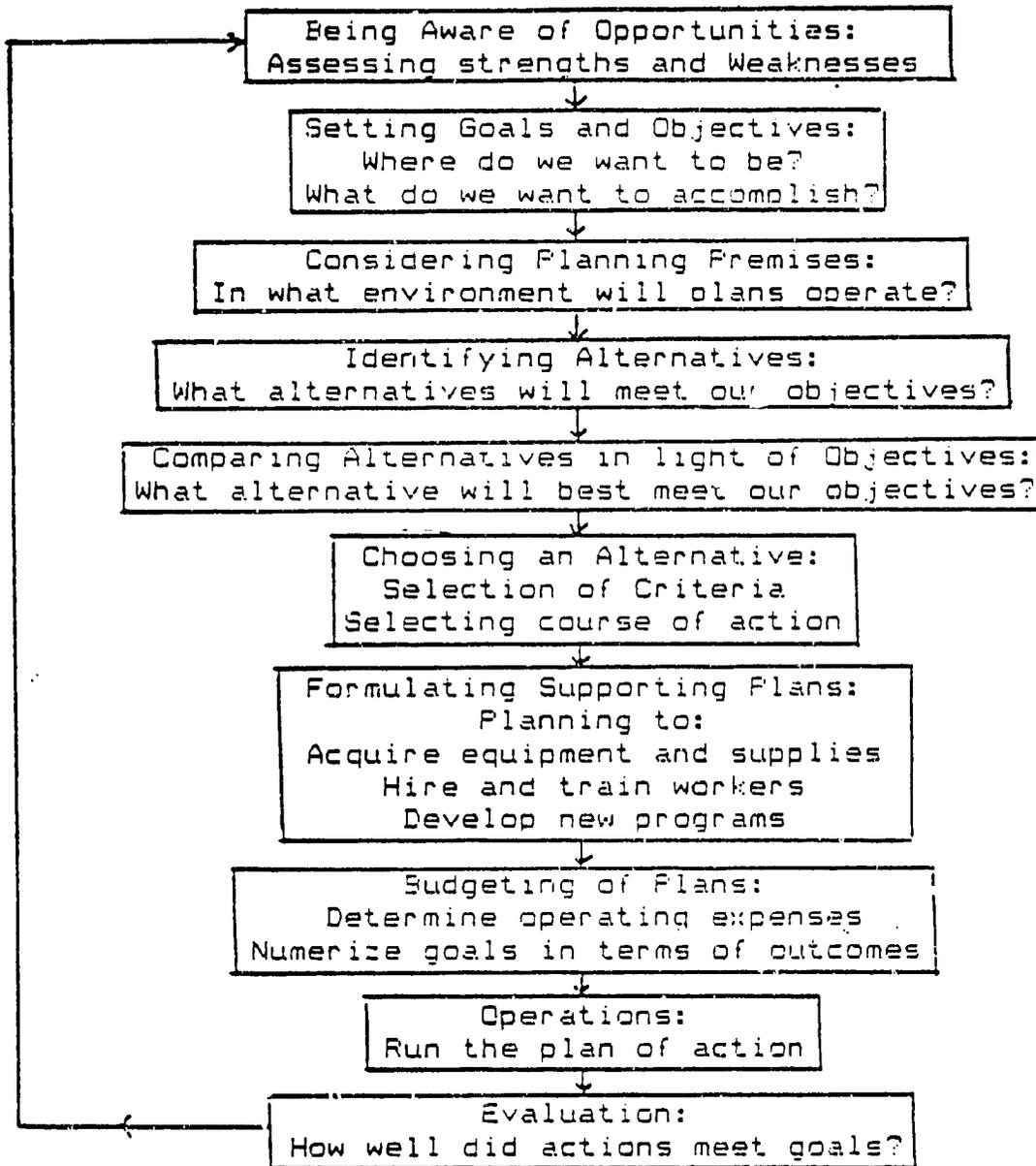
3. Develop Premises - establish, circulate, and obtain agreement to use critical planning premises and assumptions. These include forecasts, applicable basic policies, and existing organizational plans. One basic principle of planning is: THE MORE THOROUGHLY INDIVIDUALS CHARGED WITH PLANNING UNDERSTAND AND AGREE TO USE CONSISTENT PLANNING PREMISES, THE MORE COORDINATED ORGANIZATIONAL PLANNING WILL BE!

4. Determining Courses of Action - search for and enumerate all alternative course of action. DO NOT LEAVE OUT ANY AT THIS STAGE OF PLANNING. DOCUMENT EVERYTHING THAT YOU DO! Once all the alternatives have been developed, determine what criteria is going to be used to select among the alternatives and recommended to the decision makers for adoption. Some of the more obvious criteria are:

- a. do they meet their goals and objectives set?
- b. do you have the necessary resources to implement the plans?
- c. do you have money to finance these plans?
- d. do you have the trained personnel to carry out the plans?
- e. what are any particular constraints to conducting this alternative?
- f. is there any organized opposition to this alternative?
- g. do you have the necessary technology to implement this alternative?

## STEPS IN THE PLANNING PROCESS

Figure 2. is an illustration of the steps in the planning process using the systems approach.



Steps in the Planning Process  
Figure 2.

