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A SYSTEM FOR INDUSTRIAL PROJECT EVALUATION

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INTRODUCTION

Despite the pressing needs for economic growth, the newly developing countries, it is felt, are making investment decisions that often block rapid economic growth. Inappropriate decisions on scale of production, location, technology, raw materials or other strategic variables result in unproductive investments. It was with this in mind that work was started on a system for the formulation and evaluation of industrial projects in the State Planning Organization of Turkey in the Fall of 1961. An effort was made to synthesize the thinking of engineers and economists into an operational framework that was tried on actual projects and modified in a pragmatic way. It was then taught to Turkish planners in Seminars. Since then it has been taught as a Graduate Course in the School of Public and International Affairs of the University of Pittsburgh and at the Management Institute for Development Projects at the same institution in the Spring of 1964. As the system was taught, certain gaps and deficiencies came to light. Changes were made in the system as they appeared necessary.

In the Summer of 1964, the Organization of American States, in collaboration with the Planning Agency of Venezuela (CORDIPLAN), sponsored a Workshop on Project Evaluation in Caracas. The persons attending the Workshop had responsibility for planning and or evaluating projects as part of their regular duties. The first two weeks were spent in formal sessions. The next three weeks were spent by groups of participants working together on a specific project that was of direct interest to the country, in accordance with the procedures worked out in the formal sessions.

In the beginning of 1965 the Organization of American States, in collaboration with the Joint Planning Mission of Central America, conducted a Workshop on Project Analysis for participants from the five countries of Central America, namely Guatemala, Honduras, El Salvador, Nicaragua, and Costa Rica. The Central American Workshop followed the same general plan as the one in Caracas, with these differences. Formal sessions were longer, and in addition, exercises were handed out each day for return on the following day. As a result of this intensive effort, the participants were better prepared to proceed with the second phase of the Workshop, the preparation of actual projects. This took place in their respective countries under the supervision of and consultation with OAS representatives.

The main purpose of the system is to provide a basis for formulation and evaluation of projects which is meaningful to rapid economic growth and is operational under conditions of the newly developing countries.

While it is recognized that there is more to life than economic growth, the assumption is made that rapid economic growth is a necessary condition for the achievement of other important goals. Without the resources from rapid economic growth, other objectives may not be achievable.

A good system of analysis should fill important needs of communication. Large projects in particular call for detailed cooperation among different individuals. For such cooperation to be truly effective, it is important that individuals of the same profession communicate with each other, that individuals of different professions be able to communicate with each other, that different levels of authority communicate with each other, and that technical levels communicate effectively with political or management levels. In the absence of an agreed-upon system of analysis, the atmosphere of communication takes on a Tower-of-Babel quality that makes teamwork extremely difficult. In addition to facilitating teamwork, an agreed-upon-framework of analysis is more likely to lead to continuity of effort. To the extent that a system of analysis represents a consensus, one can expect greater continuity in consideration and execution of projects under conditions of political change.

The use of an agreed-upon system of project formulation and evaluation is also a means of overcoming a narrow professionalism that is characteristic of the individual technician. Each specialist, whether he is an architect, a mechanical engineer, chemical engineer or manager, tends to view a project from a narrow point of view. The specialists of less developed countries use standards which may be appropriate for conditions of the developed countries, but which may be out of step with the resources and priorities of their own countries. A suitable system of project formulation should give specialists a common and meaningful basis for making decisions consistent with the costs, priorities, and resources of their own countries.

The formulation and evaluation of projects require a large number of persons (far more than macro planning). It is desirable that the system be readily teachable, and also that it permit delegation of part of the job to others less skilled. This is in order that the few available well-trained persons may concentrate on those aspects with which only they can deal.

The system should help harness the interests of the individual organization to the interest of the entire economy.

An important characteristic of projects is its multi-dimensional character. A grave defect of existing systems of evaluation is that there are listings of qualities or even measurements in many dimensions with no explicit provision for converting these dimensions into the one dimension of yes-no or ranking of projects. This difficulty has been well stated in a U N article.

"The difficulty in project evaluation consists... in that the problem has to be determined on a multi-dimensional basis and that from this a one-dimensional decision pattern has to be derived. The multi-dimensional character is related to the fact that the project has to be considered in the context of its impact on a variety of fields, such as: anticipated yield in terms of an increase in national income or in national consumption - with, moreover, the distinction between the immediate effects and those obtained in the longer run; provision of remunerative employment; impact on the balance of payments; possibly also the impact on the distribution of income and on regional distribution of productive activity, etc. Also the production factors to be used are basically incommensurable: capital, foreign exchange; labor, skilled and unskilled; the various categories of natural resources such as land, minerals and hydro-power. The decision pattern, on the other hand, is by its nature one-dimensional: for the elaboration of programme of projects, the candidate projects are ranked in a single line priority order; and the decision regarding an individual project can either be acceptance or rejection."[1]

Aside from the straightforward dimensions of physical inputs and outputs and the factor of time, one must be able to cope with additional economic dimensions. How does one treat private advantage and public advantage in a way which furthers economic growth? How does one give consideration to foreign exchange of a project-- whether saved or spent? How does one treat the price to the consumer?

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1) "Evaluation of Projects in Predominantly Private Enterprise Economies: Selected Procedures Based on Case Studies," page 26. Prepared by the Division of Industrial Development, Department of Economic and Social Affairs, United Nations, New York, Industrialization and Productivity Bulletin No. 5.

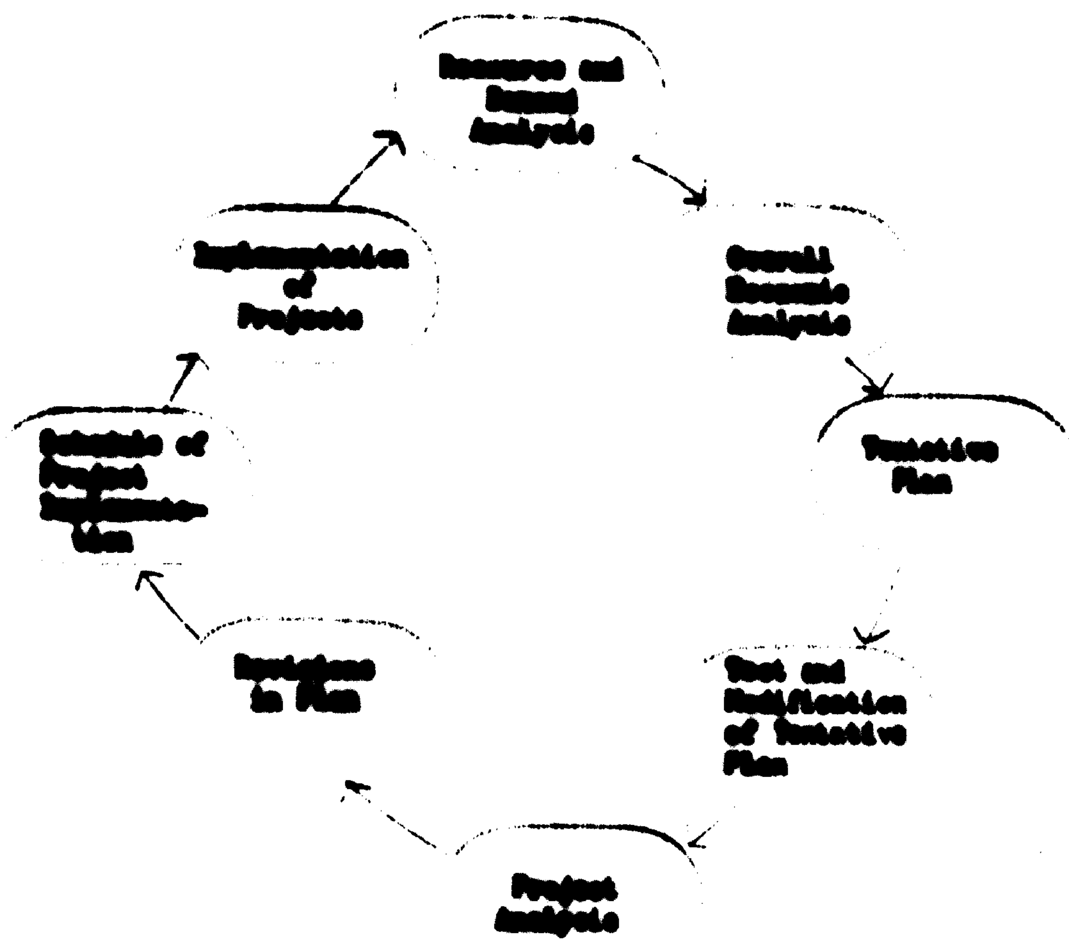
How does one take into account the time horizon? How does one take into account the opportunity cost of the product? How does one give operational meaning to the plausible concept of the national income test of Tinbergen and the reinvestable funds generation argument of Liebenstein and Galenson? Also, what about complementarities with other projects, the risks, and values other than those connected with economic growth?

All the factors and considerations have been discussed at great length in the literature. Generally, however, one, or at most a few factors are dealt with at a time. The prime need is for a unified and operational way of coping with all dimensions that are relevant for decision making in a proposed project. Somehow a way of combining all dimensions should be found.

PROJECT ANALYSIS AS A STEP IN ECONOMIC DEVELOPMENT

Project Analysis is part of a cycle and has to be conducted in proper relation to the other elements of the cycle. As a first approximation, the cycle is depicted in Chart 1, below:

Chart 1: Stages of Economic Development



The Resource and Demand Analysis may be considered reconnaissance of the economy in which the assets and liabilities of the economy are noted and implications for action are determined. An important result of such an analysis should be a flow of prospective projects and clusters of projects. Thus one could draw an arrow directly from the Resource and Demand Analysis to Project Analysis. The approaches that Bryce has suggested in his book for generating prospective projects may be used in a Resource and Demand Analysis.[2]

The Overall Economic Analysis is a macro analysis in which aggregates such as income, savings, investment, foreign exchange, and foreign aid are projected so that the limits of a total plan can be set. In addition to the aggregates, estimates are made of sub-aggregates such as components of government expenditures (health, education, roads) and other investments by area, as well as by sources of taxes and savings. Results from other steps such as Project Analysis, Project Scheduling, and Project Implementation will affect these aggregates and sub-aggregates. Therefore we could draw arrows from the other steps directly to the Overall Economic Analysis if we wanted to take these effects into account.

The drawing up of a Tentative Plan is done on the basis of all the other steps. The Test and Modification of the Tentative Plan is a determination of the consistency, realism and completeness of the tentative plan accordingly. Again, one would bring to bear the results of all the other steps toward a modified plan.

2/ "Industrial Development, A Guide for Accelerating Economic Growth," by Murray D. Bryce, McGraw-Hill Book Co., pp 19-20.

