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TABLE OF CONTENTS

I. INTRODUCTION AND BASIC IDEAS

One of the most powerful historical forces of our time is the global drive for speedy social and economic development. This development drive will undoubtedly also be a major factor during the rest of our lives.

In poorer areas development efforts may be a desperate race against time, population growth, famine and political-economic collapse. In richer parts of the world it is more a matter of satisfying increasingly ambitious aspirations for a "good life" for everybody. In the one case fertilizer plants, irrigation works, penetration roads and steel mills may be called for. In the other, perhaps electronics industries, sophisticated telecommunications systems, recreational facilities and high-quality housing. Whatever the technical manifestations, in rich nations and poor the basic motivation and policy direction are the same. There is no government in the world which does not subscribe to the idea of rapid social and economic

* This paper owes much to research carried out by the author during 1963-64 at The Brookings Institution, Washington, D.C., while on leave-of-absence from the University of California, Berkeley. The work was supported by a generous grant from the U.S. Agency for International Development. Clell C. Harral, Grace Finne and Ellie Steinberg participated. Wilfred Owen and Edwin T. Haefele were in overall charge of the Brookings research program, which emphasized the rôle of transport in economic development. The contributions of those mentioned, as well as of U.S. AID and World Bank officials, is gratefully acknowledged. In accordance with ancient tribal customs of the academic community, the author gladly accepts full responsibility for all shortcomings of the ideas presented here and claims no credits.

advancement in one way or another. It is too limiting to associate development problems with relatively backward areas in the world only.

[illegible] exist in Canada and California as much as in Greece, India and Central America.

This fundamental identity of purpose makes international co-operation for development both desirable and highly practicable. We can all learn from each other and we can often help each other. The flow of material and intellectual contributions moving across national boundaries is already impressive. The Prague Symposium sponsored by the Centre for Industrial Development, which deals with a particularly strategic aspect of development planning, emphasizes it further.

Fundamentals and Definitions

Development planning, with project evaluation as an important component, is a scientific information process. It enables executives to make rational decisions, that is, informed choices among meaningful alternatives. The end purpose is the efficient allocation of scarce resources among competing ends. Directly pertinent in established economic thought is capital investment theory. But the traditional sets of economic principles are somewhat constraining and we seem to be moving towards a General Theory of Social and Economic Development, which would incorporate elements of engineering, operations research, management, public administration and other social sciences besides economics.

Development analyses are essentially means-ends comparisons; if that specific action is taken, this will probably be the particular result. The scientific task is confirmation or rejection, on the basis of evidence, of various hypotheses which forge logical links between causes and effects. The causes are the means that can be employed (inputs, resource allocations, costs, actions of

various types) and the effects the desired ends (outputs, objectives, revenues, results of various types). Following this definition we find that the scope for development analysis is indeed great: any action that generates recognizable, if not measurable, input and output streams can be evaluated. This includes such widely diverse projects as expansion of an educational system, industrial plant modernization, marketing of tropical fruit, eradication of infectious diseases, and rural electrification.[1/]

Decision makers (executives, policy makers), whoever they may be in a given society, are effectively in command of policy instruments (action means) and must articulate and pursue policy objectives (action ends). We will quickly agree that society's ultimate objectives are ethical in nature and require so-called value judgments which are outside economic analysis. Analysts (planners, experts, consultants) act as advisors to the decision makers, adopt their viewpoint and are bound by their action range. This particular reference framework is crucial in project evaluation, as we shall see.

Out of the many theories and hypotheses that the analysts could conceivably spin, only those that relate possible development actions to desired development objectives are of any interest whatsoever. All other relationships enter into the analyses as passively endured environmental circumstances. The potential success or failure of the relevant actions is analytically tested with the aid of success criteria (evaluation standards, decision-making guides). The old view was that economic theory by itself could generate self-evident success indices, such as maximization of profit or of the benefit-cost ratio. But this begged basic questions: Whose profits? Whose costs? What exactly do we mean by benefits? The newer view is

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1/ See, for instance, Mc Kean [20, Appendix] for a list of programs carried out by the U.S. Federal Government which lend themselves to performance budgeting (physical performance contrasted with money costs) and benefit-cost analysis.

that the success criteria do not arise out of the thin air of abstract reasoning, but are quite clearly derived from the ultimate goals that are to be pursued. This puts great emphasis on determination of the objectives in the first place.

It is now also generally recognized that there are several species of development objectives, such as maximization of national product, better income distribution, more employment, education, [illegible] promotion of national culture, internal and external security, knowledge of the universe, and so on. Further, these objectives are typically incommensurate (possibly quantifiable, but no common measure exists), conflicting (attainment of one objective impairs that of the others), or complementary (mutually helpful). The old idea in economics of a unique optimum based on a single maximand or minimand, such as money income of cost, has to be discarded on these grounds alone. More promising is the concept of social and economic achievement surfaces which stretch in as many dimensions as there are incommensurate objectives. The so-called efficient surface would embody the best possible compromises between conflicting objectives: more health vs. more mobility; more production vs. more leisure; and so on. It is clear that only top political executive bodies, such as parliament or the cabinet, can resolve these crucial issues. Analysts, however, can provide most valuable information on trade-offs between different social and economic achievements. Optimization then has this meaning: a rational compromise among several conflicting objectives on the basis of good information.[2/]

For analytical convenience we define the smallest, discrete unit of decision-making that generates both inputs and outputs as a project. Physical size and

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2/ For a much better discussion of the points just briefly mentioned here see Fred Hanssmann's article [10]

technical properties are irrelevant: launching of a $100 million industrial complex or a $500 equipment purchase can both be regarded as projects. Of course, analyses and decisions themselves [illegible] precious resources and therefore projects should be of such minimum size that the gains from better executive judgment exceed extra costs.

At the lowest or microeconomic level [illegible] projects. The bundles of knowledge on them that pass from the information suppliers, the analysts to the decision-making information users, typically in well-documented confidential report form, come under the trade names of "technical and economic feasibility study", "benefit-cost analysis", "project evaluation", "pre-investment survey", "engineering-economy review" and the like. We are here primarily concerned with these basic analytical building blocks.

At the other end of the scale, the macroeconomic level, much research goes into the preparation of social and economic development plans for entire regions and nations. Such plans ideally embrace all projects, branches of activity, sectors, the public as well as the private sphere, with the time horizon for analysis and action programs extending to at least five years. As those with practical experience in national planning know, there are difficulties of making the individual project building blocks fit the macroeconomic framework and vice versa. The sequential planning and mutual reconciliation of project phases, annual government budgets, five-year programs and ten or twenty-year perspective plans is not at all easy. This is a fascinating topic in its own right.

Important Characteristics of Development Analyses

Several important characteristics common to all development studies should be noted at the outset:

1. Action Orientation. The only meaningful test of any proposed means-ends chain is practical effectiveness: Will the scheme work as specified? This is a most refreshing feature. It quite properly forces the analyst to "put up or shut up" in his work. For example, general complaints about the alleged inefficiency of governmental institutions in area A, or the supposed laziness and greed of the trade unionists in industry B, or the hopeless ignorance of management in sector C, are just empty talk. Vague dissatisfaction does not constitute a legitimate analytical problem, which implies remedial action possibilities. It is the responsibility of the analyst to come up with definite means-ends recommendations, for instance administrative reforms in the first case, progressive labour incentive schemes in the second, and a management training program in the third.

2. Need for Comprehensive Systems Approach. Very important is the need to consider analytically any suitable action, however unorthodox, as long as it brings desired results. Here the analyst must have the mental agility to look beyond his own professional bailiwick, perhaps by enlisting the support of other talent. It has often been found that highway specialists come up over and over again with nothing but highway construction solutions to the most diverse urban, location and transport problems. Likewise there are economists who never progress beyond the incredibly naive "marginal cost must equal marginal revenue" answer to all of mankind's ills.

In project analysis a comprehensive systems approach must be adopted, with the criterion simply again being the effectiveness of means in relation to ends. Thus the raising of incomes in a declining farming area, as a specific ethical end, may be accomplished in any of these ways, singly and in combination: new harbour, better

highways, more truck competition hence lower rates, irrigation scheme, co-operative marketing, storage and processing arrangements, agricultural credit, direct government subsidies, tax concessions, teaching of new cultivation methods through extension programs, strengthening of local government, and so on and so forth. The real limitations to action are only too often imposed by the decision makers' and analysts' lack of imagination, and not by given natural conditions. Fortunately, the growing recognition that often many scientific disciplines contribute to the solution of real life problems, has had a liberating effect upon professional thought processes.

3. The Essential Element of Choice. Choice is absolutely fundamental to project evaluation. In the presentation to the decision maker there must always be evidence on various courses of action among which he can choose, all designed to achieve the desired end. In fact, a "no alternative" proposal is not a reasoned recommendation - it is an ultimatum. It is important to note that the economist, in putting down "costs", is compelled anyway to consider alternative forms of resource commitment. For the true costs of one course of action - opportunity costs - are the benefits foregone from the next best course of action. Traditionally, the enjoyment one could have obtained from many different things in the market, appraised by the price yard-stick, is taken as a measure of cost. Thus the cost of one dollar simply implies ten newspapers, five ice creams, two units of electricity, and so on. "Numerous" alternative consumption offers, made under specified competitive conditions, are necessary to give the statement "cost of one dollar" some meaning.

In many situations, especially in public sector and development work, perfect market conditions will not apply and the automatic registration of cost figures is not possible. Then the analyst has to generate his own, namely by synthetically

designing meaningful alternatives. Thus the true cost of the social welfare scheme may, in essence, be the university expansion program foregone. Often the analyst may have to work with several economic, financial, social, political and ethical value dimensions simultaneously - an intellectually demanding feature of modern public sector studies.

It is axiomatic that the quality of decisions goes up with the number of alternatives that are available to the decision maker. But analytical blueprints for choice, and even the exercise of choice, costs time and resources. It has shrewdly been observed that even use of the competitive market is far from costless.[6] How many potential choices are then, in practice, necessary to gusrantee a good decision? It seems to me that at least <u>three</u>,of which the "do nothing" allternatives is one, is the <u>bare minimum</u> for sensible decisions. Unfortunately, in field work one predominantly [illegible] no action leeway to the policy makers. [illegible] these crude binary "accept or reject" choices is intellectually too strenuous. But in fact, it is usually possible for analysts to come up with a respectable number of alternative solutions, including secondary design and location variations. Pierre Massé, for example, describes a model for choosing from thirteen different electric power plants - thermal, hydro, gas turbine, tidal power, etc., - certainly a rich selection.[19] A development study [illegible] for its main action proposal, a $2[illegible] million road project, a total of eight alternatives, resulting from five location choices and several engineering design and construction options. Further subvariations involving the time dimension through project postponement or advancement, are also always possible as we shall see. Options are not a scarce commodity in this business.

4. Determination of Ends, Limitations of Monetary Indices for Welfare.

What is the end purpose of these elaborate exercises in analysis, decision-making and resource commitment? There is agreement that they must somehow result in a recognizable improvement of society's well-being. But from that point on the discussion gets murky: What do we mean by improvement? Must everybody be better off? Can there be some losers, provided they are [illegible] by the gainers? Are all members of society to be included, no matter what their initial status? Must the rich, for example, invariably be made richer? And how do we interpret welfare ? In the psychic sense? Are psychic sensations measurable? And are interpersonal comparisons in this sphere possible?

These formidable questions have agitated many fine thinkers for [illegible]. Originally it was thought that the yardstick of money income, for individuals as well as for nations, could serve as a proxy for the recording of private and social bliss sensations. But then, after unsuccessful wanderings through the intellectual maze of so-called "welfare economics", it was recognized that the distribution of income among members of society - and, one may add, among this generation and succeeding ones - definitely required ethical judgments. As one writer put it: "It is not enough to find quantitative expressions for [economic] policy standards - the standards themselves must be ethically attractive". [2] As a further difficulty, how was one to account for the flow of bliss and anti-bliss sensations that simply did not generate any money price signals in the market? What about air pollution, for example? Or leisure? [illegible] of sunshine and fine beaches? Other technical flaws in GNP and money income statistics, as standards of international and interpersonal welfare comparisons, were noted.[3]

3/ See the articles by Usher [28] and Barber [1].

Today the earlier, heavily money-oriented views have largely been abandoned. Those who still cling to them may ask themselves whether money income is the only, or even the most important welfare factor in their lives. Or to bring international per capita income comparisons into perspective, they may estimate how much additional income would induce them to move permanently from, say, the shores of the Pacific or Mediterranean to some northern metropolitan slum set among belching smokestacks.

In recent years much of the intellectual steam has thus gone out of unadulterated "GNP growthmanship". The modern view still regards money income as an important success indicator, but insists that it must be supplemented by many other moral and social criteria. With it has come great interest in all the diverse objectives society might pursue apart from money income maximization, ranging from the collective wish to extend average life expectancy, through the intention to give everybody a better education, to the desire to render foreign aid to less fortunate people elsewhere.

Conclusions

This brings us back, full cycle, to the question of means-ends comparisons which are the essence of project research and economic development planning. Meaningful analyses of this sort simply cannot be undertaken by economists and technicians without prior instructions on the ultimate objectives that are to be attained. Properly stated objectives are indispensable for the determination of operational goals and constraints, for measurement operations (especially on the benefit side) and for the application of preference orderings and related decision rules. Of course, decision makers may often find it difficult at the outset to formulate goals precisely without knowledge of the potential courses of action. Here the

analyst may become the economic psychiatrist of the subconscious collective mind, by exposing clearly the various "trade-offs", for example between higher money incomes, military preparedness, educational achievements and social welfare standards. While the policy decisions are ultimately anchored to deep rooted values of society, the rendering of scientific information as such can be regarded as an unequivocal ethical "good". [5]

To sum up, the purpose of development planning, including project evaluation, is to provide scientific information on the effectiveness of available action means in relation to stated ends in a given social-institutional environment. This formulation cuts across all national and ideological boundaries. Of course, there can still be honest differences on development objectives. To be sure, there is scope for discussion on what constitutes a "good life" in various cultural environments. "One man's meat is another man's poison", as the saying goes. And even the choice of development means - which are essentially alternative ends foregone - is open to reasonable debate. But once the means and ends are determined, the development analyses themselves are quite impartial and neutral.

II. GENERAL SETTING AND STUDY PREPARATIONS

What are the practical lessons to be learned from these fundamental ideas? To use an illustration which will accompany us through the rest of this paper, let us imagine that a developing nation wants to invigorate a socially and economically backward area. It is important to first understand the general setting for development planning. Determination of the terms of reference for the analysis then follows logically.

Chief Elements of Development Planning

1. Ultimate Objectives. In the particular example chosen, these would be improvements in the well-being, broadly interpreted, of the people living in the area. To emphasize, neither industrialization nor transport improvement nor bigger agricultural output as such are true ends. They are merely specific technical means to achieve higher-level objectives.

2. Decision Makers. The top executive body of the developing nation is in overall charge. But if international assistance for the development scheme is sought, other decision-making agencies will enter the picture, for example the United Nations, OECD, the World Bank, foreign aid organizations of richer countries, or perhaps a consortium formed by several of these. Again, both public and private interests can participate, for example an entrepreneur willing to start a plant in the area and a governmental industrial development [illegible]. Many ministries may take part in area development decisions, for example industry and commerce, transport, agriculture, social services. Each may have its particular set of lower-level objectives that at worst may relate to departmental "empire building", that is, maximization of staff, budget allocation or prestige for the particular Ministry. When several decision makers are involved, it is most advisable to clearly set out and reconcile the possibly conflicting development objectives right from the

etart.