5. Evaluating Alternatives - once the criteria for selection have been established, each of the alternatives should be examined in light of the criteria established for evaluation of the feasibility of the alternatives. It is important to record why each alternative was rejected because that alternative may become feasible at some future date, and this record will save a lot of time in future planning.

6. Selection of an Alternative - the point of decision making. Occasionally two or more alternatives may be equally feasible, so several courses of action may be selected on a trial basis.

7. Formulating Implementation Plans - once an alternative has been selected, sub plans for the implementation of the basic plan need to be developed. However, these sub-plans for implementation may be delegated to subordinate planners lower in the hierarchy of the organization, and submitted for consideration to the central planning staff. IT IS DESIREABLE THAT THE PEOPLE RESPONSIBLE FOR THE CONDUCT OF THE PLANNED COURSES OF ACTION HAVE INPUT AT THIS STAGE BECAUSE THEY WILL HAVE MORE COMPLETE KNOWLEDGE OF HOW BEST TO IMPLEMENT THE PLAN AND THE PROBLEMS THAT WILL BE ENCOUNTERED AS WELL AS THE RESOURCES NEEDED.

8. Developing a budget for the planned course of action - after the decision to implement the planned alternative course of action is made, a detailed budget for this implementation should be developed including resources needed, costs, etc.

9. Implementation of the Plan - authority and responsibility for the implementation of the planned course of action should be given.

10. Evaluation - after a given period of time of operation of the planned course of action, its effectiveness should be evaluated.

#### Other Considerations in the Planning Process:

1. the feasibility of the planned courses of action must be given close consideration as part of the selection criteria - aim high but not too high.

2. communication with all parts of the organization that will be involved with the implementation of possible courses of action under consideration is essential if the plan is to be successful.

3. there should be both short range and long range plans, with the short range plans flowing naturally from the long range plans. There should be formal coordination between short and long range plans.

4. the time period required for planning should be in relation to the amount of the organizations resources to be committed to the potential scope of the course of action.

5. Long range planning implies not planning for future decisions, but planning for the future impact of decisions made today. Decision making lies at the core of good planning; without a decision, there is no plan.

## GOALS AND OBJECTIVES

Goals should reflect the broad missions or purposes of the organization. The goals are then broken down into specific objectives. The objectives should be measurable and verifiable.

Objectives state end results and major objectives need to be stated by sub-objectives. Thus, there is a hierarchy of goals and objectives which form a network. The objectives of an organization may be incompatible across the organization lines, and lead to conflicts within the organization.

The hierarchy of objectives in an organization matches very closely the hierarchy of management within the organization. Thus, the objectives for the chief executive of the organization may focus on long term goals and objectives while the middle managers and supervisors focus on objectives that are concerned with the day to day operation of the organization. However, all of these objectives should form a network that is interlocking, and the job of the managers is to make sure that these networks of objectives fit into one another, and to resolve conflicts of objectives when they arise.

Management By Objectives (MBO) - a comprehensive managerial system that integrates many key managerial activities in a systematic manner, and is consciously directed towards the efficient and effective achievement of organizational and individual objectives. There is an emphasis on performance appraisal, short term objectives, and motivation in this approach.

The process of setting objectives in a governmental setting is slightly different than it is in a business environment. Improving the performance of government organizations through the use of planning involves:

1. identifying ineffective programs by comparing performance against preestablished objectives,
2. using zero-based budgeting related decision making techniques for alternative selection,
3. applying MBO concepts for individual performance appraisal,
4. preparing short and long range objectives,
5. installing effective control mechanisms.
6. designing sound organizational structures with clear responsibilities and decision-making authority at appropriate levels, and
7. developing and preparing government officials for managerial responsibilities.

## DEVELOPMENT OF STRATEGIES AND POLICIES

Strategies and policies are closely related.

Strategies are general programs of action geared towards the attainment of comprehensive goals. Strategies imply objectives, the commitment of resources to attain objectives, and the development of policies to be followed in using these resources. Policies guide our thinking in decision making, ensuring that decisions fall within certain boundaries. The essence of policy is using discretion, while strategy concerns the direction in which human and material resources will be applied in order to increase the chances of achieving selected objectives.

Strategies and policies help managers plan by guiding operating decisions and often premaking them. Thus, the underlying principle is that the more carefully understood strategies and policies are, the more consistent and effective ensuing plans will be.

### Requirements for Effective Strategies:

1. assessment of present and future environments, starting with a situational analysis of the present environment and then forecasting the future for 3, 5, 10, or more years. The better an organization can foresee its future environment, the better it can devise strategies and supporting plans that take advantage of that environment.
2. self appraisal - asking two basic questions: what is our mission, and what are our strengths and weaknesses.
3. an organizational structure that ensures planning and that these resulting plans are integrated into the decision making process.
4. strategies must be consistent with one another, and
5. there must be flexibility built into strategies, with contingency strategies that can be put into place quickly to avoid crisis management.

### The Major Kinds of Strategies:

1. services provided
2. getting services to clients and encouraging clients to use services,
3. growth - how fast, when, where, how?
4. organization - centralized or decentralized? what kind of departmental pattern? what kinds of staff positions?
5. personnel - compensation, hiring, training, evaluation, and job enrichment
6. public relations - enhancing communication with clients

## DECISION MAKING

Decision making is the selection from among alternatives of a course of action. Decision making is at the core of planning, as a plan cannot exist unless a decision - a commitment of resources and direction - has been made.

