Eugene J. Zak

How to Solve Real-world Optimization Problems
From Theory to Practice

Springer

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To my beloved wife Olga, and our cherished children, Konstantin and Katherine

Preface

Transitioning from theoretical research to the dynamic world of real-life practice involves navigating a multitude of intricacies, encompassing a comprehensive understanding of customer requirements, proficient modeling, the development of efficient algorithms, the application of specialized solvers, creation of commercial-grade software, as well as the ongoing aspects of maintenance and support.

The objective of this book is to serve as a guide for Operations Research practitioners with academic backgrounds who launch or advance their careers in industry or business. Based on extensive experience in large corporations and startups, the author has distilled the essential principles and insightful tips underlying successful practical projects. These principles are illustrated through real-world optimization problems drawn from original cases or the authors' earlier publications.

Redmond, WA, USA   Eugene J. Zak
September 2023

Introduction

*A lesson learned the hard way is a **lesson learned** for a lifetime.*

Working in the industry on both sides of the Atlantic, employed by high-tech companies, I have accumulated significant experience in solving practical Operations Research (OR) problems that, in most cases, are not textbook problems studied in universities and colleges. Still, academic textbook problems are often the starting points for all research and development performed in the industry. If an academic motto is "Publish or perish," an industry motto is "Monetize or necrotize." If we include non-profit organizations, the motto becomes "Bring value to the customers."

When you start writing a book, an obvious question arises: Who is the target audience? Who might be interested in reading this book? In my case, the answer is straightforward—my prime audience is OR practitioners who landed their career ambitions in the inspiring world of industry, business, and service. Saying that my prime audience is OR practitioners, I also keep in mind that the real-world formulations of the classical OR problems also present a considerable interest for the academic community and students.

To the best of my knowledge, this book is the first attempt to illuminate the similarities and differences in academia and industry R & D on the level of mathematical modeling of real-world problems. It is hard to publish your results when you work for a company. First, you may not have time to prepare a paper; second, management may not consider this time productive. And third, the most important one, companies guard their intellectual property closely—your work belongs to the company. In a few cases, the companies allowed me to publish and make presentations at scientific conferences, either for publicity or to keep the current staff and attract new employees. I see another positive side of publications even when you work in the industry—the feedback from the broader research community, which may even improve your program product.

My first assertion that I will push through the whole book—you cannot be a successful OR practitioner if you do not have a solid theoretical background. Being a good theoretician is a necessary but insufficient condition (as we sometimes say in mathematics) to be a successful practitioner. Ideally, you should possess a Ph.D. in Operations Research or Applied Mathematics. However, I met very talented practitioners with only a B.S. in Mathematics. Proficiency in mathematics and System Analysis is the cornerstone of your success as a practitioner.

You may ask—what is a sufficient condition to be a successful OR practitioner? In my view, it is an ability to get expertise in the subject area you want to work in. The Power System as a OR subject area is complex and takes significant learning time. I was glad to have an Electrical Engineering background when I started working on modeling in the power industry. If you communicate fluently in the professional language of your customer, there is a high chance you will succeed.

When we talk about "industry," we should remember that every company has its specifics and its own "culture." The significant differentiating factors are the company size, age, ownership (public or private), and the type of project you will be working on.

Some projects are "internal" projects that serve the company's needs. For example, if you work on marketing campaign optimization, your customer might be a marketing department of the same company you are in. Practically, there is no competition in this case. It might be one—if the solution already exists and you are working on the next generation of the same system. Only large companies can afford this type of project.

Other projects—"external" projects—serve your customers that are outside of your organization. For example, your company delivers a crew scheduling solution to an airline company. It automatically implies you will compete with other vendors, and winning such a competition is challenging. External projects are the only projects in small companies. When I worked on MajiqTrim™ (MAJIQTRIM: Trim optimization software 1995) in the paper industry, our team competed with five vendors, and our customers selected the best solution for their needs. Based on my working experience in both types of projects, I conclude that "external" projects are more challenging than "internal" ones because of fierce competition.

When I intended to write this book, I asked myself if someone had published something similar. To the best of my knowledge, I am not aware of it. Even so, as there are no two humans beings with identical DNA, there are no two scientists with the same career path. I am sure my career path, which spanned academia and industry, over two different economic systems, over small and big companies in the machine-building industry, paper industry, technology companies, power industry, retail e-commerce, and cloud-computing industry, is quite unique. As a result, I assume I can provide insights that readers find interesting and valuable.

And one more note. I use the term "project" and not "case study," though there are a lot of commonalities between these two. The first is widely used in industry, while the second is common in academia. "Case study" does not necessarily assume that the result of your work is a program product; "project" does, or it aims at least for that.

I structured the book in two parts. The first part summarizes lessons I learned across all my projects. The second part illustrates those lessons using the most fascinating practical projects.

Reference

MAJIQTRIM: Trim optimization software (1995) Users' manual. Majiq Systems and Software, Redmond, WA

Acknowledgments

Disclaimer

While I used ChatGPT 3.5 solely for language improvement, the book is entirely my creation from the first page to the last.

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