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## **Book Review**

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**The SAGE Handbook of Complexity and Management**

**by: Peter Allen, Steve Maguire and Bill McKelvey**

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Complexity has always been present in the human world (in fact, the entire universe). However, it had been ignored or suppressed due to its misrepresented existence and its contradiction with the exact sciences. However, especially over the last three decades many aspects associated with humanity have been accelerating at a rate that triggers the significance of better comprehending, exploring and even exploiting complexity. Complexity stimulates a hidden path in human lives and all their ‘groupings’ that cannot be fully understood and managed by focusing on order alone. Humanity and especially leaders and managers at all levels must envision beyond the Newtonian mindset. In this respect, the *SAGE Handbook of Complexity and Management* is a highly valuable publication that will provide great assistance in the new endeavour. The book is a comprehensive, diversified, and in-depth coverage of complexity, organisation, management and leadership spread over thirty six chapters/articles. It “critically reviews, juxtaposes and organizes the growing body of research at the intersection of complexity and management – work which addresses the implications of complexity science for the epistemological and methodological *foundations* of management knowledge; *applications* of complexity science concepts, theories and models to important management issues and in different organizational contexts; and theoretical developments at key *interfaces* emerging between management and adjacent disciplines”.

It is a single extensive encompassing book that links and explains complexity theory, and human organisations and its dynamics. The “new scientific approach not only embraces dynamics instead of ‘statics’ of equilibrium, but goes beyond investigation of mere ‘running’ of a given dynamical system according to fixed rules: it accepts and anticipates system plasticity (i.e., the appearance of qualitatively new features and disappearance of old ones). It embraces evolution: the emergence and qualitative development of structure and organization. Complexity is the science of organization – and in particulars its origin and evolution – and is therefore the natural framework for considering organization and connected entities”. In addition, “complexity science considers an ontology of connected entities, i.e., a network which has links that change, nodes that change internally, and capabilities that develop and change over time”.

In this case, the content is intensely relevant and vital to researchers and students in complexity and organisations, as well as leaders and managers of all human organisations

including business corporations, government bodies, institutions of learning, social communities, military units, nations and regional groups including global environment bodies. In the current context of continuous and accelerated change, the four components of complexity, human dynamics, management, and leadership are closely interconnected, non-linear and not always predictable. Apparently, an integrated analysis, exploration, comprehension and exploitation of these components, as stipulated in the book, are highly critical for the future competitiveness, survival and sustainability of the entire human race.

This book is divided into three parts, six sections, and thirty six chapters. The details of the segmentation are as follows.

### *Part 1 Foundations*

#### *A Key concepts*

- 1 complexity and systems thinking
- 2 complexity science and organisation
- 3 emergence in complex systems
- 4 constructing and appreciating complexity
- 5 thoughts on complexity and computational models

#### *B Epistemological perspectives and considerations*

- 6 a scientific realistic epistemology for complexity science
- 7 exploring organisational effectiveness: the value of complex realism as a frame of reference and systemic comparison as a method
- 8 complexity, poststructuralism and organisation
- 9 causality and explanation
- 10 complexity and limits to knowledge: the importance of uncertainty
- 11 complexity thinking: towards an oblique strategy for dealing with the complex

#### *C Methodological implications and tools*

- 12 applications of Kauffman's co-evolutionary NKCS model to management and organisation studies
- 13 using genetic algorithms (GAs) to model strategic interactions
- 14 organising at the edge of chaos: insights from action research
- 15 from skew distributions to power-law science.

