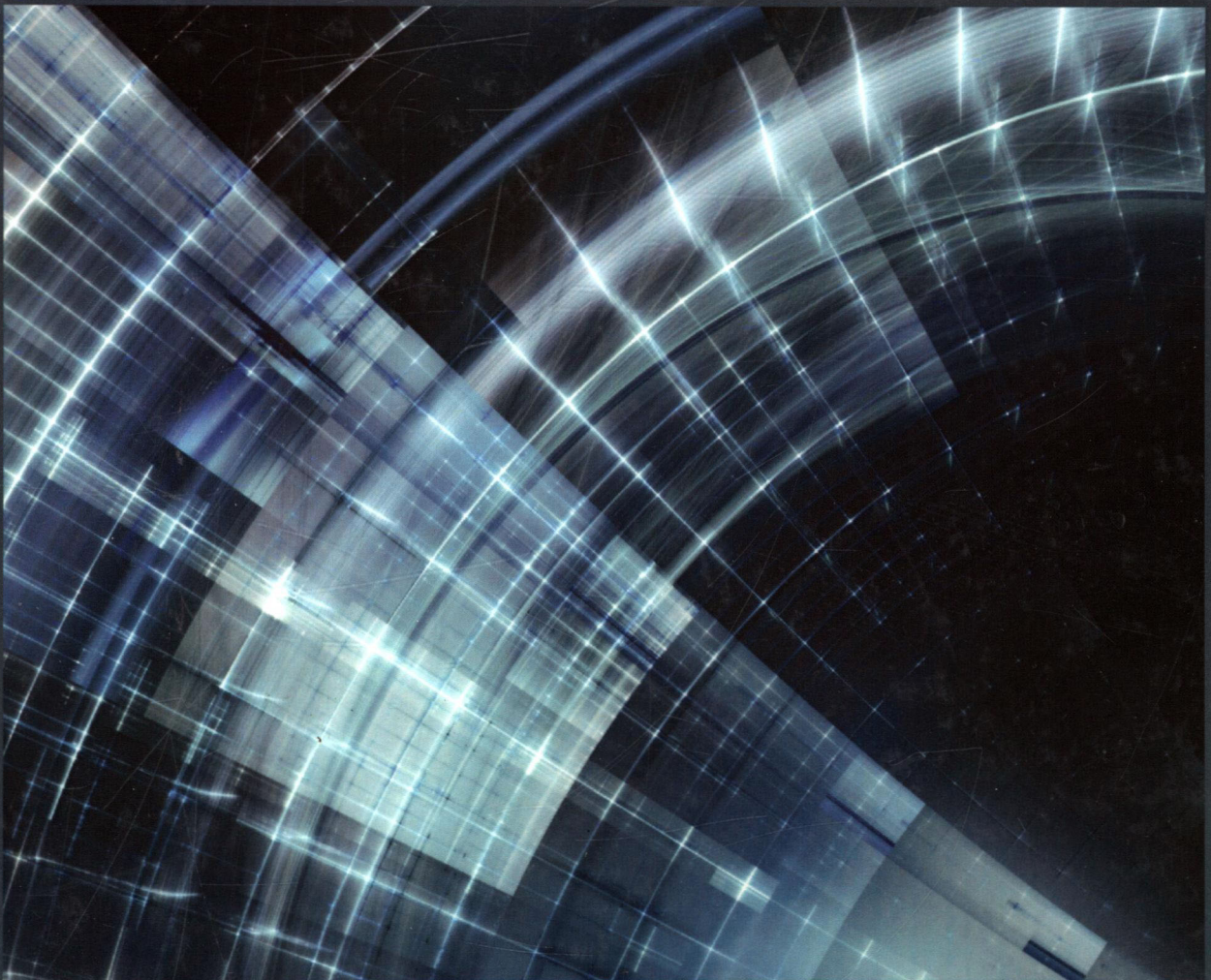


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Systems Approaches to Knowledge Management, Transfer, and Resource Development



