Translational Systems Sciences

Volume 20

In 1956, Kenneth Boulding explained the concept of General Systems Theory as a skeleton of science. He describes that it hopes to develop something like a "spectrum" of theories—a system of systems which may perform the function of a "gestalt" in theoretical construction. Such "gestalts" in special fields have been of great value in directing research towards the gaps which they reveal.

There were, at that time, other important conceptual frameworks and theories, such as cybernetics. Additional theories and applications developed later, including synergetics, cognitive science, complex adaptive systems, and many others. Some focused on principles within specific domains of knowledge and others crossed areas of knowledge and practice, along the spectrum described by Boulding.

Also in 1956, the Society for General Systems Research (now the International Society for the Systems Sciences) was founded. One of the concerns of the founders, even then, was the state of the human condition, and what science could do about it.

The present Translational Systems Sciences book series aims at cultivating a new frontier of systems sciences for contributing to the need for practical applications that benefit people.

The concept of translational research originally comes from medical science for enhancing human health and well-being. Translational medical research is often labeled as "Bench to Bedside." It places emphasis on translating the findings in basic research (at bench) more quickly and efficiently into medical practice (at bedside). At the same time, needs and demands from practice drive the development of new and innovative ideas and concepts. In this tightly coupled process it is essential to remove barriers to multi-disciplinary collaboration.

The present series attempts to bridge and integrate basic research founded in systems concepts, logic, theories and models with systems practices and methodologies, into a process of systems research. Since both bench and bedside involve diverse stakeholder groups, including researchers, practitioners and users, translational systems science works to create common platforms for language to activate the "bench to bedside" cycle.

In order to create a resilient and sustainable society in the twenty-first century, we unquestionably need open social innovation through which we create new social values, and realize them in society by connecting diverse ideas and developing new solutions. We assume three types of social values, namely: (1) values relevant to social infrastructure such as safety, security, and amenity; (2) values created by innovation in business, economics, and management practices; and, (3) values necessary for community sustainability brought about by conflict resolution and consensus building.

The series will first approach these social values from a systems science perspective by drawing on a range of disciplines in trans-disciplinary and cross-cultural ways. They may include social systems theory, sociology, business administration, management information science, organization science, computational mathematical organization theory, economics, evolutionary economics, international political science, jurisprudence, policy science, socioinformation studies, cognitive science, artificial intelligence, complex adaptive systems theory, philosophy of science, and other related disciplines. In addition, this series will promote translational systems science as a means of scientific research that facilitates the translation of findings from basic science to practical applications, and vice versa.

We believe that this book series should advance a new frontier in systems sciences by presenting theoretical and conceptual frameworks, as well as theories for design and application, for twenty-first-century socioeconomic systems in a translational and transdisciplinary context.

More information about this series at http://www.springer.com/series/11213

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Knowledge Construction Methodology

Fusing Systems Thinking and Knowledge Management

Springer

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Preface

Innovation means creating economic value by changing production and transportation methods, developing new products, reorganizing industrial organizations, or opening new markets. Continuous business idea creation, even more so than technology development, is essential to bring about innovation. Therefore, idea creation techniques for innovation have been actively developed. This book provides overviews of idea creation techniques in systems science and knowledge science and then introduces *knowledge construction methodology*, which integrates the spirits of systems thinking and knowledge management.

This book consists of five chapters, and the author wrote Chaps. 1 to 4 to publish Chap. 5. In other words, Chapters 1 to 4 constitute a long introduction for Chap. 5. Chapter 1 presents the definition and main theories of innovation. Chapter 2 outlines design thinking and systems thinking, which have attracted recent attention as idea generation methods for innovation. Chapters 3 and 4 introduce approaches to idea generation from systems science and knowledge science, respectively. Chapter 5 then argues that innovative ideas are developed in a creative space spanned by the dimensions of systems thinking and knowledge management.

Chapter 5 also claims that new knowledge is constructed by knowledge from three domains: the scientific-actual domain, social-relational domain, and cognitive-mental domain. The theme of each chapter will be expressed as a triad of knowledge or activities to show the legitimacy of this argument. In other words, innovation, management, design thinking, systems thinking, system models, and knowledge management are all driven by three types of knowledge or activities.

The concepts treated in this book are explained in detail in their respective chapters. Here, three important ones are explained briefly: tacit knowledge, knowledge construction, and knowledge justification.