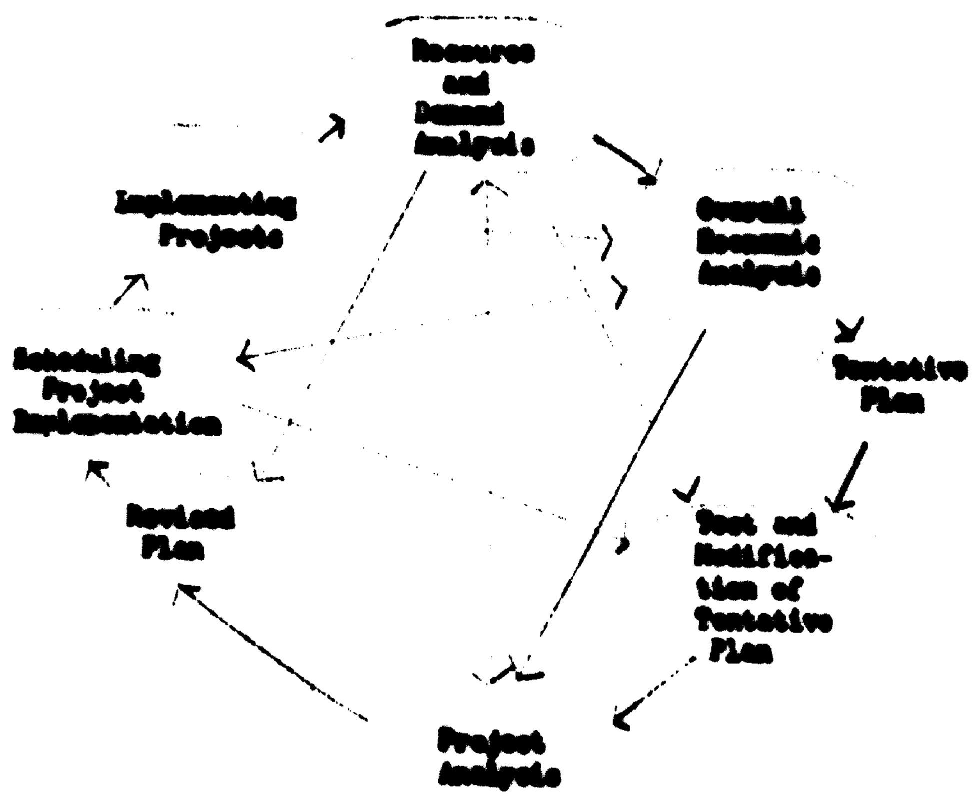
Project Analysis is the formulation of promising alternatives and the evaluation of such alternatives in a way which facilitates rational choice by the decision makers. Project Analysis uses the macro plans as a take-off point. In actual practice project analysis will take place at several levels of detail. One can work out a rough screening process in which many possibilities are tested and the least promising prospects are eliminated from further consideration. Those projects that are not eliminated are given a more detailed and costly consideration.

As projects are analysed, particularly for large projects, the results of analysis will lead to revisions of the total plan. The planning of projects should include a schedule of implementation. The schedules of implementation will affect the other steps as will the actual implementation.

The Overall and Economic Analysis and the Steps Connected with the Total Plan are generally considered part of macro planning, while the activities connected with projects are considered as micro planning. However, all steps have some elements of both. Macro and micro planning are complementary and mutually supporting. Macro planning supplies data for micro planning and vice versa. Neither is useful or fruitful without the other.

It is possible to express the cycle of development planning in a more realistic way which emphasises the interactions, as follows:

Chart 3: Interactions among Steps in Economic Planning



In view of the inter-dependent nature of the economic planning process and the interaction among steps, the effectiveness of the total effort will depend on all the steps in a chain-like manner. It does not do to concentrate on one or two links if the other links will be much weaker. In many newly developing countries, the nature of this cycle is sometimes misunderstood. It is common for a new planning group to spend years on the first two steps, the Resource and Demand Analysis and the Overall Economic Analysis, with the idea that only when they are "finished" with these can they get around to the other steps. This notion of precedence does grave harm to the planning process. It overlooks the fact that one never "finishes" macro planning and that only by taking prompt account of interactions among steps in macro planning and micro planning and actual events, can one operate effectively. For example, a Resource and Demand Analysis should lead to a flow of prospective projects which are being analyzed and incorporated in the plan as promptly as possible. At any point in time, one will have to make assumptions about income, investment and other variables and as projects are analyzed, scheduled and implemented, the Plan must reflect this new information. In addition to the notion that one must "finish" the macro planning first, there is an inadequate appreciation of the resources needed for micro planning and implementation or at least an imbalance of energy and emphasis. The planning and implementation of projects requires a relatively large number of trained persons throughout the economy. Probably the most decisive difficulty in handling projects has been a lack of an agreed-upon-framework for project analysis.

The Resource and Demand Analysis should be directed toward the identification and initiation of immediate action on two kinds of opportunities. The first kind of opportunity isone that has promise for quick and substantial gain. The most noteworthy possibility is the early achievement of higher production levels from existing resources (along with increases in employment, profit, savings, investment and possibly foreign exchange). Especially where there is some modern industry, such opportunities are typically available and the first priority should be to take immediate action to realize this potential. The immediate gains can often be spectacular and can bolster subsequent efforts considerably. Some examples of especially desirable measures[3] are multishift operation of existing facilities instead of building a new factory, seven day operation, taking steps to increase production with existing facilities through better management or making suitable price changes or using existing facilities to make a new product. Other things being equal, projects with quick and early payoff can provide more resources with which to work. The implementation of such quick return projects can also train and test management groups that can be shifted to larger and more complex opportunities in the future.

3/ "Better Plant Utilization - A Blueprint for Action" by Morris J. Solomon, Asia Publishing House, Bombay, India, 1963.

The Resource and Demand Analysis should also be directed toward outstanding opportunities that have a long lead time. It is desirable that the process of planning such projects (including the analysis) start as soon as possible.

HOW A PROJECT IS PREPARED

Consideration of the demand for the product or service will suggest an appropriate physical investment (size, technology, location). For a discussion of demand analysis, one can refer to the excellent Chapter II of the U.N. Manual on Economic Development Projects. 4/

The physical investment schedule may be described as the Physical Resource Flow Plan. It will consist of a list of physical inputs and outputs, specified as to time. The multi-dimensional nature of projects has been referred to previously. If we imagine a project calling for bricks, cement, labor, transportation........up to 199 different inputs and, say, one output, all phased over a 20 year period, we can say that the number of dimensions of the project are 200 x 20 or 4000 dimensions. If we wanted to determine whether an alternative physical resource flow plan, also with 4000 dimensions, is better, it is clearly beyond the capability of the human mind to make a meaningful comparison as long as we have that many dimensions.

4/ United Nations, "Manual of Economic Development Projects," N.Y., 1958 E/CN-12/426/Add 1/Rev. 1.

In mathematical terms we can say that the decision process requires that a point in dimensional space be mapped on to a one dimensional line for all alternative projects. The simplest way to perform this transformation is to assign weights to the various dimensions, and, treating the weighted dimension values as additive, obtain an index of desirability. There is no escape from applying weights since any decision has an implied set of weights (and treatment of weights). The vital question is what kind of weights (prices) are to be applied to each dimension.[1]

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[1] "The problem of reduction of many dimensions to a common dimension of monetary units is basic to the decision process. The centrally controlled economies are finding that to really be in a position to evaluate alternatives, they must make use of prices for decision making purposes. "The comparison of two or more alternatives is easiest, technically, in terms of techno-economic indices. In such cases, the project maker is faced with homogeneous indices. But this method has its limitations in terms of evaluation of alternatives, for example a lower output per worker rate and higher input of raw materials. In such cases the natural tendency was to use actual or devised prices as weights, investment alternatives being compared in terms of two indices, investment outlays and operating costs. It was soon realized, however, that these more generalized indices (i) depend heavily on the structure of prices (ii) left open the problem of substitution between capital outlays and current operating expense and (iii) did not take into account the impact of the tieup of investments during the construction period, technological progress, etc. Attempts to override these difficulties in comparing investment alternatives led to supplementing the method of techno-economic coefficients by appraisal of investment projects, based on assessment of total outlays in value terms." p.11, "Evaluation of Projects in Centrally Planned Economies," presented by the Research and Evaluation Division Centre for Industrial Development, Department of Economic and Social Affairs, United Nations, New York, at the Seminar on Industrial Programming, Sao Paulo, Brazil, March 4-15, 1963.

It is unfortunate that historically, prices and vested interests have been so intermingled that the vital function of prices have been distorted. Recent developments in linear programming have established an equivalence of the problem of maximizing output (or any other variable) and the problem of assigning appropriate weights (shadow prices) to factors of production. One problem is the dual of the other. To maximize overall output one needs to assign the "real" prices to the factors and make decisions as if these were the prices. These shadow prices sometimes will be different from the market prices.

"It is thus necessary to introduce in the evaluation procedure a device intended to restrain the use of the underpriced factors and stimulate the use of the overpriced ones. This can be accomplished by the use of weighted coefficients, which should be high for the underpriced and relatively scarce factors, and low for overpriced ones. A device, which amounts essentially to the same, is to base the evaluation on shadow or accounting prices instead of the market prices. The accounting prices are intended to reflect as accurately as possible the intrinsic values of the factors involved.[1/] One should be clear that prices are merely tools rather than ultimate determinants. Prices are to be regarded as a means of implementing the larger objectives rather than in opposition to these larger goals. Where prevailing prices do not reflect the intrinsic value of the factors involved, the decision should be based on such shadow prices.

1/ "Evaluation of Projects in Predominantly Private Enterprise Economies: Selected Procedures Based on Case Studies," pp 44-45; Also see "Design for Development", pp 39-41, Jan Tinbergen, Economic Development Institute, IBRD, 1961.

One caution should be noted about the use of prices. Prices must be forward looking. The prices used must be those which are realistic for the conditions which are projected.

Given a Resource Flow Plan and the prices of all the items in this plan it is possible to construct the financial documents for and industrial project. There are five basic financial documents that can give us the basis for an adequate economic analysis. The adoption of the standard format of these five basic worksheets and standard calculations can facilitate communication, teamwork, continuity, training and delegation. Of course in addition to being "standard" such a format and calculations should facilitate shaping and choosing projects that create rapid economic growth.

The five basic documents (which we shall discuss in greater detail later) permit us to convert the flow of incommensurable items of bricks, cement etc. to a common measure, a flow of value in money terms, where inputs have a negative sign and outputs a positive sign. Thus the hypothetical project that had 4000 dimensions can be converted to a flow for the 20 years - or 20 dimensions. Even this is not a form amenable to decision making.

How can we convert a money flow over time into a meaningful index? How can we choose among alternatives so that we maximize economic growth?

In most projects we start out by putting in resources with the expectation that such inputs will enable us to get substantial outputs in later time periods. It is meaningful to ask, "For each unit of input, at what rate per year is output being generated?" The higher the rate at which resources are being generated, the greater the contribution to growth by the project.

The time phasing of inputs and outputs and their evaluation is an important element in project design and analysis. A project that takes five years of construction before output is obtained is less desirable than one that produces the same output but takes four years to get into production. Getting into full production a year sooner can make a project more attractive. From the point of view of economic growth, an input is warranted only if it yields enough output some time in the future. This must be true of a large part of a country's projects, if economic development is to be rapid. By discounting flows one can measure the rate at which resources are being generated.[7]

Discounting can be used in two different ways. First, to give project planners a basis for shaping projects on a decentralized basis, the Planning Group specifies a minimum required rate of return. Using this minimum required rate of return, project planners can choose detailed alternatives without having to refer decisions to the Central Planning Group. For example, in the design of pipe insulation to prevent heat loss, the project planner can choose the thickness and material for insulation that yield marginal savings in heat loss over the life of the project that are at least equal to the minimum required rate of return. The use of the minimum required rate of return will be illustrated shortly.

7/ For an excellent treatment of the mechanics of discounting, see: Grant, Eugene L., and Ireson, W. Grant, *Principles of Engineering Economy*, Fourth Edition, The Ronald Press Company.

In designing even moderate sized projects, a project planner can make hundreds of decisions without referring to anyone else, and his decisions will be advantageous from the point of view of the economy, providing he is given and uses the proper minimum required rate of return. This has the advantage of reducing the burden on administration.

Using the minimum required rate of return to choose the best possible shape for projects, the project planners forward their projects to a Central Planning Group with the rate of return yielded by their project. The Central Planning Group is then in a position to rank the projects in order of the greatest contribution to economic growth. For example, one can imagine a Central Planning Group listing the projects submitted to them as follows:

Project	Rate of Return	Amount of Investment	Cumulative Investment
A	5?%	5,000	5,000
B	5?%	3,000	8,000
C	4?%	4,000	12,000
D	45%	18,000	30,000
E	42%	22,000	52,000
F	37%	13,000	65,000
G	35%	12,000	77,000
H	[illegible]	5,000	82,000
I	[illegible]	23,000	105,000
J	[illegible]	17,000	122,000
K	[illegible]	15,000	137,000
L	29%	2,000	139,000
M	23%	3,000	142,000
N	[illegible]	5,000	147,000
O	18%	28,000	175,000
P	17%	42,000	217,000
Q	16%	13,000	230,000
R	15%	12,000	242,000
S	[illegible]	18,000	260,000
T	[illegible]	30,000	290,000

Faced with an array of such opportunities and an availability of 150,000, a Central Planning Group would choose Projects A-M, with a cutoff of about 22%. In actual practice, information on all projects would not be available at the same time, so that decisions would have to be made on incomplete information. In addition, other criteria would have to be used. For example, some of the projects may be complementary so that the exclusion of some of the projects would call for readjustments. There are usually regional considerations and non-economic considerations that have to be incorporated in the final decisions.