*Part 2 Applications*

*A Complexity and organising*

- 16 complexity and organisation – environment relations: revisiting Ashby’s law of requisite variety
- 17 the complexity of industrial ecosystems: classification and computational modelling
- 18 complexity and the dynamics of organisational change
- 19 complex thought, simple talk: an ecological approach to language-based change in organisations
- 20 organisational learning and complexity science: exploring the joint potential
- 21 complexity and management: a pluralistic view

*B Complexity and managing*

- 22 implications of complexity science for the study of leadership
- 23 a complexity perspective on strategic human resource management
- 24 complexity and the rise of distributed control in operations management
- 25 knowledge management and complexity
- 26 complexity and innovation
- 27 complexity science contributions and the field of entrepreneurship
- 28 complexity and competitive advantage
- 29 complexity theory and corporate strategy
- 30 more than a metaphor: complexity and the new rules of management

*Part 3 Interfaces*

- 31 non-linear dynamical systems applications to psychology and management
- 32 the value in between: organisations as adapting and evolving networks
- 33 the use of complexity for policy exploration
- 34 complexity, habits and evolution
- 35 economics, management and complex systems
- 36 how complexity science is transforming healthcare.

*Six sections review*

This review is conducted based on the six sections, namely as follows:

- 1 key concepts (five articles)
- 2 epistemological perspectives and considerations (six articles)
- 3 methodological implications and tools (four articles)
- 4 complexity and organising (six articles)
- 5 complexity and managing (nine articles)
- 6 interfaces (six articles)

*In the first section, 'key concepts',* the contributors are Yasmin Merali, Peter Allen, Raymond-Alain Thietart, Bernard Forgues, Jeffery Goldstein, Steve Maguire, and Michael Prietula. This section introduces some important basic concepts of the complexity science that provides better organisational analysis, management and leadership. The first article traces the development of system thinking from more traditional system theory (including the formulation of the general systems theory by Ludwig von Bertalanffy) to the more current open evolving system concepts (including the science of complex systems). According to the authors, Merali and Allen, the latter [complex adaptive systems (CAS) and their processes] offers a more comprehensive understanding of non-equilibrium dynamics and the characteristics of evolution, emergence and self-organisation – in particular, social behaviour in human sciences. Some prominent CAS contributors and their original works/concepts discussed include those of Simon (bounded rationality), Mintzberg (emergent), Prigogine (dissipative structures), Merali and McKelvey (informational complexity), Eigen (autocatalytic cycles), Haken (synergetics), Maturana and Varela (autopoiesis), Kauffman (order for free, NKC model, fitness landscape), Reynold (agent-based model – flocking), and Langton (artificial life).

Chapter 2 focuses on complexity science and organisation. The authors, Thietart and Forgues introduce the objectivist research of complexity science [discussing concepts such as strange attractors (Ruelle), sensitive to initial conditions (Lorenz), and increasing returns (Arthur)] before venturing more specifically into self-organising (autogenesis, synergetics) systems theory (Benard, Haken, Nicolis, Prigogine, Allen, Kauffman, Stengers, Drazin and Sandelands), deterministic chaos (Allen, Sanglier, Ruelle, Brock, Malliaris, Cheng, Van de Ven), path dependency (Arthur, David), and CAS. With respect to the latter, the basic objective of the complexity adaptive systems theory as comprehended by two outstanding researchers is re-introduced. They are as follows: Gell Mann – “to understand how simplicity emerges from complex interactions”, and Holland – “simplicity arises from the aggregated behavior of interdependent adaptive agents driven by a set of rules”. A set of proposition about complex dynamics of systems is also included [(low-dimensional systems: chaos theory) versus (high-dimensional systems: self-organisation)].

Chapter 3 is an article that focuses on one of the key characteristics of CAS – emergence. Six prototypes of emergent phenomena in complex systems are listed. The current meaning of ‘emergent’ coined by Lewis (“it arises out of the combined agencies, but in a form which does not display the agents in action”) in 1875 is discussed. The four ‘folklores’ surrounding emergent namely, complexity arises suddenly from simplicity, order for free, edge of chaos, and emergence only takes place through self-organisation are analysed. The author, Goldstein concludes this article with the future of emergence in organisational research. Chapter 4 highlights the epistemological

challenges posed by complexity, which stem from issues of representation, prediction and interpretation. The author, Maguire introduces the disciplinary origins of complexity science including the European School and North American School developments. It also discusses the different views, types and aspects of complexity. The last article in this section, chapter 5 concentrates on thoughts of complexity and computational models. It argues that computational modelling is essential for understanding and advancing organisation science – in particular, the behaviour of social systems.

