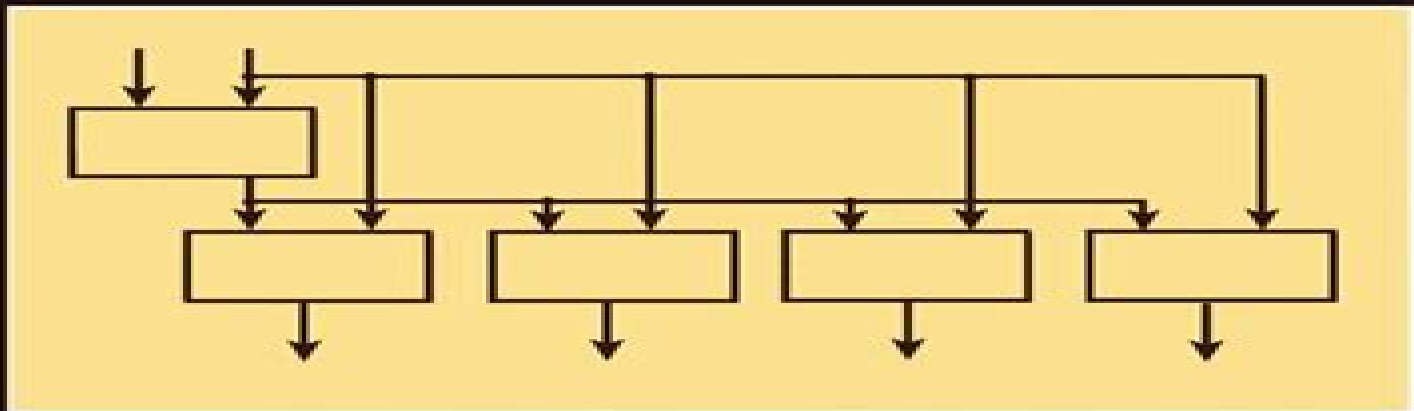


# Facets of Systems Science

**Second Edition**

**George J. Klir**



IFSR International Series on  
Systems Science and Engineering  
Volume 15

# Facets Of Systems Science

**Padhraic Smyth**



## **Facets Of Systems Science:**

*Facets of Systems Science* George Klir, 2012-10-05 This book has a rather strange history It began in spring 1989 thirteen years after our Systems Science Department at SUNY Binghamton was established when I was asked by a group of students in our doctoral program to have a meeting with them The spokesman of the group Cliff Joslyn opened our meeting by stating its purpose I can closely paraphrase what he said We called this meeting to discuss with you as Chairman of the Department a fundamental problem with our systems science curriculum In general we consider it a good curriculum we learn a lot of concepts principles and methodological tools mathematical computational heuristic which are fundamental to understanding and dealing with systems And yet we learn virtually nothing about systems science itself What is systems science What are its historical roots What are its aims Where does it stand and where is it likely to go These are pressing questions to us After all aren't we supposed to carry the systems science flag after we graduate from this program We feel that a broad introductory course to systems science is urgently needed in the curriculum Do you agree with this assessment The answer was obvious and yet not easy to give I agree of course but I do not see how the situation could be alleviated in the foreseeable future

**Facets of Systems Science** George Klir, 2013-07-13 This book has a rather strange history It began in Spring 1989 thirteen years after our Systems Science Department at SUNY Binghamton was established when I was asked by a group of students in our doctoral program to have a meeting with them The spokesman of the group Cliff Joslyn opened our meeting by stating its purpose I can closely paraphrase what he said We called this meeting to discuss with you as Chairman of the Department a fundamental problem with our systems science curriculum In general we consider it a good curriculum we learn a lot of concepts principles and methodological tools mathematical computational heuristic which are fundamental to understanding and dealing with systems And yet we learn virtually nothing about systems science itself What is systems science What are its historical roots What are its aims Where does it stand and where is it likely to go These are pressing questions to us After all aren't we supposed to carry the systems science flag after we graduate from this program We feel that a broad introductory course to systems science is urgently needed in the curriculum Do you agree with this assessment The answer was obvious and yet not easy to give I agree of course but I do not see how the situation could be alleviated in the foreseeable future