SHAPING OF PROJECTS

The formulation and evaluation of projects is a process that goes on almost simultaneously. Even where conditions for a specific project are favorable, we have the task of giving the project a specific shape. By shape we mean determining the

- scale of plant
- gestation period
- phasing over time
- location
- raw materials
- degrees of importing or indigenous manufacture
- degree of mechanization
- technology
- durability of plant
- provision for expansion

An inappropriate choice of any one of the above variables can seriously handicap a project or even turn an excellent prospect into a liability.

The engineers of the developed countries have been using an approach that is of general applicability. 8/ Conceptually, we can think of starting out with what is considered a good project and then trying to think of a change that would appear "better." We then test to see if the alternative to the proposed project is "better." If the alternative is not "better" we stick to the proposed project. If our test indicates that the alternative is "better" we discard the proposed project in favor of the alternative. In effect, the alternative becomes the new "champion." We continue to search for promising alternatives or challengers and testing these against the champion, as of that moment. Persons with technical and operating knowledge are generally in a good position to suggest changes that are promising. It is important, therefore, that those originating the project think in terms of searching for modifications or different approaches until they have exhausted what they consider to be promising possibilities. Modifications may be in scale of plant, amount of fabrication, technology, construction methods or materials, etc.

In choosing among alternative forms of projects, one should constantly look for changes that will give more product for the same investment or ways of getting the same product for less investment. This orientation of getting something for no investment or getting more

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8/ Grant and Ireson, Chapter 2, "Business Decisions are Between Alternatives."

for the same investment can yield very large gains if pursued with determination and imagination. It is useful to express the promising alternatives in money flows. Thus, if one obtains the same output for less investment (Case A) or greater output for the same investment (Case B) a glance at the money flows is sufficient to determine which alternative is preferred. In the language of the game theorist A_2 is dominant as against A_1 and B_2 is dominant as against B_1.

	Case A		Case B	
Year	Project A_1	Project A_2	Project B_1	Project B_2
1	-1,000	-800	-1,000	-1,000
2	+ 300	+300	+ 300	+ 350
3	+ 325	+325	+ 325	+ 400
4	+ 350	+350	+ 325	+ 400
5	+ 350	+350	+ 325	+ 400
6	+ 350	+350	+ 325	+ 400
7	+ 350	+350	+ 325	+ 400
8	+ 350	+350	+ 325	+ 400
9	+ 350	+350	+ 325	+ 400
10	+ 350	+350	+ 325	+ 400

Usually there is considerable scope for finding alternatives that are clearly better than others. Where there are no objections whatsoever to a "preferred alternative," one might not have to formulate the financial flow of the less preferred alternative.

A difference flow gives the additional investment (input) and the additional product (output) of the project requiring greater investment, or earlier investment. For example, the additional investment required for Project A_1 is 200. The additional output for Project B_2 is 50 in year 2 and 75 in subsequent years. The difference flows are given below

Year	Case A: Project A_1	Case A: Project A_2	Case A: Difference Flow	Case B: Project B_1	Case B: Project B_2	Case B: Difference Flow
1	-1,000	-600	-400	-1,000	-1,000	0
2	+ 300	+300	0	+ 300	+ 390	+90
3	+ 385	+385	0	+ 325	+ 400	+75
4	+ 390	+390	0	+ 325	+ 400	+75
5	+ 390	+390	0	+ 325	+ 400	+75
6	+ 390	+390	0	+ 325	+ 400	+75
7	+ 390	+390	0	+ 325	+ 400	+75
8	+ 390	+390	0	+ 325	+ 400	+75
9	+ 390	+390	0	+ 325	+ 400	+75
10	+ 390	+390	0	+ 325	+ 400	+75

Case A and Case B are illustrations of opportunities of getting something for nothing. Such opportunities should be sought out as a first priority. In addition, there will often be opportunities where by investing less you have to give up some gain in later years, but the gain you give up may or may not be so large that it is worth making the additional investment. Or one can make an additional investment in the early years which yield additional output in later years that may or may not justify the additional investment.

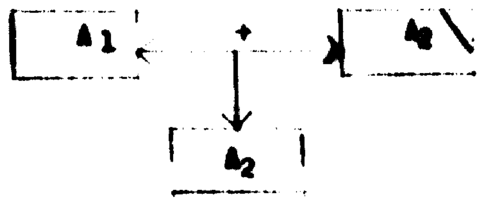
In contrast to Cases A and B, we can give Cases C and D as illustrations of alternatives that are not "obviously better." In Cases C and D one is not getting something for nothing. Rather, one has to pay something more in the early years and we must answer the question, "Is it worthwhile to make the increment investment?"

	Case C			Case D		
Year	Project C_1	Project C_2	Difference Flow	Project D_1	Project D_2	Difference Flow
1	-1,000	-1,300	-300	-1,000	-800	-200
2	+ 300	+ 350	+ 50	+ 300	+250	+ 50
3	+ 325	+ 375	+ 50	+ 375	+350	+ 25
4	+ 350	+ 400	+ 50	+ 375	+350	+ 25
5	+ 350	+ 400	+ 50	+ 375	+350	+ 25
6	+ 350	+ 400	+ 50	+ 375	+350	+ 25
7	+ 350	+ 400	+ 50	+ 375	+350	+ 25
8	+ 350	+ 400	+ 50	+ 375	+350	+ 25
9	+ 350	+ 400	+ 50	+ 375	+350	+ 25
10	+ 350	+ 400	+ 50	+ 375	+350	+ 25

A possible way to determine the answer to the question of which project to choose is to obtain the internal rate of return (yield) of the difference flow and then ask the central planning group which of the alternatives should be chosen. There are a number of objections to using the internal rate of return in this way. Normally in the design of a project, a large number of alternatives will be considered. Fortunately, many if not most of the alternatives that will be considered will be "obviously" better. Even so there will be a large number where the answer is not so obvious. As was discussed previously, to refer so many decisions to a central authority would clog the decision making channels. This can be avoided if the central authority gives the project planners a required minimum rate of return, which in effect says, "If you have an option in designing a project between making a larger investment or a smaller investment, or an investment sooner rather than later, make the greater or earlier investment only if the rate of return on the additional investment is at least the specified minimum required rate of return. In addition to permitting the project formulator to proceed on his own, he can make decisions with less computation.

It is useful to be able to express the results of a comparison schematically. This can be done as follows:

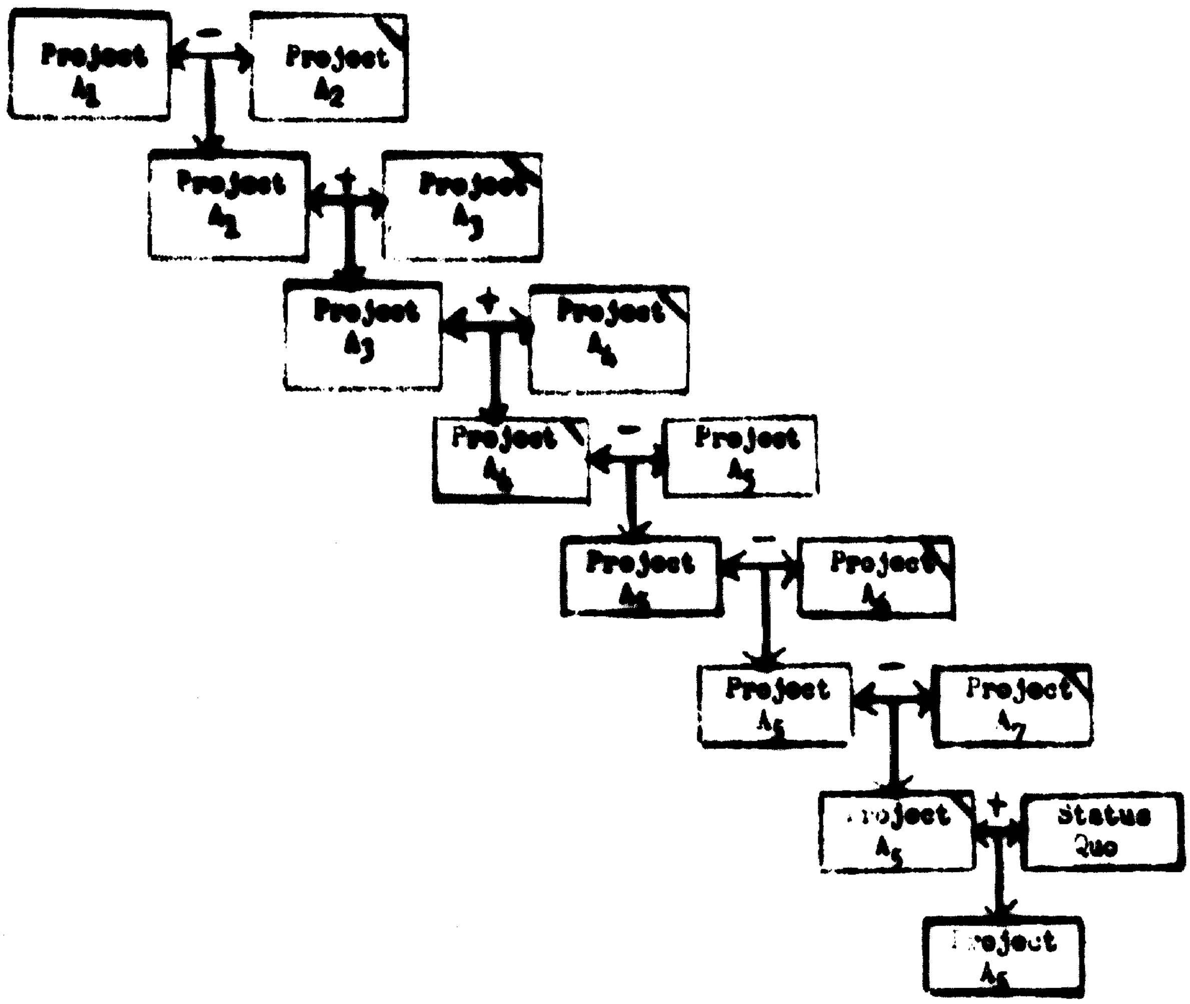
Minimum Required Rate of Return = [illegible]%



The meaning of the above is that in testing the two alternatives A_1 and A_2 , it has been found that the difference flow yields a return over and above the required minimum rate of return, [illegible]% and hence A_2, the project with the greater capital investment is preferred to A_1. The diagonal line in the right upper corner of the A_2 box denotes a larger investment.

From an economist's point of view, the minimum required rate of return is the opportunity cost of capital. Chart 3 illustrates schematically how project modification would proceed.

Chart 3: Schematic Illustration of Project Modification



SOME COMPLICATING FACTORS

Most proposed projects are affected by other projects, or affect other projects. The interdependence either stems from a user or supplier relationship. This is illustrated below:

Suppliers → Proposed Project → Buyers

The realization of a proposed project is obviously linked to other projects. The market anlysis of the product and the Resource and Demand Analysis of the economy can yield important information on these links. Especially if the economic development plan is approached as a cycle rather than a fixed plan, a good deal of complementarity of projects can be taken care of. But there are what economists call external economies that have the effect of one project sowing what the other project reaps. The external economies argument is one that is open to great abuse. Aside from the crucial need for honesty, there are two important safeguards against abuse. First, the imaginative use of the champion-challenger concept will rule out many projects that might be justified by a loose use of the "external economies" argument. Second, we must be conscious of the danger of counting benefits twice.

A central index of worth of a project will be the discounted rate of return of its money flow. However, there will be other considerations which will have an important bearing on the desirability of a project. When such considerations can be given a quantitative form, but involve a dimension other than money and cannot be converted into money terms (flow) in a meaningful way, they are called "incommensurables." If they cannot be put in any meaningful quantitative form, such considerations are "intangibles." With a little ingenuity, an analyst can often turn an intangible into an incommensurable or a money flow, or an incommensurable into a money flow. An "intangible" should be regarded as a challenge to our ingenuity. To the extent that we quantify it in a meaningful way, it becomes an incommensurable.