*In the second section, 'epistemological perspectives and considerations',* the contributors are Bill McKelvey, David Byrne, Paul Cilliers, Alicia Juarrero, Peter Allen, Jean Boulton and Robert Chia. This section provides an introduction to the epistemology of complexity science and human organisations through six articles. In chapter 6, the author, McKelvey “develops a complexity science epistemology which is not based on ontological assumptions of reality’s constituent elements being independent and combining additively but, rather, on assumptions of connected constituent elements that can interact to produce multiplicative, nonlinear outcomes”. He concludes the article with four kinds of ontologies, each calling for different epistemologies – which he names as extreme outcomes, normal distribution, Anderson’s long tail, and horizontal scalability. Chapter 7 discusses the value of ‘complex realism’ as a frame of reference and systematic comparison. In particular, the framework is useful for bureaucracies formulating and implementing of social policy.

The next article focuses on complexity, post-structuralism and organisation. Amongst the conclusions is “organizations are an inextricable part of the social fabric...We should therefore not only think of organizations in a functional way, but also, or perhaps primarily, in an ethical way. The development of an understanding of organizations and what they do, which takes the provisional ethnics of complexity seriously, stands a challenge”. Chapter 9 is an article on causality and explanation. It indicates that the appropriate role of managers and leaders should be “seen as catalysts in organic systems rather than clockmakers or controllers of mechanic ones, their objective become the creation of resilient organizations with the ability to self-organize in the face of changes or crises emanating from the environment”. The next article, chapter 10, explores the ontology of uncertainty from its historical roots to the works of Prigogine. It moves on to analyse complexity and uncertainty in human systems. The last chapter of this section examines the concept of complex thinking. The author, Chia, illustrates how this approach “has been valorized in the arts, literature, humanities, and philosophy”... and also how it can “serve as important sources of inspiration for managers seeking strategies to navigate complexity”.

*In the third section, 'methodological implications and tools',* the contributors are Richard Vidgen, Larry Bull, William Martin Tracy, Donald MacLean, Robert MacIntosh, Pierpaolo Andriani and Bill McKelvey. They discuss some of the important complexity methodological tools that could be adopted by organisations for better results. The first article, chapter 12 analyses the applications of the NKCS model of Stuart Kauffman to management. The authors, Vidgen and Bull, also suggest future research directions using this tool. Chapter 13 discusses the usage of GA models of John Holland in strategic interactions. The author also analyses the scope of these models in strategy and “outlines future directions for the application of A-based models to strategic analysis”.

The next article focuses on organising at the edge of chaos: insights from action research. The author, MacLean and MacIntosh, explore the edge of chaos in different

organisations settings, indicates the association between action research and complexity thinking, and suggests more effective managerial and organisational practices. The last article in this section, chapter 15, explains what a power law is, and why power law science is beneficial to human organisations. The authors, Andriani and McKelvey, also illustrate that the new science provides a better explanation for extreme events (punctuation points) and small niches (butterfly effect) that the traditional social sciences are not able to explain.

*In the fourth section, 'complexity and organising',* the contributors are Max Boisot, Bill McKelvey, James Baldwin, Glenda Eoyang, John Shotter, Haridimos Tsoukas, Eve Mitleton-Kelly, Ben Ramalingam and Kurt Richardson. This section examines organisations and the environment as well as organisational learning, adaptation and chance. Chapter 16, written by Boisot and McKelvey, focuses on Ashby's Law of Requisite Variety. This law was first proposed by W. Ross Ashby in 1956 and is recast by the two authors as the Law of Requisite Complexity. "Their 'Ashby space', which consists of ordered, complexity and chaotic regimes, offers a conceptual framework for thinking through the trade-offs that a system faces between stimulus simplification and response complexification as it responds and adapts to its environment". In the next chapter, the author, Baldwin, discusses the complexity of industrial ecosystems. Probable paths for evolution that indicate that interacting agents can improve the performance of the overall system are proposed. He concludes that "a much broader and deeper exploration of the possible overall improvements of an industrial ecology can be made of linked firms and agents and a shared interpretive framework and eventually an emergent collective governance developed".