Rational decision making is a process of: a. premising, b. identifying alternatives, c. evaluation of alternatives terms of goals sought, and d. the choosing of an alternative (ie. making a decision). Rational decision making is accomplished when people attempt to reach a goal that cannot be attained without planned action. However, we seldom achieve complete rationality because no one can make decisions that affect the past, the future involves uncertainty, and not all alternatives can be anticipated and analyzed. Thus we have bounded rationality limited by time, uncertainty and lack of information. Thus, in order to minimize risk, some managers allow the desire to "play it safe" to interfere with rational decision making. Herbert Simon calls this behaviour "satisficing", that is, picking a course of behaviour that is only satisfactory or good enough under the circumstances.

A Limiting Factor is something that stands in the way of accomplishing a desired objective. If we can recognize these limiting factors, we can narrow the alternatives in the decision process, and pick the best available alternative.

In evaluation of the alternatives, the qualitative as well as the quantitative aspects of the alternative must be considered. The quantitative factors can be measured in numerical terms, such as time, or costs, or clients served. The qualitative or intangible factors include such things as the quality of labor, available technology, political climate, etc. When evaluating an alternative, cost effectiveness analysis is very useful. Cost effectiveness analysis seeks the best ratio of benefits, both quantitative and qualitative, to costs. The nonquantifiable objectives can sometimes be given some fairly specific measures of effectiveness such as through the use of related statistics. For example, teacher quality may be measured by changes in teacher turnover, or years of experience.

In selecting an alternative, three decision approaches may be used: experience, experimentation, and research and analysis.

## Evaluation of the Importance of a Decision

Managers must make decisions, and they must make them as needed and as economically as possible. OFTEN, IT MAY BE BETTER TO MAKE A FAULTY DECISION THAN NO DECISION AT ALL. Guidelines as to the relative importance of decisions are useful.

1. the larger the size or length of commitment of organizational resources, the more time should be spent on the decision, and the higher the authority in the organizational hierarchy should make the decision.
2. decisions involving inflexible courses of action must carry priority over courses that can easily be changed.
3. if the goals and premises are fairly certain, a decision resting on them tends to be less difficult and to require less time and judgement than when they are highly uncertain.
4. where the goals, inputs, constraints, and variables can be accurately measured, the importance of the decision, ceteris paribus, tends to be less. and
5. where the impact of a decision on people is great, its importance is high. No one making a decision that affects other people can afford to overlook the need for those people to accept the decision.

## BUDGETING

Budgeting is part of both the planning process and control process of management. Budgeting is the formulation of plans for a given future period in numerical terms. Thus, budgets are statements of anticipated results, in financial terms, such as in revenues and expenditures and capital budgets, as well as in nonfinancial terms, such as in labor hour requirements, materials required, units produced, etc.

Budgets must be based on plans in order for an organization's funds to be allocated efficiently, and only when the organization's goals and objectives are clearly stated can a manager know how much money is necessary to do what is desired.

While there are many benefits from the budgeting process, there are a number of dangers also.

1. overbudgeting - some budgetary control programs are so complete and detailed that they become cumbersome, meaningless, and unduly expensive.
2. budgetary goals may become more important than the organizational goals. In trying to stay within the budgetary constraints, the organizational goals may become lost.
3. budgeting may be used to hide organizational inefficiency as budgets have a way of growing from precedence, and that an expenditure in the past may be used as evidence of its reasonableness in the present. Unless budget making is accomplished by a constant reexamination of standards and organizational objectives, and procedural devices through which planned action is translated into numerical terms, the budget may become a vehicle for slovenly and inefficient management.
4. budgets may promote organizational inflexibility. As an organization's programmatic plan is reduced to numerical terms, it has a tendency to be "cast in concrete". Budgets should be flexible and based on variable costs if possible.

Budget summaries are a widely used form of control device as well as a planning device. A budget summary reflects how the organization as a whole is succeeding in meeting its objectives. Budget summaries should show progress not only in terms of financial progress, but show evidence of progress in meeting organizational goals and objectives, and should serve as an important input into the planning cycle.

## FORECASTING

Forecasting is an important component in the planning process. However, there is a difference between the purposes of a planner and a forecaster. A forecaster simply wants to predict what future events will take place given a set of assumptions about the environment and other conditions, but does not want to change the future. The planner wants to change the future so that it is more closely aligned with the goals and objectives of the planner. This is to be proactively sought for through a series of carefully designed programs of actions.

Forecasting is both an art and a science. The science of forecasting is applying the mathematical formulas that produce forecasting. The art of forecasting is selecting among the results of the various forecasting methods the one that is most likely to be correct. As every forecasting method is likely to produce a different result, it is important to understand why the various methods differ, and how to select among them.

There is a hierarchy of forecasting methods, but all of the methods and techniques require that:

1. data to be used in the forecasting process be organized in a systematic fashion.
2. that the calculus used in the forecasting technique be consistent over time.
3. that the assumptions used in the forecast be clearly stated and understood,
4. that the reasons for the choice of the forecast be given.

