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a volume in SCIMA special studies

edited by **A. Ghosal**

*Council of Scientific & Industrial Research
New Delhi*

foreword by **Lovraj Kumar**

*President, Society of Management Science
and Applied Cybernetics, New Delhi*



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Applied Cybernetics and Planning



SCIMA Special Series

SCIMA SPECIAL STUDIES are edited by A. Ghosal. The Board of Advisory editors comprises of Charles I. Bartfield (American University), Martin Backmann (Brown University) A. Das Gupta (Delhi), Lovraj Kumar (Delhi), J.K. Lenstra (Amsterdam), N. Paul Loomba (Florida International University), A. Mercer (Lancaster), Ajit Mozoomdar (World Bank), R.S.G. Rutherford (Sydney), J. Rose (Editor, *Kybernetes*), Melvin F. Shakun (New York).

Forthcoming

Candidate Image and Voter Preference a cybernetic approach

AVRAHAM SHAMA, *Solar Energy Research Institute, Golden,
Colorado, USA*

The objectives of this book are to investigate the relationship between the concepts of "image" and "behavior" in the area of political behavior, and to derive promotion and advertising strategies for candidates running for office.

To achieve these objectives, the book reviews relevant literature and research projects; discusses the process of image formation; suggests a specific model of voter imageformation process; and conducts research to test the model.

Depending on the candidate attributes and voter characteristics, promotional strategies for office seekers are advanced.

To Professor M.G.K. MENON, F.R.S.

Foreword

This monograph is the first in a special series that the Society of Management Science and Applied Cybernetics (SCIMA) has launched. This special series will deal with the application of cybernetics to the problems of planning. SCIMA has been encouraged in launching the series in the conviction that a cybernetic approach can lead to a happier identification of the solutions to the real-life and real-time problems of planning at the enterprise level, the regional level and the national level and that a more rapid adoption of this approach is feasible, indeed urgent.

The monograph contains a number of papers presented at the TIMS International Conference held in Honolulu in June, 1979 by distinguished experts in system dynamics and certain others contributed at the invitation of the Society. It owes much to the initiative taken by Dr. A. Ghosal (to whom the Society already owes so much).

LOVRAJ KUMAR

*President, Society of Management Science
and Applied Cybernetics*

Cybernetics is the science of communication and control in the animal and the machine.

—NORBERT WIENER

In truth cybernetics which is defined as the science of control in the animal and the machine, is precisely about organization for this is the medium through which control is exercised. Therefore cybernetics may also be defined as the science of effective organization.

—STAFFORD BEER

Preface

Planning is an important facet in social and economic life, both in developed and developing societies. Large scale development in all the 'four' worlds brings out a new axiom—that it is impossible for any country or any closed society to be self-sufficient in all aspects; however, through a reasonable interchange of goods and services among countries and societies, it is possible to meet the requirements of a larger world community. This leads to the consideration of any planning problem from a systems viewpoint.

In the early stage of development of planning economics, efforts were directed to solve a series of suboptimization problems. On application of these solutions to large-scale economics, it has been found in many cases that a lack of synchronization among various smaller systems made their implementation inoperative. Consequently the need for injecting more of cybernetic approach in planning problems has been felt.

Cybernetics is the science of control and communication both in animate and inanimate systems. In the western world emphasis of cybernetic research has been directed mainly to the study of theoretical cybernetics and applications of cybernetics in biological systems, artificial intelligence and information processing. Applications of cybernetic approach, in economic systems have been emphasized mostly in the USSR and some countries of Eastern Europe: however, lately the western world has also been showing keen interest in it. A new science, viz. 'Policy Science', which has been developed in the USA, recognizes the use of the cybernetic approach in formulating and analyzing real-life problems. Melvin Shakun's approach of situational normativism is in fact a thesis in cybernetics. Stafford Beer's work on Chilean national planning (*Platform for Change*, Wiley, London, 1975) is a monumental work in economic cybernetics.