W.B. Lee

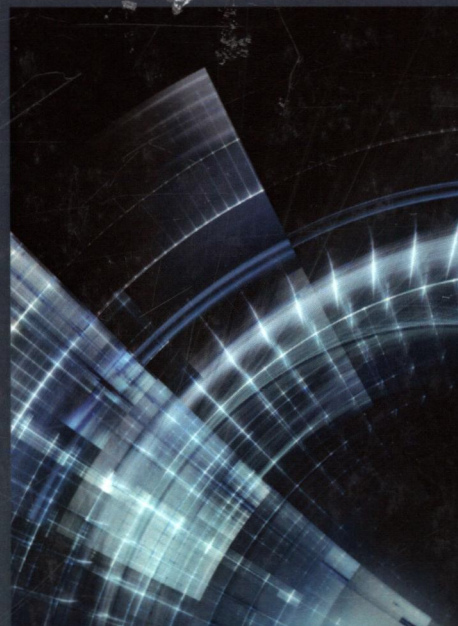
Systems Approaches to Knowledge Management, Transfer, and Resource Development

The world is moving into a new era of the knowledge economy. In the past decade, the significance of developing knowledge has grown to a level where it is now dominating other socio-economic factors.

Systems Approaches to Knowledge Management, Transfer, and Resource Development provides a new view of knowledge management through the lens of systems approach, which looks at each part of the knowledge management system as a section of the full overview. This cutting-edge resource will be essential for academicians, scientists, practitioners, and industry professionals as all of these individuals work toward a new understanding of knowledge and information management practices in the 21st century.

Topics Covered:

- Adaptive Complex Systems
- Context Management
- Epistemology, Ontology, and Semantics
- Informatics with Cybernetics and Systems Science
- Knowledge Innovation
- Knowledge Management Systems and Culture
- Organizational Learning and Complexity of Learning
- Sociological Systems Science
- Systems Theory
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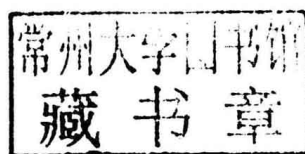
Lee

**Systems Approaches to Knowledge Management,
Transfer, and Resource Development**

Systems Approaches to Knowledge Management, Transfer, and Resource Development

W.B. Lee

The Hong Kong Polytechnic University, Hong Kong



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Preface

Background

It gives me a great pleasure and honour to introduce the first book in the Advances in Knowledge and Systems Science series published by IGI Global. This is an unique book of its kind devoted to explore the different aspects of knowledge and systems science from a multi-dimension perspective.

Looking back, our knowledge in every field of human activities has been ever exploding as well as fragmented since the industrial revolution. These encompass almost every field we know today from natural, physical, bio-medical, cognitive, information, and management, to social and philosophical sciences. Whereas on one hand we see the intensification and specialization of many subject areas which were unheard of before, on the other hand, there is also a significant parallel development in the cross-diffusion and synthesis of many domains of knowledge which sounds seemingly unrelated, but bears high resemblance in their methodologies or even ontologies. It is under such historical background where Systems Science evolves. Starting with the study of open system of Bertalanffy in the 70s, the living systems of Axelrod and Kauffman in the 90s as the nature unfolds to us, to the more recent study of complex social systems of Stacey and Snowden through a better understanding of the human interactions.

The Birth of Knowledge and Systems Science

Since the establishment of the Santa Fe Institute from a group of top scientists from Los Alamos National Laboratory in the 80s devoted to the study of complex adaptive systems, it has attracted scientists everywhere from the world, and created a new kind of scientific research community, which emphasizes multi-disciplinary collaboration in pursuit of understanding the common themes that arise in natural, artificial, and social systems. Paralleling with this development is the rapid advancements in information and communication technologies, the branch of computer science called Artificial Intelligence, AI (from the study of machine intelligence in the early years to the study of intelligent agents and systems) has found applications in many technology in autonomous vehicle, aviation, medical diagnosis, advanced user interface, and scientific classification and its application in experts systems of numerous knowledge domains. The study of AI and expert systems has also branched out and spun off into many sub-studies of knowledge representation and knowledge engineering, and knowledge science, which deals with the scientific aspects of how knowledge are represented (ontology and semantics), acquired, communicated, and learnt from different perspectives of the researchers. The modern approach in the study of AI and knowledge science has moved from formal logic and deductive reasoning to complex decision making, communication, and learning behavior in human systems.

