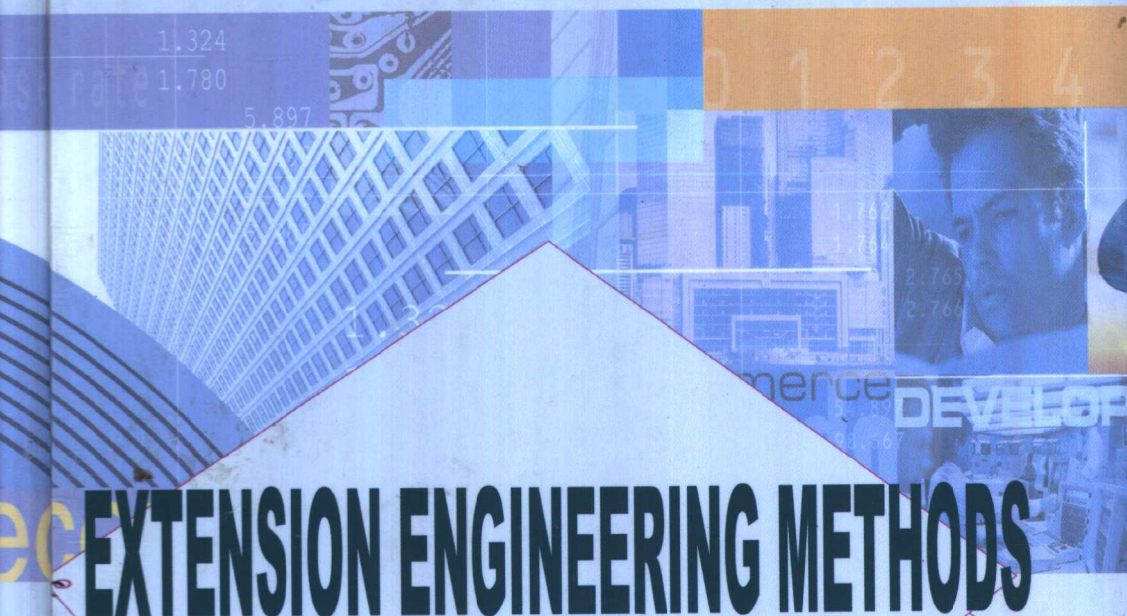
Extenics Series



EXTENSION ENGINEERING METHODS

CAI Wen YANG Chunyan LIN Weichu

科学出版社
www.sciencep.com

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Science Press
Beijing

Responsible Editors: Lu Xiujuan, Chen Jiangtao, Xue Wujian

Acknowledgements to

China National Natural Science Foundation
Guangdong University of Technology
Editorial Board for *Extencis Series*

for their great support to publish the book.

Published by Science Press
16 Donghuangchenggen North Street
Beijing 100717, China
Printed in Beijing

ISBN 7-03-011298-9/C·98(Beijing)

Editorial Board for *Extenics Series*

Abstract

This book discusses systematically the theoretic approach to extension engineering methods and their applications. Its major content includes: Chapter One: the fundamental ideas, theories and approaches. Chapter Two: the extensibility and extension method of matter-element. Chapter Three: evaluation methods and lozenge (rhombus) mode thinking. Chapter Four: transformation methods of matter-elements. Chapter Five: extension engineering methods.

This book is designed for college teachers and students, engineers, technicians as well as management personnel concerned.

Preface

Extenics was established in 1983. In the past more than 10 years, extenics has taken its initial theoretical shape and has been expanded to the field of application. Quite a few scholars and professional technicians have started to study the basic theories to apply extenics to solve various contradictory problems met in practice. We notice that the stages of applications research and practical use of extenics have come.

The key to applying theory to every actual aspect lies in methodology. In order to help more learners to acquire the basic theories, we, from the viewpoint of the basic extenics principles, have summed up in this book the results of our years' research work, and have advanced "extension method"——which acts as a "bridge" between extension theory and its actual applications. To apply extension methodology to such fields as new product designing, decision-making, searching, diagnosis, discernment and evaluation is generally known as extension engineering methods.

In the book, stress has been laid on the introduction of various extension methods and extension engineering methods. We expect that scientific researchers would combine these methods with their own researches, thus working out more extension engineering methods applicable to all specialties concerned. Meanwhile, We hope this book can serve as a bridge leading to actual application in extenics.