3. Analyets. These can be planners, civil servants, university personnel, consultants, scientists and techniciane of all descriptions. Their functions are beet deecribed as those of professional problem solvers and advisers to the executives. When distinct project studies are being tackled, their duties should be spelled out precisely through terms of reference, a task that requires a surprising arount of thought.

4. The Analytical Framework. The true scope of decision-making powers and hence of the analyses is most conveniently defined along these lines:

(a) Geographic and jurisdictional limitations (the nation? one region or area? one industry or government department?).

(b) in the social-economic dimension, by the group of people and economic organizations of concern (entire community? owners and management of just one enterprise? all farmers? the public eector only?).

(c) In the time dimension, by the intertemporal scope of the decision makers (five years? ten years? for the expected life of the present government only? to include just the present generation? or future generation as well?). This definition alone raises some profound issues. 4/

(d) By the decision maker's action range and inetrumente (what are his legal powers? fiucal? financial? managerial? regulatory?).

In our example, as in all development and public sector work, the analytical scope will extend as far as the general public interest doee. The etudy boundaries will therefore include all economic and social groups within the area or nation, the

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4/ Many dietinguished economists have written on the so-called "future generations problem," income distribution, the rôles of interest and social rates of time preference. Among them are Samueleon, Abba Lerner, Koopmans, Myrdal, Marglin, Margolis, Galenson, Leibenstein, Tinbergen, Krutilla, McKean and Hirshleifer. The literature on these subjects is vaet, but nobody seriously interested in them should neglect to read Otto Eckstein's "A Survey of the Theory of Public Expenditure Criteria" [8].

time horizon will stretch far into the future and the arsenal of action instruments at the disposal of the decision makers will probably be quite impressive.[5]

5. The Internal-External Distinction in Economics. Determination of the scope of decision-making powers has far-reaching analytical consequences. When the viewpoint is lowered from the national level to the government department, sector, industry or individual firm, the analytical range correspondingly shrinks. Any *a priori* notion that one particular domain, for example that of the private enterprise, is superior to all others and must therefore serve as the master economic model, must be rejected.

As a practical result, whatever falls outside the decision-making scope defined in the ways described above is *external* to the analysis and hence *irrelevant*. And whatever falls inside, is *internal*, hence *relevant*, and must be considered. In my opinion, this plain, common-sense working rule renders the large and confusing literature on "external and internal economies and diseconomies", plus related peculiar terms such as "pecuniary internal diseconomies", "spill-over costs", "induced benefits", "off-site gains" and the like, completely redundant. This is not the place to criticize these concepts again in detail.[6] But in a nutshell, it seems that past scholars arbitrarily started off from static models of minute economic units engaged in perfectly competitive, instantaneous adjustments. They consequently created the

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[5] Hollis B. Chenery, in an important article [4], provides a comprehensive inventory of contemporary development tools and shows the variables that can be controlled by their use. The choice of policy instruments is generally much greater than is realized.

[6] See Tillo E. Kuhn [17], especially pp. 7-32, and Appendix A, "External and Internal, Pecuniary and Technological Economies and Diseconomies", pp. 179-86.

awkward externalities themselves by their twin failure: (i) in a static world, to make the economic analysis and decision unit large enough; (ii) in a dynamic world, to extend the time horizon far enough into the future. 7/ Such slipshod definitional work cannot be tolerated in project evaluation.

To conclude, determination of objectives, decision-making scope and analytical boundaries are most important first tasks in development planning. Externalities are nothing but symptoms of an unduly restricted framework. They are signals that the decision-making scope and the system of inter-relationships under study should be widened. Externalities, of whatever type, are then redundant concepts.

7/ See Tibor Scitovsky's article [22] for elucidation.

Sample Terms of Reference for Area Development Study.

Given this general setting, sensible instructions by fictitions decision makers to the development analysts might include the following points (explanatory comments in brackets):

"1. The Problem. The Government of Mesalia regards the relatively low average standard of living as well as the poor quality of public services in the Aliveri area as an urgent problem."

(Note that factual background material on the problem obviously exists. For example:

(a) Special study of the Aliveri area which caught the Government's attention.

(b) Routine per capita income data, unemployment rates and similar statistics on area-by-area basis.

(c) Performance indices for social services (doctors and hospital beds per 100,000 population; kilometers of paved and gravel roads related to surface area, population and motor vehicles; and so on).

Such and other evidence[8] should immediately be studied by the analysts in order to better grasp the problems which have to be solved).

"2. Objective. The chief objective is to bring living and social service standards in Aliveri within ten yeare up to the national level anticipated at that time."

(This statement of objectivee provides a great deal of analytical guidance:

(a) Exieting eocial-economic disparities between Aliveri and the reet of the country are moetly quantifiable and largely known.

8/ There is a good discussion of various indices which portray "the quality and texture of life as 'end product' " in the Buchanan and Ellie book [3, pp. 5-21].

(b) Long-range projections for the national economy to 1975 and beyond prepared by the central planning office can be utilized.

(c) The gap between likely economic and social achievements in the Aliveri District and in the rest of the country <u>without</u> special actions - something that can be researched - defines the magnitude of the desired development task. The statement that the gap should be closed within ten years defines the required minimum development speed.

(Unfortunately [illegible] encountered in first [illegible] are not clear on what they [illegible].

3. <u>Action Means</u>. Any of the policy tools at the disposal of the Government of Mesalia suited for the task may be deployed, including direct public investment in industry and infrastructure, as well as encouragement of private initiative through tax relief and other incentive measures. Participation of the International Consortium Bank, under favourable loan conditions, will be sought".

(This statement is also most instructive:

(a) A thorough inventory of existing, legitimate policy instruments is called for, including a broad review of laws and regulations governing private ventures in depressed areas (ranging from tax holidays and fast depreciation schedules to low power rates and cheap public land).

(b) Consultations with the appropriate ministries will disclose exactly what they are able to do.

(c) Participation of the International Consortium Bank means that its particular action tools and decision criteria have to be taken into account for portions of the program. These might include: (i) investment in specific projects of a minimum size only, folowing outside feasibility studies carried out according to ICB specifications;

(ii) projects must be financially self-supporting, given lifespans and interest rates applied by ICB in comparable cases; (iii) projects should help the foreign-exchange situation of the country (i.e. lead to import substitutions or export increases).

Note that the Government statement does not exclude any other suitable action means not specifically mentioned. This gives the consultants an excellent chance to come up at the end with some effective policy recommendations which the Government, being concerned with many other things, may not even have thought of. Note further that the Government obviously desires maximum participation of the ICB. [9] The scope for this organization, subject to its well-known, specific "rules of the game", should be worked out first by the analysts. The remainder of the program would then have to be taken on by domestic organizations.

4. The Study Area. The study area is defined as the Aliveri River Basin, delimited by the surrounding watersheds. Field work should emphasize this geographic area, but transport and commercial interchanges with other parts of the country and the outside world - if significant for social and economic development - should also be investigated.

(This usefully concentrates the analyst's efforts in a limited area, without eliminating attention to possibly important external economic relationships. Dangers in field work are:

(a) Consultants just sit in the national capital and try to solve specific area problems with the aid of fairly meaningless macroeconomic statistics.

9/ Most developing nations have agencies whose chief job is to utilize the [illegible] forms of foreign assistance to the utmost. This is how it should be.

(b) They get so absorbed by purely local problems that broader regional and national interactions are lost sight of.

(c) Although they do start off with the specific area of interest, under the influence of the ubiquitous "everything depends on everything else" syndrome they get drawn into ever wider, more complex and expensive general research.[10/]

Obviously, a sound compromise has to be struck in the study terms of reference between overly inclusive and too restricted geographic scopes).

The above terms of reference, it would seem, define the purpose and boundaries of the analytical task for area development very well. Additional instruction might relate to study length, deadline for submission of final report, fees (if outside consultants are employed) and the assistance collaborating government agencies can provide. There is no doubt that the initial reference framework, more than anything else, determines the final results.

Sample Terms of Reference for Industrial Project

By contrast to the broad area development problem, we will now attempt to draw up instructions for a specific industrial project study. There is no suggestion that one type of problem statement is intrinsically superior to the other - it is just that they differ in purpose and scope. Greatly simplified fictitious sample terms of reference might run something like this:

"1. The Messalia Industrial Development Bank, a joint public-private institution, has received an application for financing of a petro-chemical plant at Aliveri,

10/ Transport experts, although starting off from a little highway connection problem, may easily be seduced into general development planning work. This is natural because the interactions between transport and the total economy are strong. However, it is more efficient to work down from the general to the specific, or for the transport man to join forces with the other development economists.

complete with a satisfactory analysis of the potential demand for the products."

2. The general objectives of the Bank, as well as the criteria applying to projects of this type, are stated in detail in the relevant legislation. They include in particular:

(a) Economic and financial viability, taking into account, however, general government inducements available to all forms of industrial activity.

(b) Preference for projects which can be located in depressed areas, will absorb unemployed workers, or will convey other broader economic and social benefits.

3. Although the applicant has submitted fairly detailed technical proposals, possibly desirable modifications in design, phasing of construction work, scale of plant and production, marketing operations, as well as other relevant aspects of the scheme, should definitely be investigated. The suggested Aliveri location should also be examined.

Skipping other detailed instructions that should be given, we find that there are two decision makers in this instance: (i) the private promoter, who presumably wants to run the new plant at a profit; the analysts, as a very first step, should consult him and read his proposals carefully; (ii) the Mesalia Industrial Development Bank, whose scope and interests are wider, but certainly not as comprehensive as those of the Government. This is a much tighter framework than in the previous case; many aspects which are definitely included in the comprehensive area development study are now "external" and hence ignored. The analytical task is correspondingly easier and the range of action recommendations more restricted.

It should be noted, however, that apart from the fact that the application relates to petro-chemical production, with a product demand study to back up this big first decision, all other technical location and marketing choices are left

wide open. This gives the analysts ample opportunities for the presentation of meaningful alternatives - the very basis for optimal decisions, as we have seen.

Examples of Poorly Defined Terms of Reference

In past research and planning work the author has come across numerous terms of reference for international project studies which definitely biased the analysts' research and findings, to the distinct disadvantage of the decision makers. To cite just two glaring examples:

1. A recent case involved the transport problems of two areas separated by a narrow body of water. The social and economic usefulness of a link had already been established. Sensible instructions to the engineering and economic consultants would have been: "Investigate the best means of moving people and goods between the two areas". Instead, the experts were asked to study a very specific bridge proposal, thereby needlessly excluding ferries, tunnels, causeways, floating pontoons - or perhaps flying saucers for all the decision makers should care at this stage.

2. Instructions for a port study went something like this:

> "Conduct such investigations as may be necessary to determine and recommend a technically and economically sound long-range port development plan. Construction recommended for initial implementation shall be so planned so as to afford a port facility which will most efficiently and economically serve present and projected future traffic."

Leaving aside the question of establishing the desirability of a port solution, the terms of reference might have been written more objectively as follows:

> "Conduct such studies as may be necessary to determine whether or not it may be technically and economically sound to recommend" etc. and then conclude with "if construction is not deemed advisable at the present time, state what

other measures may be initiated so as to afford.....".

This would at least have left the accept/reject option for the port proposal as such, plus a variety of alternatives within the port technology.

Generally, it seems, project terms of reference are often too specific and practically dictate the solutions: "Determine the economic and technical feasibility of a plant at Midcity for the production of 1 million gidgets per annum." Of course, the consultant finds the gidget project (or road, or port, or irrigation scheme), economically and technically "feasible". The client has obviously already made up his mind on the matter and just needs respectable, outside confirmation. Only a consultant of exceptionally staunch character, impervious to unpopularity and loss of income, will disappoint him. It is illuminating that in the entire professional career of the author he has come across just two feasibility studies which did not recommend the initial proposals which they were supposed to test rigorously; it so happens that the author had a hand in the setting-up of one of these. Although there are other circumstances to blame as well, a great part of the trouble is probably due to badly defined terms of reference.

Other studies are unnecessarily vague: "Examine economic conditions in the XYZ region". Here the decision makers appear to be vaguely dissatisfied. A general fact-finding expedition by consultants will in all likelihood be mounted. But unless it is geared to distinct action possibilities, the final report will probably contain the usual "further research should be undertaken" platitudes.

In conclusion one can only urge that great care be taken when the all-important reference framework for development studies is set up. If necessary, broadly oriented professional help for just that purpose should be enlisted. The operations research literature, which is strong on the subjects of determining true objectives and spotting genuine problems, can also be consulted with profit.

III. METHODOLOGY FOR PROJECT EVALUATION

With the study preparations out of the way, project evaluation itself can now be discussed. Efficient resource allocation is the main theme. In the economics literature some of the numerous works on investment theory and capital budgeting are particularly relevant.[11] But there is as yet by no means agreement on the appropriate methodology. We will try here to suggest theoretically sound procedures capable of practical application, without getting drawn into complex abstract debate.

Elementary Notions

All investment analyses, including project studies, consist of systematic juxtapositions of properly dated input and output series, as previously defined. They are meant to provide guidance for decision-making and are consequently exclusively oriented towards the future. For a decision once irrevocably made is past history - dead, irrelevant, and simply taken as granted for the next round of analyses and decisions. As a former professor of the author always put it, it is of no economic significance whatsoever whether a flat piece of ground which lends itself to highway or factory construction was created yesterday by bulldozers or a million years ago by glaciers. Jevon's dictum "bygones are bygones" indeed applies - already committed resources no longer represent opportunity costs and are ignored.

Figure 1 shows an effective way of looking at past and future, means and ends, and may serve to conveniently portray complex economic patterns. Zero defines the analytical starting point: the world around taken as given, no fresh resource commitments yet, the date set at exactly the contemplated action time. Along the horizontal time axis everything to the left of the origin is irrelevant past, to the right potential

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11/ See [18], [19], [20].

future events are faithfully recorded. By convention, benefits and costs - measured in some meaningful way - are shown upwards and downwards, again starting from zero. Of course, in the case of predictably repetitious series, the past may indeed have a message for the future and should then be included in such a time chart. Figure . illustrates the graphic portrayal of a complete project life history. The literature speaks of benefit-cost profiles, or input-output streams. The data can, of course, also be recorded in tabular form (Table 3).

Four Possible Investment Problem Formulations

For expository convenience, four broad investment problem formulations can be redognized. The first three have received much - [illegible] nence in economic theory.[12/] [illegible] practical [illegible].

1. The Point Input and Point Output Case. Here the resource sacrifice is concentrated at one point of time, with consumption occuring subsequently also in one period. We may think of seeding, followed later by harvesting. There are two versions to the point input-point theme. In one the time interval between seed and harvest, i.e. the investment period, is fixed. In the other version, the interval can be varied. Usual examples are trees that grow and wine that mellows in the barrel, with some discretion when consumption of wood or beverage takes place.

2. The Continuous Input and Point Output Case. One may think of raw materials that pass through various processes and eventually emerge as finished products which are then consumed all at once. Input timing is usually assumed to be variable within limits.

12/ See especially Friedrich and Vera Lutz [18] and Pierre Massé [19, ch. 1].

3. The Point Input and Continuous Output Case. Here investment is concentrated at a single point of time, whereas output is spread over a more or less lengthy period. Machines which are put up once and then render service for a long time are supposed to represent this case.