The present monograph *Applied Cybernetics and Planning* is the outcome of keen interest of a number of individuals and two societies, viz. the Society of Management Science and Applied Cybernetics and the Institute of Management Sciences (TIMS). Professor Melvin Shakun, Chairman of the Cluster on Policy Sciences, and Professor Ambar Rao, Program Chairman of the TIMS International Meeting in Honolulu, Hawaii, in

June 1979, had invited me to organize a session on 'Applied Cybernetics and Planning'. The response was good. Teams in Planning Commission (India) were already working on cybernetic features of planning under the direction of Dr. Ajit Mozoomdar, the then Secretary, Planning Commission and past President of the Society of Management Science and Applied Cybernetics: they submitted papers for this session. Workers from other parts of the world also presented papers to this session. There was a demand for a special publication on the topic; accordingly the Society of Management Science and Applied Cybernetics decided to bring out a special volume under SCIMA SPECIAL SERIES. Articles were contributed by experts in system dynamics from all over the world.

Each article was referred by a panel of reviewers. I am grateful to the reviewers and the authors many of whom sent the revised versions of their papers within a short time.

This volume contains thirteen papers. The first two papers discuss specific problems in Indian National Planning: the third paper deals with strategic planning in public sector in Sweden. The fourth paper deals with a specific problem, viz. maintenance management from a systems viewpoint. The fifth paper is a contribution to the theoretical understanding of the planning process; it also gives empirical examples from real-life. The sixth paper deals with a cybernetic model of transport planning and its application to India. The seventh paper gives a breakthrough in interpreting zero-base budgeting from a cybernetic viewpoint. The eighth paper gives a detailed structural analysis of economics of different countries from a quantitative viewpoint. The ninth paper gives a macro-analysis approach to the problem of defence management with special reference to the US scene. The tenth paper gives an insight into the strategic planning for a corporation when viewed through a cybernetic view point. The eleventh paper gives a novel approach to problem of prediction and management of floods and is a breakthrough in statistical dynamics. The twelfth paper discusses the problem of reduction of disparity in private consumption in Indian Plan. The last paper gives a new approach in forecasting air traffic in domestic sector in India under situation of constraints—it not only develops new models but also shows their validity in real-life situations.

All the papers present new ideas which can be further employed by workers throughout the world. Comments and criticism from reader are welcome—as a cybernetician I think that a work can be perfected only through feedbacks in the form of criticism.

Finally, I thank Mr. Lovraj Kumar, President of the Society of Management Science and Applied Cybernetics, Dr. Ajit Mozoomdar, past President of the Society, Professor Melvin Shakun and Professor Ambar Rao, of New York University, the editorial advisors of the SCIMA SPECIAL SERIES, reviewers, authors and Dr. L.P. Rai for their untiring efforts to

make this volume a success. I am also grateful to Professor M.G.K. Menon, F.R.S., Director-General, for encouraging me in my research pursuits and for sanctioning me a travel grant which enabled me to attend the TIMS International Meeting at Honolulu in June 1979. Lastly, I am grateful to my secretariat staff for their excellent supportive work.

NEW DELHI
3 May, 1980

A. GHOSAL

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Contents



| | |
|--|------|
| FOREWORD | vii |
| PREFACE | ix |
| CONTRIBUTORS | xiii |
| Chapter One: Cybernetic Approach to Planning Studies in India <i>Ajit Mozoomdar, Sudhir Chitale and K.C. Majumdar</i> | 1 |
| Chapter Two: Short-Term Macro-Econometric Forecasting Model Used for Indian Annual Plans, <i>Jayanta Roy and M.J. Manohar Rao</i> | 19 |
| Chapter Three: Strategic Planning in the Public Sector, <i>B. Schwarz</i> | 73 |
| Chapter Four: A Systems Approach to Maintenance Manage- ment, <i>Michael N. Chanin and George P. Sphicas</i> | 93 |
| Chapter Five: Discontinuous Change in a Planning Process, <i>A. Ghosal and Melvin F. Shakun</i> | 111 |
| Chapter Six: A Cybernetic Model of Transport Planning with an Application to India, <i>M.Q. Dalvi, T. Das, Ajay Kumar and A.K. Sinha</i> | 121 |
| Chapter Seven: Strategic Cybernetics and Zero-Base Budgeting, <i>Akira Ishikawa</i> | 141 |
| Chapter Eight: International Discrimination of Economic Struc- tures, <i>Ashish Kumar Chakraverti</i> | 153 |
| Chapter Nine: A Macro-Analysis Approach to Defense Management, <i>Murray A. Geisler and Laurence D. Richards</i> | 205 |
| Chapter Ten: The Corporate Strategy Process, <i>Michael A. Moses and Melvin F. Shakun</i> | 219 |
| Chapter Eleven: Flat Approximation to the Distribution of Extreme Values and Its Use in the Statistical Treatment of Floods, <i>Peter D. Finch</i> | 233 |