It is based on these development that we find there is a common ground emerging from these two disciplines and a great opportunity to bring scientists from the systems science and knowledge scientist together to discuss, debate, and learn from one another on how these know-how and development can be used to synthesize in the design of advanced decision support systems and knowledge systems, and to adopt the latest findings in various applications such as ontology based learning system, medicine and healthcare, financial and risk management, et cetera.

From Wikipedia, the free encyclopedia, Systems Science is an **interdisciplinary** field of science that studies **complex systems** in nature, **society**, and **science**, and covers **formal sciences** fields like **complex systems**, **cybernetics**, **dynamical systems theory**, and **systems theory**. It is of interest to note that there is no formal entry of what is knowledge science yet, the nearest of which is knowledge engineering and epistemology. The former has a tradition of building knowledge-based systems through software engineering approach, and the latter has two thousand years of history in philosophical discourse on what knowledge is, how knowledge is acquired, and how we know what we know. Nevertheless, a lot of classical debates on the nature of knowledge has something in common with the modern Knowledge Engineering (KE), which also tries to explore how human reasoning and logic work. The overlapping areas of KE and epistemology thus constitute the legitimate study of this young knowledge science. The intimate connectedness of these two disciplines is best dealt with by the systems approach, and hence the idea of the need to bundle knowledge and systems science as the 21st century epistemology, with a parallel development in neurotronics (combining cognitive science with electronic computing) and social informatics (combining the study of social systems with information sciences). The potential for cross-diffusion, applications, and challenges ahead is huge!

The Content of Knowledge and Systems Science

The above interwoven view on the development of knowledge and systems science is reflected in the content of this book. The articles in this book is a collection of most recent papers published in the *International Journal of Knowledge and Systems Science*. These are grouped into four sections. The first part is devoted to theory and model of knowledge and systems science, the second part deals with knowledge management, the third part on various knowledge technologies and the last part on specific applications. The arrangement is as below.

Theory

Y. Nakamori and A.P. Wierzbicki introduce the system approach for the study of knowledge creation from both the social, scientific, and creative dimension so as to collapse the wall between hard and soft in systems science, and to integrate the above three fields in the establishment of a new academic system. They plead for the education of a new generation of young talents as knowledge coordinators who can act as an intermediary agents in managing technology and innovation. Such emphasis on both knowledge and social is further explored by L. Edvinsson, one of the pioneers of the intellectual capital movement. His paper is non-traditional but one that takes us through a journey to navigate what Intellectual Capital is and its significance to the knowledge enterprises and nations. He calls for a new dimension of Systems Science, that is, the Intellectual Capital (IC) Science, for the re-organization of enterprises as well as mind, as embodied now in the experimental projects on Future Centres in Europe. To Edvinsson, the cultivation of IC stands for derived insights about the most important value for our Future.

The recognition from Edvinsson that our traditional educational system does not seem to give enough cultivation of our brains is echoed in Ton Jörg's review article on advocating a new theory of learning for the creation of new knowledge and new value. He points out that an adequate theory of learning embedding the role of communicative human interaction is still very much lacking, as much of our thinking is still captive of the Newtonian paradigm, with a strong reductionist view of reality. There is a need to develop a new theory about complex, generative learning for the creation and management of knowledge in learning organizations, to foster their self-generative, self-sustaining capabilities for growth and development. The complex relationship between epistemology, ontology, and methodology in knowledge science as pointed out by Jörg is elaborated further by Z. Król, Knowledge Science and Systems Thinking which are comparatively young scientific disciplines are the "equivalent" of philosophy and epistemology that are more than 2000 years, is limited by nominalism in the philosophy of language. Without any conscious person (not necessarily a human), there is no knowledge at all. In his article, some consequences of the application of a non-nominalistic philosophy of language to the definition and classification of knowledge and tacit knowledge, and effective transfer and sharing of tacit knowledge are discussed. He urges the need for a professional collaboration between knowledge science, knowledge management, and philosophy in its next stage of development.