Tacit knowledge has slightly different meanings in two different contexts. In the field of knowledge management, when used in contrast to explicit knowledge that can be expressed in words, it is defined as knowledge that is difficult to express in words. In other words, tacit knowledge is difficult to convey to others, for example, knowing how to respond to complaints or interpret sales data and understanding best practices in customer service. On the other hand, in the context of systems

thinking, tacit knowledge is a collection of various parts that are blurred subconsciously when focusing on the comprehensive whole. For example, when a collection of existing knowledge leads to the creation of knowledge for innovation, that collection is considered to become subconscious as tacit knowledge.

The methodology proposed in Chap. 5 will suggest that new knowledge is created by using these two types of tacit knowledge as *the weft and warp yarns*. Therefore, it is claimed that this methodology is the result of the fusion of systems thinking and knowledge management.

An explanation of *knowledge construction* may be a bit confusing. As a matter of fact, this book uses this term as a broad concept encompassing three concepts: knowledge creation, knowledge synthesis, and knowledge integration. The term "knowledge creation" is often used in the field of knowledge management, but it implies that new knowledge is created by inspiration that is difficult to explain analytically. Both knowledge synthesis and knowledge integration have the nuance that new knowledge is born based on multiple kinds of knowledge. However, they are different. Knowledge synthesis shifts elemental knowledge to the subconscious by focusing on the new whole. On the other hand, knowledge integration makes elemental knowledge more prominent.

Knowledge construction is defined as constructing new knowledge with multiple kinds of knowledge as building materials. In this sense, it is closest to the meaning of knowledge integration. This book, however, assumes that knowledge construction includes the meanings of knowledge creation and knowledge synthesis.

The term *knowledge justification* may be less familiar than the terms "knowledge verification" and "knowledge validation." However, when new ideas are aimed at innovation, they cannot be immediately verified or validated as correct or worthy. A new idea cannot be verified or validated unless practiced, and because there are labor and financial considerations when putting an idea into practice, you first need to get the organization's approval to do so. That is knowledge justification.

The principles of justifying new knowledge must be devised. This book introduces a set of knowledge justification principles called *constructive objectivism*. At present, this consists of the multimedia principle, emergence principle, and evolutionary falsification principle. The hypothesis is that new knowledge generated evolutionarily is justified if these three principles are satisfied. Constructive objectivism encourages the creation of innovative ideas that are difficult to verify immediately.

The expected readers of this book are those who challenge idea creation, aiming for innovation. It is particularly suitable as a textbook for young researchers such as graduate students who have just started their research. They will discover ways to promote their research by learning about innovation and creativity from this book.

The author has developed various lectures for education in systems science and knowledge science and has compiled this book focusing on the theme of innovation and creativity. It has been evaluated and improved through lectures for graduate students in various fields in Japan, China, and Thailand over the course of several years. Many sections are easy-to-understand descriptions of the research results of prominent researchers. Chapter 4 (the latter half) and Chap. 5 present original content based on the author's research.

This book begins with the definition and theories of innovation and then outlines design thinking and systems thinking that have drawn recent attention as idea creation techniques to promote innovation. Those who have already learned these are encouraged to read from Chap. 3. Chapter 3 introduces systems science, which has pursued creative methods for years, and Chap. 4 introduces knowledge science, which has appeared recently as a discipline leading the knowledge society. Those who have sufficient knowledge of these can read Chap. 5 right away.

Since this book is a compilation of lecture notes from several graduate schools, the problems prepared at the end of each chapter are intended to support graduate students and young researchers in conducting their research smoothly. Two problems are prepared in each chapter. The purpose of the first problem is to confirm the comprehension level of the chapter contents, and that of the second one is to provide practice in knowledge construction to promote research using the methodology and methods learned in the chapter.

The knowledge construction methodology introduced in Chap. 5 is a general methodology to create, integrate, or synthesize knowledge. It can also be used as a framework for developing research plans, conducting research, and verifying research results. If this framework becomes a useful guide for young researchers, it will be a great pleasure for the author.

Of course, this methodology can be used in a variety of knowledge creation contexts, which is the original purpose. The last case in this book demonstrates the creation of promotion stories to communicate the value of products or services to consumers' sensibilities. Researchers can also use this method to create stories that promote their research value to academic societies, governments, and the general public.

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