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Bruce W. Patty
Editor

Handbook of Operations Research Applications at Railroads

 Springer

Editor

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This book is dedicated to my beautiful wife, Paula, whose courage, intelligence and determination inspire me every day. Without her support and encouragement, this book would still be a dream for me.

Bruce W. Patty, Editor

Preface

I am very pleased and proud to have been able to serve as the Editor for this book. I first started working on railroad problems over 20 years ago while a member of American Airlines Decision Technologies, a consulting group within American Airlines. I quickly learned how operationally complex railroad problems are compared to airline problems. For example, passengers can transport themselves from one gate to another when they need to make a connection between flights. To connect a railcar from one inbound train to an outbound train requires several steps involving many people, tracks, and locomotives. Airlines rarely have to be concerned about the capacity *between* two airports. Railroads do not have the luxury of traveling *over* another train moving between the same two terminals. However, there are some areas where railroads have a definite advantage. Airlines would love to have the ability to add another engine to a plane, allowing it to carry more passengers. They also would love to have the ability to have two planes, each with three engines arrive at a terminal, and then have two planes depart the terminal, one with four engines and one with two. As I continued to work with railroads, I became more and more engaged with figuring out how to apply Operations Research models and approaches to address these complex rail problems.

The topics covered by the chapters in this publication have been specifically selected to give readers the complete spectrum of the role that Operations Research has played and can play in the improvement of North American freight railroads. Not only have the topics been specifically chosen to provide this spectrum, but the authors of the chapters are recognized award-winning scholars and practitioners with a deep knowledge and understanding of their specific topics. The chapters have been written in a diverse manner so that readers who are looking for an understanding of how decisions are made at railroads will find what they are looking for, as will readers who are looking for examples of mathematical programming formulations to complex problems.

The team of Carl Van Dyke and Dr. Marc Meketon have authored three chapters: Train Scheduling, Car Scheduling and Railway Blocking Process, and teamed with me on a fourth, Network Analysis and Simulation. Carl and Marc have worked with railroads for over three decades to apply Operations Research tools, most recently while

at Oliver Wyman. The tool they developed, Multi Rail, is in use at all of the Class I railroads in North America. Their work was recognized in 2003 by INFORMS as key members of the Franz Edelman prize-winning team for the work at Canadian Pacific Railway. Carl was recently awarded the 2014 Distinguished Member award of the Railway Applications Section of INFORMS. Their chapters provide readers with deep insights as to how decisions are made at railroads, the kinds of tools used, and the IT challenges that must be overcome.

The team of Ravindra Ahuja and Bala Vaidyanathan have authored two chapters: Locomotive Scheduling and Crew Scheduling. Dr. Ahuja is a renowned optimization expert, having won the Koopman Prize and the Lanchester Prize, and he has been named an INFORMS Fellow. He and his colleagues at Optym, formerly Innovative Scheduling, have applied his optimization approaches to problems at railroads for several years, including CSX Transportation, BNSF, and Norfolk Southern. Their chapters provide a detailed look at mathematical programming formulations and solution approaches to their topics.

Dr. Michael Gorman, currently a Professor at the University of Dayton, has authored two chapters: Empty Railcar Distribution and Pricing/Revenue Management. Dr. Gorman is especially well qualified to expound on these two topics. His work in the area of Empty Railcar Distribution for CSX Transportation resulted in their team being named Finalists for the Franz Edelman Award. His work in the area of Pricing for the Hub Group resulted in their team being named a Finalist for the Wagner Prize. Both of these competitions are focused on application and practice of Operations Research. Dr. Gorman has also received awards for his teaching of Operations Research. Prior to joining the faculty at the University of Dayton, Dr. Gorman led the Operations Research groups at Santa Fe Railroad and then BNSF after the merger. His chapters provide a combination of mathematical and algorithmic insights as well as insights into real-world applications.

Roger W. Baugher has worked to apply Operations Research tools to railroads for over 40 years. He has authored two chapters: Simulation of Line of Road Operations and Terminal Simulation. He was instrumental in the development of Algorithmic Blocking and Classification (ABC) while at Norfolk Southern and has also worked at BNSF. He was the first recipient of the RASIG Award for his contributions to OR in the railroad industry. Mr. Baugher has also contributed to the book, "The Railroad, What it Is, What it Does." His chapters provide significant insights into rail and terminal operations.

I have applied my understanding of network optimization approaches to various forms of transportation, including airlines, freight railroads, and intermodal. My chapter on Intermodal Rail is based on insights from my years of working in the rail industry, especially those spent in Intermodal. I helped to found the Railroad Applications Special Interest Group (RASIG) and have worked to apply Operations Research techniques at railroads for over 20 years as both a railroad employee and a consultant. I am a Franz Edelman Laureate and served on the INFORMS Board of Directors. While at American Airlines, I led the project team for the work done at Conrail during which time the Conrail Network Analysis Model (CNAM) was developed. I later spent 7 years at Pacer Stacktrain as AVP of Equipment Strategy

during a time when Pacer Stacktrain had the largest domestic intermodal container fleet in the United States, pioneering the use of sophisticated analytical approaches to chassis management.

We all hope that you enjoy the book and that it provides you with insights regarding the application of Operations Research at Freight Railroads!

San Rafael, CA, USA

Bruce W. Patty

Contents

1 Train Scheduling	1
Carl Van Dyke, Marc Meketon, and Problem Solving Competition Committee	
2 Locomotive Scheduling Problem	43
Balachandran Vaidyanathan and Ravindra K. Ahuja	
3 Simulation of Line of Road Operations	57
Roger W. Baugher	
4 Car Scheduling/Trip Planning	79
Carl Van Dyke and Marc Meketon	
5 Railway Blocking Process	119
Carl Van Dyke and Marc Meketon	
6 Crew Scheduling Problem	163
Balachandran Vaidyanathan and Ravindra K. Ahuja	
7 Empty Railcar Distribution	177
Michael F. Gorman	
8 Network Analysis and Simulation	191
Carl Van Dyke, Marc Meketon, and Bruce W. Patty	
9 Simulation of Yard and Terminal Operations	219
Roger W. Baugher	
10 Operations Research in Rail Pricing and Revenue Management	243
Michael F. Gorman	
11 Intermodal Rail	255
Bruce W. Patty	
Index	275