To comment, the first and third formulations seem rather contrived and out of touch with reality. They assume that production is timeless and costless after the first input dose. This is hard to believe: crops have to be watered and [illegible] until they are ripe; in the mellowing of wine there is the continuing cost for use of labour, premises and barrels; and machines have to be provided with motive power and must be housed and maintained. These two problem formulations do not have much practical significance and even the second case is rather restrictively formulated. Surely in most investment decisions in the real world - those involving factories, machines, buildings, infrastructure projects, research and development programs - the analyst is confronted by continuous inputs generating continuous outputs.

4. The Continuous Input and Continuous Output Case. It is perhaps not surprising that this empirically most important case has not received much attention in the literature, for it is conceptually difficult and mathematically messy to handle. It possesses a number of elements - inputs and outputs of various types and magnitudes, their respective timing, the length of the time span, different value scales - which singly and in combination create not just one but several investment planning issues. We may think of them as variations on the main theme of continuous input-continuous output.

These themes can conveniently be explained with the aid of Figure 2. In this time graph total outputs are shown by area (V), subdivided into continuing gains,

revenues or benefits (V_1) and terminal or salvage ones (V_2). Total inputs are indicated by areas (C), subdivided into initial costs (C_1), costs which may conceivably be postponed under circumstances of stage construction or "phasing" (C_2), continuing costs (C_3), and terminal or scrappage costs (C_4). It is quite unclear what is accomplished by the usual distinctions made between capital costs (expenditures on physically durable objects like machines and buildings) and operating and maintenance costs (devoted to physically more ephemeral objects like wages and fuel). All that matters in investment analysis is when resource sacrifices and output enjoyments occur in a project's life history and what their magnitudes are.

It is easy to see that the analyst may be called upon to study many different input-output problem variations, basically created by the following:

(a) Choices as to volume and timing of the input and output streams, independently and relative to each other.

(b) Technical-economic options affecting the internal composition of the inputs (labour, machines, materials etc.) and outputs (product mixes).[13/]

(c) Possibilities that outputs (social services, consumer goods, national defense) and inputs (money costs, social sacrifices), by the nature of things, must be measured on different value scales.

As a general rule, when confronted by continuous input-continuous output problems, it is most expedient to treat each input-output stream configuration as a distinct project. Investment analysis then consists of systematic comparisons of these discrete project proposals, using rational evaluation guides for selection purposes.

13/ A.K. Sen's book Choice of Techniques [23] is relevant.

Prominent Continuous Input-Continuous Output Problem Approaches

Given input and output streams of the type sketched in Figure 2, we find in the literature different methods of evaluating them, using distinct success criteria. We will quickly discuss the more prominent variants.

1. Pay-Off, Capital Recovery Period, or Capital Turnover Rate Problems. Here the question is asked how long it takes to recoup initial costs (area C_1 in Figure 2) from revenues (V). The length of the capital recovery rate is supposed to be a success indicator: a project that takes six years would be preferred over one that takes ten.

This test unreasonably neglects the performance of assets beyond the recoupment period. For example, the six-year project may fall to pieces immediately afterwards, whereas the ten-year one may be serviceable for another fifty-year span and might therefore be preferred. Further, initial costs (area C_1) are singled out, and continuing costs (C_2) are ignored for no good reason. In this way, the problem formulation is a throwback to the point input-continuous output case, not a very realistic one as was observed.

2. Capital-Output Ratio Problems. In this formulation the attempt is made to maximize outputs (V), in relation to initial inputs (C_1). A project which promises to deliver most output per unit of initial input would be preferred to all others. Occasionally, this performance criterion is also called the "product-capital ratio".

In retrospect it is hard to account for the popularity which this particular analytical device enjoyed a few years ago. After all, the definition of "capital" is quite shaky and why eliminate the continuing streams of inputs after the initial resource commitment dose (C_2), from the calcuations? The only possible explanation

is that there was a past presumption that capital resources were the only scarce factor. But such a priori reasoning is very dangerous in field work, for it prejudges vital issues the analysis is supposed to solve. Again, the capital-output ratio problem formulation, by ignoring cost streams (C_3), is a throwback to the point input - continuous output case.

3: Capital Intensity Problems. Capital intensity can conveniently be measured by the ratio of initial costs, (C_1), to continuing costs, (C_3), the latter preferably discounted to present values (see below). For brevity one can refer to the "ratio of initial costs to future costs", as stated by Luts. [18] The higher the ratio, the more capital-intensive is the project. It is usually presumed that the output stream (V) stays constant as (C_1) costs are substituted for (C_3) and vice versa. It is then argued by writers that underdeveloped countries, since they are short of investment funds, should always select less capital-intensive projects than the more advanced nations.

It is not at all obvious what is achieved by this particular formulation. We are clearly dealing with a cost minimization problem, if the assumption of constant output streams holds true. The question then is: what mix of initial costs (C_1) to continuing costs (C_3) is most advantageous? To answer this question, an interest rate or social rate of time preference must be applied to the input streams. To take one extreme, at a zero rate of interest costs (C_1) count just as much as costs (C_3). Zero interest in effect wipes out the time dimension as an economic factor. It unrealistically favours immediate heavy consumption sacrifices for the sake of possibly very late output enjoyments. However, as the interest rate goes up, less and less analytical weight is given under the usual discounting or compounding procedures to

the later cost streams (C_3) relative to the initial ones (C_1). It follows that less capital-intensive projects become more attractive as the interest rate rises, and the more capital-intensive ones show their merits as it goes down, always assuming ceteris paribus, of course.

Viewed as one aspect of cost minimization, concern with capital intensity makes sense. Even so, the inherent assumption of output streams that stay constant with changes in the (C_1) versus (C_3) proportions is rather restrictive. Further, it is inadmissable to automatically associate all projects in less developed countries by a priori reasoning with the desirability of low capital intensity and hence high interest rates.

4. Staging or Construction Phasing Problems. These are very similar to the previous ones. The question is asked whether it is advantageous to build a project all at once to full capacity, with an outlay of the entire (C_1), or whether a portion of (C_1) can be postponed until it becomes, say, the second construction phase (C_2). Examples might be the construction of a large smelter in successive stages, or the construction of a highway all at once to four-lane capacity, or in separate instalments, with just two lanes to start with and the second set a few years later.

If the output stream (V) is supposed to be the same, regardless whether there is all-at-once or stage construction, then we are dealing with a straight cost minimization problem. Again, the interest rate is strategic: a high rate favours stage construction, a low one all-at-once work. Large "setting-up expenses" (bringing men and machines to the site), or construction economies of scale in general, mean that (C_2) will be bigger than the postponed portion of (C_1). All-at-once work would then probably be advantageous. In addition, [illegible] know-how in technology and high

uncertainty in general, on the other hand, would favour staging. These different factors should be weighed carefully in project analysis.

It seems to me that postponement and advancement of suitable input portions should always be tested on paper in order to arrive at the best timing pattern. But few field analysts are aware of phasing possibilities and empirical knowledge of the subject is quite inadequate.

5. Various Input Mix and Timing Problems. Once again, with output stream (V) assumed to remain the same when different configurations of inputs (C) are being tested analytically, this is a cost minimization problem. An issue is the best composition and timing of the input components that together serve to produce output (V). Typical questions are: Is a hydro-electric or a thermal plant design more advantageous? Should a proposed bridge be built of masonry, laminated timber, steel or pre-stressed concrete? Should relatively more labor or more machinery be used on the job? Is rapid construction, involving severer engineering and management problems, or a more leisurely pace more advantageous? Once there is knowledge of the costs of various input components, as well as of the technically best ways of combining them and the interest rate, these questions can be answered unequivocally. The solving of input mix and timing problems requires particularly close collaboration between engineers and economists.

6. Various Output Mix and Timing Problems. These are analogous to the questions discussed under item (5) above. It is assumed that the input stream configuration (C) is given, but that different output types may be produced at various points in time. Briefly, this becomes an exercise in output maximization. Typical questions are: Should there be a great volume of lower-quality output, or higher-quality pro-

duction in smaller amounts? What kinds of products should be produced at what times? Market research expertise, in addition to engineering and economics talent, is required to solve output mix and timing problems.

7. Various Partial Evaluation Problems. These are discussed at some length in the U.N; Manual on Economic Development. [27, especially pp. 216-37] Among them are maximization of employment per unit of capital, of labor productivity (i.e. of production value obtained per person employed), and of foreign exchange earnings per unit of inputs. All of the partial evaluation problems, and among them we must also count the previously discussed cases (1), capital recovery period, and (2), capital-output ratio, single out specific components of the total input and output streams and relate them to each other. There is no good reason to believe that anything useful can be achieved by these procedures. Understandably, they have come under heavy criticism.

8. Complex Input-Output Mix, Timing and Multiple Value Scale Problems. These combine features of problems (5) and (6). The restrictive assumption that input and output streams will not affect each other is dropped. Now for every configuration of (C) there may be a different output stream (V) and vice versa. Typical questions are: Is it worthwhile to sacrifice more inputs to gain more outputs? Will earlier yields of (V) pay for the additional inputs (C) needed to hasten production? By what losses in (V) would possible savings in (C_3) be accompanied? Often there will be several value scales; for example, output may be measured in physical terms (number of schools constructed, acre-feet of irrigation water provided, health service coverage achieved), but inputs in market values. This complicates analysis. Appropriate success criteria are cost minimization, output maximization, or in combination, maximization of net outputs (max. V-C) if both series are commensurate.

Treatment of the Time Dimension

We have established that various economic events - input doses, accruals of outputs - will typically be spaced irregularly over time. Mere inspection or aggregation of the input and output streams yields no definite prescriptions for sensible action. With Pierre Massé we may say; "The difficulty is that, physical appearances ... notwithstanding, one franc available right now and one franc available [illegible] available at the same time. They can neither be compared nor directly added." [19, pp. 8-9]. Resource allocation decisions consequently become a form of "arbitrage in time", and investment, in the final analysis, "not an end in itself but rather a process for distributing consumption over time." [14].

Somehow the basic common-sense notion must be accommodated that a franc received or sacrificed today should count more heavily than a one-franc transaction five or fifteen years from now. Mathematically this is generally accomplished by the application of the well-known discounting or compound interest formulae. Briefly, dated input and output streams are reduced to simple (present or future) value terms and are then compared. If both series are commensurate, projects with outputs greater than inputs are accepted, those that do not meet this test are rejected. Among acceptable projects, those that promise maximum net outputs are selected. When several value scales exist - monetary plus other - more complicated procedures apply as explained later. The technical literature should be consulted for further details. A few special points are of interest here.

1. Equivalence of Discounting and Compounding. The former method works backwards, as it were, from the future to the present - the chosen viewpoint. Results are therefore "inputs and outputs in present terms". Compounding works in the opposite direction, with the date of project expiration being the chosen viewpoint.

results are "inputs and outputs in future terms". Both procedures lead to exactly the same project choices and policy prescriptions. It is sometimes erroneously believed that discounting has unique merits of its own. This is wrong. Given the same input and output data, there is nothing discounting to present values can do which compound interest calculations to terminal values cannot do just as well.

2. Differential Weighting of Future Events. Both methods essentially assign declining analytical-statistical weights to the future. This weighting is a function of the interest rate and the total project time span. At a zero rate, inputs and outputs expected in the year 2015 count just as much as those of 1965, the present time. But given an interest rate of 4 percent, the weight is reduced to 14 percent five decades from now. And applying a rate of 8 percent it declines to a mere 2 percent (see Figure 3 and Table 1). The rapid shrinkage of input and output importance during the first few years should be noted. As the time horizon expands to infinity the analytical weights will, at any positive interest rate, gradually approach zero. Such are the powerful effects of compound interest mathematics !

In Figure 3 and Table 1 it can also be observed that changes in the length of time horizon and in the level of the interest rate are partial substitutes for each other. For example, boosting the interest rate from 4 to 8 percent has about the same effect on analytical weights as cutting the time horizon from 40 to 20 years. Likewise, using 8 percent instead of 1 percent, is equivalent to shrinking the time horizon from 40 to as little as 5 years. Putting this another way, inputs and outputs in the year 2005 assessed at 1 percent will exercise the identical influence on final analytical results as the same inputs and outputs in 1970 appraised at 8 percent, assuming ceteris paribus, of course. Practitioners, it seems, are often not aware of these interrelationships.

3. Choice of Interest Rate. The interest or discount rate is a most strategic project selection device - the higher its level, the more projects will be "rationed out". How, then, should the level be selected? At first it was thought that any project could, as it were, generate its own "internal rate of return" - the rate which just exactly equates the discounted or compounded input and output series. "Maximize the internal rate of return" would then be the project selection criterion. However, serious problems with this analytical artifact arose: (a) Some series generate not just one, but several internal rates of return. [14] (b) For mutually interdependent projects of the type encountered in systems or networks (see below), the decision rule "maximize the project internal rate of return" simply breaks down. (c) Any internal rate of return implies that funds can be re-invested elsewhere at exactly that rate; this would be the case by coincidence only. Similar objections must be raised against maximization of the benefit-cost ratio, a project selection guide often advocated in the public sector literature. The current view is that the input-output appraisal rate must somehow be determined outside the project framework. There are two schools of thought on how this can be done. One school thinks of time preferences as a competitive market phenomenon, with people trading present for future dollars at a certain rate. It is this rate, or range of rates, which adherents of this mode of thought would use for project planning. Their approach is particularly applicable to shorter-range, purely commercial transactions, it seems, where money market phenomena do indeed furnish some guidance for the future.

Other writers, and among them are highly regarded economists such as Eckstein, take a rather broader view of what they term "social rates of time preference". They suggest that the capital market is "rife with rationing, ignorance, differential tax

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[14] See the important articles by Lorie and Savage [17a] and Hirshleifer [14, especially pp. 348-51].

treatments" and so on, and is generally blatantly imperfect [8 , pp. 495-504]. Fundamentally they believe that investment changes consumption patterns over time. Consequently, the choice of interest rates for economic development work is essentially a matter of value judgments, leading to income re-distributions among different generations of people.

For purely financial analyses, as in our example of the petro-chemical plant, the first view is correct. But for broad social and economic planning purposes, for instance in the case of area development, one surely must subscribe to the second school of thought. It stands to reason that all the analytical devices which express time preferences - time horizons, salvage values and scrappage costs, high or low input and output estimates, and especially interest rates, - should ultimately be tailored to the results society wants to obtain. The interest rate then becomes a <u>deliberate planning device</u>: high rates will be used to encourage consumption and discourage investment; low rates to achieve the opposite effect.

<u>Treatment of Project Interdependencies</u>.

A whole spectrum of interactions among projects can be visualized. At one extreme there is <u>complete incompatibility</u>: if Project A is accepted, then Project B cannot be executed. Practical examples are buildings, power dams or other installations that vie for a unique site. Moving through various degrees of <u>competitiveness</u> among projects (A and B will inflict revenue losses and/or cost increases upon each other, but both projects can survive in a fashion), we recognize <u>complete project neutrality</u>. An example would be a fertilizer factory in Chile that exercises no conceivable influence upon a highway project in Thailand. Proceeding further, there are different intensities of **complementarity** (A and B bestow revenue increases and/or cost decreases upon each other, but can survive separately). Classic examples are feeder road and main highway, or an

irrigation scheme associated with marketing and transportation improvements. Finally, at the other end of the spectrum, there is complete dependence in the sense that A cannot survive without B and vice versa. It is best to treat perfectly dependent proposals as one project. Examples are machine and power supply, railway equipment and track, factory and raw material supply.

