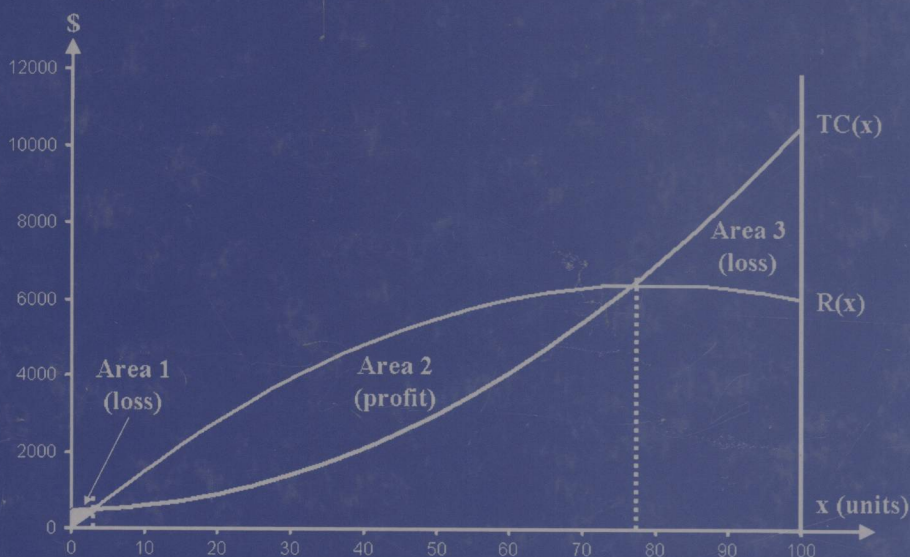


ADEDEJI B. BADIRU
OLUFEMI A. OMITAOMU

Computational Economic Analysis for Engineering and Industry



CRC Press
Taylor & Francis Group

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E2009000879



CRC Press

Taylor & Francis Group
Boca Raton London New York

CRC Press is an imprint of the
Taylor & Francis Group, an **informa** business

CRC Press
Taylor & Francis Group
6000 Broken Sound Parkway NW, Suite 300
Boca Raton, FL 33487-2742

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Printed in the United States of America on acid-free paper
10 9 8 7 6 5 4 3 2 1

International Standard Book Number-13: 978-0-8493-7477-7 (Hardcover)

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Acknowledgments

We thank all those who contributed to the completion and quality of this book. We thank our students at the University of Tennessee for their insights and ideas for what to include and what to delete. We especially thank Sirisha Saripali-Nukala and Bukola Ojemakinde for their help in composing many of the examples and problems included in the book. We also thank Jeanette Myers and Christine Tidwell for their manuscript preparation and administrative support services throughout the writing project. Many thanks go to Em Chitty Turner for her expert editorial refinement of the raw manuscript. We owe a debt of gratitude to Cindy Renee Carelli, senior acquisitions editor at CRC Press, and her colleagues for the excellent editorial and production support they provided for moving the book from idea to reality.

Dedication

This book is dedicated to our families, from whom we directed our attention occasionally while we labored on this manuscript.

Preface

The bottom line, expressed in terms of cost and profits, is a major concern of many organizations. Even public institutions that have traditionally been nonchalant about costs and profits are now beginning to worry about economic justification. Formal economic analysis is the only reliable mechanism through which all the cost ramifications of a project, public or private, can be evaluated. Good economic analysis forms the basis for good decision making. Modern decisions should have sound economic basis. Decisions that don't have good economic foundations will eventually come back to haunt the decision maker. This is true for all types of decisions including technology decisions, engineering decisions, manufacturing decisions, and even social and political decisions.