Chapter 18 is an article on complexity and the dynamics of organisational change. The author, Eoyang indicates a change from the Newtonian perspective/mindset to the complexity perspective/mindset is essential. The recognition, comprehension and usage of complexity metaphors offer a better understanding to organisational change. "The challenge now is to use emerging insights about complexity science to accelerate theory development and to inspire practical innovation". In the next chapter, the authors, Shotter and Tsoukas, also focuses on complexity thought, and an ecological approach to language-based change in organisations. The authors indicate that in human organisations where subjectivities and communicative relationships are vital the complexity approach is more realistic. Chapter 20 is an article on learning organisations and complexity. The authors, Mitleton-Kelly and Ramalingam, indicate that organisational learning is not a new domain. They analyse the implications of complexity to organisations and suggest a new research agenda. The last article in this section, chapter 21, examines complexity and management: a pluralistic view. The author, Richardson, argues that based on complexity science there is no one optimal way to management an organisation. "He also derives practical lessons for managers, including that they should expect to be wrong and that flip-flopping is okay because dogmatism is rarely effective as a strategy in the long term".

*In the fifth section, 'complexity and managing',* the contributors are Russ Marion, Mary Uhl-Bien, Barry Colbert, Elizabeth Kurucz, Arash Azadegan, Kevin Dooley, Max Boisot, Pierpaolo Andriani, Benyamin Lichtenstein, Oliver Baumann, Nicolaj Siggelkow, Kathleen Eisenhardt, Henning Piezunka and James Hazy. This is an interesting and critical section that has the most number of articles (nine chapters). It reviews how the complexity science can improve management and leadership, and also provide a better theory for organisational dynamics, management and leadership. Chapter 22 implications

of complexity science for the study of leadership, is contributed by Marion and Uhl-Bien. “They describe three emerging complexity perspectives on leadership – adaptive leadership, administrative leadership and enabling leadership – and explore difference among them”. They also explain how enabling leadership plays the important role of an ‘interface’ between the other two types of leaderships. The next chapter is an article on a complexity perspective on strategic human resource management. The authors, Colbert and Kurucz, “illustrate how a particular thread of complexity science – the complex response possess perspective – can be leveraged to explain how a resource-based advantage comes into being and how, in turn, an organization can build ‘competitive potential’”. The next article, chapter 24 focuses on complexity and operation management. The authors, Azadegan and Dooley, discuss production systems as CAS, and the ways central control and distributed control can be better comprehends using the Ashby’s law of requisite variety.

Chapter 25 examines complexity and knowledge management. The author, Boisot, indicates the human world is becoming more complex as knowledge intensifies due to the accelerated development of information technology. He illustrates that the “insights and from complexity science can therefore benefit the discipline of knowledge management”, and he “presents an integrative framework which is used to theorise the cyclical nature of social learning”. The next chapter focuses on complexity and innovation. The author, Andriani, indicates that “innovation is about turning knowledge and new ideas into social and economic changes through the deployment of new technologies”. He concentrates on the ‘technosphere’ and discusses ‘a new playing field for innovation’. He concludes that “innovation keeps the economy in a far-from-equilibrium state by renewing the set of products/services and altering/creating small worlds networks around emergent technologies”. The next article, chapter 27 concentrates on complexity and entrepreneurship. The author, Lichtenstein, indicates that there are four types of complexity in entrepreneurship namely, metaphorising complexity, discovering and describing complexity, modelling complexity, and generative complexity. He concludes that his analysis “reflects a view of entrepreneurship as emergence: the study of entrepreneurship is the exploration of emergence, including its processes, dynamics and outcomes”.