The first chapter of the book introduces in brief the fundamental ideas, theories and methods of extenics. The second chapter introduces matter-element extension methods. The major concepts of the

book are discussed in § 2.1 for the convenience of narration and its users. The third chapter introduces the quantified means of extenics. The fourth chapter introduces matter-element transformation and transforming bridge method. The methods introduced in chapter two, three and four are generally known as extension methodology, and typical of extenics. The fifth chapter is about the application approaches of extenics——the extension engineering methods. A number of cases are given in the last part to help the readers comprehend the basic methods and potential applications of extenics.

We have tried our best to demonstrate the basic principles and methods of extenics in simple terms and with examples from actual life when writing this book, and give precise explanations to some indispensable signs and concepts.

Because of the author' s limitation in both ability and learning, inaccuracy is inevitable. Your kindly correction will be much appreciated.

The author
1997

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Chapter 1 Introduction

§ 1.1 The Study Objects of Extenics

Section One The Producing Background of Extenics Emergence

Human beings have solved various kinds of contradiction problems since the very beginning of human history, which makes society advance gradually. The development of relationship between human beings and the nature can be divided into three stages: the first stage when human beings submitted to the nature; the second stage when human beings struggled with the nature; the third stage when human beings are taming the nature and developing harmonious ties with the nature, a stage which is characterized by intelligence, because of the advance of science in the 21st century.

Human beings were confronted with numerous problems in its long history. Ancient apes moved from in trees to the ground in order to change their ecosphere; human beings learned to get fire by drilling wood in order to drive away the coldness; human beings learned to treat diseases in order to survive these diseases; ancient people relied on slash-and-burn cultivation, encirclement and raising of animals to meet the basic needs of food and clothing. Human beings learned to build dam to fight against flood. The high development of science after first industrial revolution solved different kinds of problems.

In the course of social development, contradictions between men are countless. In order to win a battle, people came up with all kinds

of great strategies, e. g. During the Three Kingdoms (220 - 265), Kongming won a battle by using "empty-city stratagem"——presenting a bold front to conceal a weak defence. This is a good case of few defeating many. And during the Warring States (475～221. B. C), Sunbin besieged Wei state to rescue Zhao state——to relieve the besieged by besieging the base of the besiegers, to solve the contradiction between long distance and inadequate time.

In economic construction and in the management of modern enterprises, the executives of the enterprises need to cope with complex problems in a large system; a large project involves many problems in its sub-system; the detectives of the public security department want to solve a case while a criminal wants to escape; in the circumstances of more and more intense market competition and endless emergence of new products, every enterprise wants to solve its problems so that they can survive...

Contradictions are omnipresent and arise constantly. One has little fund, but he wants to open up a large company; one wants to walk in the rain, but he does not want to get drenched; the traffic systems of right-side-driving and left-side-driving will join into a large system...It is not difficult to find out the common feature of these problems: there are two incompatible parts in these problems, which are called contradiction problems.

We can say the history of human being is the history of solving contradiction problems. To solve contradiction problems, we have to extend life space, every field of science, macro or micro, so the history of human beings is also the history of extension.

The main theme of human beings is contradiction and extension. In the face of a contradiction problem, some people can do nothing with it, while others can come up with many excellent ideas. There are many solutions to any contradiction problem. These solutions are so-called "knacks", "ways", "strategies". Of course, some ideas are

feasible, while others are not.

Then, do we have any regular ways to solve contradiction problems? Can we describe the process of solving contradiction problems in formalized ways, to solve them with the aid of computers? Can human beings extend by a particular rule to make the extension activity and the nature become harmonious? Can human beings conquer the earth with its intelligence and establish harmonious relationship with the nature in the course of solving contradiction problems? This is also the real background for the emergence of extenics.

The study object of extenics is contradiction problems in the real world, and the study direction is to examine the rules and ways of solving contradiction problems. Its emergence and development is the inevitable result of the development of human society. The study of extenics will not only smarten human beings, but also make the extension activity more harmonious with the nature.

Section Two The Contradiction Problems

Contradiction problems are ubiquitous and can be put into three categories according to their natures:

(1) Subjective-objective contradiction problem (or Incompatible problem), resulting from the contradictions between one's will and objective conditions. For example, to weigh an elephant as heavy as several tons with a steelyard only capable of weighing 100kg (see note "Tsao Chung weighed elephant"*), and to move a machine which is 3 meters high through a gate that is 2 meters high is also an

* Tsao Chung, the youngest son of the emperor Tsao Cao in the Three Kingdoms, was asked to weigh an elephant, and he put the elephant into a boat and marked the water line, then substitute some stones for the elephant in the boat to get the same water line. By weighing the stones he solved the problem successfully.

incompatible problem.