Whenever interdependencies of one sort or another exist, projects must be analyzed within the proper systems or network context. All possible combinations must be tested, for example, A,B,C, A+B, A+C, B+C, A+B+C, in the case of three interrelated projects. The number of potential combinations is governed by the formula: 2^n-1. In our example: $2^3-1 = 7$. If all inputs and outputs of all projects are commensurate, then maximization of net outputs is the correct rule for selection of the optimal project bundle. As Hansman suggests [10, p. 234], "dependence relations can be exhibited in matrix form". Explanations of this technique and numerial examples are provided in Kuhn [17. pp. 92-100. 110-23]. With several value dimensions, correspondingly more complex analyses and decisions guides must be employed. This entire subject of project interdependence - an important one in development work - needs scholarly attention urgently.

Treatment of Location and Transport Aspects.

Apart from accurate dating, all input and output values should also carry locational subscripts. It makes a great deal of difference when the consumption and consumption locii are introduced into the analyses. While proper justice cannot be done to this subject within the present context, we note that as a rule transport costs should be added to the project input and output flows. Different locational configurations should then be tested, just as if they were discrete projects. Maximization of net output and corresponding decision rules again apply.

Towards the Infallible Decision Guide for Project Evaluation?

Starting from the very simple idea of means-ends comparisons, which are really at the bottom of project evaluation, the discussion has become more and more complex as various real world circumstances were introduced. The question arises whether a universal, foolproof decision guide for development project evaluation can be devised. The answer is that the nature of the problem, as visualized in the initial terms of reference and research design, directly determines the success and decision-making criteria.

This proposition can be elucidated by means of Table 2. Proceeding from top to bottom, the analytical scope is widened from the single, completely independent project (surely a rare case in practice), through the project bundle (sectoral program, system, network), to the all-embracing national or regional economy (simply the sum total of all projects and programs). At what point on the vertical scale the analysis should be set, depends entirely on the decision maker's viewpoint and instructions. The individual entrepreneur would just be concerned with his petro-chemical plant project. The Ministry of Industry (Petro-Chemical Division), or the National Association of Chemical Producers, would probably adopt a middle-position, strictly sectoral approach. National and regional development planners would employ quite comprehensive analyses, in accordance with the outlook of the executives to whom they report.

Likewise, still in Table 2, we can visualize that the comprehensiveness of research and measurement operations increases as we move from left to right. At one extreme, market value (monetary) revenues and costs only are taken into account. This would suit the requirements of the money profit maximizing entrepreneur, that famous figure in economic science fiction. His place would be in the top left-hand corner. Multiply him over and over again, then a society would emerge that would engage exclusively in monetary transactions and would be guided by maximization of market value Net National Product or Net Regional Product (bottom left).

The right-hand column, by contrast, incorporates any number of broad social and economic values, not to forget monetary ones. In the case of single, completely independent projects (top right), possible success indices include simple goal achievement ("malaria can be eradicated"), cost minimization or requirement approach [15] ("by choosing carefully among several alternative ways of doing it, malaria can be eradicated in the cheapest and most convenient way"), output maximization ("most malaria eradication can be achieved per dollar"), or [illegible]. And the most ambitious planning, research and measurement approaches are, of course, to be found at the bottom right. This is the analytical box into which the comprehensive area development effort of our previous example properly belongs. Comparisons of various "achievement states" that might be brought about by appropriate actions in the Aliveri District of Mesalia would be called for. Among these the decision makers must choose, using ethical and other value judgments. Presentations by the analysts of so-called social and economic planning accounts, including evidence on income distribution effects (or benefit incidence), would definitely facilitate their difficult task [16].

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[15] McKean [20] uses this term.

[16] These are just some highly compressed and provisional thoughts on a subject that is still largely in flux. John S. MacDonald, of the United Nations and the Corporación Venezolana de Guyana, is the author of some stimulating unpublished papers. Available relevant sources include writings by Walter Isard [15, especially chapters 4 and 12], Wubnig and Baldwin [29], and Cushen [7]. A draft chapter in a book manuscript of the [illegible] economic planning accounts. This seems a most promising approach to development problems, but perhaps other techniques can be devised.

In conclusion, we may conclude that there can be no single, infallible decision guide that suits all circumstances in development work. Indeed, if all inputs and all outputs are entirely measurable on the same monetary scale, then maximization of net outputs (or net revenue, gain, profit, etc.) can be the "counsel of perfection", as Nelson [20] puts it; it incorporates cost minimization and output maximization anyway, and can be "forced" to apply to interdependent project bundles, as well as to the entire economy. But as soon as other social goals and values intrude - as will usually be the case in most development work - broader criteria are called for.

IV. DEMONSTRATION CASES

It will be helpful at this point to round out the preceding methodological exposition with some practical, if fictitious, project evaluation examples. The petro-chemical plant proposal will illustrate the [illegible] financial analysis of a single, independent project, using the simple success criterion of net money revenue maximization (top left in Table 2). The area development scheme may be taken as the prototype of a comprehensive public development effort evaluated, according to broad policy criteria (bottom right in Table 2).

Petro-Chemical Project — Research Phases

Consultants have been retained by the Mesalia Industrial Development Bank to test the "technical and financial feasibility" of the Aliveri petro-chemical plant proposals in accordance with the terms of reference mentioned previously. They may proceed with their research along the following lines:

(a) Input and Output Series. The best possible information on the C and V series generated by different plant configurations must be obtained. Input and output values, in the first instance measured in monetary terms only, are recorded month by month and year by year, exactly as they are expected to occur. Realistic salvage values and scrappage costs must be put down.

(b) Technical Design, Engineering Cost Estimates. This phase will largely be the responsibility of engineers. It embraces research on suitable production processes, equipment, plant layout, scale of operations, physical lives of project portions, and many other technical aspects. 17/ The crucial end result, from the point of view of investment analysis, are precise and well-documented cost estimates for the various

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17/ For further details, as well as illustrative cases, see the U.N. Manual [27, ch. III, "Project Engineering", pp. 55-99].

components of the plant, with dates attached to the input sequences. Physical quantities as well as unit prices must be shown, for example: "five stainless steel pressure tanks type 437 @ $14,000 = $70,000 total cost". In this way checks and adjustments for price changes can easily be carried out. A breakdown between foreign exchange and domestic currency costs is also required. Close collaboration between engineers and economists is essential for the preparation of sound cost estimates.

(c) Market Study.[18] Here the talents of demand forecasters and market researchers are needed. The end purpose is determination of potential product sales over time, specified both in terms of prices fetched and quantities disposed of. If this has not already been accomplished before, it is most advisable to begin with a market study for the sector as a whole (here chemicals, or petro-chemicals). Such a study broadly delineates present and future demand for the product group, factors favoring or retarding demand growth, international trade aspects, competition with related products, and so on. Enquiries can subsequently narrow down to the specific market shares which the proposed plant might capture. Distinctions should be made between potential demand for final consumer products (generally responsive to changes in price, income and sales efforts) and for industrial materials and other intermediate products (more closely related to overall macroeconomic developments). Product quality, as well as changes in tastes and technology must be taken into account throughout.

First Research Results. Suppose that the facts of this greatly simplified demonstration case are as follows:

(a) The engineers advise:

(i) A promising type of petro-chemical plant could be constructed during

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18/ See the Manual [27], ch. II, "Study of the Market", pp. 11-54.

the years 1966 and 1967 at a total initial cost of $10 million, covering design, supervision, construction and contingencies. Of this total, $5 million are payable on December 31, 1966 (t_1), and the other $5 million on December 31, 1967 (t_2).

(ii) Physical life of the facility is five years after its completion, i.e. the project expires on December 31, 1972 (t_7). There are scrappage costs (dismantling, site clearance) of $1 million.

(iii) Continuing costs (operation, maintenance, administration) are $1 million per annum, always payable on December 31 of each of the five production years to make calculations simple.

(iv) All inputs are measurable in market value terms; there are no non-market costs at all.

(b) The market researchers, in conjunction with the engineers, advise:

(i) The plant will yield no outputs during 1966 and 1967, and will go into productive operation January 1, 1968.

(ii) Expected product sales, assuming most suitable pricing, marketing strategy etc, are $2 million in 1968, $3 million in 1969, $5 million in 1970, $5 million in 1971 and $3 million in 1972. Revenues are always collected on December 31 of each year.

(iii) As a firm estimate, $1 million can be realized from project scrappage (sales of salvaged materials and equipment, disposal of site) on December 31, 1972.

(iv) All outputs are measurable in market values; there are no non-market gains.

(c) The financial experts advise that: (i) the plant entrepreneur himself could obtain loans on the open money market at 8% interest per annum; (ii) the Mesalia Industrial Development Bank might grant a more favorable loan at 3% interest per annum. After consultation with the two decision makers it is decided that these rates should alternately be applied for project screening purposes. There are no limits on the total size of the loan.[19]

Evaluation. The research results, which look a little complicated in words, should as a first step be recorded systematically in time chart (Figure 4) or tabular form (Table 3). Using initially r = 0.03, the output and input series are then discounted[20] in the following way:

$$V = \frac{2.0}{(1+0.03)^3} + \frac{3.0}{(1+0.03)^4} + \frac{5.0}{(1+0.03)^5} + \frac{5.0}{(1+0.03)^6} + \frac{4.0}{(1+0.03)^7} = 16.2486.$$

$$C = \frac{5.0}{(1+0.03)^1} + \frac{5.0}{(1+0.03)^2} + \frac{1.0}{(1+0.03)^3} + \frac{1.0}{(1+0.03)^4} + \frac{1.0}{(1+0.03)^5} + \frac{1.0}{(1+0.03)^6} + \frac{2.0}{(1+0.03)^7} =$$

$$= 14.6969.$$

For computational convenience as shown in Table 3, the appropriate discount factors can be taken directly from standard mathematical tables.

19/ This is an important condition. It eliminates the so-called "budget problem", which is prominent in the public sector literature. Briefly, it calls for possibly sub-optimal maximization of revenues in relation to rationed investment funds. In investment theory of the private firm, similarly the rate of return on the entrepreneur's own capital (assumed to be given) needs to be maximized. [18, pp. 15-42] Either way, rigid input constraints do not make much sense.

20/ The literature [9], [18], [19], or [17, pp. 104 - 5] should be consulted on the correct discounting formulae and procedures.

The net gains (V - C) from this project, if assessed at an interest rate of 3%, are thus $1.5517 million. Policy advice is to accept the project under these circumstances. In words this means that if the petrochemical plant entrepreneur borrows money at 3% per annum from the Mesalia Industrial Development Bank, invests it and generally runs the plant as recommended by the consultants, he can wind up the project at the end of 1972, cover all his costs, repay all his debts, and still realize net revenues of over $1.5 million in terms of the present time, i.e. December 31, 1965. It should be emphasized that interest payments and amortization are automatically taken care of by the discounting calculations described here. If, on the other hand, the input and output series are assessed at an interest rate of 8%, then a net loss of $0.222 million is incurred. Under these circumstances the project should be rejected, since it does not meet the fundamental "outputs must at least be equal to inputs" test. In case of choices among several alternative project proposals, design and scale variations, the one proposal which maximizes net revenues at the given interest rate should be selected by the decision makers. As pointed out before, when more project options are evaluated in this fashion, executive judgment gets sharper, and the final decision approaches true optimality.

Methodological Observations

Possible analytical simplifications, as well as further embellishments, can now be introduced.

Simplification. When both the output and input streams are measurable on the same monetary scale, as in this case, unnecessary calculations can be eliminated by simply discounting the net values of the two series, for instance by 3%:

$$V - C = -\frac{5.00}{1.03^1} - \frac{5.00}{1.03^2} + \frac{1.00}{1.03^3} + \frac{2.00}{1.03^4} + \frac{4.00}{1.03^5} + \frac{4.00}{1.03^6} + \frac{2.00}{1.03^7} = \$\ 1.551 \text{ mill.}$$

This is equivalent to the cost series being "folded over" the revenue series and processing the remainders only (see Figure 5). In economic writings,[21] the net series are often recorded consecutively as negative (cost) or positive (revenue) values. Starting with year t_o, the results here would thus be simply written as: 0, - 5.00 - 5.00, 1.00, 2.00, 4.00, 2.00.

21/ See, for example, Hirshleifer's article. [14].

Compound Interest and Discount Calculations. It was argued before, that present and future values are mirror images of each other, as it were, and that there is no special magic to one calculation method or the other. Both tell us whether a project with given sets of inputs and outputs is economically viable when a particular interest rate is applied. Figure 6 demonstrates how net present and future values from the petro-chemical plant can be converted into each other and can be switched around in time by means of the usual formulae. If desired, any year between the present and the remote future, for instance the midpoint or perhaps year t_6, can also be chosen as analytical viewpoint. Consequently, the terms "interest rate" and "discount rate" are logically one and the same and can be used interchangeably. 22/ Both, in effect, attach identical analytical weights to economic events occuring at future dates.

Embellishments. Many additional features can be grafted onto the simple discounting techniques. Among these are:

(a) Differential interest rates over time, for instance 6% in year t_1, 10% in t_2, 4% in t_3, and so on. All other things being equal, relatively high rates will encourage consumption at the particular point in time and will discourage investment, i.e. sacrificed consumption. Relatively low rates have the opposite effect. In these ways, differential rates will influence choice among projects with different time profiles. In our example, a project with low input requirements and high outputs (or big "cash throw-offs", as they are called in the literature) in year t_2 would be favoured.

22/ This brings up a slight disagreement with Massé who writes: "we shall use the expression 'discount rate' instead of 'interest rate' whenever we shall be concerned with economic calculation rather than about financial transactions. A borrower and a lender agree on an interest rate, while a decision-maker uses a discount rate". [19, p. 14] Massé's distinction is elusive.

(b) Different lending and borrowing rates can be introduced into the formulae, if desired. It is often the case that governments -- by virtue of their size or powers of coercion - can obtain investment funds at lower rates than those at which they could lend money. There is an active methodological debate on all this, especially on the question whether governments and public enterprises possess the power of re-investment.

(c) Real world loan terms are often quite complex and may stipulate periods of grace, lower rates for funds held in reserve by the lender but not yet called up by the borrower, various penalties and rewards for slow or fast repayment patterns, and so on. Discount analysis of actual cash flows can take care of these circumstances, however complicated they may be.

(d) Analysts may be called upon to carry out quarterly, monthly, daily or hourly discounting. This is easily possible. Even continuous discounting may be desirable, especially in theoretical work, permitting use of the differential and integral calculus. [19, pp. 15-17].

(e) Sometimes it is hard to decide what the physical life of a project should be. Buildings and machinery could theoretically be maintained and rebuilt ad infinitum, and the right-of-way of a road physically never wears out. In these cases it is possible to postulate infinite project lives and calculate the present values of never-ending input and output streams. However, it is surprising how little difference the lengthening of lifespans from 50 to 100 years or to infinity makes when interest rates of, say, more than 4% prevail. This can be confirmed by checking the relevant discount factors in a book of mathematical tables.

(f) As with all predictions, no one series of project inputs and outputs will be absolutely correct. The basic condition of uncertainty is ever present. The analyst

can render an important service by assigning probability weights to the input and output values. Of course, the decision-maker wishes to know the joint risk attached to both series taken together: Hence the probability distribution of costs and revenues combined (i.e. of the present value of future net revenues) needs to be worked out.