Forecasts can only be made if the forecaster makes certain assumptions about the environment in the future, and what events are likely to take place. These may include assumptions regarding:

1. birth rates,
2. death rates,
3. economic conditions,
4. political and social conditions,
5. administrative policies, and
6. acts of god.

There is a hierarchy of forecasting methods:

1. eyeballing the data,
2. percentage increases from year to year,
3. the cohort survival technique,
4. regression techniques,
5. economic modeling,
6. census based forecasting

## FORECASTING USING THE ORDINARY LEAST SQUARES REGRESSION TECHNIQUE

The Ordinary Least Squares Regression Forecasting Technique is useful for forecasting any set of numbers. The following steps and calculations should be used.

1. Set up the array of data as shown on Figure 1. attached. (range a4..g11)
2. Row 5 is the year, thus year 1 is the 1980-81 school year, and year 6 is the year to be forecast.
3. Cell c19 equals the sum of the years. This is calculated by summing  $x_1+x_2+x_3+x_4+x_5$ , where  $x$  is the year. Thus, for this example, the sum of the years is equal to  $1+2+3+4+5=15$ .
4. range c7..g7 gives the enrollment of grade five for each of the five years. The enrollment is designated by the symbol "y", thus the enrollment for year 1 =  $y_1$ , and the enrollment for the year to be predicted is equal to  $y_6$ .
5. Cells c20 through c24 represents the sum of the enrollments for each year for each of the five grades. For example, the sum of the enrollments for all years for grade five is denoted mathematically as  $y_1+y_2+y_3+y_4+y_5$ , and is calculated for this example by summing the numbers in the range c7..g7, or  $28.6+23.2+22.6+25.9+29.4 = 129.7$
6. cell c25 represents the mean or average of the years, or  $(x_1+x_2+x_3+x_4+x_5)/5$ , or for this example:  $(1+2+3+4+5)/5 = 3$ .
7. cells e19 through e23 represent the sum of the product of multiplying the year by the enrollment for that year. This is denoted mathematically as  $x_1y_1+x_2y_2+x_3y_3+x_4y_4+x_5y_5$ . For grade five in this example, this is calculated by the following:  
 $(1)(28.6)+(2)(23.2)+(3)(22.6)+(4)(25.9)+(5)(29.4)=393.4$ .
8. Cells e24 through e28 represent the mean or average of the enrollments for each grade. Thus, in this example, cell e24 represents the average enrollment for grade five for the five years under analysis, and is calculated by:  
 $(y_1+y_2+y_3+y_4+y_5)/5 = (28.6+23.2+22.6+25.9+29.4)/5 = 25.9$ .
9. Cell g19 equals the sum of the years squared, represented by  $(x_1*x_1)+(x_2*x_2)+(x_3*x_3)+(x_4*x_4)+(x_5*x_5)$ . For this example, this is equal to  $1*1+2*2+3*3+4*4+5*5 = 55$ .

10. Cell g20 represents the sum of the years, squared. This is represented by  $(x_1+x_2+x_3+x_4+x_5)(x_1+x_2+x_3+x_4+x_5) = 55$ .

11.  $N$  = the number of years of data available, in this example,  $N=5$ .

12. Cells g22 through g25 represent the slope of the regression line. This number is calculated by the formula:

$$B = \frac{N(\text{sum } XY) - (\text{sum } X)(\text{sum } Y)}{N(\text{sum } X \text{ squared}) - (\text{sum } X)^2}$$

In this example,  $B = .43$  for grade five.

13. cells H22 through H26 represent the Y intercept, or where the regression line crosses the Y axis in a graph. This is calculated by the formula:

$$\begin{aligned} Y \text{ intercept} &= Y \text{ mean} - (B)(X \text{ mean}). \\ Y \text{ intercept} &= 25.9 - (.43)(3) = 24.7 \end{aligned}$$

14. Finally, cells h41 through h45 are the calculations of the forecasted enrollments using the calculations from above through the following formula:

$$\begin{aligned} \text{forecasted } Y &= Y \text{ intercept} + (B)(X \text{ year}) \text{ or} \\ Y &= 24.7 + (.43)(6) = 27.3. \end{aligned}$$

## FORECASTING USING LINEAR REGRESSION

$$y = a + bx \quad \cdot \quad x = \text{year}$$

$$y = \text{enrollment}$$

$$N = \# \text{ years} = 5$$

$$\sum x = x_1 + x_2 + x_3 + x_4 + x_5 = 1 + 2 + 3 + 4 + 5 = 15$$

$$\sum y = y_1 + y_2 + y_3 + y_4 + y_5 = 85.7 + 81.8 + 85.0 + 85.6 + 86.7 = 424.8$$

$$\sum xy = x_1 y_1 + x_2 y_2 + x_3 y_3 + x_4 y_4 + x_5 y_5 = (85.7)1 + (81.8)2 + (85.0)3 + (85.6)4 + (86.7)5 = 1280.2$$

