Tools for Manpower Planning

The World Bank Models

Volume II

User's Guide for the Country (Compound) Model

Ismail Serageldin
Bob Li

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When this paper was first published Ismail Serageldin was chief of the Urban Projects Division and Bob Li was senior operations officer and leader of the Organization and Management Unit, Technical Assistance and Special Studies Division, both in the Europe, Middle East, and North Africa Regional Office of the World Bank.

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Foreword

The explosion of international migration in the Middle East and North Africa Region in the 1970s was a major development on the international economic scene with profound implications for both the labor-importing and the labor-exporting countries. The World Bank undertook a research study on the subject in 1978 under the leadership of Ismail Serageldin and his group of committed colleagues in the Technical Assistance and Special Studies Division of the EMENA Projects Department. The study was completed in 1981 and the Report has been widely disseminated. It has been published in book form this year. 1/

The set of simulation models developed by the Technical Assistance and Special Studies Division and elaborated during the research project has been applied to study manpower problems and planning issues in several countries and proven to be a useful tool for manpower planning. The wide availability and a full description of these models is important and to be welcomed.

Vinod Dubey

Chief Economist

Europe, Middle East and North Africa Region

May 1983

1/ Ismail Serageldin, James A. Socknat, Stace Birks, Bob Li, and Clive Sinclair, Manpower and International Labor Migration in the Middle East and North Africa (Oxford University Press for the World Bank, 1983).

Preface

This document, published in four volumes as part of the World Bank's staff working papers, is intended to set forth the mathematical formulation of the Bank's various Manpower Planning Models, most of which have now been used in a number of countries and studies, but whose technical documentation was not hitherto available to the public.

Applied Models are living entities, constantly changing and (we hope) improving to meet the new requirements introduced by their users. The present publication must therefore be seen as a snapshot in time, but one which presents the interested user with the opportunity of reviewing the technical documentation as well as the user's guides as they stand at the beginning of 1983. They are not likely to change significantly until a new round of intensive applications produces a new generation.

The technical presentation provides, for completeness, a detailed discussion (pp. 98-132) of a simultaneous procedure method for the migration model. This has not been implemented to date, partly because time and resources constraints prevented its complete development and elaboration, but it nevertheless sketches out the likely direction of our next round of research and development efforts, planned for 1983/84.

It is important to emphasize, however, that while we were the main protagonists in the development of these models, the work would not have been possible without the support, guidance and incisive comments of many colleagues in and outside the Bank. To all of them we owe a great debt of intellectual and moral gratitude. We emphasize, however, that any errors or shortcomings in the present manuscript are purely our own.

Among those in the Bank who provided constant support and encouragement during the six year life of these manpower planning efforts, of which this document is just a small part, we must thank in particular Mr. Vinod Dubey, Chief Economist of the EMENA region, whose constant personal and technical support from the earliest days to the present have made this task possible. The long-term study efforts have also benefitted from the strong support of Messrs. R. Chaufournier, Vice-President of EMENA; and M.P. Benjenk, currently Vice-President, External Relations and formerly Vice-President of EMENA; and Messrs. A. David Knox, currently Vice-President for West Africa (formerly Projects Director, EMENA); A. Karaosmanoglu, currently Vice-President for East Asia and Pacific (formerly Director of Programs, EMENA), and M.P. Bart, Director of Programs, EMENA; and A.S. El Darwish, Director of Projects, West Africa (formerly Assistant Director of Projects, EMENA); and especially Messrs. R. Picciotto, Director of Projects, EMENA; and J.J. Stewart, Assistant Director of Projects, EMENA. A special mention is also needed of the support given by Mr. D. Avramovic when he was Director of the Bank's Development Economics Department, and Mr. S. Acharya when he was Research Advisor.

Many colleagues from the Bank have contributed valuable comments and insights to the general studies of which these Models were the central part, among these we must name S. Birks, C. Blitzer, F. Colaco, Z. Ecevit, I. Hume, J.P. Jallade, T. King, G. Pennisi, R. Prosser, N. Sherbiny, C. Sinclair, J. Socknat, and M. Wilson. The computer related work was ably done by Peter and Tom Wolfe (Consultants). Earlier versions were programmed by A. McClinton of the Phoenix Corporation. Applications on various countries were undertaken with the support of G. Cima, B. Krishna, B. Smith, M. Pemmarazu, M. Youssef, and M. Allak.

Among the colleagues from the academic world, special thanks are due to the contributions of Professors I. Sirageldin (Johns Hopkins University), C.S. Kelly (Ohio State University), R. Davis and W. Alonso (both of Harvard University), and the late Arthur Smithies (Harvard University).

