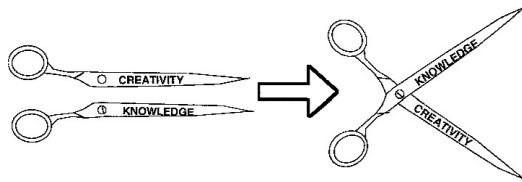


# PREFACE

The purpose of this book is to help problem solvers improve their “street smarts.” We know that every individual possesses creative skills of one type or another, and that these skills can be sharpened if they are exercised regularly. This book provides a framework to hone and polish these creative problem-solving skills.

*Strategies for Creative Problem Solving* is intended for students, new engineers, practitioners, or anyone else who wants to increase his or her problem-solving skills. After studying this book, you will be able to encounter an ill-defined problem, identify the real problem, generate and implement solutions, and then evaluate what you have accomplished. You will develop the skills needed to achieve these goals by examining the components of a problem-solving algorithm and studying a series of graduated exercises intended to familiarize, reinforce, challenge, and stretch your creativity in the problem-solving process.

To cut through the maze of obstacles blocking the pathway to the solution to the problem, we need skills analogous to a pair of scissors with two special blades.



One of the shears is made of the **knowledge** necessary to understand the problem and to develop technically feasible solutions. Of course, no cutting can be done—and no problems of invention can be solved—with just one shear. The other shear contains creativity that can generate new and **creative** ideas. Likewise, creativity alone will not necessarily generate solutions that are technically feasible—and no cutting can be done with just this single shear, either. Instead, the combination of creativity with a strong technical foundation allows us to cut through the problem to obtain original solutions.

With the aid of a major grant from the National Science Foundation, we researched the wide variety of problem-solving techniques used in industry. Teams of students and faculty visited a number of companies (see the list of acknowledgments later in this preface) to study their problem-solving strategies. We also carried out an extensive survey of new employees, experienced engineers, and managers in industry to collect information on the problem-solving process. As a result of our research, which we share in this text, we know you can become a better problem solver.

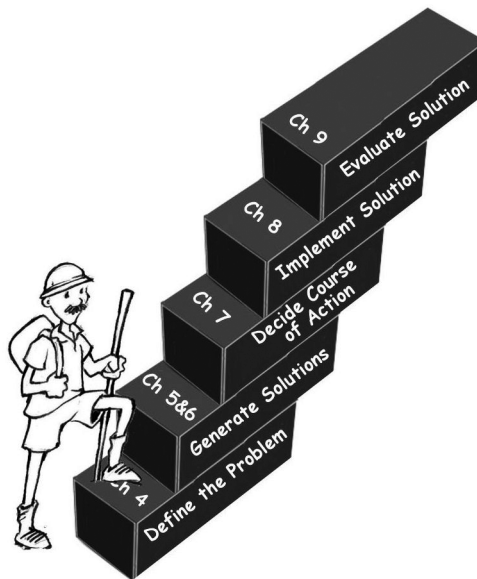
A number of the engineers and managers provided examples of industrial problems that were incorrectly defined. These examples of ill-defined problems vividly illustrate the need to define the *real* problem as opposed to the *perceived*

problem. We believe that if a problem-solving heuristic had been applied to some of these problems in the first place, then the real problem would have been uncovered more rapidly.

*A problem-solving heuristic is a systematic approach to problem solving that helps guide us through the solution process and generate alternative solution pathways.* The heuristic in this book is quite robust and is applicable to many types of problems. The problem-solving techniques presented in this book provide an organized, logical approach to generating more creative solutions.

This book is designed to guide you step by step through the problem-solving process. Chapter 1 illustrates the need to apply an organized method of solving problems and gives an overview of the heuristic (i.e., a systematic approach) introduced in this text. Chapter 2 discusses the need to approach the problem with a positive attitude and emphasizes the importance of teamwork. Chapter 3 describes how to gather more information to learn more about the problem.

The next chapters move step by step through the five building blocks of the problem-solving heuristic (shown below) to increase your problem-solving “street smarts.” We start by laying down the first building block, *Define the Problem*, and then lay one building block upon another as we move through the problem-solving process. The last block to be laid down is *Evaluate the Solution*, where we analyze all we have accomplished.