(g) Much has been written on the subject of shadow-pricing - the systematic purification of input and output values in order to turn them into genuine economic quantities. For example, in many less developed countries foreign exchange is severely rationed and the rates are pegged at an artifically low level. If such unduly low rates were used in project [illegible], then investment proposals with relatively small foreign exchange input requirements and/or high foreign exchange earnings potentials would be penalized - surely an undesirable result! Introduction of a "realistic" rate (i.e. the one which would prevail without exchange restrictions), would lead to much better project selection results. Various inputs, especially labour, are often undervalued or overvalued, and corresponding adjustments ought to be applied. It stands to reason that tax and subsidy distortions must also be removed.

While many of these suggested shadow-price adjustments make eminent sense, the subject as a whole needs scholarly attention. It is not clear, for example, what types of taxes in our present-day world are purely distortive and should be eliminated, which ones [illegible] for instance) and should therefore be left alone. Again, one may wonder what the aggregate results are when many individual project analysts merrily shadow-price away without paying attention to the macroeconomic cross effects. Surely it is better procedure to develop the overall future macroeconomic framework first and to deliberately assign true scarcity values to labour, foreign exchange etc., rather than let the project analysts struggle with this problem. But is this done in practice?

Conclusion.

Purely financial analyses of commercial and industrial ventures, such as the fictitious petro-chemical plant, are really quite straightforward. With the exception of shadow-pricing, the relevant economic methodology is well established and non-controversial. Provided the time preference or interest rate is given, discounting techniques can easily be mastered and used in the field. A number of worthwhile additional features can be grafted onto the basic method. If both the input and output series are entirely measurable on the same monetary scale, maximization of the present value of net revenues is the correct success criterion. It yields unequivocal solutions to the following problems: (i) acceptance or rejection of single projects; (ii) selection of the best project from several alternative proposals; (iii) selection of the best project bundle from combinations of mutually interdependent proposals. However, as soon as multiple objectives and incommensurate value scales are admitted - conditions to be expected in development field work - many complications arise. We will touch on these briefly now with the aid of the area development example.

Aliveri Area Development Scheme

The study terms of reference clearly showed that the national government is determined, for good reasons, to vigorously press forward with social and economic development in the backward Aliveri area. This sort of broad problem setting - one that is encountered over and over again in many parts of the world - unfortunately strains contemporary know-how to the utmost. No formal economic and social development theory exists which could guide the field worker. And although much practical experience has been gained here and there during the last ten or twenty years, it has not yet been distilled and organized enough for general application.

Thorough treatment of the subject is quite impossible within the scope of the present paper. However, in order to stimulate discussion, we may imagine ourselves in the rôles of the Aliveri development planners and sketch the main phases of our work. Suppose only agriculture, industry and infrastructure are of interest.

1. Defining the Problem. A thorough analysis of the existing situation in the Aliveri area is a useful first step. Chief problem components might be:

(a) Agriculture in this predominantly rural area suffers from low productivity, lack of markets and poor transportation.

(b) There are as yet no industrial or other employment opportunities which would absorb surplus agricultural labour.

(c) Infrastructure and social service qualities are well below national levels.

Ample statistical and other factual evidence to support these points can be amassed.

2. Clarifying the Objectives. The desired direction, impact and speed of the governmental development effort can fortunately be easily deduced from the study terms of reference.

3. Inventory of Potential Action Instruments. It is worthwhile to understand the institutional setting and to explore all action possibilities, however unconventional. Examplee are:

(a) In agriculture, public investment in irrigation; land reform; encouragement of new farming methods through education (extension program), by example (pilot plot) or through direct financial encouragements (easy loans, cash subsidies).

(b) Establishment of a petro-chemical plant in the area, by means which were previously discussed.

(c) Direct government investment and encouragement of private initiative, through diverse devices, in the fields of transport, electric power, telecommunications, housing, education and so on.

4. Individual Project Study Phase. The merits of each one of these potential sets of actions should initially be investigated separately; What are the benefits and costs of irrigation in the Aliveri valley? What are the prospects for land reform? Is there a pay-off from further mechanization on the farm, crop rotation, use of fertilizers? In transport, are new penetration roads called for or technical improvements of the exieting network? Is rapid electrification desirable? If yes, should hydro-electric power sources be exploited or should a thermal plant be built?

Theoretically any one of these questions needs to be answered by a fully-fledged project report. In practice, some of the proposals will be so obviously sound that they need little deliberation. For others, earlier studies will already exist. It is often the case that reports have been piled upon reports over the years, with little action to show for. Integrated area development planning can be an excellent

medium for unearthing some of these buried treasures of knowledge and putting them to work.

5. Testing of Interdependencies. This is a most challenging study phase, one for which little theoretical guidance exists. In our example the following competitive and complementary relationships might be explored:

(a) Agriculture will compete with industry for use of land, labour and other scarce resources. On the other hand, the proposed petro-chemical plant would supply farmers with cheap fertilizers.

(b) The industrial plant depends heavily on good infrastructure services (harbour, highway transport, telecommunications, housing for employees, educational and recreational facilities). At the same time it will, up to point, pre-empt funds that might have been devoted to agricultural and social service purposes.

(c) The whole public sector both gains and loses from the agricultural and industrial schemes. Greater prosperity in the Aliveri area will boost government revenues, cut down on unproductive unemployment benefit payments and the like, and therefore expand the scope for worthwhile infrastructure improvements. At the same time, as many a local government has found to its chagrin, getting a big industry established may have its drawbacks: industrial wastes have to be disposed of; there is air pollution; the local water supply and transport systems may prove inadequate. It is important to explore whether the community as a whole gains or loses. There will be strong interactions within the public sector: irrigation might be combined with a hydro-electric power scheme; highway improvements would inhibit railway transport.

The analytical goal is to come up with a combination of projects which will, in some sense, maximize social and economic advancement for the Aliveri area as a whole.

6. Sequences, Time Schedules. For physical reasons many of the schemes will have to be tackled in sequence, for instance land reform first, construction of penetration roads next, followed by rural electrification, farm mechanization, and introduction of new crops. Limitations of finance, manpower, contractors and materials will also prohibit all-at-once crash programs. Consequently sensible time priorities and progress schedules must be worked out. Critical path methods and similar techniques will prove helpful, as will formal investment analysis of the type described earlier.

7. Evaluation, Choices. Gradually alternative sets of proposals will emerge, which will differ somewhat in their ultimate effects. The one may speed industrialization and absorption of the unemployed, but agriculture and the social service may get short shrift. Another one may create a model infrastructure in Aliveri, complete with paved roads, good water supplies, excellent housing and modern schools, but the growth of private disposable incomes may be disappointing. Depending on the importance attached by the decision body to these different types of achievement, a vigorous search must be undertaken for the optimal compromise program. Marginal trade-offs should be brought to the attention of the decision makers, for example, the interesting fact that an additional $1 million would "buy" any of these: schools for 1000 children; 50 km of main highway or 250 km of penetration road; 10% capacity expansion for the petro-chemical plant and hence additional employment for 30 people; and so on.

8. Final Recommendations. All this analytical work will culminate in precisely

worded, well-documented alternative sets of action proposals, complete with suggestions when the various steps should be taken. The one set of policies which in the opinion of the analysts best accomplishes the stated objectives of the decision makers, should be singled out. The other alternatives should, however, also be presented, since they are the only benchmarks against which the soundness of the recommendations can be measured.

If such or similar procedures are followed by the analysts, there is every chance that sensible executive decisions can be made, leading to speedy development progress.

Conclusions.

We discussed two extreme development planning problems: a self-contained, profit-making industrial project and a comprehensive social and economic improvement scheme for an entire area. Boht require efficiency of resource allocation and both analyses rely on elaborate means-ends comparisons. Otherwise there are great differences in the decision makers' objectives, study terms of reference, and the whole array of analytical techniques employed.

After years of struggling with infrastructure and comprehensive planning problems the author is of the firm opinion that industrial project evaluation is a much easier task: the framework is tighter, inputs and outputs are commensurate, the analytical procedures are well-established, and the success criteria are unambiguous. If one had the choice between evaluation of a highway and a petro-chemical plant, one would opt the latter any time. Of course, there are compensations in infrastructure work. Experts are very scarce in this field and yet huge resources are pumped into it regularly. In most developing countries, transport alone regularly absorbs between one-third and two-thirds of all public investment funds. There is also the somewhat doubtful consolation of working in a rather "safe" field. As Albert Hirschman points out,

[13 , p. 84/ it is not easy to prove that transport and other infrastructures ventures are failures. Success or lack of success of an industrial plant, on the other hand, is for everyone to see. We will return to the subject of follow-up checks on project performance later.

V. PROJECT PLANNING AND EXECUTION: STATE OF THE ART

Last year, at the Brookings Institution, the team of experts including the author tried to determine what the "state of the art" of economic and international project analysis is. 23/ We looked at 81 field reports, relating to development problems of almost 40 countries. Most of the reports were confidential documents prepared by consultants. Just to put our hands on them was a major feat - there is no library or documentation center anywhere in the world that stocks such material. 24/ Of these 81 studies, 33 were general economic development and investment planning surveys, 42 transport project evaluations covering highways, ports, railways and airports, and the remaining 6 studies dealt with power and telecommunications schemes.

The team reviewed 20 of the 81 studies in great detail, emphasizing methodology, in accordance with a "survey format" which was developed specially for the purpose. These selected studies comprised roughly 5000 pages of print, with many tables, engineering drawings, etc. in addition. They cost about $4 or $5 million in professional fees to prepare, not reckoning staff and executive time of the clients for these efforts, mainly international development agencies, as well as counterpart contributions of the developing countries in question. Altogether over $2 billion worth of investments were proposed in the reports, including such projects as a $478 million African power scheme and a $135 million highway network for a Latin American nation. The remaining 61 studies, although read entirely, were analyzed in less detail

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23/ The results of this research are described in more detail in a forthcoming Brookings Institution publication. [11]

24/ See the proposal for creation of development documentation center in the Appendix.

since they definitely corroborated the conclusions drawn from the selected group of reports.

Since that time the author has seen various other reports of this type and, indeed, has made use of them. He has also had opportunities to speak to development officials and planners in the field and to look at US AID, Greek and other international data on project planning and execution speeds, including so-called "disbursement patterns".

To conclude the present paper, the author wants to convey briefly his impressions on the current status of project planning and execution gained in these various ways.

Time Lags in the Investment Process

There is general interest in "slippages" or "time lags" in project planning and execution. Tinbergen urges analysts to take account of them [26, p. 15] and the OECD, among other international agencies, has commented on the undesirable "growing lag between fund commitments and disbursements". [21, pp. 25-26]. Apart from a recent internal report of a development agency on its experiences with disbursement delays, little factual information has been published on the subject.

The investment process is a highly complex phenomenon. It is important to understand the chain of events that typically takes place from the first notion that an investment opportunity exists until the project is completed and goes into production. Figure 7 sketches the principal stages of this process. The chain starts with the first substantial project idea (A), usually an official request to a development agency. There follow various consultations. If the proposals prima facie looks promising, there will be a decision to launch an investment analysis. After framing the terms of reference selecting personnel and so on, the analysis will start

their field work (B). After they have submitted their report (C), there will be further involved deliberation phases, culminating in a formal decision to go ahead with the project (D). In case of international schemes this is signified by the signing of a loan agreement. For purely domestic projects, allocation of funds represents the same step. There follow all sorts of time-consuming contracting, land acquisition and engineering design phases, leading up to first money disbursement (E) and physical construction work. At point (F) the project is completed and then produces until it expires at (G) - either through physical deterioration or through economic obsolescence, whichever causes the demise first.

Empirical Evidence.

With the kind co-operation of the US Agency for International Development and with supplementary data from another international development organization, [illegible] was able to stitch together various pieces of evidence on time taken up in this complex process. A great variety of schemes was covered: a sugar mill, airport runway construction, aluminium plant expansion, a number of highway projects, purchases of railway equipment and automotive parts, a pulp and paper mill, and many others. The results are summarized in Figure 7. It is exceedingly difficult to collect complete project histories and one is reluctant to draw inferences from the available small dossier of cases. There are more plentiful data on disbursement patterns, owing to a thorough staff study of 289 cases by an international development agency (see item (f) in Figure 7). No solid evidence at all seems to exist on productive life spans of various types of projects, from physical completion (F) to termination (G). This is a very serious gap in knowledge. All manner of project life-span assumptions are made by field analysts, ranging from perhaps five years for a frail piece of equipment up to the 67 years for a power plant in a study [illegible] seen.

Assumed life span can exercise great influence on the outcome of project investment studies and the subject should therefore definitely be investigated from the engineering and economic points of view.

Disbursement Patterns. Turning to the study of 289 project cases, it must be emphasized that money disbursements do not necessarily follow the work schedule closely. In fact, there is often a "trickle effect" at the end, for instance because small amounts are held back pending final acceptance of the work although the project is really completed. Alas, no data at all exist on actual physical project execution speeds and payment experiences are all we have to go by.

The study provides valuable insights on the factors that may contribute to project speed or delay. There are, of course, many individual variations, but some generalizations can safely be made (see Table 4). Ports, irrigation and mining projects tend to be rather slow - perhaps five years or more - largely because they are technically difficult. By contrast, certain types of industrial plant, machinery and agricultural equipment loans can obviously be handled much faster, usually in less than four years. Power and road projects are in the middle range. Again, general development and multipurpose schemes, which are composed of various subprojects, naturally take much longer than single projects which are often fully designed before a decision is made. New ventures are more difficult to execute than expansion or modernization of existing schemes. Interestingly, sizes of projects do not seem to influence execution speeds significantly. But there are differences between projects launched in developed and less developed areas, probably indicating relative "absorptive capacities" and administrative efficiencies of the countries concerned. There may be differences in time lags between internationally financed projects (the category discussed here) and purely domestic ones. Research on this

point would be interesting.

Comments and Conclusions. It is most interesting to note the very long lead times - five to eight or more years from project idea to project completion - with which one has to reckon in the development field. It will, of course, take additional years until the project fully produces and its beneficial impacts are really felt by the economy at large. Indeed, it is interesting to speculate how long it might take a somewhat backward economic system to adjust to major "development action shocks", such as electrification, big improvements in transportation, or introduction of a large new industry. And yet further years will go by until investment costs are paid off. All told, it seems to me, the facts of life point to very long time horizons in development work, probably thirty years or more.

Conclusions on time lags are: (a) The investment planning process itself - perhaps not shortage of foreign exchange, or of capital in general, or of skilled personnel - may often be the really serious bottle-neck in economic development. (b) Technology, planning and decision-making impose a rather stately, slow pace; perhaps the investment process, like nature, cannot be rushed. (c) The frequent failure of grandiose development plans to live up to expectations may partly be due to the extremely long gestation periods between idea, plan, decision, action and harvesting of results. This is a most significant aspect. It should definitely be looked at further. (d) Infrastructure construction projects are rather sluggish policy measures and therefore unsuitable for short-term anti-cyclical pump priming purposes unless they can be prepared in advance and put on a "public works shelf". (e) The time dimension is analytically most important. Lags are a fact of life and the economic planner clearly has to recognize them. [illegible] all those methodological constructs which do not incorporate the time dimension,

simply cannot be used for practical development tasks. Unfortunately, a good proportion of the economics literature seems to [illegible].