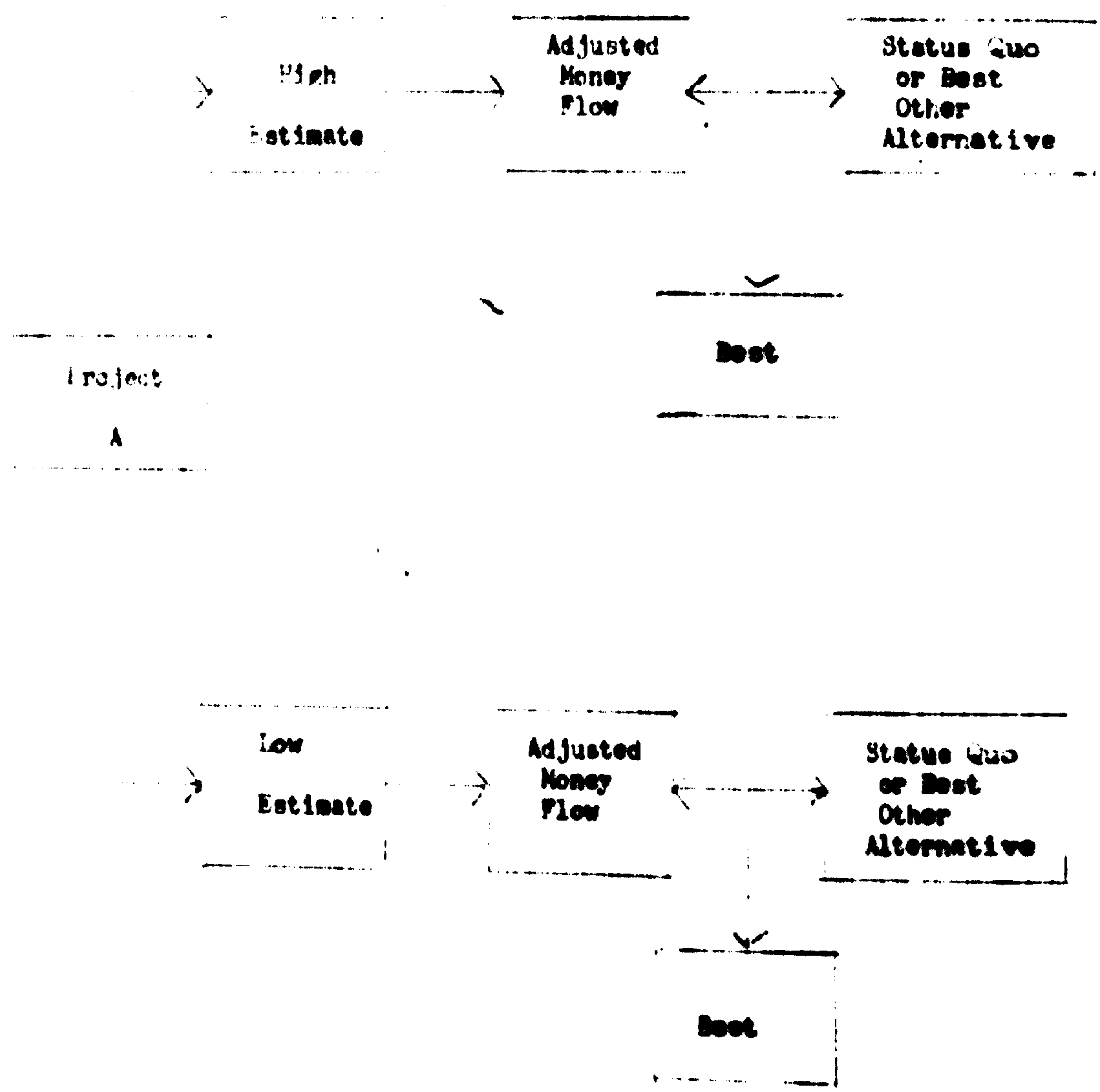
There are two aspects of incommensurables and intangibles. First, one must be able to estimate the effect of a proposed project with respect to such considerations. For example, if we are concerned with the inconvenience of families displaced by a proposed dam, we should have some estimate of how many families will be affected. Second, we must somehow or other give the proper weight to each consideration. In considering a proposed dam, even if we know how many families are affected, we would have to give this consideration its proper weight in the decision process.

There are a number of useful ideas on handling incommensurables and intangibles:

One can make explicit estimates of the incommensurable factors in terms of money flows. Where it is difficult to convert a factor to money cost, one might use a high estimate and a low estimate. If the decision is not affected by which end of the range is assumed, the particular consideration can be handled by using our best estimate, without further ado. Chart 4 illustrates such a process. In the case of a proposed dam, one might estimate the money cost of "compensating"

Chart 4

Use of Estimates of Range To Reach Decisions



the displaced families for their trouble. If either end of the range of money cost hardly affects the decision, we can use our best estimate within the range, simplifying the problem enormously. If, however, decisions are sensitive to which part of the range is correct, then one may have to give more careful consideration to the estimates to narrow the range. This approach can be applied to estimating many relatively insignificant items of a project in the interest of moving ahead with the project analysis.

Another approach is to obtain the cost of achieving the values in other dimensions in terms of additional cost. In effect, one is determining the extra cost of achieving values in other dimensions. We can illustrate this with respect to an important problem that often arises in newly developing countries, namely the development of backward areas.

Let us assume that there are two possible locations for a facility and their money flows and the flow of the status quo are as follows:

Year	A_1	B_1 (Backward Area)	Status Quo
1	-900	-1000	+100
2	+1350	+1200	+100

It is clear that Project A_1 is uniformly better, since it requires a smaller investment and gives greater output than B_1. Therefore, if we take the rate of return as the index of desirability we push aside Project B_1 as unworthy of our attention. The result we would get is:

Minimum Required Rate of Return - 15%

A1 Status Quo

A1

Suppose, however, that there are other reasons for wanting to put the project in the backward area (Project B_1). The project analyst does not make the final decision, but he has an important service to perform. He can determine the cost of putting the plant in the backward area. The difference flow of A_1 and B_1 represents the economic disadvantage of Project B_1 as follows:

Year	A_1	B_1	Difference Flow
1	-900	-1000	-100
2	+1350	+1300	-50

By getting the present value of this flow at the minimum required return we have a meaningful measure of the cost. The actual choice of the decision maker will depend on whether alternatives are found which permit him to accomplish the same purpose in the backward area at lower cost. In the absence of such measurements, decisions can easily disregard the economic advantage of a location or whatever factor that is relevant. Some factors that need this kind of pricing are national pride, political promises that have been made, and local pressures. At the very least, analysis can give the cost of catering to such considerations. Analysis enables the decision maker to satisfy such interests without paying too much.

Another way of treating incommensurables and intangibles is to disregard them. This is justified to the extent that there are more appropriate means for achieving desired values of incommensurables and intangibles. Like any instrument, project choice can be used to achieve a multitude of goals, including some values that are incommensurable or intangible. A hatchet can be used to cut paper, but one would pay a price for such cutting as against using scissors. Similarly, while projects can be chosen to satisfy incommensurable and intangible criteria, one should weigh the cost in terms of rate of return (and other considerations) and the feasibility of dealing with these incommensurable and intangible criteria by other instruments of control. While inequality of income is certainly a legitimate consideration, we need not shape projects to achieve greater equality to the extent that we are willing to make vigorous use of other instruments such as tax policy, institutional reform, education expenditures, public works expenditures and outright welfare expenditures. Where such instruments are used niggardly, it is likely that pressures on project choice will be strong. Analogous considerations exist with respect to monopoly considerations, regional development, and population growth.

Explicit Treatment of Uncertainty

If a project has been modified to remove as much of the uncertainty as possible and there is still substantial risk involved, this risk should be given weight in the decision as to whether to choose the project. In general, one could afford greater risks in small projects than in large projects.

When there is considerable uncertainty about important parameters, the analysis should be run for different values of these parameters. For example, if the course of prices is in question, the results should be obtained for the major possibilities. Or, if there is some uncertainty about the date at which full production will be obtained, the effect of a likely possibility should be tested. In some cases, if the effect is important enough, it may be possible to take steps to remove such uncertainty or somehow find some way of reducing the risk. For example, a management contract that guarantees full production by a certain date can be negotiated. The size of the market may be an important uncertainty. Such uncertainty might be removed by further market research, intensive product development efforts, or a foreign sales contract. Another possibility is to reject the project. In taking uncertainties into account one must exercise judgment. Otherwise, the job of calculating the different possibilities can become unmanageable. One should take only the major uncertainties into account. The existence of contingencies which could have a bad effect on the project is a challenge to the analyst and the decision maker to modify the project so as to reduce the chance of the deleterious contingencies coming to pass.

ECONOMIC YARDSTICKS TO BE APPLIED TO PROPOSED PROJECTS

There are three main ways of looking at a project, from the point of view of the entrepreneur, the business enterprise, and the economy. A good project is one which is attractive from all points of view. An objective of project analysis is to shape the project so that it is attractive to all concerned. Where an analysis shows that a project is attractive from one point of view, but is not sufficiently attractive from another point of view, this should initiate an effort to modify the project so that benefits are shifted toward the least favored of the participants, preferably without damage to anyone, but possibly even at the expense of one of the participants.

Various criteria or yardsticks can be applied to a project:

Business Enterprise Rate of Return

This is the annual rate of return to the business enterprise on the total resources invested in a project, including equity capital and loan funds. This is a measure of success from the business enterprise point of view. It can be derived from ordinary accounting data, including the projected capital account and the pro forma profit and loss statement. The chief difference from conventional accounting usage is to treat depreciation as an output (availability) instead of as a cost (input).

Rate of Return to the Entrepreneur

In projects undertaken by private enterprises the main risk is taken by the entrepreneur who borrows money from a bank or obtains a loan elsewhere. While the money that is borrowed yields a fixed rate of return, all earnings above the fixed rate of return and amortisation payments of the loan accrue to the entrepreneur. If a project goes well, one would expect an entrepreneur to get an attractive return on his investment. If the project goes poorly, then the entrepreneur would do worse than expected. In a sense, the entrepreneur's return on investment is the margin for error for those who lend to the enterprise. To the extent that this margin is large, there is less risk for the lender. From the point of view of the entrepreneur the inputs of the financial flow are investment funds which are supplied by himself. The outputs are depreciation and profit of the entire enterprise, less required amortisation payments.

National Gross Rate of Return

We would like a rate of return that can be used as an index of worth to the whole economy. We would like it to be as comprehensive as possible, but we should be clear that it cannot include all considerations. After we have computed our index, the decision maker will still have to take additional considerations that are incommensurable or even intangible, into account. "In practical problem solving — we have to look at some 'proximate' criterion which serves, we hope, to reflect what is happening to satisfaction, profits or well being. Actual criteria are the practical substitutes for the maximization of whatever we would ultimately like to maximize."[9] A major index of the economic worth of a project from the point of view of the economy is the national gross rate of return. The national gross rate of return is the annual rate at which the project generates value added for each unit of input.[10]

In calculating the national gross rate of return, the value of output is considered as a benefit, regardless of the particular person or group that is the recipient. In general, one would avoid counting a benefit twice. A benefit that one person gains at another person's expense would not be a benefit from the point of view of the economy. Benefits accruing to the individuals are not necessarily identical with benefits to the economy. If there is no marketable product or service, the product or service would still have a value.

We would like our measure of value added to reflect something real rather than fictitious. The computation of the national gross rate of return requires that the physical flows of a project be converted to a financial flow. While it is not possible to handle physical resource flows, at the same time we want the counterpart money flows to be true to reality. This should alert us to the possibility that the merit of the

9/ Page 29, "Efficiency in Government Through Systems Analysis," a Rand Corporation Study by Ronald N. McKean.