(2) Subjective contradiction problems, also called antithetical problems. That means, in the same condition, one wants to achieve two or more aims that cannot be achieved at the same time. For example, to put a wolf and a chicken in the same cage; to design light but durable aircraft parts; to produce a transmitter which can transmit signals with several. Parameters in the same time in the man-made satellite. These are the antithetical problems.

(3) Objective contradiction problems. They are the problems caused by the contradiction of objective things. For instance, a plant wants to live in the desert, a mouse has to evade a cat's pursue.

Obviously, contradiction problems widely exist in every field of human activities, and exist in natural science, social science and engineering technology. It is called system contradiction problems when the object involved is a system. System contradiction may be one or more of the three types of contradiction that we have just referred to. For example, the traffic system in Hong Kong and the traffic system in the mainland of China are two antithetical systems because their traffic regulations are antithetical. Connecting them into a whole system is a problem of system contradiction.

Section Three Research on the Changeability of Matters

To settle contradiction problems, we must change some of the aims or conditions of the problems. So, we must study whether things can be changed? What methods can be used to change them, What results will be achieved because of the change? That is, we must study the changeability of things and the laws of their changes.

There are two forms of changes. One is natural change; the other is artificial change. Natural change, without influence of hu-

man, is only the change of things themselves or their environment. Artificial change is the change as a result of man's intervention. People mainly use artificial change to turn contradiction problems into compatible problems.

In the objective world, everything is the unity of quality and quantity. Therefore, the changes of things can be divided into two kinds: qualitative change and quantitative change. In the process of solving contradiction problems, we must consider the change of quality as well as the change of quantity. To solve contradiction problems, Extenics combines the research of quantitative change with that of qualitative change, studying not only the quantity relation and the changes of matters, but also the relation and changes among things and combining them together.

The theory of extenics is called extension theory. Its basic method is called extension methodology. And the application of extension methodology in every field is known as extension engineering method.

§1.2 The Theoretical Frame of Extenics

Extenics studies rules and methods of solving contradiction problems by employing formalized tool, i.e. qualitative analysis and quantitative analysis. The theory pillar of extenics is matter-element theory and extension set theory, and its logical cell is matter-element.

Section One The Logical Cell of Extenics

Quality change and quantity change are closely related to each

other and interact with each other. Classical mathematics studies quantity relation and space form, regardless of quality factor. It and its methodology are widely used under a given circumstance. However, the resolution of contradiction problem must consider both quality change and quantity change. Mathematical models are weak in solving contradiction problem because it disregards quality factor.

Proved by a great number of case analyses, mere consideration of quantity is not enough for seeking formalized ways to solve contradiction problems, characteristic and its measure of a matter must be considered as a whole, qualitative analysis and quantitative analysis must be combined to solve contradiction problems. Therefore, extenics utilizes the concept of "matter-element", which combines quality and quantity, an ordered triple of a matter, its characte-ristic and its measure as to the characteristic, denoted by $R=$ (a matter, its characteristic, its measure) $=(N, c, c(N))$. The concept of matter-element correctly reveals the relationship between quality and quantity, so we regard it as the logical cell of extenics. It helps to describe more precisely the changing process of objective matters, and in itself it conceives the possibility of from elementary description to advanced description and form simple description to complex description, and hence provides practical tools for solving contradiction problems.

Because matter-element has internal structure and internal structure has changeability, so matter-element transformations provide us with feasible tool to describe parallelism, unity and changeability of thinking activities undertaken in solving contradiction problem.

Section Two The Matter-Element Theory

The changeability of matters is called the extensibility of matter-

element. The changes of matters are described by transformations of matter-element. The kernel of matter-element theory is the extensibility of matter-element and the transformations of matter-element and the properties of matter-element transformation.

Matter-element theory describes the changeability and changes of matters in formalized language. Therefore, reasoning and calculation can be done and even computer can be used as its tool.

The advance of matter-element theory enables us to understand matters in an overall way, for example, to know the internal-external relation, paralleled relation and implication relation and the possibility of integration or decomposition of matters, on which solution to contradiction problem is based.

The advance of matter-element theory enables us to describe in formalized language the various effects caused by matter change, particularly the chain reaction and cause-effect relation, to decide on solution to problems by using the cause-effect relation, to study the side-effect caused by matter change by using the conductivity of matter-element transformation.

The advance of matter-element theory enables us to describe thinking process of human beings in a formalized way, to think in a proper and reasonable way so that we can get the strategy, ideas and solution we need.

Section Three The Theory of Extension Set

To quantify the process of solving contradiction problems, to solve contradiction problems by computers, extenics must create a tool corresponding to such quantification . Its basis is extension set theory, including extension set, dependent function and extension re-