Study Lengths and Costs

It generally appears that project evaluation itself does not consume excessive amounts of time in relation to the entire project planning and execution process. Understandably, there are great variations in study length - the observed range among a sample of 23 studies is from 2 to 23 months - largely because the technical-economic scope of the field research efforts differs greatly. Detailed location studies, soil borings and design work for example, are quite time consuming. Reconnaissance reports, which emphasize economic appraisal, can be completed much faster. It is possible that some field research is [illegible] rushed relative to the deliberation and decision-making stages. Offhand, a study period of, say, five or six months to appraise a $50 or $100 million investment, appears too short.

Study costs are obviously related to the size of the object, the complexity of the problem and above all the engineering inputs that go into the research work. Purely economic studies tend to be cheap. [illegible] a small sample the author observed the following variations in study costs as a percentage of proposed total investments: (a) River basin economic survey in Africa - 0.03 percent. (b) Electric power study in Africa - 0.03 percent. (c) Port development in Asia - 2.27 percent. (d) Detailed technical report on specific road and bridge project in Latin America - 5.52 percent. From limited observations one may think of 0.5 to 2.0 percent as a typical range.

It should often be possible to first carry out a quick and reasonable economic reconnaissance study, with permissible cost-benefit estimate tolerances

of, say, + 50%. Even on the basis of such rough first evidence it will often be possible to rule out obviously unsound projects, without getting drawn into cumbersome and expensive engineering work. Only if the economic reconnaissance results give grounds for optimism about the project, should one proceed to further field study commitments. This particular technique for saving research and planning resources was successfully used by US AID, with the advice of the Brookings Institution, in the case of an East African highway proposal. At very low cost it was possible to reject the project outright.

Methodological Weaknesses of Development Studies

After reading through the various field studies, one is forced to conclude that many of them suffer from serious methodological defects. Sometimes these are quite obvious: use of disreputable analytical techniques, [illegible] benefit estimates, common arithmetic errors. In other cases the observer has to be extremely alert to discover significant mistakes which are hidden under a welter of assumptions and technical verbiage. It would take up too much space here to offer detailed critiques, but a few commonly found shortcomings should be mentioned:

(a) Many studies fail to integrate the specific project proposal with the general physical and economic discussion. In a highway report, numerous pages were devoted to geology, climate, GNP trends, land values and similar subjects. None of this information was specifically related to the proposed project. At the same time, important investments contemplated in the road project area were not covered.

(b) Quite obvious project interdependencies are often neglected. One study almost completely ignored the effects of a proposed new road on existing water, rail and air connections for the same route.

(c) With few exceptions, field studies are deficient in the treatment of the time dimension. The typical report, apart from cursory references to interest rate aspects, ignores time. By claiming benefit flows right from the start, many reports imply that project implementation - from financing and the turning of the first shovel of dirt to full operation - can be achieved instantaneously. This bias results heavily in favour of the particular project. Drastic efforts, perhaps through personnel training or issuance of manuals - will be necessary to bring about competent treatment of the time dimension.

(d) There is much confusion on decision criteria. Most popular among consultants is the benefit-cost ratio, a device of doubtful validity. The time has perhaps come

to settle once and for all the old controversies between maximization of rates of return (V/C, internal rate of return) and net benefit maximization (V-C), a superior guide in the author's opinion lies beyond the conventional results, namely the income distribution shifts as well as of other non-market value effects of public actions must somehow be reconciled and integrated with the traditional financial and economic criteria. This is a difficult subject, but also one in which field research needs guidance.

Reliability of Study Results, Biases

There are a few organized, scientific attempts to compare anticipated project performance, as claimed ex ante by the consultants, with actual ex post performance. We may think of four aspects: (a) cost estimates; (b) benefit or revenue estimates; (c) conclusions drawn by the analysts from these two series and other evidence; (d) the alleged effectiveness of means implied by the final action recommendations.

It should be fairly easy to make comparisons of estimated versus actual project costs. It is common knowledge that engineering consultants almost always underestimate construction project costs. Strangely, very little documented evidence on this point exists. In our Brookings research we came across the following discrepancies: (i) highway construction, actual cost $ 27.4 million, estimate $ 16.0 million; (ii) highway construction, $ 47.0 vs. $ 19.5 million; (iii) airport improvement , $ 2.7 vs. $ 1.5 million; (iv) highway construction, $ 8.0 vs. $ 5.3 million. And in Greece the following extreme cost over-runs were observed [25].

(a) Construction of Hotel Mount Parnis, Attika: original cost estimate about $ 9 million, final costs are said to be about $ 30 million.

(b) Irrigation scheme at Iliki, Plain of Thebes: anticipated costs $ 4 million, actual costs about $ 7 million.

(c) Nitrogen fertilizer plant at Ptolemais, Northern Greece: original cost estimate $ 39 million, final costs $ 80 million.

Some of the figures cited here are being disputed, but there is little doubt that initial project appraisals and cost estimations were weak.

At the same time it should be pointed out that in Greece, as probably everywhere else, for every troublesome project there are several satisfactory ones which do not attract so much attention. To mention but one good example in passing, [illegible] favourably impressed with the planning and execution of the new smelter of Aluminium of Greece at Saint Nicolaos, Gulf of Korinth, a so-called "turn-key" scheme carried out by a French company. This project, which with a total investment of $ 120 million (including all infrastructure works) represents the biggest single development effort in the country, is quite close to original cost estimates. Execution speed has been remarkable: studies began in 1960, contract negotiations, land acquisition and clearance, dock construction etc. followed, structural steel went up in the spring of 1964, and the entire plant will already go into operation in September or October of this year. Plant location - a sensitive matter because of the proximity of Delphi and other precious historic and natural resources - is well chosen and provisions for housing, schools, social services and recreation are exemplary. There will be regular employment for about 800 workers, of which 93% will eventually be Greeks. A good proportion of these, through the company's fine training program, will literally have been transformed from shepherds and other rural labourers into skilled mechanics. It seems to me that many good lessons can be learned from the Saint [illegible] project. Perhaps a case study should be carried out to highlight the success ingredients. Of interest is also Hanley's quantitative examination of cost revisions of Indian irrigation and other projects [12]. [illegible] investigation of the projects in their initial phases.

In some instances poor cost estimates may be due to inflationary price increases

occuring between project study and execution, but one could allow for this very easily by "constant dollar" adjustments. More insidious is the fact that project consultants often assume the rôle of deliberate project promoters, through the simple expedient of submitting artificially low cost and high benefit estimates to eliminate these practices through penalty clauses in consulting contracts.

The author has no knowledge of the quality of money revenue estimates in commercial and industrial project studies. However, some infrastructure project reports, the field with which he is familiar, come up with some quite ridiculous benefit claims. One study attribute benefits equivalent to several times the GNP of the entire country to just one highway investment! It is often alleged that particular projects can deliver growth contributions of, say, 400 percent - implied by a benefit-cost ratio of 5 to 1 - when the economy as a whole is expected to grow at only 30 or 40 percent over the planning period. These are highly suspect results.

Briefly, three errors are commonly found in benefit analysis:

1) Benefit Attribution Errors. The particular sector, for example transport, rapaciously claims the growth in the production of goods and services generated by the entire economy.

2) Double-Counting Errors. A number of sectors may indulge in double-counting of growth effects. For example, highways claim the same benefits that agriculture, industry, power, health and education are already crediting to their particular investment schemes.

3) Benefit Valuation Errors. Studies may arbitrarily convert non-market effects (leisure time, smoothness of automobile ride, etc.) into market values. At the same time they may pass off important market or non-market costs (accidents, air pollution) as insignificant or immeasurable. The highway sector is notorious for such practices. Other sectors may fall behind in this game and get less attention.

Any of these erroneous analytical operations can [illegible] enormous distortions

into investment analysis, leading inevitably to poor resource allocation decisions.

Many of the troubles plagueing contemporary benefit-cost analysis can be traced to quite basic bookkeeping errors. These could be eliminated by the use of the so-called social and economic planning accounts which have been proposed by the author and others. Practical experminentation with these analytical devices, in combination with good sectoral, regional and macroeconomic studies, would be most desirable.

Generally, practically all studies err on the optimistic side. Vicious incentive links can partly be blamed. Many supposedly neutral, outside consultants have direct monetary interests in project acceptance: if they can show the scheme to be "technically and economically feasible", then a juicy engineering design and construction contract may come their way. Likewise, government departments have a natural tendency to push their particular brand of projects for purposes of "empire building". Highway departments in the United States and elsewhere - the biggest public money spenders these days - are well-known for their passion with which they bulldoze and pave anything in sight. And it has been said about the U.S. Bureau of Reclamation that dam building is its raison d'être and its zeal to discover reasons against building a dam is conspicuous by its absence. Observers suggest that the Bureau is always prone to exaggerate the potential benefits and discount the potential dangers of any dam project anywhere.

Some institutional reforms seem to be needed, so that project advocates are not also project beneficiaries and adjudicators of the project proposal. Further, it is most desirable to provide the high-level decision makers with adequate study review capacity, of the sometimes complicated project reports, either through well-trained staff or through expert outside project evaluation "auditors". It is a sad truth that few government departments and international agencies have the time to read voluminous consulting studies, leave alone discover shoddy methodology and faked

field data. It is an illusion that entrusting a problem to outside, independent consultants automatically produces good results - quality control through expert advisors who are mentally one step ahead of the experts retained for the job is definitely needed.

In conclusion, there is a great need for improved methodology and practice in project planning. The United Nations will undoubtedly continue to make contributions in this field. Some tentative suggestions for worthwhile research activities are put forward in the Appendix. Development and investment problems of great public welfare significance will have to be solved in the years to come. It is important to put the best analytical tools in the hands of planners and project evaluators as quickly as possible.

TABLE I - DISCOUNT FACTORS

Years	Interest or Discount (r)				
	.01	.02	.04	.06	.08
1	.99010	.98039	.96154	.94340	.92593
5	.95147	.90573	.82193	.74726	.68174
10	.90498	.82035	.67556	.55839	.46303
15	.86133	.74301	.55526	.41727	.31528
20	.81967	.67297	.45639	.31180	.21459
25	.77942	.60953	.37512	.23300	.14605
30	.74239	.55207	.30833	.17411	.09434
35	.71480	.50003	.25342	.13011	.06765
40	.67159	.45289	.20829	.09722	.04605
45	.63939	.41020	.17120	.07265	.03134
50	.60827	.37153	.14071	.05429	.02133

(Source: Mathematical Tables)

T A B L E 2 - APPLICATION OF DECISION CRITERIA

Scope of Analyses	POSSIBLE SUCCESS INDICES	
	A. For Single Projects	
Project	Net Revenue Maximization Maximization of Benefit-Cost Ratio.	Simple Goal Achievement Cost Minimization, Requirement Approach. Output or Benefit Maximization Maximization of Net Social and Economic Benefits.
	B. For Project Bundles or Systems	
Project Bundles, Sectoral Programs, Systems, Networks	Net Revenue Maximization for Project Bundle. Examine all Project Combinations. Test Interdependencies.	Maximization of Net Social and Economic Benefits for Project Bundle. Examine all Project Combinations. Test Interdependencies.
	C. For the Economy as a Whole.	
Economy, National Plan	Maximization of Net Money Income Growth. Test Combinations and Interdependencies. Comparisons of Potential NNP's or NRP's.	Maximization of Net Social and Economic Benefits, Subject to Achievement of Society's Multi-Dimensional Goals. Comparisons of Potential "States", As Described by Social and Economic Planning Accounts.
Comprehensiveness of Research and Measurement Operations.	Market Value Subsystem	Comprehensive Set of Social and Economic Values.

TABLE 3 - TABULATED PROJECT LIFE HISTORY AND DISCOUNTING TO PRESENT VALUES

(1) End of Year	(2) Analytical Time	(3) Revenues or Outputs (V) $ mill.	(4) Costs or Inputs (C) $ mill.	(5) =(3) - (4) Net Revenues /Net Costs/ (V-C) $ mill.	(6) Discount Factors a/ at r=0.03	(7) =(5) x (6) Present Values of Net Revenues/Costs/ $ mill.	(8) Discount Factors a/ at r=0.08	(9) =(5) x (8) Present Values of Net Revenues/Costs/ $ mill.
1965	t_0	0	0	0	1.0000	0	1.0000	0
1966	t_1	0	5.00	/5.00/	0.9709	/4.8545/	0.9259	/4.6295/
1967	t_2	0	5.00	/5.00/	0.9426	/4.7130/	0.8573	/4.2865/
1968	t_3	2.00	1.00	1.00	0.9151	0.9151	0.7938	0.7938
1969	t_4	3.00	1.00	2.00	0.8885	1.7770	0.7350	1.4700
1970	t_5	5.00	1.00	4.00	0.8626	3.4504	0.6806	2.7424
1971	t_6	5.00	1.00	4.00	0.8375	3.3500	0.6302	2.5208
1972	t_7	4.00	2.00	2.00	0.8131	1.6262	0.5835	1.1670

a/ Calculated from formula $DF = \frac{I}{(I+r)^t}$, or taken from standard mathematical tables.

Total Present Values for Project Life			
Interest Rate (r)	0	0.03	0.08
Net Revenue /Loss/	$ 3.0 mill.	$ 1.551 mill.	/$ 0.222 mill./
Policy Advice	Accept	Accept	Reject

TABLE 4 - POSSIBLE FACTORS UNDERLYING PROJECT EXECUTION SPEEDS

(Source: Staff Study of an international development agency)

DISBURSEMENT SPEED	SLOW	MEDIUM	FAST
Project Types	Multipurpose Mining Development Banks Ports Irrigation	Power, Roads	Equipment in General Industry Railways Agricultural Machinery
Number of Loans Surveyed	57	135	97
Average Three-Year Disbursement Rate (Percent of Loan Value Paid Out After Three Years)	29-49%	about 60%	80-99%
Possible Explanatory Factors for Slow Disbursement Speed	a) Technical complexity; lack of pre-engineering. b) Many sub-projects; project interpendencies; sequencing requirements; program loans in general. c) Complicated financing arrangements; several lenders. d) Shortages of local currency. e) Limited "absorptive capacity" in less developed country; administrative weaknesses; "red tape". f) New projects; first loans granted to developing countries; general lack of experience.		

