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978-0-521-82620-4 - Innovation on Demand
Victor Fey and Eugene Rivin
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Innovation on Demand

This book describes a revolutionary methodology for enhancing technological innovation called TRIZ. The TRIZ methodology is increasingly being adopted by leading corporations around the world to enhance their competitive position. The authors explain how the TRIZ methodology harnesses creative principles extracted from thousands of successful patented inventions to help you find better, more innovative solutions to your own design problems. You'll learn how to use TRIZ tools for conceptual development of novel technologies, products and manufacturing processes. In particular, you'll find out how to develop breakthrough, compromise-free design solutions and how to reliably identify next generation products and technologies. This explains the book title. Whether you're trying to make a better beer can, find a new way to package microchips or reduce the number of parts in a lawnmower engine, this book can help. Written for practicing engineers, product managers, technology managers and engineering students.

Victor R. Fey is Adjunct Professor of Mechanical Engineering at Wayne State University and a Principal Partner and co-founder of the TRIZ Group. He is one of the few TRIZ Masters personally certified by Genrikh Altshuller, the creator of TRIZ. He has authored or co-authored seven patents, over 30 papers and two books.

Eugene I. Rivin is a professor and director of the Machine Tool Laboratory in the Mechanical Engineering department at Wayne State University and a co-principal and co-founder of the TRIZ Group providing TRIZ training and methodology for problem solving and technological forecasting. He is a Fellow of ASME and SME and an active (full) member of CIRP. Rivin holds over 60 patents and has authored more than 160 papers and 15 books.

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CAMBRIDGE UNIVERSITY PRESS
Cambridge, New York, Melbourne, Madrid, Cape Town, Singapore, São Paulo

Cambridge University Press
The Edinburgh Building, Cambridge CB2 2RU, UK
Published in the United States of America by Cambridge University Press, New York

www.cambridge.org
Information on this title: www.cambridge.org/9780521826204

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First published 2005
Printed in the United Kingdom at the University Press, Cambridge
A catalog record for this publication is available from the British Library

Library of Congress Cataloging in Publication data

ISBN-13 978-0-521-82620-4 hardback
ISBN-10 0-521-82620-9 paperback

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Preface

This book describes a powerful methodology for systematic technological innovation called TRIZ (pronounced *treez*). TRIZ is the Russian acronym for the Theory of Inventive Problem Solving (***T****eoriya* ***R****esheniya* ***I****zobretatelskikh* ***Z****adach*). The book acquaints the reader with basic tools of TRIZ and their applications to the conceptual development of novel technologies, products, and manufacturing processes.

This book is principally intended for practicing engineers whose responsibilities run the gamut from R&D activities, to design, to shop floor administration. Engineering students will also benefit from its contents. The book describes the vital role of TRIZ in the process of technological innovation. Technology managers who use TRIZ approaches often find strategic opportunities that non-users tend to overlook. They capitalize on these opportunities by developing new products and processes, as well as novel services and organizational structures.

TRIZ originated in the former Soviet Union, where it was developed by Genrikh Altshuller and his school, beginning in 1946. TRIZ was used extensively in the Soviet space and defense industries to enable engineers to overcome difficult technological challenges within an inefficient economic system. It was virtually unknown in the West, however, until a translation of one book by Altshuller was published in 1984 (*Creativity as an Exact Science*, by Gordon and Breach, New York). While the book initiated a few devotees to TRIZ, a poor translation minimized its impact.

In 1991, a TRIZ-based software package, developed by the Invention Machine Corporation, was demonstrated in New York and commercially launched. Although the software attracted significant interest, it was, essentially, only a series of illustrated problem-solving analogies that failed to reveal the thought process required for the effective application of the methodology itself. Since the software's users were by and large unfamiliar with the thought processes behind TRIZ, they were unable to fully utilize the power of this methodology.

Throughout the 1990s, small consulting groups began to appear in the West, usually founded by immigrants from the former Soviet Union. Their principals were experienced TRIZ practitioners. Many of those pioneers were students and collaborators of TRIZ's founder, Genrikh Altshuller. Those groups were solving problems for their client companies and training customers in TRIZ fundamentals. As a result of these

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efforts, leading corporations in the U.S. and overseas have reported significant benefits from using TRIZ (e.g., see Raskin, 2003).