10/ Value added is the value created by the project. It is the sales or value of product less cost of materials, supplies, or services purchased from other enterprises. It is based on the idea that the value represented by purchased materials, supplies or services are attributable to the investment made by the other enterprises. Thus, the value of a manufactured product represented by cost of power is "credited" to the investment in the power rather than the production facility of the proposed project.

project will be determined by the prices we allocate to output or input. The issue of price can be faced squarely. In comparing the money flow of the project with that of the alternative, it is important that the price per unit of output be the same for both money flows. Therefore, where the total value added by a proposed project is greater than the value added from the alternative because of a difference in price to the customer, the benefit of the proposed project is exaggerated unless an adjustment is made. The adjustment will be an addition or subtraction from the flow of the project, depending on whether the price to the consumer is under or over the price that would exist under the alternative.

Where there is a scarcity of foreign exchange and/or the official rate of foreign exchange does not reflect the "true worth of foreign exchange," we would use a shadow price for foreign exchange in deriving the money flow for the national gross rate of return. This shadow price for foreign exchange would be determined by the central authority and used in all computations of the national gross rate of return for projects. The effect will be to favor projects that are import savers or foreign exchange earners and penalise projects that create imports, on a uniform basis for all projects.

To maintain comparability between a proposed project and its alternative, in both cases tax revenue is treated as part of the national gross flow. This is the one deviation from the usual definition of value added.

A summary of the features of the national gross rate of return is as follows:

1. Conversion to time phased money flows.

2. Discounting to allow for the critical importance of time.

3. Use of difference flows to properly compare alternatives.

4. Use of constant prices for the proposed project and its alternative to allow for fictitious value added.

5. Treatment of taxes as value added to maintain comparability of the proposed project and its alternative.

6. Shadow price for foreign exchange to allow for the value of foreign exchange from the point of view of the economy.

Surplus Rate of Return

The national gross rate of return is the ratio $\frac{\text{value added}}{\text{investment}}$, expressed as the rate of growth per unit of time, with adjustments for price of product and corrected prices for inputs. Its appeal lies in the undoubted fact that a severely limiting factor in newly developing countries is the capital available per capita. In the face of such a scarcity, it can be argued that a society that invests so as to maximize the value added per unit of investment, will maximize income over time. The latter statement holds only if it is assumed that the society can choose to channel any desired proportion of income to investment.

The national gross rate of return counts value added without regard to who in the economy receives the income or what is done with the income generated. Whatever the income distribution resulting from projects, if taxes and savings siphon off a sufficiently large part of the resulting income and such taxes and savings are invested, then project analysis need be concerned only with the return in terms of value added without regard to the distribution effects of the project, at least from the point of view of economic growth. However, the assumption of a sufficiently large proportion of current income being channelled into investment, independent of the form of income, generally does not hold in any society.

If economic growth has a high priority and we admit that savings will be limiting economic growth, we cannot rely entirely on the national gross rate of return. We need a yardstick that takes into account the savings which will be generated by the project.

The investment inputs of a project are in effect surplus (to consumption) resources that are made available to the project during the investment period. To the extent that the project generates large surpluses soon, it makes it possible to engage in additional projects. Therefore, a meaningful yardstick for national development is the answer to the question, "For each unit of surplus made available to the project, at what annual rate are reinvestable funds generated by the project?" This rate is the surplus rate of return of the project. As an approximation, the surplus is computed as the difference between total sales value of the project and the cost of purchased inputs (raw material, power, etc. and labor costs). The surplus is taken to be equivalent to profits, depreciation, interest payments, and taxes. This is a surplus looked at from the point of view of the economy rather than from the point of view of the business enterprise or entrepreneur. The assumption is made that practically all such funds will in fact be used for further investment (and growth) while wage and salary payments will be spent entirely on consumption. If circumstances are appropriate, alternative assumptions will be made. For example, one might assume that 5 per cent of salary payments are saved and 90 per cent of dividends are saved, but in most cases such a refinement could not be justified.

A society can make investments so that the national gross rate of return is high, yet have little or no capacity to grow from its own resources. We can illustrate this by an extreme example. Imagine a society that has a large number of handloom weavers who are unemployed because they do not have cotton to work on. If someone will lend them money to import cotton they can sell enough finished goods abroad to continue to import the cotton and sell the rest of their product in the home market, with the value added per year amounting to five times the investment in cotton. Assume that their compensation is at a low level and they cannot save any part of their earnings. Under such circumstances the national gross rate of return for the project would be very high, but the surplus rate of return would be zero. While the first burst of income can continue indefinitely, any further increase cannot arise from this project. The project has a zero capability of generating reinvestable funds.

Relation of National Gross Rate of Return, Surplus Rate of Return, and Economic Growth

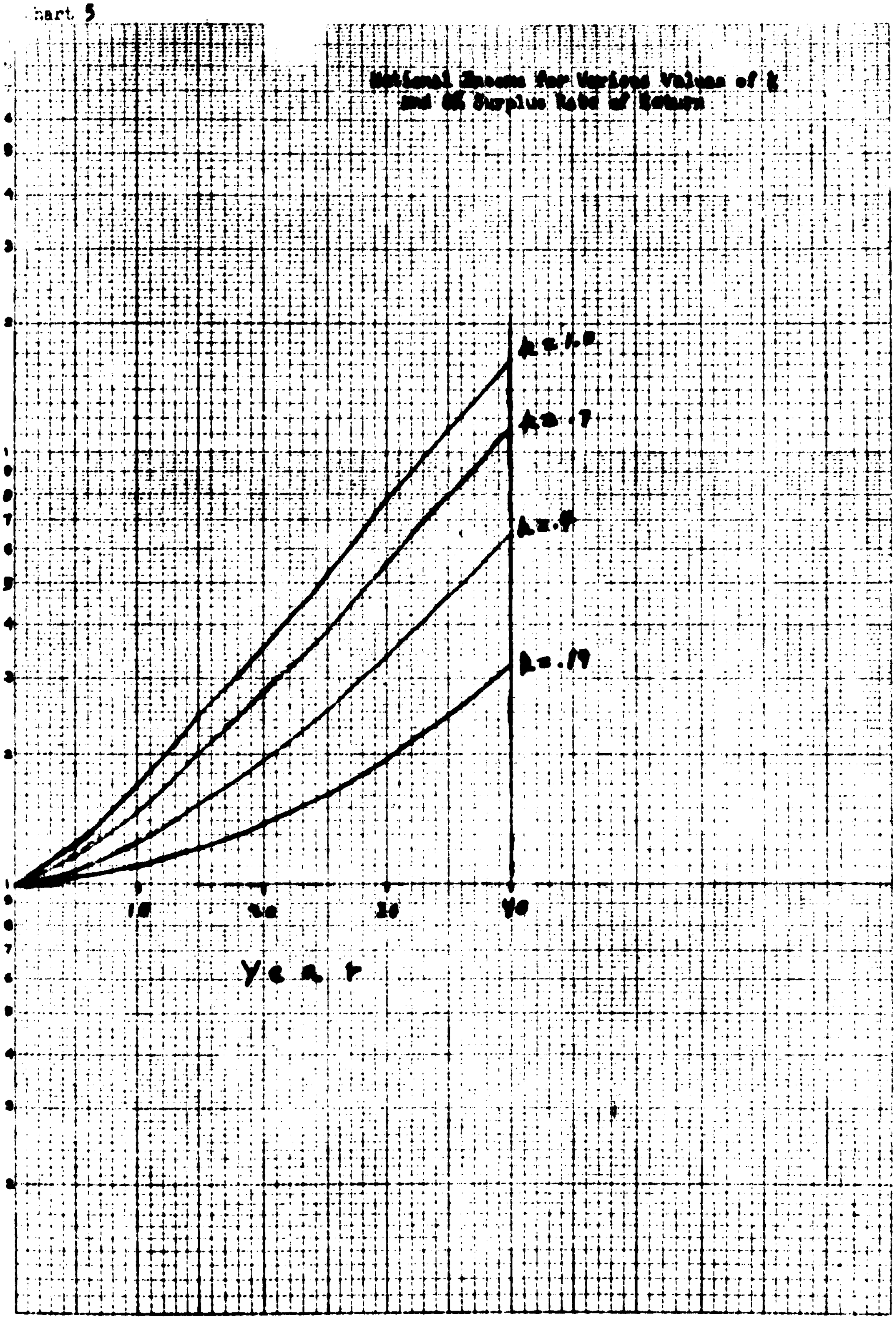
In essence our system calls for computing two indexes, both of which contribute to economic growth.11/ How important is each, however?

11/ Readers familiar with the economic literature will recognize the national gross rate of return as closely related to Tinbergen's National Income, and the surplus rate of return as closely related to the Galenson and Liebenstein criterion. See Jan Tinbergen, Ibid, and W.Galenson and H.Liebenstein in "Investment Crieteria, Productivity and Economic Development," Quarterly Journal of Economics, Vol 69, No.3, (August 1953), pp 343-370.

To answer this question let us assume a hitherto static society whose income is $1,000. Also assume that it can save $50 the first year and it will continue to save that amount from "old income". It is free to choose projects with alternative values of national gross rate of return, k, and alternative values of surplus rate of return, i. We program a computer to calculate the national income over a 40 year period for a range of values of k, each value of k coupled with a value of i from a range of i values. We obtain the national income streams for about 400 combinations of i and k for 40 year periods. If we fix the value of i and plot the national income for alternative values of k, we could readily see that k had a large impact on the growth of national income. This can be readily seen in Chart 5, where an i of .08 is assumed. Similarly, if we fix k and vary i, we would see that i had a large impact on the growth of national income. The results merely reflect the fact that national income growth is jointly determined by both k and i.

For many choice situations, alternatives which are attractive with reference to k will also be attractive with reference to i. This is particularly true for alternatives within a project. Those shaping projects should grasp opportunities that will give high values of both k and i. However, particularly between different projects, there will be projects with high k and low i competing with projects that have low k and high i. Faced with such a situation, on what basis can "tradeoffs" be carried out? How much of a loss of i is worth a gain of k in terms of economic growth, since both i and k contribute to growth? Considerable light is shed on this question when we ask, "If we want to achieve a given average annual increase in national income (say 2%) over a ten year period, what pairs of

Chart 5


National Income for Various Values of k
k=.7
k=.9
National Income
Year
10
20
30
40

average k and i will yield this increase. This is plotted in Chart 6. We can see that there is a wide range of combinations. For example P_1 has a high value of k and a low value of i, while P_2 has a low value of k and a higher value of i. Based on political and social considerations P_1 would be preferred. In general, we can expect P_1 to give more employment, since the chief difference between k and i is the payment to personnel. However, the choice of P_1 carries a penalty to which political authorities should be alert. If we plot the curves for 20 years, P_1 will yield a smaller increase in income than P_2 over the 20 year period. The explanation of this is that the surplus rate of return has greater force in the longer period. In fact, it can be shown analytically that in the long run the rate of income increase converges to the surplus rate of return.

This analysis has a very interesting bearing on tax policy and the use of a shadow price for labor. It is clear that taxes, insofar as they preempt resources that would otherwise go into consumption and are used for projects, have the effect of increasing the growth potential of the economy.

