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OPERATIONS RESEARCH IN NATIONAL
PLANNING

by

Dr. Mohamed I. Dessouky

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3. MOHAMED MAZHAR - ZAMALEK

Mohamed I. Dessouky
National Institute of Management Development
Cairo, U.A.R.

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cepts and techniques to problems of national planning, and evaluating and the difficulties encountered in the use of these techniques. The paper is not to be a comprehensive survey of the subject, a task which would cover a vast field. It is rather an investigation, through a number of practical examples, of the possibilities and limitations of such applications, drawing mainly on experiences in the field.

The paper is addressed to operations researchers who are interested in the applications of their field of knowledge to national planning, as well as to policy makers who are eager to familiarize themselves with modern approaches with a view to sharpen their decision-making processes. For the interest of the former group, mathematical definitions and partial mathematical formulations of some of the problems have been included as illustrations. The latter group may skip those without loss of the main theme of the paper.

2. National Planning:

Since the end of the last World War, revolutions have swept many areas, particularly those which have been traditionally known as underdeveloped countries.

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The author is Professor and Acting-Chairman, National Institute of Management Development, Cairo, U.A.R.

Planning for economic development by central governments was not an equal measure of central government control, or by public ownership enterprises.

Central planning has been undertaken by free-enterprise countries and communist countries. Questions such as which investment projects for the next five years, and what should the capital intensity be for are equally important to the governments of countries with varied political systems. This is particularly true when those countries are faced with the problem of development under limited resources, a problem which has gained particular importance because of the high rates of population growth and the "revolution of rising

The point of departure for such countries is mainly their means of production. A socialistic government would tend to invest its funds directly as recommended by the national plan, while a capitalistic government would take measures to encourage private business to channel its investments in the same direction.

A national plan is not exclusively the creation of a central government, but rather the outcome of a long chain of decisions at different levels. What distinguishes a national plan from any other type of plan is the number of stages it has to go through before it is finalized. The degree of participation in the decisions differs between one country and another and in the same country at one time and another. However, the function of the central planning agency is to coordinate the various decisions and to ensure that they are consistent with the national plan.

...be extremely difficult and/or delayed in the absence of a
total supply and total demand, at the national level, of such resources
these bottlenecks are foreseen, national planning techniques may also
them by suggesting the appropriate action to be taken in advance. As a
curacy of predictions of future demands on such critical resources as p
be greatly improved by accounting for the direct and indirect demands o
by the planned projects. Consequently, power plants or cement factories c
necessary, in anticipation of the rising demand on their products.

The coordination of investment plans is another important function of
g. The development of most large industries hinges upon the existence of
of supply the raw materials or use the end products; therefore, the pro
development in a country with a modest industrial base is generally associa
establishment of a number of industries which are introduced according to a
planning of such varied industries and their approval generally falls un
of different government ministries, without any of them knowing what th
Unless some central planning agency undertakes the task of coordinating
the final group of investments are likely to be an unbalanced mixture.
tional plans can be classified according to scope into comprehensive and
the two there are intersectoral plans. A comprehensive plan takes into
erent aspects of economic activities, including the economic implicatio

activities included under a sector plan with the level at which a sectoral plan is made. The economic and techniques of planning can be applied does not have to be a nation, planning of regions within the nation have been successfully demonstrated in many countries.

3. Mathematical Models in National Planning:

Although the activity of applying mathematical models in economics is described as mathematical economics or econometrics, many applications are made by economists, which often tackled problems outside the domain of the United Arab Republic. A case in point is the use of mathematical models in the United Arab Republic. It was mainly due to the first Operation of which the author was a founding member, that such an activity was established at the Institute of National Planning in 1959⁺. A series of studies performed by this group will constitute a major part of the work of the Institute.

The mathematical models used in national planning are either predictive or normative. Predictive models help in determining the future behavior of a system as a result of certain specified decisions. Consequently, the feasibility of a plan can be tested, and the decision-maker may be shown the consequences of a plan so that he can choose the most appropriate. Simulation is a success in connection with such models. Normative models, on the other hand, are used to determine the best possible plan.

⁺ Credit for establishing this group must be given to Dr. Ibrahim al-Jundi, the Executive Director, United Nations Industrial Development Organization.

the number of sectors into which the economy is divided, and the large number of activities grouped under each sector. Some of the factors influencing the uses of the model, the data available, the capacity of the system and the complexity of the mathematical model used. Examples of models and degrees of aggregation are cited in this paper.

4. The Scope of the Paper:

This paper is intended to present examples which are representative of the areas of national planning. In the area of national comprehensive planning, aggregate models are first discussed, and are then followed by a description of a complex study conducted in Venezuela. A brief presentation of input-output models is given, and its use for studying intersectoral relationships, especially in the area of investment planning, is emphasized. An illustration of the use of input-output models in depicting intersectoral relationships is given in the Cairo Charter on optimum investment planning model.

The paper goes on to discuss sectoral planning models, and three illustrations from the U.A.R. are quoted.

This is followed by a quick review of regional planning, and two examples of the important question of tying sectoral, and/or regional, plans with central plans are discussed in the light of three approaches: two-level planning, two-dimensional planning, and multi-level planning. The applicability of these approaches to the U.A.R. is discussed. In addition to the evaluation of each study presented in the paper, a general discussion of the applications of operations research methodology to national planning is given.

planning.

...year plan, the Harrod-Domar model was used with no distinction among sectors⁽⁹⁾. The Harrod-Domar model in its basic form; the rate of growth of income depends on the proportion of income saved and the rate of growth of capital depends on the savings ratio. The model has been mostly used to determine capital requirements and to make comparisons with the available supply of capital could be made accordingly.

Studies based on the Harrod-Domar model were capital-centered and of a similar nature. In the Algerian ten-year plan the economy was divided into nine sectors and in the Egyptian five-year plan frame four main sectors were used. Using a labor-capital or a capital-output ratio, the increase in employment resulting from the investment program could be estimated.

Employment-centered models are generally constructed when full or a high level of employment is the objective of the national plan. Full employment was the objective of the Egyptian five-year plan. Based on the projected labor force and an assumed level of productivity, the level of the national product at the end of the period and during the intervening years was determined for gross investment, domestic consumption, exports and investments. Then, on the basis of determining input requirements and the balance of payment. Employment was then projected on the basis of the production levels obtained, and the results were compared with the aggregate labor supply.⁽⁴⁾

An aggregate model was constructed in a study made by the United Nations in Latin America, which was centered around foreign exchange, considering that

other factors into account.

and soundness of national planning models, two improvements will have to

1. The model should allow the consideration of several constraints simultaneously.

2. The economic activities should be broken down into a larger number

Two examples for attempts in these directions are shown below: the

Economy of Venezuela and the Cairo Channel Model.

2. Simulation of the Economy of Venezuela:

El Centro de Estudios del Desarrollo (CEN DES, an affiliate of the Venezuela) and the Simulmatics Corporation in New York started in 1963 ing Venezuelan economic data and formulating a dynamic model of that n be simulated by a digital computer⁽²⁴⁾.

The model was to be developed on two stages; in the first stage a "model" and several submodels in more specific terms, representing different were to be formulated. These models were to be tested and adjusted separately used for studying certain limited policy questions for which it was appropriate.

In the second stage of the project, the submodels of individual activities with the global model, and relationships pertaining to finance and to different groups in the population were to be added to complete the final model.