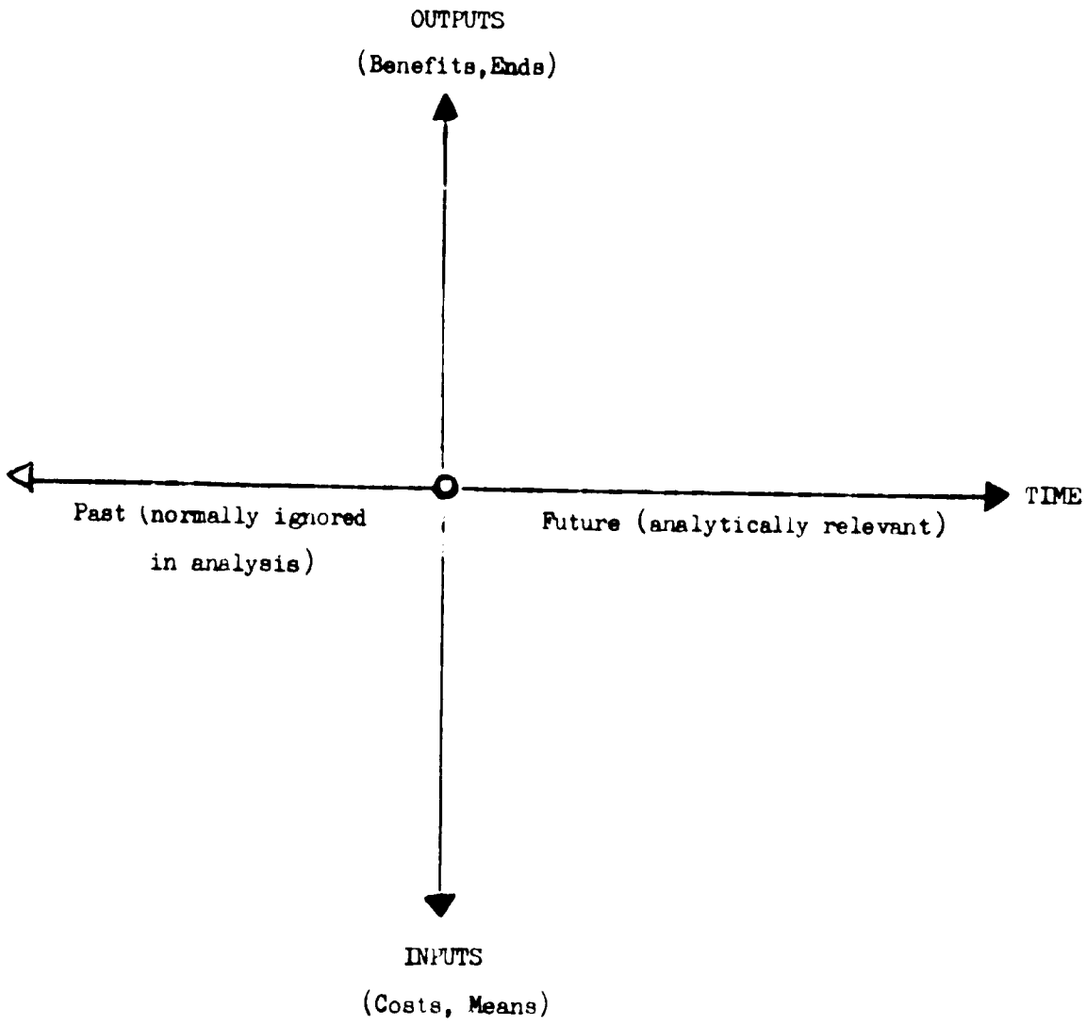
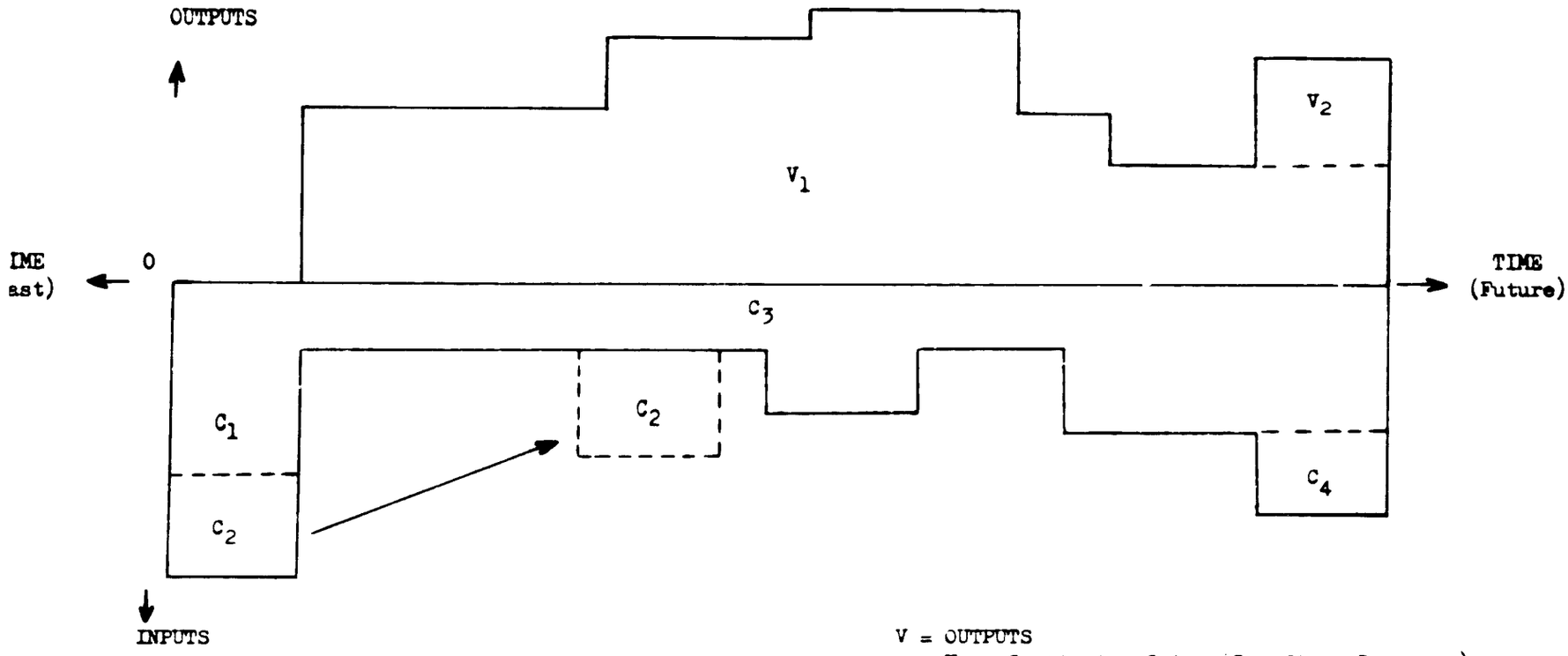


FIGURE I - BASIC PORTRAYAL SCHEME FOR PROJECT ANALYSIS



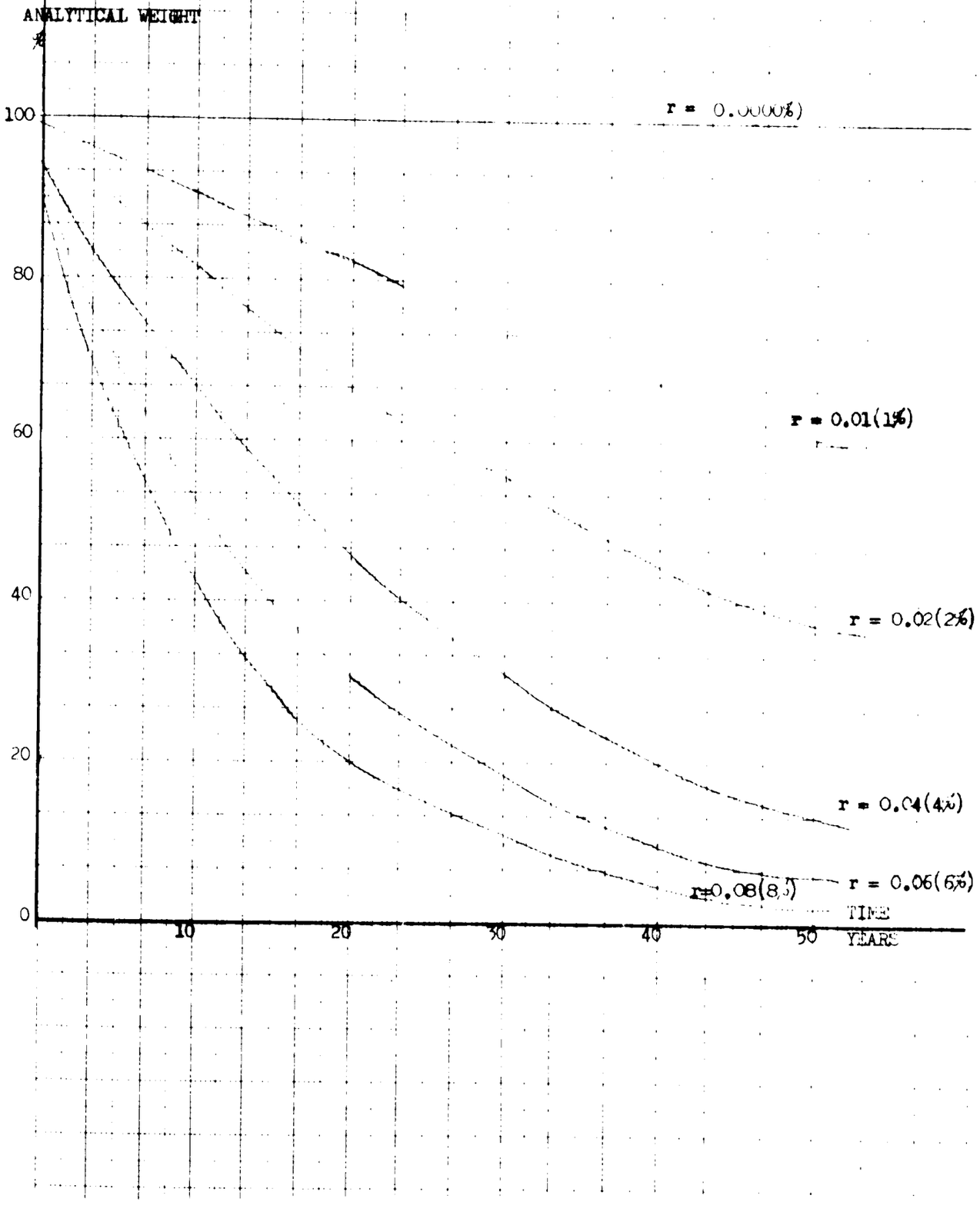
V = OUTPUTS
- V_1 = Continuing Gains (Benefits, Revenues)
- V_2 = Terminal (Salvage) Gains

C = INPUTS
- C_1 = Initial (Capital) Costs
- C_2 = Postponable Costs (in stage construction)
- C_3 = Continuing (Maintenance, Operating) Costs
- C_4 = Terminal (Scrappage) Costs