When a shadow price for labor is used, in effect what one is doing is paying \$1.00 for a unit of labor (market or conventional price) even though the value of output of the unit of labor is less than \$1.00. The flow of national gross is the value of output as against the alternative of having idle labor. The national gross rate of return will tend to be attractive. The surplus rate of return will exclude the incremental value created by labor. The difference between the price paid and the shadow price is a deduction from reinvestable funds. Hence the use of a shadow

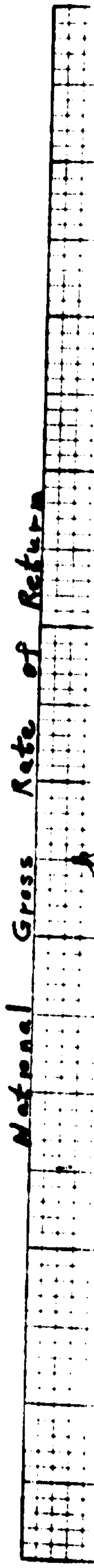
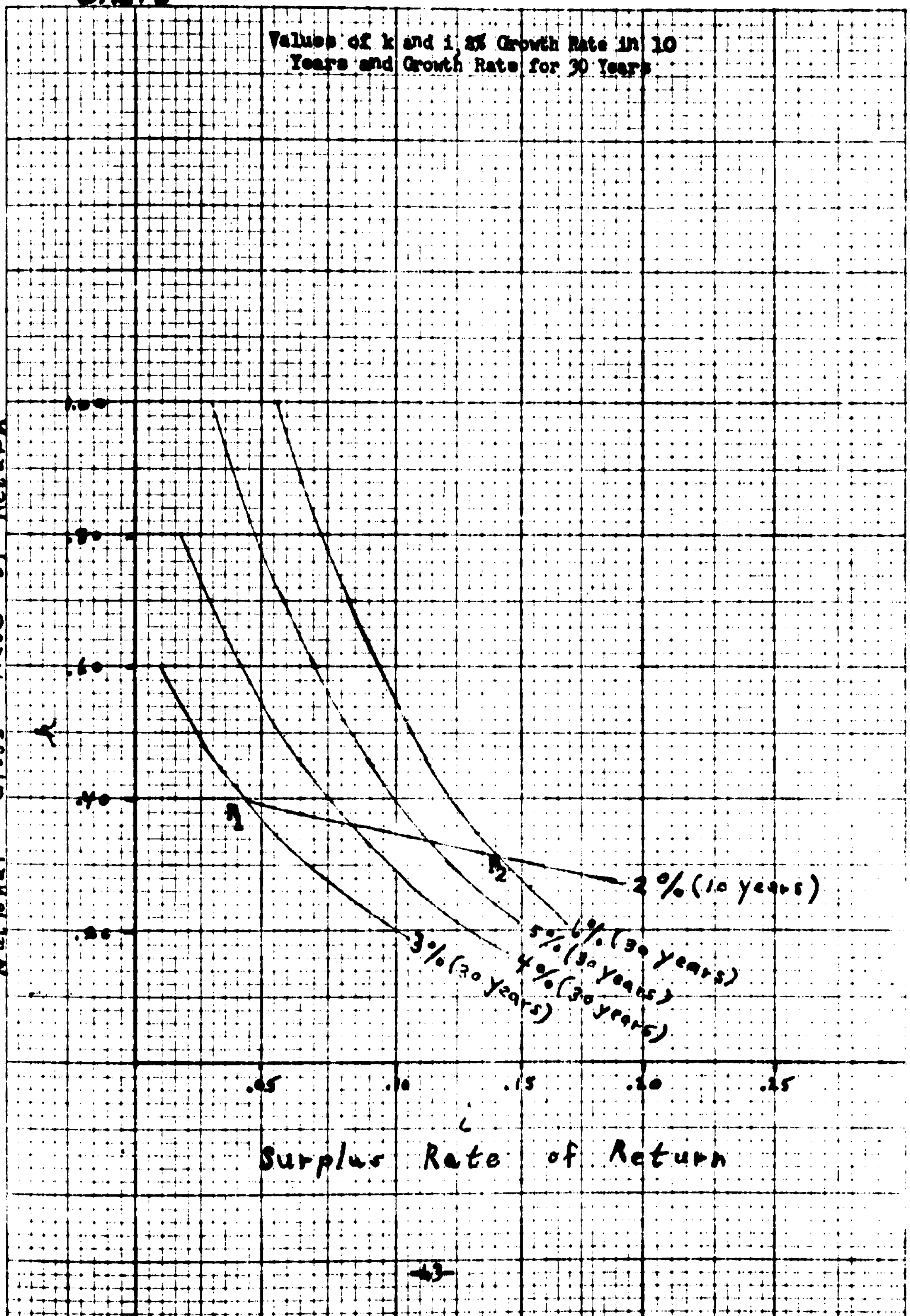


Chart 6



Values of k and i 2% Growth Rate in 10
Years and Growth Rate for 30 Years
1.00
.80
.60
.40
.20
k
National Gross Rate of Return
.05
.10
.15
.20
.25
i
Surplus Rate of Return
2% (10 years)
6% (30 years)
5% (30 years)
4% (30 years)
3% (30 years)

price for labor creates a negative surplus rate of return. In effect such use of labor is a drag on economic growth. Of course it is possible to counter this drag by a suitable level of taxes.

THE FIVE BASIC WORKSHEETS FOR AN ILLUSTRATIVE PROJECT

While the details of carrying out the computation may not be of immediate interest, it will be useful to give the five basic worksheets of a proposed chemical enterprise for one of the newly developing countries. (Tables 1-5)

The columns on the left indicate how to treat the respective elements of the project, according to a particular point of view, as follows:

BE - Business Enterprise

E - Entrepreneur

NG - National Gross

S - Surplus

FE - Foreign Exchange

T - Tax

Table 1

FOREIGN INVESTMENT SCHEDULE FOR CHEMICAL PROJECT

T	PE	S	MG	E	ME		Source of Financing	1	2	3	4	5..........15	16
0	0	0	0	-	-	Equipment	Foreign Entrepr.	-	-	1 115		(5-16 nothing)	
0	-	-	-	0	-	Equipment	Foreign Loan	3 088	1 377	5 535		"	
0	-	-	-	-	-	Foreign Freight*	Nat'l Entrepr.*	65	29	140		"	
0	0	0	0	-	-	Engin. Install.	Foreign Entrepr.	-	-	1 145		"	
0	-	-	-	0	-	Guarantee	Foreign Loan	-	-	-	1 300	"	
								-	-	-	-		-2 7[illegible]
0	-	-	-	-	-	Foreign Material Inventory*	Nat'l Entrepr.*	-	-	162		-162	
0	-	0	0	-	0	Payment on Loan	Depreciation and Profit	-	-	-	(1 130 from 4-13)		

*To be furnished by government in exchange for local currency provided by local entrepreneur.

Table 1 (a)

FOREIGN INVESTMENT SCHEDULE FOR CHEMICAL PROJECT

Source of Financing	1	2	3	4		14	15	16
BE	-3 153	-1 406	-6 097	-1 380	(- from 5-13)	-	+162	+2 780
E	-65	-29	-2 962	-1 130	(-1 130 from 5-13)	-	+162	+2 780
BS	-3 153	-1 406	-5 897	-1 380	(- from 5-13)	-	+162	+2 780
S	-3 153	-1 406	-5 897	-1 380	(- from 5-13)	-	+162	+2 780
FS	-3 153	-1 406	-5 897	-2 430	(-1 130 from 5-13)	-	+162	+2 780
....	(- throughout)							

Table 2

DOMESTIC INVESTMENT SCHEDULE FOR CHEMICAL PROJECT

Table 2

DOMESTIC INVESTMENT SCHEDULE FOR CHEMICAL PROJECT

T	FE	S	NC	E	DE	Investment	Source of Financing	1	2	3 .	4	15	16
0	0	0	0	-	-	Land	Nat. Entrepr.	100					-100
0	0	-	-	-	-	Buildings	" "	500	2 691	1 529			
0	0	-	-	-	-	Erection Expense	" "		150	800			
0	0	-	-	-	-	Domestic Freight	" "	65	134	140			
+	0	0	0	-	-	Duty on Imported Equipment	" "	309	138	665			
0	0	-	-	-	-	Domestic Insurance	" "	32	15	70			
0	0	-	-	-	-	Organization Expense	" "	100					
													-1 464 a/
						Working Capital							
	0	-	-	-	-	Domestic Materials Inventory	" "			206	217	-423 b/	
	0	0	0	-	-	Personnel Payments	" "				51	-51 b/	
	0	0	0	-	-	Accounts Receivable minus Accounts Payable	" "			237		-237 b/	
	0	-	-	-	-	Finished Inventory					456	-456 b/	
+	0	0	0	-	-	Duty on Imported Materials	" "			39		-39	

a/ Value is assumed to be the book value based on a useful life of 15 years. The estimate of residual value would be based on whatever seemed reasonable under the particular circumstances.

b/ Working capital is assumed to be available at the end of the period.

Table 2 (a)

DOMESTIC INVESTMENT SCHEDULE FOR CHEMICAL PROJECT

Source of Financing	1	2	3	4		15	16
DS	-1 106	-3 128	-3 606	-724	(- from 5-14)	+1 206	+1 564
E	-1 106	-3 128	-3 606	-724	"	+1 206	+1 564
NS	- 697	-2 990	-2 745	-473	"	+679	+1 464
S	- 697	-2 990	-2 745	-473	"	+679	+1 464
FE	-	-	-	-	"	-	-
T	+ 309	+ 138	+ 784	-	"	-39	

Table 3

PROFIT AND LOSS STATEMENT OF THE CHEMICAL PROJECT ENTERPRISE

Table 3

PROFIT AND LOSS STATEMENT OF THE CHEMICAL PROJECT ENTERPRISE

T	FE	S	MG	E	RE		4	5	6	7	8	9	10	11	12	13	14	15
o	-	o	o	o	o	Foreign Personnel	58	72	36	18	0	0	0	0	0	0	0	0
o	o	o	+	o	o	Personnel	514	632	632	632	632	632	632	632	632	632	632	632
+	o	+	+	o	o	Personnel Taxes	89	110	110	110	110	110	110	110	110	110	110	110
o	o	o	o	o	o	Raw Materials, Domestic	1 286	1 703	1 880	1 880	1 880	1 880	1 880	1 880	1 880	1 880	1 880	1 880
+	o	+	+	o	o	Raw Materials, Taxes	110	151	160	160	160	160	160	160	160	160	160	160
o	-	o	o	o	o	Raw Materials, Foreign	33	44	49	49	49	49	49	49	49	49	49	49
+	o	+	+	o	o	Raw Materials, Customs Duty	11	15	16	16	16	16	16	16	16	16	16	16
o	-	o	o	o	o	Operating Supplies, Imported Operating Supplies, Customs	120	149	172	172	172	172	172	172	172	172	172	172
+	o	+	+	o	o	Duty	30	36	40	40	40	40	40	40	40	40	40	40
o	o	o	o	o	o	Operating Supplies, Domestic	191	260	270	270	270	270	270	270	270	270	270	270
+	o	+	+	o	o	Operating Supplies, Taxes	22	30	31	31	31	31	31	31	31	31	31	31
o	o	o	o	o	o	Electricity	552	741	817	817	817	817	817	817	817	817	817	817
+	o	+	+	o	o	Electricity, Taxes	50	64	68	68	68	68	68	68	68	68	68	68
o	o			o	o	Insurance	60	60	60	60	60	60	60	60	60	60	60	60
o	o	+	+	+	+	Depreciation	1 409	1 409	1 409	1 409	1 409	1 409	1 409	1 409	1 409	1 409	1 409	1 409
o	o	o	+	o	o	Maintenance, Labor	155	179	180	180	180	180	180	180	180	180	180	180
+	o	+	+	o	o	Maintenance, Labor Taxes	16	20	20	20	20	20	20	20	20	20	20	20
o	-	o	o	o	o	Maintenance Parts, Imported Maintenance Parts, Customs	219	265	265	265	265	265	265	265	265	265	265	265
+	o	+	+	o	o	Duty	51	62	62	62	62	62	62	62	62	62	62	62
o	o	o	o	o	o	Maintenance Parts, Domestic	132	183	188	188	188	188	188	188	188	188	188	188
+	o	+	+	o	o	Maintenance Parts, Taxes	8	10	10	10	10	10	10	10	10	10	10	10
o	o	o	+	o	o	General Expense, Personnel General Expense, Personnel	209	242	256	256	256	256	256	256	256	256	256	256
+	o	+	+	o	o	Taxes	23	27	28	28	28	28	28	28	28	28	28	28
o	o	o	o	o	o	General Expense, Supplies & Services	542	628	662	662	662	622	622	622	622	622	622	622
+	o	+	+	o	o	General Expense, Supplies & Services Taxes	37	50	50	50	50	50	50	50	50	50	50	50
o	-	o	o	o	o	Foreign Interest	678	622	565	508	452	396	339	282	226	170	113	56
+	o	+	+	o	o	Production Tax	1 984	2 641	2 903	2 903	2 903	2 903	2 903	2 903	2 903	2 903	2 903	2 903
						SUBTOTAL OF COST	8 586	10 405	10 939	10 864	10 791	10 734	10 677	10 620	10 564	10 508	10 451	10 394
						Sales	9 028	11 967	13 151	13 151	13 152	13 151	13 151	13 151	13 151	13 151	13 152	13 151
o	o	+	+	+	+	Profit Before Taxes	442	1 562	2 212	2 287	2 361	2 417	2 474	2 531	2 587	2 643	2 700	2 757
+	o	o	o	o	o	Corporation Tax	155	547	774	800	826	846	866	886	905	925	945	965
o	o	o	o	o	o	Dividends to Nationals			1 035	1 070	1 105	1 131	1 158	1 185	1 211	1 237	1 264	1 290
o	-	-	-	o	o	Dividends to Foreigners			259	268	275	283	289	296	303	309	316	323
o	o	o	o	o	o	Surplus	287	1 015	144	149	154	157	161	164	168	172	175	179