*The Five Building Blocks of the Problem-Solving Heuristic*

Chapter 10 extends the material in Chapter 4 on defining the problem to discuss techniques for troubleshooting both everyday problems and highly technical problems. We close with Chapter 11, which includes two case studies that incorporate the principles of the first 10 chapters. The first case study focuses on a project carried out by Engineers Without Borders (EWB) and was provided by Dr. Marina Melitic. The second case study is from a term project in a senior-level problem-solving course at the University of Michigan, entitled “Problem Solving, Troubleshooting, and Making the Transition to the Workplace,” in which a draft of the second edition of this book was used as the text. The syllabus for this course can be found on the CD-ROM that accompanies this book.

### Chapter Objectives

The chapter-by-chapter objectives for this new edition of the text are shown below. They provide a logical pathway to help improve and exercise your problem-solving skills.

- **Chapter 1: Problem-Solving Strategies: Why Bother?** Chapter 1 documents several examples where people defined and proceeded to solve the *perceived problem* instead of defining and solving the *real problem*. This chapter also introduces a problem-solving heuristic that can help define the real problem.
- **Chapter 2: The Characteristics, Attitudes, and Environment Necessary for Effective Problem Solving.** Chapter 2 takes an introspective look at the characteristics, habits, and actions that effective problem solvers use and helps readers develop the skills necessary to be an effective and productive members of a team that is working together to solve problems.
- **Chapter 3: Gathering Information on the Problem.** Chapter 3 describes different methods to gather information so as to define and solve the real problem. These techniques include collecting and analyzing information, talking with people who are familiar with the problem, viewing the problem firsthand, and confirming all findings.
- **Chapter 4: Problem Definition.** Chapter 4 provides four techniques you can use to help ensure that you have defined the real problem instead of the perceived problem: critical thinking, the Duncker diagram, the statement–restatement technique, and Kepner–Tregoe (K.T.) problem analysis.
- **Chapter 5: Breaking Down the Barriers to Generating Ideas.** Chapter 5 provides techniques that will help you break down barriers and preconceived notions that get in the way when you are trying to generate solutions to the problem. It also suggests ways to try to enhance your risk taking, because most truly innovative solutions require some risk.

- **Chapter 6: Generating Solutions.** Chapter 6 provides a number of techniques to help you generate solutions to the correctly defined problem, including brainstorming, vertical and lateral thinking, futuring, analogy, and TRIZ.
- **Chapter 7: Deciding the Course of Action.** Chapter 7 provides algorithms that will help you decide which problem you should work on first, which solution you should choose, how to identify potential problems, and how you can prevent problems from occurring in the future.
- **Chapter 8: Implementing the Solution.** Chapter 8 describes the steps necessary to implement the decisions you made using the techniques described in Chapter 7.
- **Chapter 9: Evaluation.** Chapter 9 shows you how to evaluate the solution you have implemented, making sure it completely solves the problem, is ethical, and is safe for both people and the environment.
- **Chapter 10: Troubleshooting.** Chapter 10 provides an algorithm and a worksheet that you can use for troubleshooting problems of malfunctioning industrial equipment and systems. This algorithm also finds application to nontechnical problems.
- **Chapter 11: Putting It All Together.** Chapter 11 shows how all of the problem-solving techniques presented in Chapters 1 through 10 can be applied to two real-life case studies.

### What's New in the Second Edition

- **Reorganization.** Related topics are more appropriately grouped together in a more coherent manner.
- **Teamwork.** The text provides guidelines to help team members work together more effectively and to resolve any conflicts they experience.
- **Critical Thinking.** Socratic Questioning and critical thinking are suggested as strategies to define the real problem.
- **New Examples.** A number of new examples are used in problem definition techniques, brainstorming, and implementation.
- **TRIZ.** This approach to problem solving helps resolve contradictions.
- **Troubleshooting.** Algorithms for troubleshooting to find the root cause of industrial equipment and process problems are presented.
- **Real-Life Case Studies.** Chapter 11 includes two new case studies that illustrate the techniques presented in the first 10 chapters. One is based on a project carried out by Engineers Without Borders in India, and the other focuses on a class term project involving employees at a local restaurant.
- **Software.** Both the CD-ROM and a Web site have been added to this edition.