FIGURE 2 - CONTINUOUS INPUT AND CONTINUOUS OUTPUT PROBLEMS

FIGURE 3

ANALYTICAL WEIGHT OF FUTURE INPUTS AND OUTPUTS AT VARIOUS POINTS OF TIME AND USING DIFFERENT INTEREST RATES



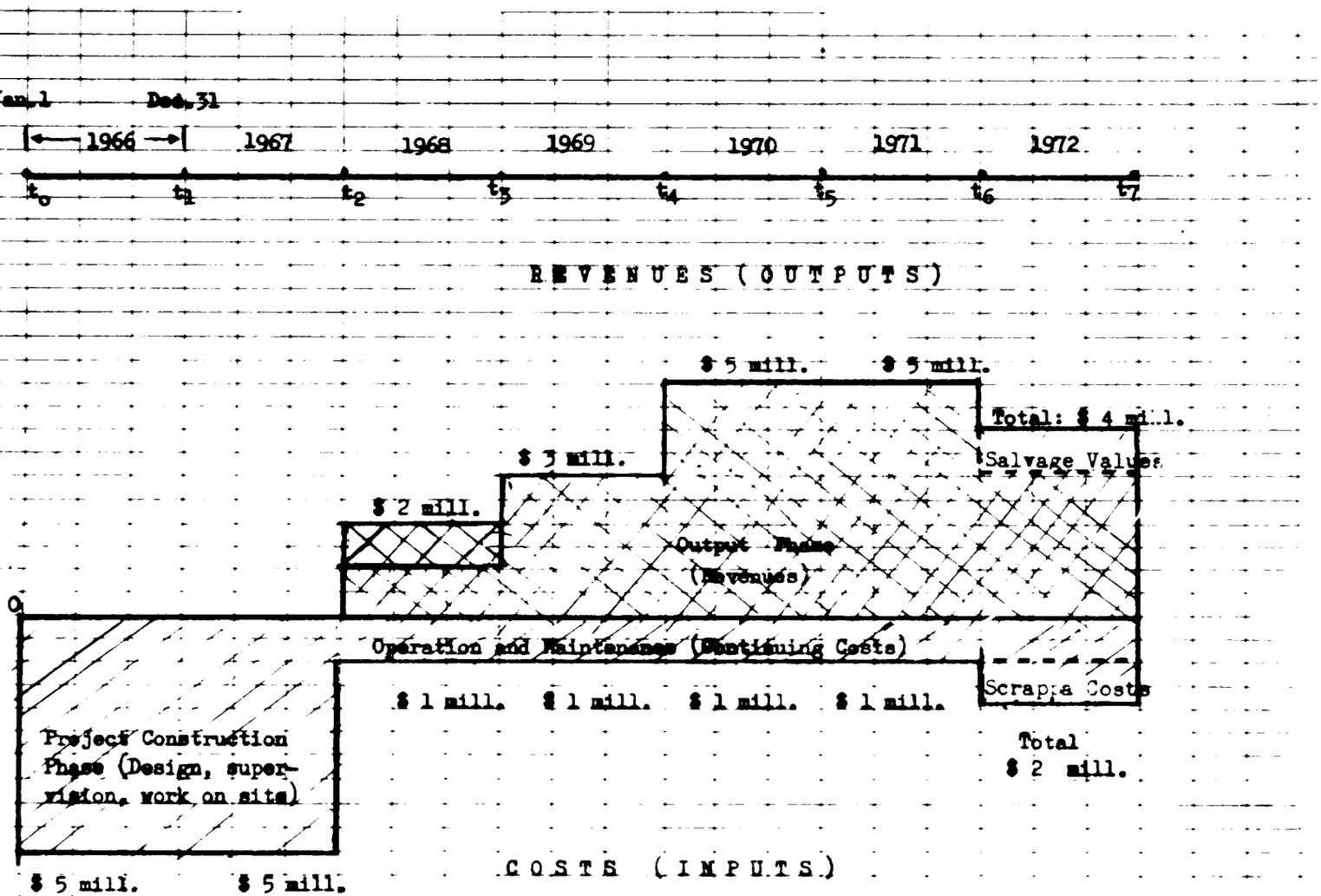


FIGURE 4 - TIME GRAPH REPRESENTATION OF PROJECT EXAMPLE

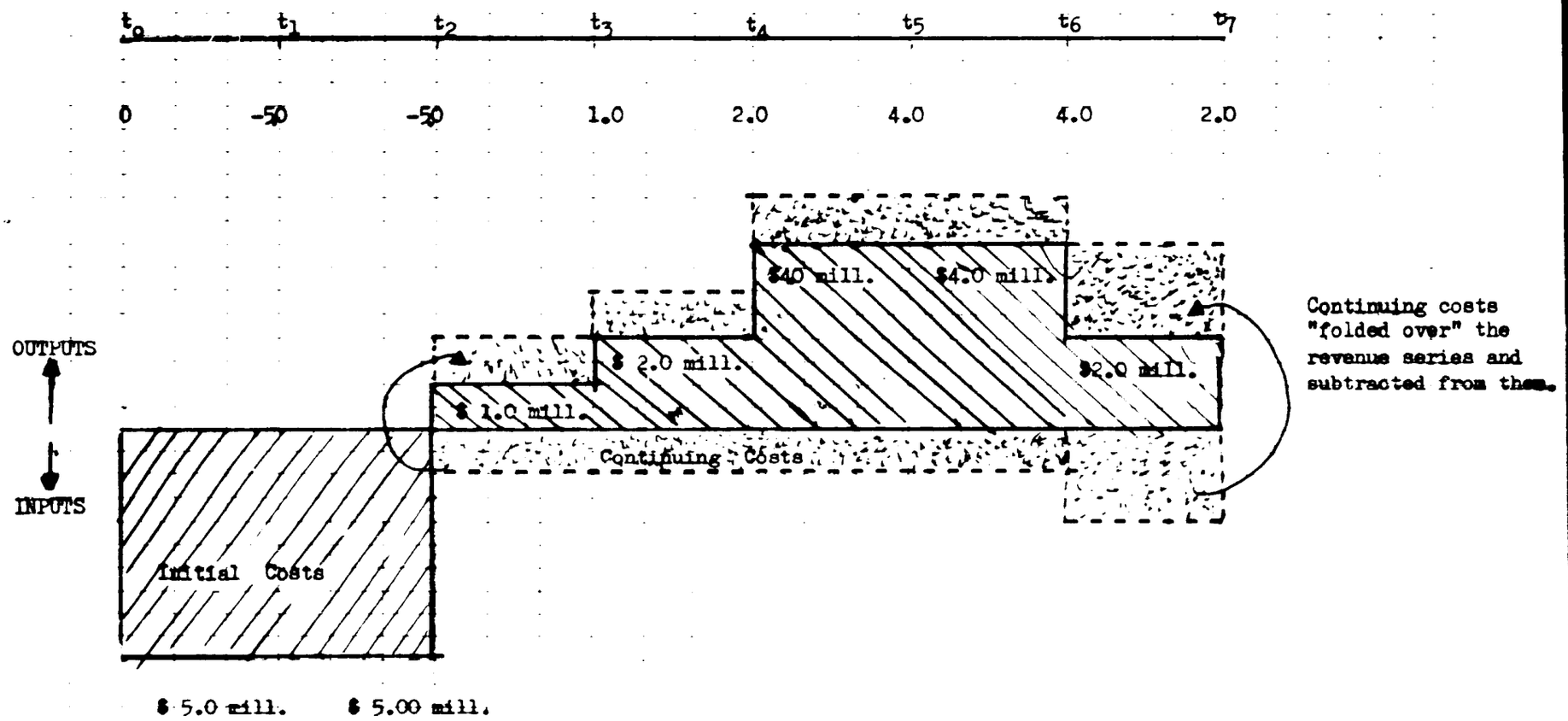


FIGURE 5 - RECORDING OF NET VALUES FOR DISCOUNTING

(Note: This is only possible when both the inputs and the outputs can entirely be measured on the same market-value scale).

Assumption: r = 0.03 (3%)	PRESENT VALUES t_o Standpoint	Y E A R S							TERMINAL VALUES t_7 Standpoint
		t_1	t_2	t_3	t_4	t_5	t_6	t_7	
OUTPUTS	16.248	0	0	2.00	3.00	5.00	5.00	4.00	19.984
INPUTS	14.697	5.00	5.00	1.00	1.00	1.00	1.00	2.00	18.076
NET OUTPUTS [NET INPUTS]	1.551	[5.00]	[5.00]	1.00	2.00	4.00	4.00	2.00	1.908

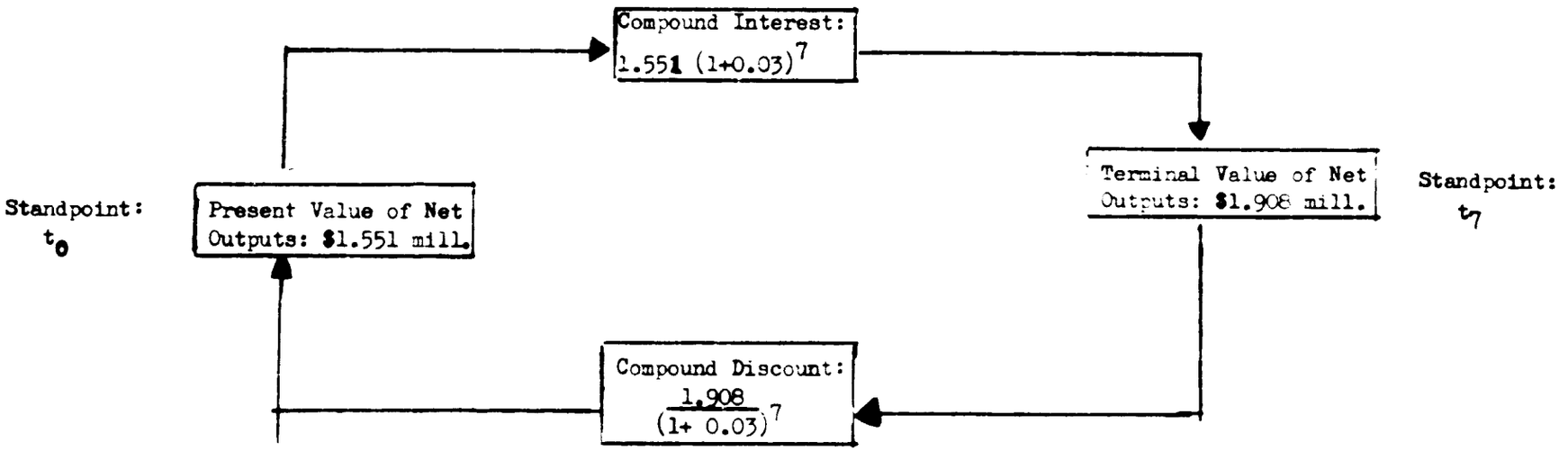
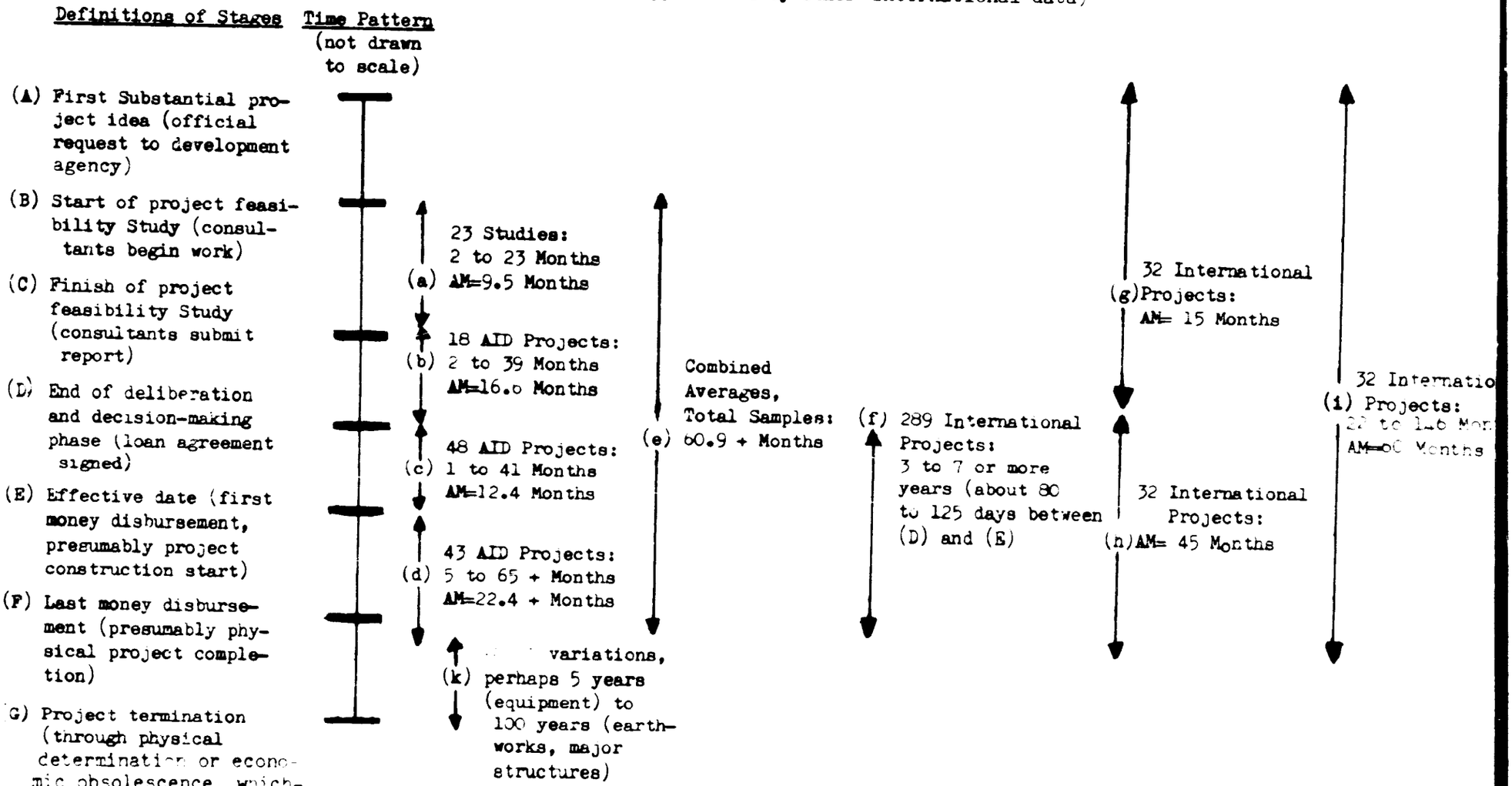


FIGURE 6 - COMPOUND DISCOUNT (PRESENT VALUE) AND COMPOUND INTEREST (TERMINAL VALUE) CALCULATIONS (Assumptions: (a) Outputs and Inputs occur at end of years indicated; (b) interest rate, r = 0.03).

FIGURE 7 - TIME CONSUMED IN DIFFERENT PROJECT PLANNING AND EXECUTION PHASES
(Source: Special US AID - Brookings Institution Research [illegible]

FIGURE 7 - TIME CONSUMED IN DIFFERENT PROJECT PLANNING AND EXECUTION PHASES
(Source: Special US AID - Brookings Institution Research, 1964, supplemented by other International data)



APPENDIX

RESEARCH PROPOSALS AND DISCUSSION POINTS

Proposal for Creation of a Development Documentation Center

At the present time it is often very difficult, if not impossible, to gain access to the numerous consulting reports, project studies and planning documents which are the main intellectual backup for development decisions of governments and international agencies. Much precious time and effort is wasted through futile information search in the field. An international documentation center specializing in the collection, library analysis and distribution of applied field material (as distinct from standard publications), would greatly assist development knowledge and progress.

The documentation center might be sponsored and operated by the United Nations, New York, but speedy establishment of branches at the three U.N. Economic Commissions would probably be very desirable. The most modern library techniques for classification and information retrieval should be employed, so that enquiries relating to different countries or regions (e.g. West Africa, or Chile), types of projects and programs (irrigation, steel plants, electrification), particular subjects (market analysis, economic integration, cost estimation, financing), and combinations of these, can be quickly satisfied. There should be facilities for reproduction of reports, perhaps by Xerox or microfilm methods, but fees might be charged for these special services.

As a rule, national government and/or international agencies have the proprietary rights over documents of this type and the problem of access to the material therefore needs to be handled very carefully. Different classifications might be established, for example: (a) document to be released by special permission of the national government or international agency only; (b) classified until such-and-such

date, then free access; (c) library consultation of document only, no reproduction; (d) free access for specified types of personnel (UN and international agency employees, bona fide scholars, etc.), others by special permission only.

Proposal for Creation of a Project Evaluation Manual

Creation of an authoritative manual, embodying best contemporary methodology, would be a great step forward. Considering the relatively poor state of field work, the proposal should be given a high priority. The new manual might usefully build upon the U.N. Manual on Economic Development Projects, and similar existing documents. It should be simple, definite and yet comprehensive. It should provide guidance to users of project studies (for example, by showing how first to instruct consultants and then how to evaluate their work), as well as to the analysts themselves. Starting off from the common basis of the nature of the development process, typical objectives of decision makers, the reference framework for studies and so on, the manual might then branch out and encompass such diverse problems as [illegible] profit-making industrial schemes, mixed private-public ventures, infrastructure projects and social services. Guidance may have to be sought during the preparation of the manual from competent experts on a number of controversial issues and doubtful aspects. Some of these are outlined below in the form of discussion points.

The Project Planning and Execution Process

What is the mechanism by which fruitful project ideas are typically generated? Broad economic survey missions? Specialized reconnaissance studies? Follow-up on earlier feasibility reports? Suggestions in national planning documents? Proposals by ministries, public agencies?

Can the choice and use of outside consultants be improved? Is higher-level help

needed to properly define development objectives and the true problems to be solved, so that a meaningful study can be commissioned? Is really best use being made by developing countries of expensive project studies? Is it true that the majority of reports is "gathering dust" in some government office? What percentage of project proposals really scores and is carried out? What are the reasons for the possible lack of implementation? Poor analyses? Unrealistic recommendations? Lack of action means of one sort or another? Administrative deficiencies? Are the study review, decision-making and implementation capacities of developing nations generally inadequate? If yes, what can be done about this? How can project evaluation and financing, annual budgeting, national long-range planning and related procedures be mutually reconciled? Should outside consultants working in a developing country also fulfill training and implementation functions?

How can the reliability of study results be improved? Would "audits" of doubtful reports by recognized international experts be useful? How can the chronic problem of low cost estimates and/or exaggerated benefit and revenue claims be overcome? Should there be ex post performance penalty clauses in the consulting contracts? Generally, is it possible to remove existing heavy biases of consultants and clients in favour of project acceptance? Are there generally biases in favor of: (a) "safe" infrastructure projects? (b) investment as distinct from administrative reforms, training, maintenance etc.? (c)big show-off projects? If yes, what are the remedies?

Can the project planning and execution process be speeded up? Do the various deliberation phases, budget allocation, signing of loan agreement etc. take too long? Could some of these stages be telescoped? Would further systematic research on time lags, disbursement patterns, physical construction progress, be useful? What are typical productive lives of various projects?

Methodological Aspects

Can agreement be achieved on appropriate decision criteria under various circumstances? Can the old debate on maximization of rates of return (profit rate, benefit-cost ratio, internal rate of return) versus maximization of net revenues (benefits, gains) be resolved once and for all? What do we know about typical development objectives around the world, both explicit and implicit ones? Income distribution aims? City vs. country? Agriculture vs. industry? Public vs. private sector growth? Consumption vs. investment? More private income vs. better social services? Are such diverse development objectives successfully accommodated in economic theory and contemporary planning procedures? What do we know about trade-offs? About social and economic achievement surfaces? How can social and financial project analyses and criteria be integrated?

What do we mean by "benefits"? Is it possible to devise strict benefit accounting and measurement rules? Would the value-added national income accounting framework be suitable in case of purely monetary benefits? How to handle other value [illegible], such as health, welfare, education, [illegible], untraded goods and services in general? Are social and economic planning accounts suitable [illegible] for broad development appraisal purposes? Which of the large number of existing cost concepts (marginal, fixed, opportunity, variable, spillover, intangible, off-site, social, incremental etc.) are of practical use in development work? Can [illegible] cost estimation standards be developed? Should individual project analysts be responsible for shadow pricing and other adjustments, within their own little sphere, or should such value purifications be handled at the macroeconomic level? Should routine taxes be purged by means of shadow pricing? How do government functions fit into the idealized general equilibrium model?

Does this model have any practical significance in development work?

Is it possible to reach agreement on the analytical treatment of the time dimension, so-called "externalities", project interdependencies, indivisibilities, location and transport aspects, as well as other departures from the old competitive schema? Can some rules be developed for the analytically crucial choices of project life and rate of time preference (or discount rate)?

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