Finally, Professor John Kantner (Johns Hopkins University) and Mr. Mervin E. Muller (Senior Advisor to the Vice-President and Controller) reviewed this manuscript, and Mr. R. Wolfe (Consultant) provided editorial support. To each and everyone our thanks and appreciation.

Ismail Serageldin and Bob C. Li

The World Bank
Washington, D.C.
May 1983

Note

The purpose of this User's Guide for the Country (Compound) Model is to describe the input, output, use, and operation of the Compound Model, a manpower forecasting model, implemented for IBM 370 systems.

Staff of the Technical Assistance and Special Studies (TASS) Division of the World Bank are available, under appropriate arrangements, to discuss with potential users the collection and preparation of required input data for running the Model. In some cases, the TASS Division can also conduct short orientation and training sessions on the capabilities and operation of the Model.

Those users who wish to know about the internal and external system specifications of the Compound Model, should refer to the following documents, available on request from the TASS Division:

- An Integrated Computer Based Manpower Planning Model: Subroute Descriptions and Flow Charts;
- The Compound Model: General Approach and Internal Specifications;
- The Compound Model: External Specifications: Input/Output;
- The Compound Model: The Allocation of Manpower Supply; and
- The Compound Model: A Linear Programming Approach to Expatriate Manpower Allocation.

TABLE OF CONTENTS

INTRODUCTION

The Compound Model provides an analytical tool to facilitate the initiation, updating and evaluation of manpower forecasts. The model adopts the approach of portraying a country as a whole, where manpower inventories, demand, and supplies, including importation of expatriates, are simulated over time. The model is deterministic, that is, all future events of the dynamic interactions are simulated according to specified procedures without involving random elements.

The model is designed to contain and handle essential details representative of the country's manpower inventories, demand, and supplies conditions. It is not overwhelmed by attempting to simulate all the details of every event. The model's utility, in fact, resides as much in its rejection of inessential details as in its retention of essentials.

To start a manpower forecasting exercise, it is necessary to begin with the collection of relevant data which may or may not be readily available. If data are not available, subjective judgement must be exercised to provide estimates. This is not an easy task. It may just be one of the most difficult steps in the whole exercise.

The forecasting of manpower requirements and supplies is only one aspect of the Compound Model applications. Another aspect is the evaluation of various manpower oriented strategies. The evaluation of the impact of these strategies on manpower and economic development would assist decision makers in selecting the most suitable policies. The Compound Model can aid in the evaluation and selection process by providing analyses of the possible consequences of these strategies. Without a comprehensive manpower model, the evaluation and comparison of various manpower strategies would almost be impossible.

Model building involves many different disciplines. How effectively one uses the model depends very much on the user's experience. It is highly recommended that a team with experience in the field of economic, manpower, education, and system analysis be assigned to collect data, run the Compound Model, analyze the results of the simulation run, and prepare reports and recommendations to be submitted to decision makers for action.

SECTION I

OVERVIEW OF THE MODEL DESIGN

The Compound Model contains several interrelated submodels. The figure on next page presents an overview of the relationships among the submodels and of some of the variables contained therein. The submodels are:

(1) Labor Force Model

(2) Manpower Requirement Model

(3) Education Simulation Model

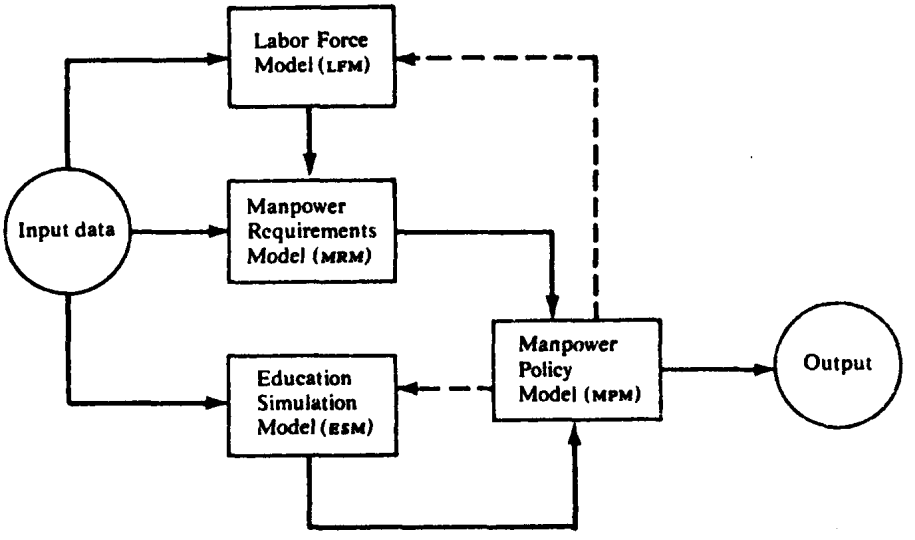
(4) Manpower Policy Model.

