Systems Optimization Methodology

Part I

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Part I

Translated from Russian
by Mr Y M Donets

V V Kolbin
Leningrad University

World Scientific

Singapore • New Jersey • London • Hong Kong

Published by

World Scientific Publishing Co. Pte. Ltd.

P O Box 128, Farrer Road, Singapore 912805

USA office: Suite 1B, 1060 Main Street, River Edge, NJ 07661

UK office: 57 Shelton Street, Covent Garden, London WC2H 9HE

British Library Cataloguing-in-Publication Data

A catalogue record for this book is available from the British Library.

SYSTEMS OPTIMIZATION METHODOLOGY — Part 1

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ISBN 981-02-1589-4

This book is printed on acid-free paper.

Printed in Singapore by Uto-Print

*I dedicate this book to Dr. Galina Kolbina,
my wife and friend.*

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PREFACE

Teleological problems are wide in scope and perhaps go back to pre-Socratic times when science and myth were still one. Dealing with system optimization necessarily implies the problem of goal-oriented behavior. The term “goal-oriented” behavior has at least two meanings: “the behavior directed towards a goal” and “the behavior directed by a goal” The statement that an object is moving toward a goal or is directed by a goal contains no teleology, for we have merely an answer to the question: where is the object moving? In the second case, when the object (or a system) is directed by the goal, the situation is completely different. The goal now becomes an external cause of movement of the object. Teleology serves as a basis for the functional approach to describing reality in such a way that all phenomena, systems, and processes are penetrated by mutual utility: one thing arises for the sake of the other. Teleological problems came to the fore when cybernetics, general systems theory, system approach and other scientific and quasi-scientific disciplines whose names contain the word “system” evolved.

This monograph defines the notion of a “system” by reference to those systems which exhibit the goal-oriented behavior and utilize the notion of decision making and controls. Such systems allow for phenomenological description and fix the nature of causal transformations of input effects into output quantities. The study of consequences of the fact that the systems possess some properties constitutes the content of systems optimization methodology which goes beyond the scope of descriptive classification of systems.

Chapter 1 deals with philosophical problems of systems methodology. An attempt is made to systematize and analyze the problems of scientific methodology as applied to systems modeling methodology which is viewed as the most general concept utilized in modern science.

Chapter 2 focuses on problems of qualitative analysis in natural and social sciences. Attention is drawn to problems of measurement theory and quantitative analysis of systems.

Approaches and methods of systems analysis and synthesis form the central portion of the book. Much study is given to the methods of systems decomposition, an integration using both the discrete and the continuous description of objects, processes, and phenomena. Examples of complex goal-oriented systems are also provided.

The remaining part of the book is largely centered around methodology of multiobjective systems optimization.

The book is provided with references to relevant lines of investigation.

I would like to thank V. I. Zubov, member of the Russian Academy of Science, whose interest in this book stimulated my writings. In particular, I wish to express my indebtedness to N. L. Kirichenko, typist, Y. M. Donets, translator, the editorial and production staff of World Scientific Publishing, and all those who have contributed to the preparation of this book.

St. Petersburg, November 1996

V. V. Kolbin

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