$$\sum x^2 = x_1^2 + x_2^2 + x_3^2 + x_4^2 + x_5^2 = 55$$

$$(\sum x)^2 = 225$$

$$\bar{x} = 15/5 = 3 \quad \bar{y} = 424.8/5 = 84.96$$

$$b = \frac{N \sum xy - \sum x \sum y}{N \sum x^2 - (\sum x)^2}$$

$$= \frac{5(1280.2) - (15)(424.8)}{5(55) - 225}$$

$$= \frac{6401 - 6372}{275 - 225}$$

$$= \frac{29}{50}$$

$$= .58$$

$$a = \bar{y} - b\bar{x}$$

$$= 84.96 - .58(3)$$

$$= 83.22$$

Prediction

$$y = a + bx$$

$$= 83.22 + .58(6)$$

$$= 86.7$$

A	B	C	D	E	F	G	H
2	FORECASTING EXAMPLE						
3	Grade	Enrollment Per Year (in 1,000's)					S.R.
4		1980-81	1981-82	1982-83	1983-84	1984-85	
5		1.0	2.0	3.0	4.0	5.0	
6	Four	27.5	26.8	30.2	34.8	35.9	
7	Five	28.6	23.2	22.6	25.9	29.4	0.8473
8	Six	22.2	24.1	19.6	19.1	21.5	0.9407
9	Seven	13.7	19.7	21.5	17.4	17.0	0.8893
10	Eight	21.2	14.8	21.3	23.2	18.8	1.0803
11	Total	85.7	81.8	85.0	85.6	86.7	
12							
13	Survival Rates		0.8436	0.8433	0.8576	0.8448	
14			0.8427	0.8448	0.8451	0.8301	
15			0.8874	0.8921	0.8878	0.8901	
16			1.0803	1.0812	1.0791	1.0805	
17							
18	Regression Analysis:						
19	Sum of X	15.0	Sum of XY	393.4	Sum X SQ.	55.0	
20	Sum of Y	129.7		313.1	(Sum X)SQ	225.0	
21		106.5		272.2	N =	5.0	Intercepts:
22		89.3		301.5	B =	0.4300	24.7
23		99.3		1280.2		-0.6400	23.2
24		424.8	Y Mean	25.9		0.4300	16.6
25	X Mean	3.0		21.3		0.3600	18.8
26				17.9		0.5800	83.2
27				19.9			
28				85.0			
29							
30							
31	Cohort Survival Forecast						
32	Year	1.0	2.0	3.0	4.0	5.0	6.0
33	Fifth	28.6	23.2	22.6	25.9	29.4	30.4
34	Sixth	22.2	24.1	19.6	19.1	21.5	24.7
35	Seventh	13.7	19.7	21.5	17.4	17.0	19.1
36	Eighth	21.2	14.8	21.3	23.2	18.8	18.4
37	Total	85.7	81.8	85.0	85.6	86.7	92.6
38							
39							
40	Least Squares Estimate						
41	Fifth	28.6	23.2	22.6	25.9	29.4	27.2
42	Sixth	22.2	24.1	19.6	19.1	21.5	19.4
43	Seventh	13.7	19.7	21.5	17.4	17.0	19.2
44	Eighth	21.2	14.8	21.3	23.2	18.8	20.9
45	Total	85.7	81.8	85.0	85.6	86.7	86.7
46							
47							
48							
49							
50							

A1: (FO) ↑A  
 B1: ↑B  
 C1: ↑C  
 D1: ↑D  
 E1: ↑E  
 F1: ↑F  
 G1: ↑G  
 H1: ↑H  
 A2: (FO) 2  
 E2: 'FORECASTING EXAMPLE  
 A3: (FO) 3  
 B3: 'Grade  
 C3: ' Enrollment Per Year (in 1,000's)  
 A4: (FO) 4  
 C4: '1980-81  
 D4: '1981-82  
 E4: '1982-83  
 F4: '1983-84  
 G4: '1984-85  
 H4: 'S.R.  
 A5: (FO) 5  
 C5: 1  
 D5: 2  
 E5: 3  
 F5: 4  
 G5: 5  
 H5: '  
 A6: (FO) 6  
 B6: 'Four  
 C6: 27.5  
 D6: 26.8  
 E6: 30.2  
 F6: 34.8  
 G6: 35.9  
 H6: '  
 A7: (FO) 7  
 B7: 'Five  
 C7: 28.6  
 D7: 23.2  
 E7: 22.6  
 F7: 25.9  
 G7: 29.4  
 H7: (F4) (@SUM(D13..G13)/4)  
 A8: (FO) 8  
 B8: 'Six  
 C8: 22.2  
 D8: 24.1  
 E8: 19.6  
 F8: 19.1  
 G8: 21.5  
 H8: (F4) (@SUM(D14..G14)/4)  
 A9: (FO) 9  
 B9: 'Seven  
 C9: 13.7  
 D9: 19.7  
 E9: 21.5

```

9: 17.4
9: 17
9: (F4) (@SUM(D15..G15)/4)
10: (F0) 10
10: 'Eight
10: 21.2
10: 14.8
10: 21.3
10: 23.2
10: 18.8
10: (F4) (@SUM(D16..G16)/4)
11: (F0) 11
11: 'Total
11: @SUM(C7..C10)
11: @SUM(D7..D10)
11: @SUM(E7..E10)
11: @SUM(F7..F10)
11: @SUM(G7..G10)
12: (F0) 12
13: (F0) 13
13: 'Survival Rates
13: (F4) +D7/C6
13: (F4) +E7/D6
13: (F4) +F7/E6
13: (F4) +G7/F6
14: (F0) 14
14: (F4) +D8/C7
14: (F4) +E8/D7
14: (F4) +F8/E7
14: (F4) +G8/F7
15: (F0) 15
15: (F4) +D9/C8
15: (F4) +E9/D8
15: (F4) +F9/E8
15: (F4) +G9/F8
16: (F0) 16
16: (F4) +D10/C9
16: (F4) +E10/D9
16: (F4) +F10/E9
16: (F4) +G10/F9
17: (F0) 17
18: (F0) 18
18: 'Regression Analysis:
19: (F0) 19
19: 'Sum of X
19: +$C$5+$D$5+$E$5+$F$5+$G$5
19: 'Sum of XY
19: +$C$5*(C7)+$D$5*D7+$E$5*E7+$F$5*F7+$G$5*G7
19: 'Sum X SQ.
19: +$C$5*$C$5+$D$5*$D$5+$E$5*$E$5+$F$5*$F$5+$G$5*$G$5
20: (F0) 20
20: 'Sum of Y
20: @SUM(C7..G7)
20: +$C$5*(C8)+$D$5*D8+$E$5*E8+$F$5*F8+$G$5*G8
20: '(Sum X)SQ
20: +$C$19*$C$19