**Facets of Systems Science** George J. Klir, 2012-12-06 This book has a rather strange history It began in spring 1989 thirteen years after our Systems Science Department at SUNY Binghamton was established when I was asked by a group of students in our doctoral program to have a meeting with them The spokesman of the group Cliff Joslyn opened our meeting by stating its purpose I can closely paraphrase what he said We called this meeting to discuss with you as Chairman of the Department a fundamental problem with our systems science curriculum In general we consider it a good curriculum we learn a lot of concepts principles and methodological tools mathematical computational heuristic which are fundamental to understanding and dealing with systems And yet we learn virtually nothing about systems science itself What

is systems science What are its historical roots What are its aims Where does it stand and where is it likely to go These are pressing questions to us After all aren't we supposed to carry the systems science flag after we graduate from this program We feel that a broad introductory course to systems science is urgently needed in the curriculum Do you agree with this assessment The answer was obvious and yet not easy to give I agree of course but I do not see how the situation could be alleviated in the foreseeable future

**Systems Science: Theory, Analysis, Modeling, and Design** George E.

Mobus, 2022-03-09 This book describes a comprehensive approach to applying systems science formally to the deep analysis of a wide variety of complex systems Detailed how to examples of the three phases analysis modeling design of systems science are applied to systems of various types machines organic e.g. ecosystem and supra organic e.g. business organizations and government The complexity of the global system has reached proportions that seriously challenge our abilities to understand the consequences of our use of technology modification of natural ecosystems or even how to govern ourselves For this reason complex mathematics is eschewed when simpler structures will suffice allowing the widest possible audience to apply and benefit from the available tools and concepts of systems science in their own work The book shows in detail how to functionally and structurally deconstruct complex systems using a fundamental language of systems It shows how to capture the discovered details in a structured knowledge base from which abstract models can be derived for simulation The knowledge base is also shown to be a basis for generating system design specifications for human built artifacts or policy recommendations policy mechanisms for socio economic ecological systems management The book builds on principles and methods found in the authors textbook Principles of Systems Science co authored with Michael Kalton but without prerequisites It will appeal to a broad audience that deals with complex systems every day from design engineers to economic and ecological systems managers and policymakers

**Systems Science and Cybernetics - Volume II**

Francisco Parra-Luna, 2009-10-30 The subject Systems sciences and cybernetics is the outcome of the convergence of a number of trends in a larger current of thought devoted to the growing complexity of primarily social objects and arising in response to the need for globalized treatment of such objects This has been magnified by the proliferation and publication of all manner of quantitative scientific data on such objects advances in the theories on their inter relations the enormous computational capacity provided by IT hardware and software and the critical revisiting of subject object interaction not to mention the urgent need to control the efficiency of complex systems where efficiency is understood to mean the ability to find a solution to many social problems including those posed on a planetary scale The result has been the forging of a new academically consolidated scientific trend going by the name of Systems Theory and Cybernetics with a comprehensive multi disciplinary focus and therefore apt for understanding realities still regarded to be inescapably chaotic This subject entry is subdivided into four sections The first an introduction to systemic theories addresses the historic development of the most commonly used systemic approaches from new concepts such as the so called geometry of thinking or the systemic treatment

of non systemic identities to the taxonomic entropic axiological and ethical problems deriving from a general systemic cybernetic conceit Hence the focus in this section is on the historic and philosophical aspects of the subject Moreover it may be asserted today that beyond a shadow of a doubt problems in particular problems deriving from human interaction but in general any problem regardless of its nature must be posed from a systemic perspective for otherwise the obstacles to their solution are insurmountable Reaching such a perspective requires taking at least the following well known steps a statement of the problem from the determinant variables or phenomena b adoption of theoretical models showing the interrelationships among such variables c use of the maximum amount of wherever possible quantitative information available on each d placement of the set of variables in an environment that inevitably pre determines the problem That epistemology would explain the substantial development of the systemic cybernetic approach in recent decades The articles in the second section deal in particular with the different methodological approaches developed when confronting real problems from issues that affect humanity as a whole to minor but specific questions arising in human organizations Certain sub themes are discussed by the various authors always from a didactic vantage including problem discovery and diagnosis and development of the respective critical theory the design of ad hoc strategies and methodologies the implementation of both qualitative soft system methodologies and formal and quantitative such as the General System Problem Solver or the axiological operational perspective approaches cross disciplinary integration and suitable methods for broaching psychological cultural and socio political dynamisms The third section is devoted to cybernetics in the present dual meaning of the term on the one hand control of the effectiveness of communication and actions and on the other the processes of self production of knowledge through reflection and the relationship between the observing subject and the observed object when the latter is also observer and the former observed Known as second order cybernetics this provides an avenue for rethinking the validity of knowledge such as for instance when viewed through what is known as bipolar feedback processes through which interactions create novelty complexity and diversity Finally the fourth section centres around artificial and computational intelligence addressing sub themes such as neural networks the simulated annealing that ranges from statistical thermodynamics to combinatory problem solving such as in the explanation of the role of adaptive systems or when discussing the relationship between biological and computational intelligence

