
Contents

Foreword	ix
Preface	xiii
Part 1. The Foundations of Systemics	1
Introduction to Part 1	3
Chapter 1. The Legacy of Norbert Wiener and the Birth of Cybernetics	5
1.1. The birth of systemics: the facts	6
1.1.1. The idea of integration	8
1.1.2. Implementation and the first applications.	14
1.2. Modeling for understanding: the computer science singularity	21
1.3. Engineering in the 21st Century	24
1.4. Education: systemics at MIT	29
Chapter 2. At the Origins of System Sciences: Communication and Control	33
2.1. A little systemic epistemology	33
2.2. Systems sciences: elements of systemic phenomenology	38
2.2.1. Control/regulation.	42
2.2.2. Communication/information	45
2.3. The means of existence of technical objects.	51

Chapter 3. The Definitions of Systemics: Integration and Interoperability of Systems	55
3.1. A few common definitions	55
3.2. Elements of the system	59
3.3. Interactions between the elements of the system	62
3.4. Organization of the system: layered architectures	65
3.4.1. Classification trees	65
3.4.2. Meaning and notation: properties of classification trees.	74
Chapter 4. The System and its Invariants	83
4.1. Models	83
4.2. Laws of conservation	89
4.2.1. Invariance	96
4.2.2. System safety: risks.	106
Chapter 5. Generations of Systems and the System in the System	113
5.1. System as a language	116
5.2. The company as an integrated system	119
5.2.1. The computer, driving force behind the information system	120
5.2.2. Digital companies.	126
Part 2. A World of Systems of Systems	129
Introduction to Part 2	131
Chapter 6. The Problem of Control	133
6.1. An open world: the transition from analog to all-digital	133
6.2. The world of real time systems	142
6.3. Enterprise architectures: the digital firm.	145
6.4. Systems of systems	147
Chapter 7. Dynamics of Processes	151
7.1. Processes	153
7.2. Description of processes	158
7.2.1. Generalizing to simplify	165
7.2.2. Constructing and construction pathways	166
7.2.3. Evolution of processes	168
7.2.4. Antagonistic processes: forms of invariants	170
7.3. Degenerative processes: faults, errors and “noise”	173

7.4. Composition of processes	176
7.4.1. Antagonistic interactions	178
7.5. Energetics of processes and systems	181
Chapter 8. Interoperability	191
8.1. Means of systemic growth	195
8.2. Dynamics of the growth of systems	197
8.2.1. The nature of interactions between systems	200
8.2.2. Pre-eminence of the interaction	204
8.3. Limits of the growth of systems	207
8.3.1. Limits and limitations regarding energy	211
8.3.2. Information energy	214
8.3.3. Limitations of external origin: PESTEL factors	216
8.4. Growth by cooperation	221
8.4.1. The individuation stage	223
8.4.2. The cooperation/integration stage	226
8.4.3. The opening stage	233
Chapter 9. Fundamental Properties of Systems of Systems	235
9.1. Semantic invariance: notion of a semantic map	235
9.2. Recursive organization of the semantic	239
9.3. Laws of interoperability: control of errors	240
9.3.1. Models and metamodels of exchanges	241
9.3.2. Organization “in layers” of the models and systems	243
9.3.3. Energy performance of the interaction between systems	245
9.3.4. Systemic approach to system safety	247
9.4. Genealogy of systems	252
Conclusion	257
List of Acronyms	269
References	275
Index	277