```

A21: (F0) 21  
C21: @SUM(C8..G8)  
E21: +\$C\$5\*(C9)+\$D\$5\*D9+\$E\$5\*E9+\$F\$5\*F9+\$G\$5\*G9  
F21: ' N =  
G21: 5  
H21: 'Intercepts:  
A22: (F0) 22  
C22: @SUM(C9..G9)  
E22: +\$C\$5\*(C10)+\$D\$5\*D10+\$E\$5\*E10+\$F\$5\*F10+\$G\$5\*G10  
F22: ' B =  
G22: (F4) ((((\$G\$21)\*(E19))-(((\$C\$19)\*(C20))))/((((\$G\$21)\*(\$G\$19))-(\$G\$20)))  
H22: (E24)-((G22)\*(\$C\$25))  
A23: (F0) 23  
C23: @SUM(C10..G10)  
E23: +\$C\$5\*(C11)+\$D\$5\*D11+\$E\$5\*E11+\$F\$5\*F11+\$G\$5\*G11  
G23: (F4) ((((\$G\$21)\*(E20))-(((\$C\$19)\*(C21))))/((((\$G\$21)\*(\$G\$19))-(\$G\$20)))  
H23: (E25)-((G23)\*(\$C\$25))  
A24: (F0) 24  
C24: @SUM(C11..G11)  
D24: 'Y Mean  
E24: @AVG(C7..G7)  
G24: (F4) ((((\$G\$21)\*(E21))-(((\$C\$19)\*(C22))))/((((\$G\$21)\*(\$G\$19))-(\$G\$20)))  
H24: (E26)-((G24)\*(\$C\$25))  
A25: (F0) 25  
B25: 'X Mean  
C25: +C19/G21  
E25: @AVG(C8..G8)  
G25: (F4) ((((\$G\$21)\*(E22))-(((\$C\$19)\*(C23))))/((((\$G\$21)\*(\$G\$19))-(\$G\$20)))  
H25: (E27)-((G25)\*(\$C\$25))  
A26: (F0) 26  
C26: '  
E26: @AVG(C9..G9)  
G26: (F4) ((((\$G\$21)\*(E23))-(((\$C\$19)\*(C24))))/((((\$G\$21)\*(\$G\$19))-(\$G\$20)))  
H26: (E28)-((G26)\*(\$C\$25))  
A27: (F0) 27  
E27: @AVG(C10..G10)  
A28: (F0) 28  
E28: @AVG(C11..G11)  
A29: (F0) 29  
E29: '  
A30: (F0) 30  
A31: (F0) 31  
C31: 'Cohort Survival Forecast  
A32: (F0) 32  
B32: 'Year  
C32: 1  
D32: 2  
E32: 3  
F32: 4  
G32: 5  
H32: 6  
A33: (F0) 33  
C33: 'Fifth  
D33: +\$C\$7  
E33: +\$D\$7  
F33: +\$E\$7

```

33: +$F$7
33: +$G$7
33: +$G$6*$H$7
34: (FO) 34
34: 'Sixth
34: +$C$8
34: +$D$8
34: +$E$8
34: +$F$8
34: +$G$8
34: +$G$7*$H$8
35: (FO) 35
35: 'Seventh
35: +$C$9
35: +$D$9
35: +$E$9
35: +$F$9
35: +$G$9
35: +$G$8*$H$9
36: (FO) 36
36: 'Eighth
36: +$C$10
36: +$D$10
36: +$E$10
36: +$F$10
36: +$G$10
36: +$G$9*$H$10
37: (FO) 37
37: 'Total
37: @SUM(C33..C36)
37: @SUM(D33..D36)
37: @SUM(E33..E36)
37: @SUM(F33..F36)
37: @SUM(G33..G36)
37: @SUM(H33..H36)
38: (FO) 38
39: (FO) 39
40: (FO) 40
40: 'Least Squares Estimate
41: (FO) 41
41: 'Fifth
41: +$C$7
41: +$D$7
41: +$E$7
41: +$F$7
41: +$G$7
41: +H22+(G22*$H$32)
42: (FO) 42
42: 'Sixth
42: +$C$8
42: +$D$8
42: +$E$8
42: +$F$8
42: +$G$8
42: +H23+(G23*$H$32)
43: (FO) 43