Knowledge Management

The discussion on the future role of knowledge management is grouped around the second part of this book. If a simple distinction is to be made between Knowledge Science (KS), Knowledge Engineering (KE), and Knowledge Management (KM), the difference is that KS deals with knowledge representation and interpretation, KE which deals with extraction, classification, storage and retrieval of unstructured information embedded in various sources and format, and KM which deals with organizational knowledge creation, development and assessment. These three areas are not independent of one another. For example the building of a taxonomy for classifying and retrieving useful information invokes a good working knowledge of ontology and semantics (KS). For the systems to be successfully designed and built, one needs to be aware of the strategic needs of the organization and the human factors involved (KM). Although the importance of Knowledge Management to create an organization's competitive advantage has been widely recognized, there are different views as to what is the essence of KM to make this into a reputable discipline as distinct from information management. David Griffiths addresses the dissatisfaction of both academics and practitioners in the area of Knowledge Management and the common weaknesses in existing thinking about KM. A new model of knowledge management is proposed. On the other hand, Jean-Louis Ermine raised the risk of massive knowledge loss problem as a result of the global aging population. Such a "knowledge crash" should be included in the general framework of any knowledge management program to be implemented. In order to retain knowledge, the importance of inter-organizational knowledge transfer is emphasized by Hepu Deng who presents a conceptual framework for the effective management of knowledge in an organization, and the development of a transformation model between data, information and knowledge.

Knowledge Technology and Applications

In the subsequent part addressing on knowledge technology, J. Gu throws light on the on the research direction of knowledge science and management by showing how a meta-synthesis knowledge system

based on the meta-synthesis system approach and knowledge science can be developed for solving problems related to the open, complex and giant systems. Essential feature of the system is that it combines human brain and computer (man-machine), synthesize opinions from experts (group knowledge), the left brain and right brain (quantitative and qualitative analysis), the reality and virtual reality (reality and virtual), and the reduction and holism (analysis and synthesis). It is well known to information scientists that ontology and semantics are the cornerstones in building knowledge systems. The state of art of the ontology mapping methods is addressed by Tatyana Ivanova, and in this section a semantic model to match knowledge descriptions in diverse language based on semantic technologies is introduced by Weisen Guo and Steven B. Kraines.

The rapid advances in Internet and Communication Technology (ICT) over the last decades does not only change the speed at which business are run, but also has profound effect on the way how information is shared and how knowledge is generated in on-line and virtual communities. Social Network and its analysis play an important role in understanding the interactions and social dynamics of these communities, The network modeling of on-line community such as the open source software community as a supernetwork is analyzed by Haoxiang Xia, whereas the effect of network structure on knowledge process and group performance are tracked by Hua Zhang and Younim Xi. Wiki technology and on-line conference are widely used nowadays to enhance communication and collaboration. The adoption of Wiki is evaluated by Christian Wagner et al. based on Media Choices Theories and come up with new insights in running an enterprise, whereas the use of a qualitative modeling and visualization tool to achieve the Web-based human-machine interaction in on-line conferencing among researchers is described by Bin Luo and Xijin Tang in details.

The last part of the book deals with the applications of various knowledge tools and methods. These include expert mining of Traditional Chinese Medicine (TCM) by Gu Jifa et al., use of semantics in government portal services by C.C. Kui et al., systems engineering approach to risk management by Mike Brownsword, group decision-making for risk response in petroleum investment by Gang Xie, modeling technique for identifying relations between design and feeling by analyzing customer requirements by Hongli Ju and J. Nakamori, and sharing and reusing tacit knowledge in robotic manufacturing by Lei Wang et al.

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Acknowledgment

I would like to thank the authors for their contributions to share their insights and thoughts in this book series. I hope this volume continues to be a source of valuable information for academics and practitioners to develop the disciplinarily of knowledge and systems science as well as to inspire their research.