In 1993, after modifying the approach to TRIZ training adopted in the Soviet Union to better suit American audiences and after offering several successful public seminars, the authors started a four-credit course on TRIZ at Wayne State University in Detroit. Students appreciated the course immediately. The experiences accumulated through the course instruction, as well as knowledge gained from training and consulting projects for industrial clients in the US and overseas (through The TRIZ Group founded by the authors), convinced us that a comprehensive text-book on TRIZ principles was necessary.

This book covers the basic concepts and tools of contemporary TRIZ. The only criterion for including a subject was whether it was essential for the successful application of the methodology. Every notion, method and technique is illustrated by real-life examples gleaned from different areas of technology. Many examples are based on our own inventions, both patented and otherwise, made with the help of TRIZ. Most chapters end with a set of problems and exercises that give the reader an opportunity to sharpen his or her understanding of the earlier described material.

Today's TRIZ contains numerous problem analysis and concept generation tools, not all of them well formalized. In this book, we primarily describe the most formalized tools, such as the ideality tactics, the separation principles, the sufield analysis, the Standards, ARIZ, and some others. Major non-formalized, but still powerful tools of TRIZ, such as the system operator, the size–time–cost method, and the "smart little people" method are described in other books (e.g., Altshuller, 1994, 1999; Mann, 2002).

This book addresses the application of TRIZ to two basic activities which engineers and scientists in a technology-based company may be responsible for: (A) The improvement of existing technologies, products and manufacturing processes ("problem solving"); and (B) The development of next-generation technologies, products and processes ("technological forecasting"). TRIZ has proven to be greatly beneficial for both these activities.

Proliferation of TRIZ in the West started from marketing Invention Machine™ software. Now there are several software products on the market that claim computerization of TRIZ. Usually, these products contain vast knowledge bases of various TRIZ techniques and physical effects, as well as some problem formulation tools. They also contain libraries of good design concepts gleaned from various engineering domains. In our experience, engineers trained in TRIZ to the degree of deep understanding of its principles and thought processes, can be helped by these products. This can be compared with other computer-assisted engineering activities. Extremely powerful software packages for finite element analysis (FEA) can treat a huge variety of stress/strain problems. The results, however, can be right or wrong depending on the model of the analyzed problem that was constructed by FEA software's user. So, one must be good in strength of materials and/or theory of elasticity to generate adequate FEA results. The same can

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be said about CAD packages. Although these give many prompts to the operator, it is hard to imagine somebody without a mechanical (or electrical) design background and education making a good set of design drawings.

The book is organized in six chapters and five appendixes. Chapter 1 is an introduction that demonstrates the need for systematic innovation. Chapter 2 describes TRIZ tools for resolving conflicts between competing design requirements. Application of these tools results in compromise-free design solutions. Chapter 3 introduces a TRIZ substance–field approach used for modeling physical interactions in technological systems. Chapter 4 describes the Algorithm for Inventive Problem Solving, the most powerful problem analysis and concept development tool of TRIZ. Chapter 5 describes the foundation of TRIZ – the laws of technological system evolution. Chapter 6 outlines a comprehensive approach for guided development of next-generation products and manufacturing processes based on the laws of evolution.

Appendix 1 contains a brief biography of Genrikh Altshuller, the creator of TRIZ. Appendix 2 outlines an alternative TRIZ approach to resolving conflicts. Appendix 3 expands upon the subject of the substance–field modeling approach, introduced in Chapter 3, and describes the 76 Standard Approaches to Solving Problems and the algorithm for using these Standards. Appendix 4 presents an overview of the application of TRIZ to resolving management (i.e., non-engineering) challenges. Appendix 5 contains a glossary of TRIZ terms.

For a comprehensive understanding of contemporary TRIZ, reading of the whole book is desirable. As with many textbooks, however, a selective reading may satisfy some individuals not so much concerned with applications of TRIZ to specific problems but rather interested in assessing its overall potential. Those readers who are mostly interested in the problem-solving tools of TRIZ, should pay more attention to Chapters 2–4. The readers with the primary interest in the management of technology innovation and development of next-generation technologies will mostly benefit from Chapters 5 and 6.

We know that this first TRIZ textbook is not perfect and are grateful in advance for any constructive comments and criticisms.

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