```

B43: 'Seventh  
C43: +\$C\$9  
D43: +\$D\$9  
E43: +\$E\$9  
F43: +\$F\$9  
G43: +\$G\$9  
H43: +H24+(G24\*\$H\$32)  
A44: (FO) 44  
B44: 'Eighth  
C44: +\$C\$10  
D44: +\$D\$10  
E44: +\$E\$10  
F44: +\$F\$10  
G44: +\$G\$10  
H44: +H25+(G25\*\$H\$32)  
A45: (FO) 45  
B45: 'Total  
C45: @SUM(C41..C44)  
D45: @SUM(D41..D44)  
E45: @SUM(E41..E44)  
F45: @SUM(F41..F44)  
G45: @SUM(G41..G44)  
H45: +H26+(G26\*\$H\$32)  
A46: (FO) 46  
A47: (FO) 47  
A48: (FO) 48  
A49: (FO) 49  
A50: (FO) 50

## THE ROLE OF DIAGNOSIS IN EDUCATIONAL PLANNING

### Definition of Diagnosis:

An investigation or analysis of the cause or nature of a condition, situation, or problem; a statement or conclusion concerning the nature or cause of the same phenomenon.

### Areas of Educational Diagnosis:

- I. Intra-Educational
  1. educational stock - #'s of schools, classrooms, teachers, training facilities, labs, etc.
  2. internal efficiency - rates of retention and drop-out, rates of passage from level to level, rates of success on exams (measures of educational wastage).
  3. student flows - from grade to grade
  4. financial resources - financial resources available for both capital expenses and recurrent expenses.
  5. costs - total costs per level, cost per student by level, etc.
  6. issues of equality and disparity - equality of access to education, and equality of educational opportunity - three basic sources of inequalities: social, sexual, and regional.

### II. Areas of Extra-Educational Diagnosis:

1. demographic factors - includes growth in the school age population disaggregated by region, sex, etc.
2. socio-economic factors - social class structure, aspirations, attitudes, and expectations about education, rural/urban distributions of the population, and migration trends and patterns, general economic conditions.
3. political factors - political stability and effects on educational policy.
4. external efficiency of education - the fit between education and the needs of society.
5. educational needs - who defines them, what are they, etc.

### Information Needed in Educational Planning:

Claimant:	Type of Information:
government	government educational policy aspects of educational development
public opinion	general attitudes about education and schools
statistical sources	demographic and general data on trends
financial sources	budgetary resources for education
researchers	general impact of education and educational needs for the future

educational admin.	enrollments, problems, wastage, student flow rates, etc.
teachers	level of education, experience, etc.
students	achievement, attainment levels, work patterns, etc.
employers	worker productivity, quality of schooling

**Purpose of Diagnosis:**

to find out what is happening with the educational system:

1. student flows - admission rate, promotion, repetition, drop-out and transition rates (internal efficiency of educational system).
2. financial analysis - will discover possible imbalances in the allocation of educational resources to different branches of the educational system in the country, identifies the factors responsible for the rapid increases in expenditures, and to see if there are potential sources of revenues not yet tapped.
3. teaching personnel - level and type of education, qualifications and level of training, specialization, locations, and sex.
4. non-teaching personnel - how many and how many unfilled vacancies, how many too well trained, subject specialization, workload and geographical distribution, age distribution and wastage.
5. facilities - the quantity and quality of the educational facilities including schools, classrooms, labs, and workshops.
6. equalities and disparities - many types:
  - a. equality of access - who gets into school
  - b. equality of resource inputs - the quality and quantity of resources flowing to different groups of learners.
  - c. equality of performance - what groups are performing better than others in a systematic fashion and why?

**Measures Used in Diagnosis:**

1. The Student Population - Measures of Flow and Wastage
  - a. the admission rate: the proportion of pupils eligible for admission in a grade who were actually admitted.
  - b. the promotion rate: the number of students promoted from a grade among those in the grade.
  - c. the repetition rate: the students that repeat a grade among those in the grade.
  - d. the dropout rate: the students that dropout from school in a grade.
  - e. the completion rate: the students that have successfully completed a level of schooling.

2. Educational Costs - evaluation of costs and expenditures.
  - a. educational expenditures in relation to GNP
  - b. educational expenditures in relation to total government expenditures.
  - c. unit costs by region, by sector, by level, etc.
3. The Teaching Stock - numbers of teachers by level, sex, year, region, etc.

#### The Use of Indicators in Educational Planning

Indicators are used to show general directions and trends. The basic characteristics of indicators are:

1. a quantitative expression that expresses a relationship
2. has policy relevance
3. is associated with a period of time enabling an analysis of trends over time.
4. can be expressed at different levels of disaggregation.
5. is of direct normative interest (ie. one direction is "good" and the other direction is "bad").
6. has to be sensitive to changing situations
7. has to be based on data that are available when needed.
8. has to be understandable and easily interpreted.

