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System Dynamics

Modelling and Simulation

Springer

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ISSN 2192-4333 ISSN 2192-4341 (electronic)
Springer Texts in Business and Economics
ISBN 978-981-10-2043-8 ISBN 978-981-10-2045-2 (eBook)
DOI 10.1007/978-981-10-2045-2

Library of Congress Control Number: 2016951454

This Springer imprint is published by Springer Nature
The registered company is Springer Nature Singapore Pte Ltd.
The registered company address is: 152 Beach Road, #22-06/08 Gateway East, Singapore 189721, Singapore

Foreword

The world, today, is passing through a period of great turmoil, socially, politically and environmentally, in spite of the numerous technological wonders that are taking place almost everyday. One needs to take a systems view of the influencing factors and their interactions and impacts in order to find the root causes of these problems and to arrive at viable policy options. System dynamics provides such an approach. The book authored by Professor Bala, Professor Fatimah and Professor Noh presents the principles of system dynamics in very simple language and illustrates its use with the help of five real-life case studies.

This book is divided into two parts. The first part of the book presents, in a very simple way and starting with the fundamental principles, how complex interactions among the interacting forces can be modelled by capturing their cause–effect interrelations through dynamic models, how the models can be simulated and evaluated to depict reality and how policy interventions can be tested for testing their viability. Although the material covered in this part of the book is not new, the examples supporting the theoretical nuances of the subject covering population growth, grain storage, food security, commodity production, food relief, crop livestock, shrimp farming, crop irrigation and pollution are very interesting and appealing.

In the second part of the book, the authors discuss case studies related to the areas of agriculture, aquaculture and environment in Bangladesh and Malaysia. Both hilsa fish and rice are important for the economy of Bangladesh, just as food security and cocoa production for Malaysia. The case study for solid waste management is well chosen as it is a perennial problem in third-world countries. This part of the book is illustrative of the power of system dynamics methodology as to how it can address many complex issues of today very easily.

I believe that a newcomer to the field of system dynamics will find the book extremely useful and will be highly motivated to use system dynamics and systems thinking in understanding and addressing the issues that arise out of the behaviour of systems that are integral part of their lives.

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September 2014

Preface

This book *System Dynamics: Modelling and Simulation* is a totally new book with numerous examples and case studies for better understanding the complex systems and their changes through modelling and simulation to aid in policy formulation and developing management strategies for sustainable development. This book provides a comprehensive introduction to systems thinking and modelling of complex systems with application to agricultural, aquacultural, environmental and socio-economic systems. Also this book essentially provides the principles of system dynamics with numerous examples and a good number of case studies in agricultural, aquacultural, environmental and socio-economic systems. It covers all aspects of system dynamics starting from systems thinking to participatory model building to provide a tool for policy planning, and the main focus is to aid in policy design.

This book has been written primarily for undergraduate and postgraduate courses on system dynamics, systems engineering, system simulation, agricultural systems and multidisciplinary courses on agricultural, aquacultural, environmental and socio-economic systems. This book can be adopted for courses in electrical engineering and computer science. It will also serve as an excellent reference for practicing system dynamists, system dynamics researchers and policy planners. It is the outcome of several years of teaching and research in system dynamics modelling and simulation with applications in agricultural, aquacultural, environmental and socio-economic systems and also is an updated and a new book on principles of system dynamics.

This book covers the wide spectrum of system dynamics methodology of modelling and simulation of complex systems: systems thinking, causal diagrams, system structure of stock–flow diagrams, parameter estimation and tests for confidence building in system dynamics models with a good number of worked-out examples in diverse fields using STELLA and VENSIM. In case studies, problem statement with dynamic hypothesis is followed by causal loop diagrams, stock–flow diagrams, parameter estimation, model validation and policy design. Exercises have also been included at the end of each chapter for further practices.

The authors have a great pleasure in expressing the acknowledgements which they owe to many persons in writing this book. Professor B K Bala warmly recognises the continuing debt to his teacher, Dr. Donald R. Drew, W. Thomas

Rice professor of systems engineering, Virginia Polytechnic Institute and State University, USA, who introduced him to system dynamics at the Asian Institute of Technology, Bangkok, Thailand. Thu authors also express sincere acknowledgements to Professor P K J Mohapatra, Indian Institute of Technology, Kharagpur, India who is the Father of System Dynamics in India has written the foreword of this book. The authors have a great pleasure in expressing the acknowledgements to Dr. Serm Janjai, Department of Physics, Silpakorn University, Nakhon Pathom, Thailand, for his encouragement and support in the preparation of this book and my colleague Professor Ashraful Haque, Department of Farm Power and Machinery, who read the manuscript and made many helpful suggestions. I owe my thanks to Mrs. Emmy Farhana Alias, Institute of Agricultural and Food Policy Studies, Universiti Putra Malaysia, Malaysia, for her help in the preparation of the manuscript and Dr. Itsara Masiri of the Department of Physics, Silpakorn University, Nakhon Pathom, Thailand, for the assistance in graphics and in drawing the beautiful figures.

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