Systems Thinking and Systems Engineering

Volume 2

A Discipline of Mathematical Systems Modelling

Volume 1
A Journey Through the Systems Landscape
Harold “Bud” Lawson

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Matthew Collinson, Brian Monahan, and David Pym

Systems Thinking and Systems Engineering Series Editors
Harold “Bud” Lawson bud@lawson.se
Jon P. Wade jon.wade@stevens.edu

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Matthew Collinson,
Brian Monahan,
and
David Pym

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Scientific Director: Dov Gabbay
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Preface

The mathematization of the sciences, of engineering, and of economics has been an outstandingly successful intellectual enterprise, enabling the modern world. As the operations of the world become more and more dependent on highly interconnected, massively complex, networked systems of computational devices, the need to develop a mathematical understanding of their properties and behaviours is increasingly pressing.

Our approach, described in this monograph, is to combine the compositionality of formal specification — using techniques from algebra, computation theory, logic, and probability theory — with the control of level of abstraction afforded by the classical mathematical modelling method.

The first chapter provides a complete high-level view of the approach to systems modelling that is developed in the monograph. It provides both conceptual and philosophical background and introductions to the technical development. The remaining chapters develop the mathematical and computational aspects of our approach. Each chapter develops a specific mathematical or computational component, clearly integrated into the overall development. Examples, including ones based on industrial and commercial applications, are provided throughout. An implementation of a simulation engine (Core Gnosis) for executing models is available for download from HP Labs: see the College Publications website, `www.collegepublications.co.uk`, for more information.

This is book is about the conceptual and mathematical foundations of a modelling approach, with indications of how it can, and has been, deployed in practice. We defer to another occasion an account of the pragmatics of the deployment.

Dr. Matthew Collinson is a Lecturer in Computing Science, University of Aberdeen.

Dr. Brian Monahan is a researcher in the Cloud and Security Lab, HP Labs, Bristol.

Prof. David Pym is 6th Century Chair in Logic, and SICSA Professor of Computing Science, University of Aberdeen.

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