Decision making is the principal function of an engineer or manager. Over two-thirds of engineers will spend over two-thirds of their careers as managers and decision makers. Ordinary decision making involves choosing between alternatives. Economic decision making involves choosing between alternatives on the basis of monetary criteria. Economic analysis is a fundamental tool of the decision-making process. Traditionally, the application of economic analysis techniques to engineering problems has been referred to as engineering economy or engineering economic analysis. However, the increasing interest in economic analysis in all disciplines has necessitated a greater use of the more general term, economic analysis. Over the past few decades, the interest in engineering economy has increased dramatically. This is mainly due to a greater awareness and consciousness of the cost aspects of projects and systems. In the management of technology, it is common for top management people to consist largely of former engineers. It has, consequently, become important to train engineers in the cost aspects of managing engineering and manufacturing systems. Colleges and universities have been responding to this challenge by incorporating engineering economy into their curricula. All engineering and technology disciplines now embrace the study of engineering economy. This has, consequently, created a big and delineated market with a growing demand for engineering economy books. The rapid development of new engineering technologies and the pressure to optimize systems output while minimizing cost has continued to fuel the market momentum. Unfortunately, the pace of generating text materials for engineering economy has not kept up with the

demand. This is even more so in the very complex industrial environment, where integrated computational analyses are required.

This book on **Computational Economic Analysis for Engineering and Industry** provides direct computational tools, techniques, models, and approaches for economic analysis with a specific focus on industrial and engineering processes. The book integrates mathematical models, optimization, computer analysis, and the managerial decision process. Industry is a very dynamic and expansive part of the national economy that is subject to high levels of investment, risks, and potential economic rewards. To justify the investments, special computational techniques must be used to address the various factors involved in an industrial process.

A focused compilation of formulations, derivations, and analyses that have been found useful in various economic analysis applications will be of great help to industry professionals. This book responds to the changing economic environment of industry. Recent global economic anxiety indicates that more focus needs to be directed at economic issues related to industry. The book provides a high-level technical presentation of economic analysis of the unique aspects of industrial processes. Existing conventional techniques, while well proven, do not adequately embrace the integrated global factors affecting unique industries. Conceptual and philosophical publications are available on the worldwide developments in industry. But industry-focused computational tools are not readily available. This book fills that void. The contents of the book include new topics such as:

- New economic analysis models and techniques

- Tent-shaped cash flows

- Industrial economic analysis

- Project-based economic measures

- Profit ratio analysis

- Equity break-even point

- Utility based analysis

- Project-balance analysis

- Customized *ENGINEA* software tool

The book will provide students, researchers, and practitioners with a comprehensive treatment of economic analysis, considering the specific needs of industry. Topics such as investment justification, break-even analysis, and replacement analysis are covered in an updated manner. The book provides a pragmatic alternative to conventional economic analysis books. Readers will find useful general information in the Appendixes, which contain engineering conversion factors and formulae.

Adedeji B. Badiru
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2007

The Authors

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December 2006

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chapter one

Applied economic analysis

Industrial enterprises have fundamentally unique characteristics and require unique techniques of economic analysis. Thus, although the methodologies themselves may be standard, the specific factors or considerations may be industrially focused. Fortunately, most of the definitions used in general economic analyses are applicable to industrial economic analysis. This chapter presents computational definitions, techniques, and procedures for applied industrial economic analysis. As in the chapters that follow, a project basis is used for most of the presentations in this chapter.

1.1 Cost- and value-related definitions

We need to define and clarify some basic terms often encountered in economic analysis. Some terms appear to be the same but are operationally different. For example, the term *economics* must be distinguished from the term *economic analysis*, and even more specifically from the term *engineering economic analysis*. *Economics* is the study of the allocation of the scarce assets of production for the purpose of satisfying some of the needs of a society. *Economic analysis*, in contrast, is an integrated analysis of the qualitative and quantitative factors that influence decisions related to economics. Finally, an *engineering economic analysis* is an analysis that focuses on the engineering aspects. Examples of the engineering aspects typically considered in an economic design process include the following:

- Product conceptualization
- Research and development
- Design and implementation
- Prototyping and testing
- Production
- Transportation and delivery

Industrial economics is the study of the relationships between industries and markets with respect to prevailing market conditions, firm behavior,