Knowledge and Systems Science Yoshiteru Nakamori, 2013-07-12 Integrating ideas from the fields of systems science and knowledge science Knowledge and Systems Science Enabling Systemic Knowledge Synthesis shows how to create and justify various pieces of knowledge systemically Written by one of the foremost experts in this area the book presents approaches for the systemic integration of knowledge which

**Systems Science and Cybernetics - Volume I** Francisco Parra-Luna, 2009-10-30 The subject Systems sciences and cybernetics is the outcome of the convergence of a number of trends in a larger current of thought devoted to the growing complexity of primarily social objects and arising in response to the need for globalized treatment of such objects

This has been magnified by the proliferation and publication of all manner of quantitative scientific data on such objects advances in the theories on their inter relations the enormous computational capacity provided by IT hardware and software and the critical revisiting of subject object interaction not to mention the urgent need to control the efficiency of complex systems where efficiency is understood to mean the ability to find a solution to many social problems including those posed on a planetary scale The result has been the forging of a new academically consolidated scientific trend going by the name of Systems Theory and Cybernetics with a comprehensive multi disciplinary focus and therefore apt for understanding realities still regarded to be inescapably chaotic This subject entry is subdivided into four sections The first an introduction to systemic theories addresses the historic development of the most commonly used systemic approaches from new concepts such as the so called geometry of thinking or the systemic treatment of non systemic identities to the taxonomic entropic axiological and ethical problems deriving from a general systemic cybernetic conceit Hence the focus in this section is on the historic and philosophical aspects of the subject Moreover it may be asserted today that beyond a shadow of a doubt problems in particular problems deriving from human interaction but in general any problem regardless of its nature must be posed from a systemic perspective for otherwise the obstacles to their solution are insurmountable Reaching such a perspective requires taking at least the following well known steps a statement of the problem from the determinant variables or phenomena b adoption of theoretical models showing the interrelationships among such variables c use of the maximum amount of wherever possible quantitative information available on each d placement of the set of variables in an environment that inevitably pre determines the problem That epistemology would explain the substantial development of the systemic cybernetic approach in recent decades The articles in the second section deal in particular with the different methodological approaches developed when confronting real problems from issues that affect humanity as a whole to minor but specific questions arising in human organizations Certain sub themes are discussed by the various authors always from a didactic vantage including problem discovery and diagnosis and development of the respective critical theory the design of ad hoc strategies and methodologies the implementation of both qualitative soft system methodologies and formal and quantitative such as the General System Problem Solver or the axiological operational perspective approaches cross disciplinary integration and suitable methods for broaching psychological cultural and socio political dynamisms The third section is devoted to cybernetics in the present dual meaning of the term on the one hand control of the effectiveness of communication and actions and on the other the processes of self production of knowledge through reflection and the relationship between the observing subject and the observed object when the latter is also observer and the former observed Known as second order cybernetics this provides an avenue for rethinking the validity of knowledge such as for instance when viewed through what is known as bipolar feedback processes through which interactions create novelty complexity and diversity Finally the fourth section centres around artificial and computational intelligence addressing sub themes such as

neural networks the simulated annealing that ranges from statistical thermodynamics to combinatorial problem solving such as in the explanation of the role of adaptive systems or when discussing the relationship between biological and computational intelligence

**Information Systems and Global Assemblages: (Re)configuring Actors, Artefacts, Organizations** Bill Doolin, Eleni Lamprou, Nathalie Mitev, Laurie McLeod, 2014-11-29 This book constitutes the refereed proceedings of the IFIP WG 8.2 Working Conference on Information Systems and Organizations IS ethnographic account of IS use structures and networks health care IS social media and IS design

International Encyclopedia of Systems and Cybernetics Charles François, 2011-12-07 No detailed description available for International Encyclopedia of Systems and Cybernetics

**Getting It Right in Science and Medicine** Hans R. Kricheldorf, 2016-05-31 This book advocates the importance and value of errors for the progress of scientific research Hans Kricheldorf explains that most of the great scientific achievements are based on an iterative process an innate self healing mechanism errors are committed being checked over and over again through which finally new findings and knowledge can arise New ideas are often first confronted with refusal This is so not only in real life but also in scientific and medical research The author outlines in this book how great ideas had to ripen over time before winning recognition and being accepted The book showcases in an entertaining way but without Schadenfreude that even some of the most famous discoverers may appear in completely different light when regarding errors they have committed in their work This book is divided into two parts The first part creates a fundament for the discussion and understanding by introducing important concepts terms and definitions such as natural sciences and scientific research laws of nature paradigm shift and progress in science It compares natural sciences with other scientific disciplines such as historical research or sociology and examines the question if scientific research can generate knowledge of permanent validity The second part contains a collection of famous fallacies and errors from medicine biology chemistry physics and geology and how they were corrected Readers will be astonished and intrigued what meanders had to be explored in some cases before scientists realized facts which are today's standard and state of the art of science and technology This is an entertaining and amusing but also highly informative book not only for scientists and specialists but for everybody interested in science research their progress and their history