xvi CONTENTS

| | |
|---|-----|
| Chapter Twelve: Reduction of Disparity in Private Consumption in Draft Five Year Plan—1978–83, <i>K.C. Majumdar</i> | 253 |
| Chapter Thirteen: Studies in Innovative Forecasting for Air Traffic in Domestic Sector in India, <i>A. Ghosal, J.K. Choudhury, V.D. Gangolly and V. Singh</i> | 263 |
| AUTHOR INDEX | 295 |
| SUBJECT INDEX | 297 |

CHAPTER ONE

Cybernetic Approach to Planning Studies in India

AJIT MOZOOMDAR, SUDHIR CHITALE AND K.C. MAJUMDAR

The paper analyses the application of various cybernetic phenomena in the context of Indian planning. The first part of the paper develops a system development which takes into account goals of various macro-elements and the overall national economy and delineates a hierarchical structure for macro-planning. The second part discusses a few models which take into account feedback phenomena in making effective forecasts and allocating resources. One problem which is of particular use in developing countries is the characteristic of capacity restrictions which in their turn affect future generation of demands. In another problem the dynamics of macro-planning have been studied by choosing modified Leontief models. Empirical studies have been given.

1. Introduction

Any control system with a builtin feedback mechanism is essentially a problem of cybernetics (Ghosal 1978). Planning models can be thought of as a problem of this system. In planning the development of an economy, the main endeavours lie in efficient allocation of resources like manpower, capital, foreign exchange and technical skills to attain a set of social objectives. At any point in time the planners are called upon to consider policy decisions on a number of issues. In the Indian Planning Commission a system of models which bring out the trade offs involved in alternative policy presumptions in terms of a given set of social objectives is considered. While one works in the framework of long and medium term plans aimed at guiding the economy along a specific development path, there may be a number of reasons depending upon actual performance of the economy and changes in the policies which at any stage require restructuring and

2 *Applied Cybernetics and Planning*

reorientation of the existing plans. There is thus an explicit need for a feedback of information formally into the planning process. The Indian Planning Commission considers this to be crucial in achieving the plan objectives and targets through proper plan implementation procedures and monitoring of information. In what follows, we shall discuss the planning procedure along with the idea of a feedback and its implications in planning process in India.

2. Features of the Indian Planning Process

Economic planning involves conscious direction of economic activity with a view to achieving given social objectives within a specified time horizon. The case for planning arises, when the social objectives are inconsistent with the free market *laissez faire* solution. The Indian planning process is designed for an economy in which a large part of the population lives below the poverty line. It is an extremely heterogeneous economy which is characterized by dualism in which the modern sophisticated sector coexists with the rural underdeveloped. Further, economic planning in India must take place within the framework of a federal democracy in which there is only a partial control on the means of production. The framework of a mixed economy adopted in India consists of :

Permitting a predominant private ownership of property and means of production and freedom to utilize them in economic activity within legal and constitutional constraints.

Permitting market forces to operate over a large part of the economic activity subject to controls like fiscal and monetary policies meant to modify the market forces so as to make them conform to social objectives.

Controlling certain general sectors of the economy through the operation of the public sector or through direct government intervention in the economic activity.

Framework of mixed economy coupled with the fragmentation of public control between Central and State Governments which makes planning a complex task. While public production can directly be controlled to conform to overall social objectives, the production decisions in that part of the economy in which market mechanism is allowed to operate can only be indirectly guided. This also makes it difficult in India to accurately predict impact of a specific policy over a long horizon. This again suggests the need for a method by which the response of the economy to any policy prescription is recorded and fed back into the planning mechanism for suitable corrective action. The extent to which response can be accurately predicted