The Labor Force Model calculates the available labor force at the beginning of each simulation year by sectoral/occupational categories, including expatriates residing in the country. The stock of manpower available is then updated to reflect labor force attrition, the supply from the educational system and the net importation of expatriates.

The Manpower Requirements Model accounts for:

(a) the total manpower requirements to achieve a given target output by sector and occupational categories, taking into account, if necessary, productivities in each sector; and

Simplified Schema of the Manpower Model



(b) the net manpower requirements by sector and occupational categories after comparing the total manpower requirements against the available manpower stock.

It is to be noted that for selected sectors (e.g. Petroleum and Government) the user may wish to use the option of entering manpower requirements directly because better data are often available from officials in such key sectors than what would be generated by use of projection techniques. Also, teacher requirements may be estimated by

the Education Simulation Model, taking into account enrollment figures and teacher-student ratios, among other variables. This technique of estimating teacher requirements is an optional feature of the model.

The Education Simulation Model (ESM), originally developed by UNESCO, estimates school leavers by age and level. However, not all of the school leavers participate in the labor force; some are below the legal minimum age to enter the labor force; others do not participate because of social, cultural and other reasons. These facts are taken into account by introducing a time dependent filter matrix.

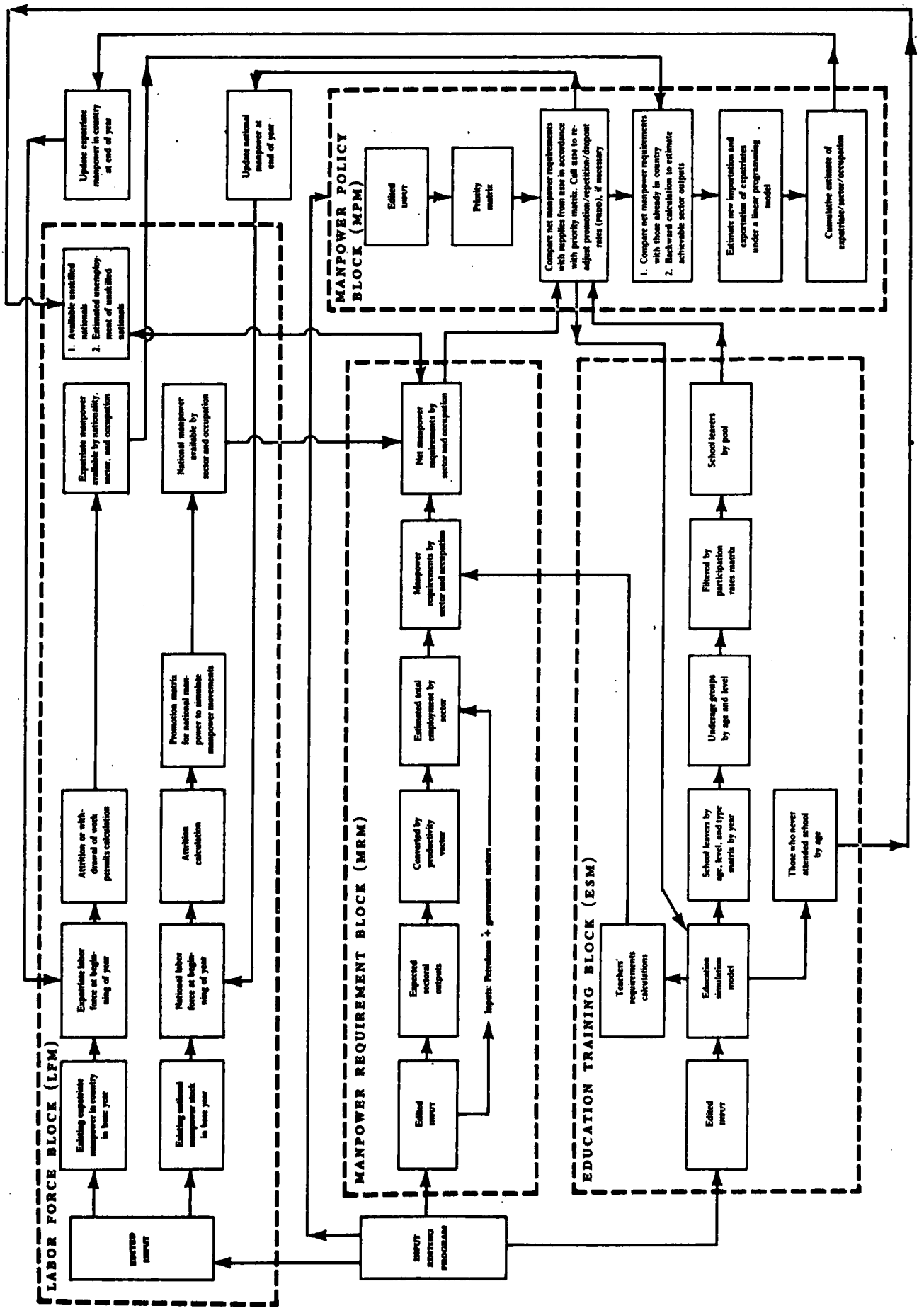
The school leavers who enter the labor force are pooled into groupings with similar educational level attainments.