System , Fractal and Multifractal Facets in the Structure and Dynamics of Physiological Systems and Applications to Homeostatic Control, Disease Diagnosis and Integrated Cyber-Physical Platforms Paul Bogdan, Plamen Ch. Ivanov, Andras Eke, 2020-06-25 Widespread chronic diseases e.g. heart diseases diabetes and its complications stroke cancer brain diseases constitute a significant cause of rising healthcare costs and pose a significant burden on quality of life for many individuals Despite the increased need for smart healthcare sensing systems that monitor measure patients body balance there is no coherent theory that facilitates the modeling of human physiological processes and the design and optimization of future healthcare cyber physical systems HCPS The HCPS are expected to mine the patient's physiological state based on available continuous sensing quantify risk

indices corresponding to the onset of abnormality signal the need for critical medical intervention in real time by communicating patient's medical information via a network from individual to hospital and most importantly control actuate vital health signals e.g. cardiac pacing insulin level blood pressure within personalized homeostasis To prevent health complications maintain good health and/or avoid fatal conditions calls for a cross disciplinary approach to HCPS design where recent statistical physics inspired discoveries done by collaborations between physicists and physicians are shared and enriched by applied mathematicians control theorists and bioengineers This critical and urgent multi disciplinary approach has to unify the current state of knowledge and address the following fundamental challenges One fundamental challenge is represented by the need to mine and understand the complexity of the structure and dynamics of the physiological systems in healthy homeostasis and associated with a disease such as diabetes Along the same lines we need rigorous mathematical techniques for identifying the interactions between integrated physiologic systems and understanding their role within the overall networking architecture of healthy dynamics Another fundamental challenge calls for a deeper understanding of stochastic feedback and variability in biological systems and physiological processes in particular and for deciphering their implications not only on how to mathematically characterize homeostasis but also on defining new control strategies that are accounting for intra and inter patient specificity a truly mathematical approach to personalized medicine Numerous recent studies have demonstrated that heart rate variability blood glucose neural signals and other interdependent physiological processes demonstrate fractal and non stationary characteristics Exploiting statistical physics concepts numerous recent research studies demonstrated that healthy human physiological processes exhibit complex critical phenomena with deep implications for how homeostasis should be defined and how control strategies should be developed when prolonged abnormal deviations are observed In addition several efforts have tried to connect these fractal characteristics with new optimal control strategies that implemented in medical devices such as pacemakers and artificial pancreas could improve the efficiency of medical therapies and the quality of life of patients but neglecting the overall networking architecture of human physiology Consequently rigorously analyzing the complexity and dynamics of physiological processes e.g. blood glucose and its associated implications and interdependencies with other physiological processes represents a fundamental step towards providing a quantifiable mathematical definition of homeostasis in the context of critical phenomena understanding the onset of chronic diseases predicting deviations from healthy homeostasis and developing new more efficient medical therapies that carefully account for the physiological complexity intra and inter patient variability rather than ignoring it This Research Topic aims to open a synergetic and timely effort between physicians physicists applied mathematicians signal processing bioengineering and biomedical experts to organize the state of knowledge in mining the complexity of physiological systems and their implications for constructing more accurate mathematical models and designing QoL aware control strategies implemented in the new generation of HCPS devices By bringing together multi disciplinary researchers seeking to



understand the many aspects of human physiology and its complexity we aim at enabling a paradigm shift in designing future medical devices that translates mathematical characteristics in predictable mathematical models quantifying not only the degree of homeostasis but also providing fundamentally new control strategies within the personalized medicine era

**Thinking** Nima Rezaei, Amene Saghaezadeh, 2022-09-05 The THINKING Bioengineering of Science and Art is to discuss about philosophical aspects of thinking at the context of Science and Art External representations provide evidence that the fundamental process of thinking exists in both animal subjects and humans However the diversity and complexity of thinking in humans is astonishing because humans have been permitted to integrate scientific accounts into their accounts and create excellent illustrations for the effects of this integration The book necessarily begins with the origins of human thinking and human thinking into self and others body and life Multiple factors tend to modify the pattern of thinking They all will come into play by this book that brings thinking into different disciplines humanities natural sciences social sciences formal sciences and applied sciences The thinking demands full processing of information and therefore the book considers the economy of thinking as well The book thoroughly intends to explore thinking beyond the boundaries Specifically several chapters are devoted to discipline this exploration either by artistic thinking alone or by art and mathematics aided engineering of complexities In this manner the book models variations on thinking at the individual and systems levels and accumulates a list of solutions each good for specific scenarios and maximal outcomes