	4	5	6	7	8	9	10	11	12	13	14	15
	+1 851	+2 971	+3 621	+3 696	+3 770	+3 826	+3 883	+3 940	+3 996	+4 052	+4 109	+4 166
	+1 851	+2 971	+3 621	+3 696	+3 770	+3 826	+3 883	+3 940	+3 996	+4 052	+4 109	+4 166
	+5 157	+7 240	+7 928	+7 994	+8 060	+8 109	+8 160	+8 210	+8 259	+8 309	+8 359	+8 409
	+4 282	+6 187	+6 860	+6 926	+6 992	+7 041	+7 092	+7 142	+7 191	+7 241	+7 291	+7 341
	-1 108	-1 152	-1 346	-1 280	-1 214	-1 165	-1 114	-1 064	-1 015	- 965	- 915	- 865
	+2 586	+3 763	+4 272	+4 298	+4 324	+4 344	+4 364	+4 384	+4 403	+4 423	+4 443	+4 463

Table 4

TRANSACTIONS OF THE ALTERNATIVE

	Year 4	5	6 ----	>16
CIF cost	5894	7858	8644	8644
Customs	337	449	494	494
Municipal tax	50	67	74	74
Consumption tax	2064	2752	3028	3028
Harbor fees	156	208	229	229
Other costs	143	191	210	210
Traders labor cost	45	45	45	45
Traders other expense	145	145	145	145
Traders profit	769	1016	1122	1122
Value added from land	5	5	5	5
Flows				
National Gross	+3270	+4334	+4768	+4768
Surplus	+3220	+4284	+4718	+4718
Foreign Exchange	-5894	-7858	-8644	-8644
Tax	+2451	+3268	+3596	+3596

Table 5 - ADJUSTMENT FOR THE DIFFERENCE IN PRICE UNDER THE PROPOSED PROJECT AND THE ALTERNATIVE

	Product				
	A	B	C	D	TOTAL
Domestic sales price per ton	690	845	280	125	
60% capacity - tons	5 904	a/ 4 588	1 496	6 732	
Domestic sales, 60% capacity (thousands)	3 890	3 877	419	842	9 028
Imported price	714	909	248	118	
Imported sales	4 273	4 170	371	794	9 608
Difference (Year 4)					+580
91% capacity - tons	8 008	6 006	2 002	9 009	
Domestic sales, 91% capacity	5 205	5 075	561	1 126	11 967
Imported sales	5 718	5 459	496	1 063	12 736
Difference (Year 5)					+769
100% capacity - tons	8 800	6 600	2 200	9 900	
Domestic sales, 100% capacity	5 720	5 577	616	1 238	13 151
Imported sales	6 283	5 999	546	1 168	13 996
Difference (Year 6-15)					+845

a/ Sales and production in excess of 60% capacity.

The conventions used are as follows:

- input
+ output
0 ignore

Notice that the treatment of any item is open to scrutiny and check.

The bottom lines are subtotals that are obtained in accordance with the indicators of the left hand columns, making the computation of returns a process that is orderly, checkable and teachable.

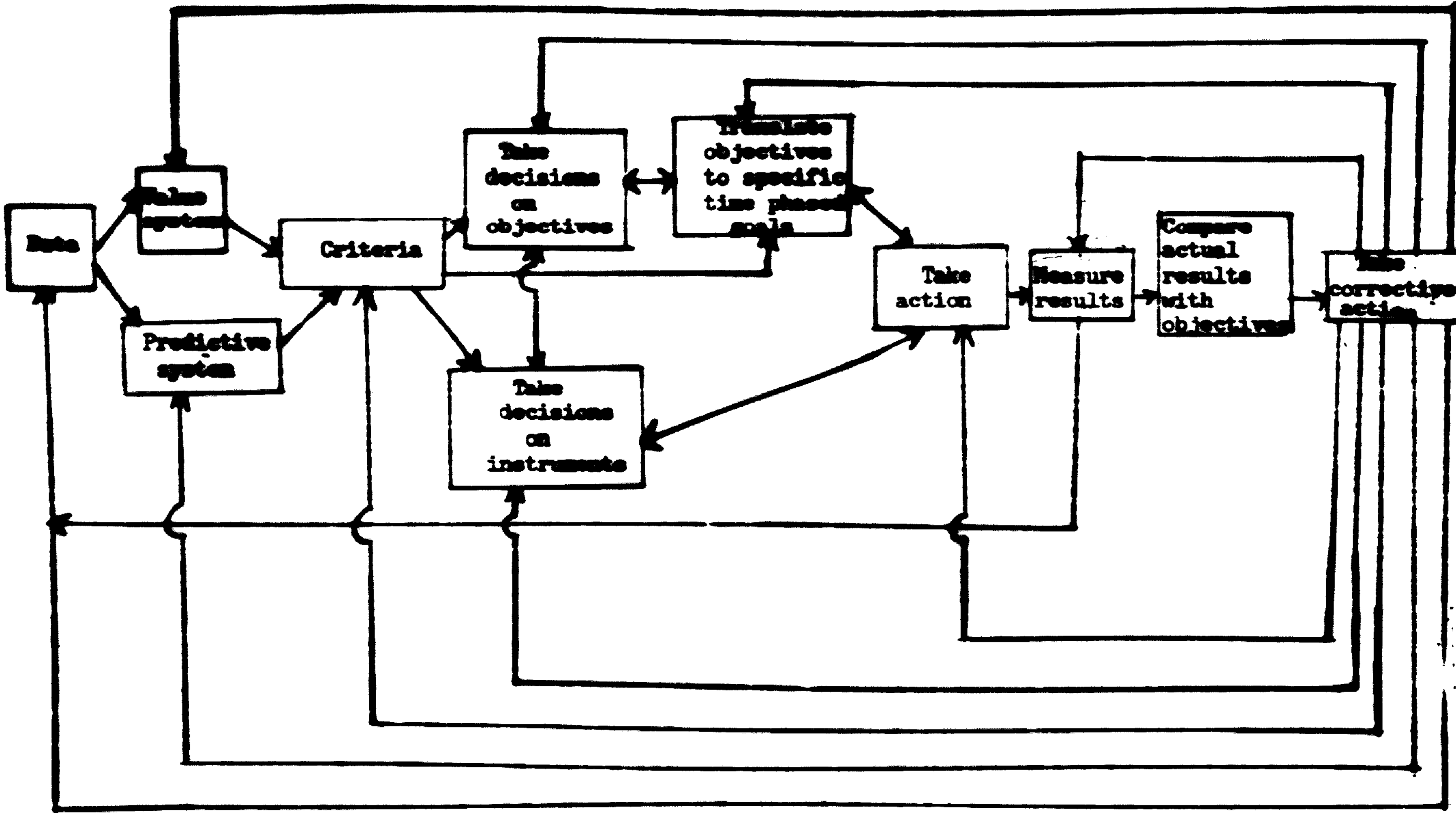
THE DECISION PROCESS AND THE PLANNING-ACTION-FEEDBACK-CYCLE OF PROJECTS

While we have been concentrating on project formulation and evaluation for purposes of exposition, we must not forget that project analysis is a step in the process of economic development and must be sychronised with these steps. In addition, however, the planning of projects has its own cycle. This cycle can be called the decision making planning-action cycle. Unless the whole cycle is carried out effectively, a project cannot be successful. Again, we have a chainlike process. Chart 7 presents this cycle which is fundamental to any activity.

Data on the past, along with planning factors, yield criteria that can be used to decide on alternative objectives and instruments, when combined with the priorities of the value system and the predictive system. In project analysis, the data would be relevant physical and technological relationships, cost factors, and past sales that have a bearing on future demand and the design of the project. The predictive system encompasses the methods used for projecting relationships and costs into the future. The five basic worksheets are essentially a predictive device for project-

Chart 7

Interaction of Process of Decision Making and The Planning-Action Feedback Cycle



ing a future shape of the proposed project. The value system used in project analysis is not completely specified. It assumes however that economic growth is an extremely important objective, and leaves it open to the decision maker to integrate this consideration into the decision process, along with other considerations. Criteria are operational yardsticks that are applied to specific proposals. In our system the important criteria are the rates of return to the business enterprise and the entrepreneur, the national gross rate of return, and the surplus rate of return. In a sense the first two rates are criteria that are desired because they indicate whether we can depend on private effort. It cannot be overemphasised that the formulation and evaluation of projects will not be better than the weakest link of the cycle.

In this system of project analysis we drive toward a plan for time phased goals. In actually making decisions on project goals, the larger objectives and the decisions on instruments will determine in a vital way the restraints and assumptions of the projects. Instruments are such things as tariffs, fiscal incentives, promotion policies, labor laws, and administrative procedures. Unless these instruments are appropriate, the best efforts of those who formulate and evaluate projects cannot bear fruit.

THE PERT SYSTEM OF PLANNING AND IMPLEMENTING PROJECTS

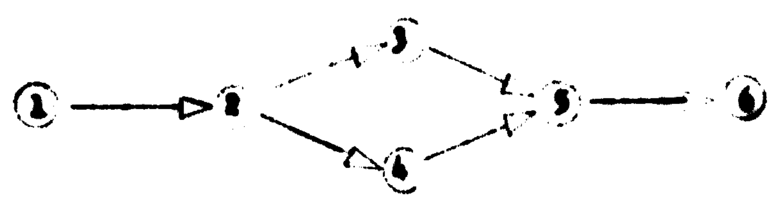
Assuming that we have formulated a good project, and have given it the best possible shape, it is important to break down the plan for the project into detailed units of achievement, and as time passes, to measure progress in the same terms as the plan for the project. To meet this need the O A S Workshop has included work in implementation, specifically the PERT system of planning and implementation. The PERT system (Program Evaluation Review Technique) provides a detailed planning and implementation procedure that has been used with great success by experienced managers in the developed countries. There is reason to believe that the gain from PERT can be much greater when used by relatively inexperienced planners.

In the PERT system a project is laid out in a network of nodes and arrows. The symbols are as follows:

Event

——> Activity

Thus one could have a simple network as follows:



where the nodes have the following meaning:

1 Approval of project.

2 Engineering specifications accepted for bid purposes.

3 Request for bids for machinery mailed out.

4 Request for bids for plant mailed out.

5 All bids received.

6 All contracts awarded.

1 → 2 Arrow denotes drawing up of engineering specifications.

2 → 3 Arrow denotes preparation and mailing out of bid specifications for machinery.

2 → 4 Arrow denotes preparation and mailing out of bid specifications for plant.

3 → 5 Arrow denotes preparation by vendor and mailing of bids on machinery.

4 → 5 Arrow denotes preparation by vendor and mailing of bids on plant.

5 → 6 Arrow denotes selection of bids and drawing up of contracts.

For details on the use of PERT the reader is referred to the self-teaching Volumes I, II, and III, "PERT Fundamentals," published by the PERT Orientation and Training Center, Washington 25, D.C.[12/]

The PERT method is an excellent framework that can supplement the project analysis framework of the O A S. It provides:

- A disciplined basis for detailed planning of a project.
- A clear picture of the scope of a project.
- A method for evaluating goals.
- A means of preventing omission of activities that naturally belong to the project.
- A definition of the responsibilities of the various groups or departments involved.
- An aid in refining the design of a project.
- An excellent vehicle for training.
- A basis for measuring progress, comparing goals with achieved results, and initiating corrective action.