The Manpower Policy Model compared the net manpower requirements against manpower supplies from the educational system, and attempts to allocate manpower in accordance with a priority matrix where the priority and proportion of nationalization in each sector/occupation are specified by policy makers.

After this has been done, labor policies on importation or exportation of expatriates are taken into account by exercizing a linear programming feasibility model (as contrasted to an optimization model) which operates on policy constraints.

Finally, a by-product of the system is worth mentioning. The system calculates the existing labor force including national and expatriate labor already residing in the country, and, at the same time, also calculates the manpower supply from the ESM. From this set of data, the system estimates the achievable sectoral output based on the existing labor in the country without importing additional foreign labor.

The Compound Model



SECTION 2

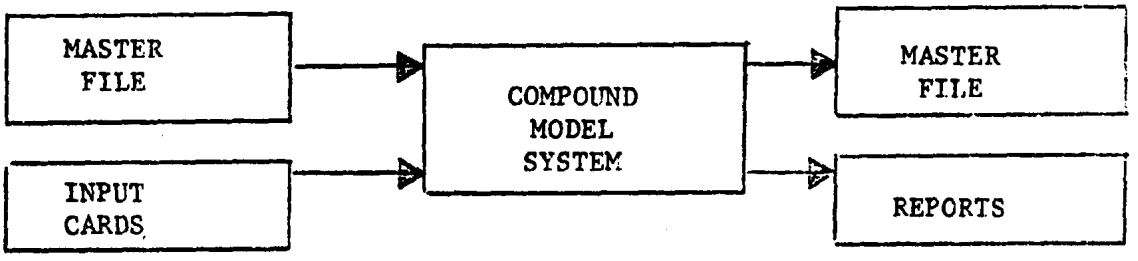
SUMMARY DESCRIPTION OF OPERATION

Purpose

The purpose of this section is to provide a summary description of how to use the Compound Model residing on the George Washington University Computer (IBM 370/148)[1/]. The user of the Compound Model should be thoroughly familiar with the content of this Operational Manual before attempting to run the model.

Overview of the Compound Model System

From a user's point of view, the Compound Model system looks as depicted in the figure below:



On the input side (left side of the picture), the Model receives input cards and a masterfile containing information which is used by the Model to calculate projection data. On the output side, the Model presents the calculated data on reports and, optionally, produces an updated version of the master file. The computer execution of the Compound Model system is conducted serially in six steps:

EDIT
PASS5
LKEDT
MODEL
REPORT
SUMRY

1/ The only difference in the operation of the Compound Model residing on other computer installations is in the format of the IBM Job Control Card (see paragraph "IBM System Control Input" in this section).

The EDIT step reads data from input cards and master file and checks for their validity. Any data errors are displayed on the Error Messages Report (See Section 4). Major errors cause the computer run to be terminated. If this happens, the user must correct the errors in the input data and re-submit the run to the computer center.

The PASS5 step prints all input data (from cards and from master file) on the Input Data Report.

The LKEDT step assembles the programs required by the MODEL step in a way that can be used by the computer to run that step.

The MODEL step performs all projections of the Compound Model. These include: Labor Force, Manpower Requirements, Educational Systems, and Manpower Policy projections.

The REPORT step formats the projection data produced by the MODEL step and generates all Compound Model reports.

The SUMRY step collects certain major projection data and formats them into the Highlights Report.