**HISTORY AND PHILOSOPHY OF SCIENCE AND TECHNOLOGY -Volume I** Pablo Lorenzano, Hans-Jörg Rheinberger, Eduardo Ortiz and Carlos Delfino Galles, 2010-09-27 History and Philosophy of Science and Technology is a component of Encyclopedia of Physical Sciences Engineering and Technology Resources in the global Encyclopedia of Life Support Systems EOLSS which is an integrated compendium of twenty one Encyclopedias The Theme on History and Philosophy of Science and Technology in four volumes covers several topics such as Introduction to the Philosophy of Science The Nature and Structure of Scientific Theories Natural Science A Short History of Molecular Biology The Structure of the Darwinian Argument In The Origin of Species History of Measurement Theory Episodes of XX Century Cosmology A Historical Approach Philosophy of Economics Social Sciences Historical And Philosophical Overview of Methods And Goals Introduction to Ethics of Science and Technology The Ethics of Science and Technology The Control of Nature and the Origins of The Dichotomy Between Fact And Value Science and Empires The Geo Epistemic Location of Knowledge Science and Religion Scientific Knowledge and Religious Knowledge Significant Epistemological Reference Points Thing Called Philosophy of Technology Transitions from Function Oriented To Effect Oriented Technologies Some Thought on the Nature of Modern Technology Technical Agency and Sources of Technological Pessimism These four volumes are aimed at a broad spectrum of audiences University and College Students Educators and Research Personnel

**Principles of Systems Science** George E. Mobus, Michael C. Kalton, 2014-11-10 This pioneering text provides a comprehensive introduction to systems structure function and modeling as applied in all fields of

science and engineering Systems understanding is increasingly recognized as a key to a more holistic education and greater problem solving skills and is also reflected in the trend toward interdisciplinary approaches to research on complex phenomena While the concepts and components of systems science will continue to be distributed throughout the various disciplines undergraduate degree programs in systems science are also being developed including at the authors own institutions However the subject is approached systems science as a basis for understanding the components and drivers of phenomena at all scales should be viewed with the same importance as a traditional liberal arts education Principles of Systems Science contains many graphs illustrations side bars examples and problems to enhance understanding From basic principles of organization complexity abstract representations and behavior dynamics to deeper aspects such as the relations between information knowledge computation and system control to higher order aspects such as auto organization emergence and evolution the book provides an integrated perspective on the comprehensive nature of systems It ends with practical aspects such as systems analysis computer modeling and systems engineering that demonstrate how the knowledge of systems can be used to solve problems in the real world Each chapter is broken into parts beginning with qualitative descriptions that stand alone for students who have taken intermediate algebra The second part presents quantitative descriptions that are based on pre calculus and advanced algebra providing a more formal treatment for students who have the necessary mathematical background Numerous examples of systems from every realm of life including the physical and biological sciences humanities social sciences engineering pre med and pre law are based on the fundamental systems concepts of boundaries components as subsystems processes as flows of materials energy and messages work accomplished functions performed hierarchical structures and more Understanding these basics enables further understanding both of how systems endure and how they may become increasingly complex and exhibit new properties or characteristics Serves as a textbook for teaching systems fundamentals in any discipline or for use in an introductory course in systems science degree programs Addresses a wide range of audiences with different levels of mathematical sophistication Includes open ended questions in special boxes intended to stimulate integrated thinking and class discussion Describes numerous examples of systems in science and society Captures the trend towards interdisciplinary research and problem solving

**Integrative Systems Approaches to Natural and Social Dynamics** M. Matthies,H. Malchow,J. Kriz,2001-08-28 At the start of the new millennium mankind is challenged by a paradox the more we know about the world the more uncertain we become in understanding and predicting how it works This book presents an outline of a new basis for Systems Science and a methodology for its application in complex environmental economic social and technological systems

**Systems Philosophy and Management** Kris K Murthy,1999

**Collective Beings** Gianfranco Minati,Eliano Pessa,2006-12-26

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**China's National Governance from the Perspective of Technological Innovation and System Management** Zhicheng Tang,2021-09-01      Context ,

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