12/ The reader is advised to exclude from consideration Chapters 5 - 6 of Volume II.

Corrective action can take a variety of forms such as:

- Bring resources to bear on weak elements.
- Point out to responsible personnel the shortcomings of their effort.
- Shift personnel.
- Take disciplinary action.
- Change instruments (policies, procedures, incentives, etc.)
- Revise goals.
- Make more detailed measurements.

When the PERT techniques are combined with cost information, one has an integrated system for implementation.

PROBLEMS OF DATA

The kinds of data required for project analysis are:

1. General Statistical Data of the Economy.
2. Current Operating Statistics.
3. Cost and Technological Data for Alternative Forms of Projects.

General Statistical Data of the Economy

Probably the most important general statistics for project analysis are the import and export statistics. For many possible items, the import statistics may be the sole source of estimated usage. Yet classifications are often too broad for project analysis purposes. In some countries, the imports of government agencies are not recorded. In general, the usual custodian of foreign trade documents, the Customs Department, has not been very responsive to making foreign trade documentation serve project analysis needs. By the same token those who formulate projects have not pinpointed their needs. There is a need for a pilot study in a few countries for making foreign trade statistics more responsive to the needs of project analysis.

Statistics on income and population growth at least on a national basis are useful. National estimates on a sample basis can be managed with relatively little resources. Regional estimates are more demanding.

Statistics on manufacturing are a very much neglected field, especially in view of their great potential utility and the relative ease of collection. The ease of collection stems from the usual concentration of modern industry. In addition to usual industrial statistics (value added, depreciation, investment, etc) estimates of capacity utilization can be very valuable for project analysis.

Current Operating Statistics

Current operating statistics are a much neglected field. Measurements of results achieved tends to be sporadic and poorly related to goals that have been set. The importance of setting meaningful goals and the measurement of actual achievements in a manner consistent with goals, and the taking of corrective action, is illustrated by the two cases of measurement of capacity utilization known to the writer. In both cases (in Latin America) a comprehensive and careful measurement of capacity utilisation was ignored by administrators because the fuller utilisation of capacity and related effects were not considered important. A fine and potentially action inducing statistical effort in each case accomplished nothing. There is no point in measuring something which decision makers are not going to be concerned with. The PERT system lends itself very well to setting detailed cost and time schedules, their measurement, and taking prompt action. The measurement process will be fruitful only to the extent that it is related to the entire cycle.

In general, we can hope to make statisticians responsive to other elements of the cycle, providing those directly involved with these other elements are conscious of their data needs.

Cost and Technological Data on Alternative Forms of Given Projects

At present, cost and technological data on alternative forms of given projects are not readily available. There is a need for data in published form which would permit economists and engineers of newly developing countries to carry out the early screening process with dispatch and with proper regard for probable costs and technological considerations. This gap has been recognised by a number of agencies and there is reason to expect greater progress in the near future.

Past efforts have been handicapped by a failure to adopt a general format that is applicable to a great variety of situations.[11]

11/Two massive attempts to meet this need have been the plant requirement booklets put out by the U.S.AID Agency and the small scale industry series put out by the Commission of Small Scale Industry of India. An important deficiency of this material is that a particular configuration of a plant is given with very little basis for adaptation and choice according to the particular conditions of the country in question. Recent attempts by the United Nations to provide such data for these industries is in a more helpful form, but suffer from excessive presentation of history, leaving it to the reader to "normalise" such history. Studies in Economics of Industry, No.1, United Nations, New York, 1963; Preinvestment Data on the Aluminum Industry, ST/ECLA/CONF 11/L.24, January 28, 1963.

A recent effort that represents a breakthrough in the field of industry studies is a study on the flat glass industry prepared by Prof. Lee Charles Nehrt of Indiana University.[14] By referring to the study, and relating the data to conditions in his own country, an engineer or economist can readily determine the prospects for a sheet glass plant for his own country. There is reason to believe that using the Nehrt study as a prototype, a series of analogous studies could be turned out for likely industries which would be of great value to a large number of newly developing countries. This is clearly a task for an international agency.

On a less refined basis, but of potential use for very rough screening of projects are the aids that the engineering profession has evolved for arriving at preliminary cost estimates.[15] The potential use of these and other aids deserves a more careful exploration by qualified engineers.

A recent valuable aid to screening and evaluating is the AID collection of and indexing of project studies made throughout the world. First, there is the "Index to Catalog of Investment Opportunities." This lists the titles of each study by country and by product. Second, there is a set of abstract cards that summarizes each study. Third, there are the studies themselves, copies of which can be made available to interested

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14/ "A Pre-Investment Study of the Flat Glass Industry," by Lee Charles Nehrt, Indiana University, sponsored by the International Bank for Reconstruction and Development, International Development Association, Oct. 26, 1964.
H. C. Bauman

15/ See "Fundamentals of Cost Engineering in the Chemical Industry, "Rheinhold Publishing Co, and "Chemical Engineering Costs, A Condensed Handbook of Chemical Plant Equipment and Process Costs for Cost Estimating Purposes," by Charles E. Dryden and Michael D. Winfield, 1963 Edition, The Engineering Experiment Station.

planners. The Index would appear to be the minimum requirement for planners.[16]

SOME LESSONS OF THE O A S WORKSHOPS

It is clear that efforts to train personnel for the formulation and evaluation of projects are futile unless the other elements of the environment are consistent with good project analysis. For example, the value system of the top decision makers may so restrict the project analysis process as to make it hopeless. Or, the follow-up on the design of the project may be so loose as to make the analysis an exercise with very little relation to reality. For the project analysis to function effectively, it must be understood and taken seriously at three levels, the top political authorities, the senior technicians, and the working technicians.

The O A S Workshops have been aimed primarily at the working technician level. While they have been relatively successful at this level, it is clear that if project analysis is to be truly effective, it will have to be more adequately communicated to the other two levels. It appears that the order of communication used created resistance at the higher levels, leading to the conclusion that the order of communication should be from the top down. Prior success at a lower level creates resistance at the higher levels. A prior success at the higher level tends to smooth the way for efforts at the lower levels.

Also, aside from the efficiency of top-down communication, we have to face up to the fact that important decisions are ultimately made

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[16] The most expeditious way of getting a copy of the index is to request a copy from the local USAID mission. Otherwise, a copy can be obtained from the Dept. of State, Agency for International Development, Office of Development Finance and Private Enterprise.

by the political authorities of a country. Unless the political authorities have some minimum understanding and acceptance of the rationale of the system used by the technicians, it is very unlikely that they can adequately discharge their functions as final decision makers. The political authorities lay down the restraints and policies that the technicians assume in project analysis. In the course of analysing projects, technicians have to make explicit assumptions on taxation, tariffs, industrial promotion, labor laws, administrative procedures, and other instruments of government policy. In many cases, explicit consideration of such assumptions in projects will indicate the need for changes in government policies. Unless the top political levels become familiar with the impact of their policies in specific contexts of project development, they are not likely to generate or permit the necessary changes.

Many of the existing instruments that are barriers to project development are strongly entrenched in law, tradition, and vested interests. Changes that are indicated in the analysis will often run counter to dearly held values and short run political currents. Before political authorities take the trouble to make the difficult changes that are called for, they have to be convinced that a strong need exists for such changes. They will not become convinced without becoming familiar with the specific effects of existing policies. While they need not become experts in detail, they should have an interest in, an appreciation of, and genuine acceptance of the logic of the analysis. Participation of the top political authorities in project evaluation can bring about a fruitful dialogue between technicians and political authorities. Such a dialogue is absolutely essential if newly developing countries are to reverse perverse policies that are serious obstacles to economic development.

It does not make sense to train working technicians until their supervisors are sufficiently familiar with the analysis. One can hardly expect suitable support from a supervisor who sees his subordinate become an expert before he does.

A promising program for installing an effective project analysis system is outlined below:

1. Have a team visit newly developing countries to discuss a potential program with top political authorities and senior technicians.
2. If interest is strong enough, arrange for a 3 day Seminar for the top political authorities and other influential leaders. Such a Seminar should include influential legislative as well as non-governmental leaders.
3. If the Seminar indicates a strong enough interest in pursuing a program, arrange for a two week Seminar with senior technicians.
4. At the end of the Senior Technicians' Seminar, the senior technicians would get together with the political leaders and agree on minimum changes in policy needed for good project development and what constitutes a promising program for installing a project analysis system in their country.

5. Once having satisfactorily achieved the above, the following steps would be in order:

a. Workshop sessions of two weeks for working technicians along the lines of the Central American Workshop of 1965 (includes training in PERT)

b. Practical guidance in Project Formulation and Evaluation and PERT by consultants, extending over at least a year. In addition to being thoroughly familiar with the system of analysis, such consultants should have an engineering background.

c. Arrangements for obtaining technical data as needed for specific proposed projects. Such arrangements would range from collecting useful publications in a central library to getting technical specialists on the scene when required.

d. Arrangements for prompt consideration by financing agencies for projects formulated under the program.

e. Arrangements for part-time courses in Project Analysis in the country conducted by previous graduates of Workshops with experience in carrying through project analysis.

f. Incorporation of similar courses in project Analysis in engineering and economics curricula of the country.

g. Provision for periodic consultation of technicians with political authorities on the adequacy of restraints and conditions that are imposed on project planners.

h. Provision of summary progress reports that point toward corrective action.

The program outlined above may appear utopian to some, but the logic of rapid economic development calls for such an effort. There are rich dividends awaiting the country that will take such a program seriously. In pursuing a program of project development from planning through implementation, it will be necessary to develop aids in the form of planning factors, industry study formats, and training devices. If these are developed and documented with an eye to more general use, the experience in this country can be a base for training of other countries.

SOME SPECIFIC PROPOSALS FOR ACTION

1. There is an urgent need for an agreed-upon framework for the formulation, evaluation, and execution of projects. Such an agreed-upon framework, based on a consensus, should be incorporated in a Manual and other training material such as films, self-teaching course material, and other teaching aids.

2. Following the adoption of such a framework, it is important that an intensive effort be mounted in a few carefully selected countries to develop training materials, and test these materials on actual projects. The political authorities of these selected countries should at the very least be receptive and accessible. Furthermore, the obstacles should not be so large as to preclude successful use of promising approaches. An approach to selecting such countries has been outlined in a previous section. While a crucial test for materials developed will be their success in "pilot countries", an effort should be made to put such training materials in a form that is of general applicability to newly developing countries. This implies an expanded testing effort after promising materials have shown their value in a few countries. There should be modifications to this material to reflect experience. Out of such an effort would come courses for various levels of economic administrators, including political authorities. While a large part of the effort would have to be directed toward project development, the program should include all the steps of economic development and the full decision making-planning-action cycle. The whole range of management activites,

including the very strategic element of full plant utilization, would necessarily be covered.

3. An effort to develop a series of industry studies would be parallel and complementary with work in pilot countries. A failure to adopt a format that is applicable to a great variety of situations has handicapped past efforts. It should be possible to produce industry studies of general interest to newly developing countries by building on the excellent Nehrt study previously referred to. The creation of industry studies is an activity that can be parcelled out to qualified persons or groups, provided there is a suitable prototype. A central coordinating group would be needed, however. Another task for such a group would be to stimulate and coordinate research to adapt the aids to cost estimation that have been developed by engineers of the developed countries.

4. At a later point, it would be useful to carry out research on the development of a computer system to aggregate project variables so that micro planning can be made to interact with macro planning on a prompt and effective basis. A starting point for such an effort would be a country that has carried out project development on a comprehensive basis. This task is clearly one which can be started after some progress has been made with one or two pilot countries.

17/ See H. C. Bauman, "Fundamentals of Cost Engineering in the Chemical Industry," Rheinhold Publishing Corp., 1964 ; Charles E. Dryden and Michael D. Winfield, "Chemical Engineering Costs, A Condensed Handbook of Chemical Plant Equipment and Process Costs for Cost Estimating Purposes," 1963 Edition, The Engineering Experiment Station, Ohio State University, Columbus, Ohio

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