W.B. Lee

Hong Kong Polytechnic University, Hong Kong

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Theory and Model

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Section 1 **Theory and Model**

Chapter 1

Systems Approach to Knowledge Synthesis 1

Yoshiteru Nakamori, Japan Advanced Institute of Science and Technology, Japan

Andrzej P. Wierzbicki, National Institute of Telecommunications, Poland

This article presents a systems approach to knowledge synthesis or construction, starting with a new systems thinking named the informed systems thinking, which should serve as the basic tool of knowledge integration and support creativity. Based on this new systems thinking, a new systems approach to knowledge synthesis or construction has been developed as a systems methodology that consists of three fundamental parts: how to collect and synthesize knowledge, how to use our abilities in collecting knowledge, and how to justify the synthesized knowledge. This article first describes the informed systems thinking and then introduces a new systems approach to knowledge synthesis and the features of this new approach from a viewpoint of knowledge creation.

Chapter 2

Evolution of IC Science and Beyond 15

Leif Edvinsson, Lund University, Sweden & The Hong Kong Polytechnic University, Hong Kong

Today we are bombarded by information and news signals, including health, meteorological, and financial issues. The interpretation of many of these signals will call for a new dimension of Systems Science for enterprises and society, which can be called Intellectual Capital (IC) Science. This article will look into the evolution of IC Science during the past 20 years and emerging signals for its future applications.

Chapter 3

A Theory of Learning for the Creation and Management of Knowledge in Learning

Communities and Organizations 28

Ton Jörg, University of Utrecht, The Netherlands

Social sciences have been in crisis for a long time, partly by being the captive of the Newtonian paradigm, and partly through the effects of this paradigm on practice. This crisis was recognized in the past by the Russian psychologist and philosopher Lev Vygotsky, and continues to this day. The educational crisis is just one instance. It is hard to imagine how to escape this crisis, and a real shift of paradigm is needed. In this article, such a shift toward the paradigm of complexity is advocated. The shift implies a reframing of complexity and a new kind of thinking in complexity. The new paradigm implies the development of a causally generative complexity theory of change and development. Ultimately, the fundamental challenge is to harness the complexity of complex, generative learning in the communities of learners in learning organizations.

Chapter 4

Towards The New Episteme: Philosophy, Knowledge Science, Knowledge and Tacit Knowledge 45

Zbigniew Król, Japan Advanced Institute of Science and Technology, Japan & Institute of Philosophy and Sociology of The Polish Academy of Sciences, Poland

The usual horizon of knowledge science is limited to nominalism, empiricism, and naturalistic and evolutionary epistemologies. I propose to broaden this horizon by applying some other philosophical attitudes, such as a non-nominalistic philosophy of language. A basic methodology for the new episteme, including (non-nominalistic) typology and a definition of knowledge and of tacit knowledge, is proposed. Several types of knowledge and the corresponding tacit knowledge are discussed within a broadened philosophical context. There are many types of knowledge and tacit knowledge using different methods of sharing. The main problem with the effective sharing of tacit knowledge is sharing knowledge *relevant* to the given problem. The transfer, change and transformation of tacit knowledge into explicit knowledge are possible. An example of such a transition, which I call *conceptualization*, is described. Conceptualization exemplifies *how* new knowledge can be created with the use of tacit knowledge. A need also exists for a professional collaboration between knowledge science, knowledge management and philosophy.

Section 2

Knowledge Management

Chapter 5

Are We Stuck With Knowledge Management? A Case for Strategic Knowledge Resource

Development 61

David Griffiths, University of Edinburgh, UK

Serge Koukpaki, University of Edinburgh, UK

This is a conceptual paper offering an approach to apparent practitioner and academic dissatisfaction with the field of Knowledge Management (KM). Discussing definitions of knowledge, the drivers for its value as an organisational resource and comparing these against definitions of Knowledge Management, this paper suggests a divergence between operational needs and KM as the medium for coordination. Offering an historical perspective of knowledge as a resource it suggests KM to be too broad a concept to be effective in fulfilling the needs of organisations. The authors suggest a continuum for knowledge