#### The Uses of Indicators:

1. used in policy statements
2. used to monitor progress and changes
3. used by researchers
4. used for classification for comparisons

#### Principal Indicators of Educational Systems:

1. Indicators of Inputs:
  - a. involvement of human resources:
    1. enrollment ratios
    2. admission rates
    3. student/teacher ratios
    4. percentage qualified teachers
  - b. involvement of financial and material resources
    1. ratio of students per classroom
    2. ratio of textbooks per student
    3. unit costs by level
    4. government expenditure on education as a percentage of national budget
    5. total ed. expend. as % of GNP
2. Indicators of Performance:
  - a. dropout rates
  - b. repetition rates
  - c. promotion rates

- d. transition rates
  - e. standardized examination results
  - f. female involvement
  - g. orientation of studies by speciality
3. Indicators of Disparities:
- a. urban vs rural admission rates
  - b. % of secondary school students from rural areas
  - c. performance on tests urban vs. rural
4. Indicators of Outputs:
- a. #'s of school leavers and graduates
  - b. % of school leavers to school enters
  - c. specializations of graduates
5. Indicators of Political and Socio-Economic Context:
- a. demographic indicators -
    - 1. rate of population increase over next 10 years
    - 2. internal migration patterns
    - 3. population by region and age group
  - b. political and social indicators -
    - 1. voting trends
    - 2. electoral participation
    - 3. the literacy rate
    - 4. mass-media consumption - radios per 1000 pop.
  - c. economic indicators -
    - 1. economic growth rates for country and regions
    - 2. % of GNP spent on education
    - 3. unemployment rates
    - 4. rates of return to investment in education
    - 5. % of national budget spent on education
    - 6. foreign debt as a % of export earnings (used in contemplation of aid for education that would be debt to country as from world bank).

#### Educational Statistics and Data Base Management

Educational statistics have a wide range of functions.

- 1. for description of the stock and flow of pupils, teachers, administrators, facilities, materials, etc.
- 2. for comparison of educational provision and performance between different educational institutions and populations groups.
- 3. for monitoring and accounting of the day-to-day operations
- 4. for planning
- 5. for evaluating the performance of the educational system.
- 6. for educational research investigating the relationships between factors inside and outside the educational system.

### Uses of Educational Statistics

- a. In educational planning:
  1. formulation of policies, goals, and objectives
  2. planning for future educational development
  3. preparation of programs and projects
  4. evaluation of results of educational programs and projects.
- b. In educational management:
  1. day-to-day administration of the ed. system,
  2. identification of problems and working out solutions
  3. monitoring of ed. programs
  4. accounting for ed. facilities provided and ed. expenditures incurred.
- c. In assessing qualitative change in education:
  1. planning research studies for the qualitative improvement of education,
  2. development of performance indicators
  3. providing information for feedback to educational policy makers
- d. Meeting data needs of other users:
  1. planning for future development in other sectors such as manpower planning, health programs, manufacturing, etc.
  2. providing information on education to public, political bodies, and media.
  3. meeting data needs of international organizations such as UNESCO and the World Bank.

### Principles of Data Collection:

1. data should be based on unambiguous definitions
2. data should be complete, not only by respondents but by key information.
3. data should be accurate
4. data should be sufficiently disaggregated
5. data should be timely
6. data should be user related
7. data should be easily accessible to user groups

### Principles of Questionnaire Design and Construction:

1. clear, easy to read forms
2. do not ask for unnecessary information
3. include guidelines for filling out questionnaire
4. include of letter of introduction
5. explain any changes in the questionnaire from previous years.
6. limit the size of the questionnaire, but give respondents sufficient room to answer questions asked.
7. field test questionnaire before general distribution
8. have data requested be for a certain date.

9. make sure respondents have access to information needed to answer questions
10. questionnaires should be clearly worded
11. wording should not unintentionally bias the response, or be objectionable to the respondent.
12. if a list of possible responses is given, be sure that all possible responses are given, or that an "other" space is available.
13. questions should be designed so that definite answers can be given to facilitate easy coding and analysis.
14. do not ask respondents to do unnecessary work, (ie. if there are calculations to be done based on the data to be provided, do not have the respondent do the calculations because the computer can do them a lot faster and more accurately.)

#### Principles of Questionnaire Distribution and Collection:

1. compile a complete list of all questionnaire respondents and check for accuracy
2. provide a date for the return of the questionnaire.
3. distribute questionnaire well in advance in the deadline date.
4. request that a particular person, ie. the headmaster, complete the questionnaire.
5. upon receipt of the returned questionnaires, check for accuracy and completion of items. Check for non-respondents. Continually check for item response reliability and validity.
6. To improve response rates: hold informational seminars with respondents, send reminders through mail or phone, or do follow up visits.
7. if there is missing data, try to obtain it first, and if this is not possible, try to estimate the missing data rather than not performing analysis.

#### Principles of Data Base Management:

1. Array the data in a consistent fashion
2. keep the data in as disaggregated a level as possible
3. set up a computerized relational data base if possible
4. have backups of the data base on a daily basis.
5. limit access to the input and updating of the data base
6. have copies of the coding structure readily available.
7. have a number of standardized reports available as output from the data base to meet as many needs of the various constituencies of the data base as possible.

8. allow for the data base to answer as wide a range of uses as possible
9. be able to pull subsets of the data base off for analyses
10. have descriptions of the contents of the data base available to potential users.
11. design the data base to be as flexible in meeting data requirements as possible.