Contents

The Era of Convergence 1
William Sims Bainbridge and Mihail C. Roco

Part I Concepts and Methods **15**

Principles and Methods That Facilitate Convergence 17
Mihail C. Roco

Biocognitive Evolution 43
Jonathan C. Peck

Collective Intelligence Systems 53
Jerome C. Glenn

Consilience 65
Ullica Segerstrale

Convergence-Divergence Process 79
Mihail C. Roco

The Convergence of Curation 95
Michael Lesk

Decision Making in a Convergent Society 113
Igor Linkov, Viktoria Gisladottir, and Matthew D. Wood

Dimensions of Research 125
William Sims Bainbridge

Modeling and Simulation 139
J. Tinsley Oden

Science and Technology Forecasting 149
David Rejeski, Eleonore Pauwels, and Joyce Koo

Self-Organization and Emergence of Dynamic Systems 163
James K. Gimzewski, Adam Z. Stieg, and Victoria Vesna

Handbook of science and technology convergence

digitalisiert durch:
IDS Basel Bern

Systemic Interdependencies 181
Gregorio D'Agostino and Antonio Scala

Visionary Scenario Development of Emerging Fields 195
Anita Street, Nora Savage, and Angela Page

Part II Foundational Technologies Platform **207**

NBIC 209
Mihail C. Roco

Cognitive Technology 227
James L. Olds

Complex Biological Systems 239
Andrew J. Spakowitz

Convergence of Nanotechnology and Biotechnology 253
Hyo-Jick Choi and Carlo D. Montemagno

Information Technology Supported Convergence 279
George O. Strawn and William Sims Bainbridge

Nanotechnology-Neuroscience Convergence 293
Jo-Won Lee and Moonkyung Mark Kim

Neurotechnology-Centered Convergence 307
Zack Lynch

Services Science and Societal Convergence 323
Jim Spohrer

Transition from Inert to Living Systems 337
Catalina Achim

Unifying Concepts in Physics, Chemistry, and Engineering 349
Chunli Bai and Chen Wang

Part III Human-Scale Platform **361**

Human-Technology Collaboration 363
William Sims Bainbridge

Citizen Science 377
William Sims Bainbridge

Collaboratories 391
Gary M. Olson

Communication Media 401
Robert Amant and Thomas E. Horton

Convergence with the Arts 413
Andy Miah

Co-Robots: Humans and Robots Operating as Partners 427
Brian Scassellati and Katherine M. Tsui

Distributed Manufacturing 441
Jian Cao, Kornel F. Ehmann, and Shiv Kapoor

Human Computation and Convergence 455
Pietro Michelucci

Open Source Technology Development 475
Kevin Crowston

Participation in Convergence Research 487
Batya Friedman

Personalized and Interactive Literature 501
Michael Mateas and Noah Wardrip-Fruin

Virtual Meetings 517
Walt Scacchi

Part IV Earth-Scale Platform **531**

The Earth-Scale System 533
Bruce Tonn and Dorian Stiefel

Astrosociology (Social Science of Space Exploration) 545
Jim Pass and Albert A. Harrison

Demographic Transition 559
William Sims Bainbridge

Global Risk Assessment 573
Ortwin Renn

Linguistic Convergence 591
Magdalena Bielenia-Grajewska

Network of Cooperation Between Science Organizations 607
Katherine Richardson and Will Steffen

Science and Technology Globalization 621
William Sims Bainbridge

Space Exploration 635
Roger D. Launius

Sustainable Global Food Supply 651
Norman R. Scott, Hongda Chen, and Robin Schoen

Socio-Ecological Systems 669
Claudio Cioffi-Revilla

Whole-Earth Monitoring 691
Bruce Tonn, Erin Rose, and Beth Hawkins

Part V Societal-Scale Platform **711**

Twenty-First Century Society 713
William Sims Bainbridge

Boundary Organizations 729
Michael E. Gorman

Cognitive Society 743
Aude Oliva and Santani Teng

Convergence in Ethical Implications and Communication of Emerging Technologies 755
David M. Berube and Christopher L. Cummings

Cultural Science 767
William Sims Bainbridge

Digital Government 781
Jane E. Fountain

Ethics of Convergence for Enhancement of Cognition 795
George Khushf

Human Enhancement in Sports 815
Andy Miah

Intellectual Property Rights 833
William Sims Bainbridge

Institutional Transformation 847
Robert M. Mason

Medical Approach to Wellness 861
Christopher Hartshorn and Piotr Grodzinski

Polycentric Governance 877
David Feldman

Systematizing Global and Regional Creativity 891
Terry Nichols Clark and Scenes Project Collaborators

Technology and Religion 907
Robert Geraci

Unifying Ethical Concepts 919
Barbara Herr Harthorn

Part VI Convergence in Education **931**

Reconceptualization of Education 933
R. P. H. Chang, Jennifer Shanahan, and Matthew Hsu

Academic Research Centers: Platforms for Convergence of Science, Technology, and Innovation 957
Dragana Brzakovic and John H. Cozzens

Assistive Technology in Education 973
Francis Quek, Yasmine El-glaly, and Francisco Oliveira

Convergence Science and Technology at Seoul National University 985
Y. Eugene Pak and Wonjong Rhee

Cyberlearning 1007
Janet L. Kolodner

Informal Science Education of Converging Technologies 1023
Larry Bell

Integrative Graduate Education and Research 1045
Carol J. Van Hartesveldt

Learning in a World of Convergence 1059
Susan Rundell Singer

Life-Long Learning 1073
Anne Collins McLaughlin, Jing Feng, and Richard Pak

Norms and Standards of Learning 1089
James Murday

Online Courses 1105
Douglas H. Fisher

Precollege Convergence Education 1119
R. P. H. Chang, Jennifer M. Shanahan, and Matthew Hsu

Index 1141