In chapter 28 the authors, Baumann and Siggelkow, analyse complexity and competitive advantage. The authors “illustrate how complexity science, and in particular computational methods of adaptation on fitness landscapes, is shedding light of the relationship between complexity and competitive advantage”. They also examine how some organisation structures, and internal and external environment complexity will affect effective strategy. The next article focuses on complexity theory and corporate strategy. The authors, Eisenhardt and Piezunka, indicates that business corporations are CAS, and they concentrates on corporate strategy of organisations with multiple business units. The complexity perspective is business unit-centric, and focuses on processes such as ‘morphing’, ‘rewiring’ and ‘patching’. The last article of this section, chapter 30 by Hazy focuses on complexity and management practices. He indicates a new paradigm for management practice is essential. He also formulates five new rules namely, think evolution of resilience and not for design for stability, be open to surprises across all level of scale, drive effectiveness looking forwards, build models and encourage focused experimentation, and recognise and reinforce larger scale patterns to ride waves of

renewal. Hazy concludes by emphasising that nurturing a complexity mindset is vital in the current and future context.

*In the last section, 'interfaces',* the contributors are Stephen Guastello, Cesar Hidalgo, Steven Bankes, Geoffrey Hodgson, Paul Ormerod and Brenda Zimmerman. This section looks into the perspective between organisations and other disciplines by exploiting the trans-disciplinary roots of the complexity science. The new knowledge that emerges from the studies is shared in the next four chapters. Chapter 31 discusses the dynamical systems applications to psychology and management. The author, Guastello, emphasises that consciousness bring about sensation processes, perception, cognition, learning, memory and adaptation. First, he focuses on the individual interacting agent in a complex environment. Next, he examines social cognition, motivation, conflicts, connectivity, and leadership from a collection of interacting agents that forms a CAS.

The next article concentrates on organisations as adapting and evolving networks. The author, Hidalgo, examines how network sociology/science can contribute to a better understanding of complexity in human organisations – in particular through enhancing self-awareness. Chapter 33 focuses on the use of complexity for policy exploration. The author, Bankes, recognises that “not only must policy be adaptive to cope with deep uncertainty and changing circumstance, but its analytic structure are also context dependent, requiring adaptive responses because policy coevolves with the system towards which it is directed”. He concludes by emphasising that one great challenge is to exploit complexity modelling that is able to adapt to changes both frequent and rare (cannot be anticipated) so that the resilient of the system is enhanced.

Chapter 34 is an article on complexity, habits and evolution. The author, Hodgson, discusses several perspectives including adaptive populations, hyper-rationality, habits and complex environment, organisational routines, and Darwinian evolution. He emphasises that individual habits and organisation routines are part of the multi-level evolution dynamics of a society. The next article concentrates on economics, management and complex systems. The author, Ormerod, indicates that certain key features in complexity provide a better analysis of economics – including behaviour of economic actors and economic rationality. He concludes the article with an illustrative agent-based CAS model. The final article of the book, chapter 36 is an article on complexity and health science. The author, Zimmerman, indicates that healthcare in the Western societies is at a turning point and complexity science can provide a constructive transformation. She explains how complexity science has been tapped for insights to address public policy, overcome clinical and management challenges, redesign health care delivery system, diagnose and treat cardiac conditions (using fractal geometry).

Vividly, the *SAGE Handbook of Complexity and Management* is highly stimulating and beneficial. It provides an extensive coverage on how spaces of complexity can be better understood, managed and exploited by many types of human organisations. The collection of brilliant knowledge and insight from a group of 45 prominent complexity researchers is mind-probing and indicates a clearer direction for today's turbulent new economy and rapidly transforming human dynamics. In general, the complexity theory and in particular, the concepts and properties of CAS will redefine the thinking and understanding of the entire human world – providing more brilliant insights that can solve or minimise daunting problems in which the current traditional disciplines are encountering difficulties. However, as the complexity science is relatively new its research frontiers are still expanding and fresh knowledge is continuously emerging. Nonetheless, for nurturing better resilient and sustainability, both to minimise damages



(destructive outcomes) and to reap enormous profits (constructive outcomes), all spaces of complexity in the human world have to be recognised, comprehended, explored and exploited. Human organisational complexity theory and its applications (encompassing and integrating numerous human associated domains and existing disciplines) is an emerging discipline that will be greatly beneficial to leaders and managers at all levels. Ultimately, for any human organisation, it will be definitely more competitive and sustainable if all its interacting agents possess certain level of comprehension of complexity.