## The Software

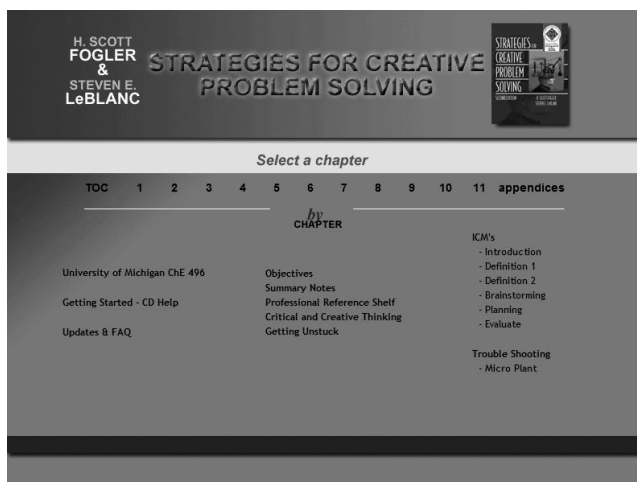
The CD-ROM and Web site (<http://www.engin.umich.edu/scps>) provide a number of learning resources:

- Summary Notes
- Web Material
- Interactive Computer Modules
- Professional Reference Shelf

The Summary Notes contain highlights from lectures on each chapter used in a senior-level problem-solving course, whose syllabus can be accessed from the CD-ROM or Web home page. The Web material contains such things as FAQs, Chapter Objectives, Critical and Creative Thinking, and Thoughts on Problem Solving. The Professional Reference Shelf offers material from the first edition along with additional examples and material for each chapter.

The interactive software found on the CD-ROM reinforces the concepts developed in the text and can be run on IBM-compatible computers. Information on how to obtain additional copies of the software for individual or class use may be obtained by writing P.S. Interactive Software, c/o CACHE Corporation, P.O. Box 7939, Austin TX 78713-7379, Fax: 512-471-7060, Email: [cache@uts.cc.utexas.edu](mailto:cache@uts.cc.utexas.edu).

Mike Kravchenko developed the Web site (<http://www.engin.umich.edu/scps>) and the CD-ROM by incorporating all of the Summary Notes and the material found in the Professional Reference Shelf. Dr. Nihat Gurmen developed the format for the Web site and CD-ROM and supervised the development of the interactive computer modules. Nihat's and Mike's creativity and attention to detail to make everything consistent was amazing.



Slides from the Summary Notes can be used for classroom presentations.

Seven interactive computer modules are available on the CD-ROM to supplement and reinforce material in the text.

- **Introduction** (Chapters 1 and 2): An interactive puzzle/game that stresses the foundations of problem solving to help students learn the concepts.
- **Definition 1** (Chapter 4): This module reviews and offers practice with problem definition techniques.
- **Definition 2** (Chapter 4): The student can sharpen his or her problem definition skills by working on one of three scenarios involving vague problem statements.
- **Brainstorming** (Chapter 6): This module leads the student through a variety of brainstorming and blockbusting techniques.
- **Planning** (Chapter 8): This module helps the student practice implementation of a problem solution using a student bridge-building competition scenario.
- **Evaluation** (Chapter 9): Playing the part of an employee in a paper mill, the student is asked to evaluate a proposed plant expansion.
- **Troubleshooting** (Chapter 10): Actual equipment malfunctions from chemical plants were collected and incorporated into this model of a plant manufacturing ethyl benzene. The student must troubleshoot the plant to identify the two faults that are randomly generated each time he or she signs on. Additional information on process equipment is available on the Web site at <http://www.engin.umich.edu/labs/mel/class/probsoly/pshome.html>.

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Kraft General Foods  
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Monsanto  
Procter & Gamble  
Shell

3M  
Upjohn

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We are particularly grateful to Professor Donald Woods for his pioneering work in bringing a structure of problem solving and troubleshooting to the engineering professions as well as initiating and stimulating the authors’ interest in teaching problem solving.

The production staff at Prentice Hall was outstanding as usual. We also would like to recognize our publisher, Bernard Goodwin; our production editor, Julie Nahil; and our copyeditor, Jill Hobbs, for their excellent work.

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One person who deserves special recognition for her work in making this book possible is Janet Fogler, our de facto editor. Janet spent endless hours going through every page of the manuscript, rewriting sentences, making sure things followed logically, giving us suggestions on how to make things clearer, and helping in many other ways. She took our original manuscript and raised it to a higher level and, indeed, is an integral part of this work.

H. Scott Fogler, Ann Arbor, Michigan  
Steven E. LeBlanc, Toledo, Ohio  
June 2007

**Strategies for Creative Problem Solving Web site:**  
**[www.engin.umich.edu/scps](http://www.engin.umich.edu/scps)**