

PREFACE

PROLOGUE

Operations research (OR) had its origins in the late 1930s when a group of British Royal Air Force officers and civilian scientists were asked to determine how recently developed radar technology could be used for controlled interception of enemy aircraft. The task required scientists from various disciplines to leave their academic and laboratory settings and participate in field operations, testing, and evaluation. This embryonic but seminal applied research activity was followed by the formation of OR groups to investigate military problems encountered by the services on land, sea, or in the air. The resulting methodological approach was called operational research in the U.K. and operations research in the U.S. The salient feature of this research activity was to bring scientists from diverse disciplines directly into the field to solve operational military problems and make related tactical and strategic recommendations. Throughout World War II (WWII), on both sides of the Atlantic, OR groups analyzed critical military problems. The solutions they produced led to changes in military strategy and tactics that greatly improved results. OR helped the Allies win the war.

At the end of WWII, the U.S. military services, recognizing the wartime contributions of OR, continued their support of OR groups with the problems now focused on logistics, combat modeling, and force planning. Similarly, senior scientists who had participated in wartime OR in the U.K and U.S. were convinced that OR could be used to solve management and operational problems of nonmilitary enterprises and government. OR groups were soon formed and employed by governmental

entities and private companies in the U.K. and U.S., professional societies organized, OR consultancies established, and academic OR programs initiated. Today, OR is recognized worldwide as a modern, decision-aiding science that has proved to be of great value to management, business, and industry. The history of how this came about has been reported in many papers and books in the usual narrative form. In contrast, we chose to present this history by means of individual profiles of OR's pioneers and innovators.

What is Operations Research?

"Operations Research is a scientific method for providing executive departments with a quantitative basis for decisions regarding the operations under their control" [Goodeve, C. 1948. Operational Research. *Nature* **161**(4089) 377–384].

Operations Research is defined by "mathematical or scientific analysis of the systematic efficiency and performance of manpower, machinery, equipment, and policies used in a governmental, military, or commercial operation" (*The American Heritage Dictionary of the English Language* 1976, 921).

Operations Research is the science of decision making.

OR is a relatively young field. Many of its developers are still alive and records of their accomplishments are available from them and/or from colleagues and friends. Similarly, for those who have passed on, writings and reports of their OR activities are still reasonably accessible, and can be amplified with the memories of close collaborators or friends. These fortunate circumstances related to timely access led us to believe that the history of OR could be told in a comprehensive and interesting manner through individual profiles. We felt that we had a window of opportunity to capture the story of these pioneers as they charted their courses through the early years of OR and saw it mature as a field. To accomplish this objective, we drew upon historical and technical articles, autobiographies, biographies, interviews, the resources available via the World-Wide Web, and existing accounts of the history of OR. And, most important, we were able to find authors who, as close colleagues or friends, were in the best position to relate the professional and personal histories of the persons they profiled.

We have organized the 43 profiles of this book chronologically, in ascending order of the date of birth (by day, month, and year) of the profilees. The reader progressing from Patrick Blackett's profile (Chapter 1, born in 1897) through Ronald Howard's profile (Chapter 43, born in 1934), will be exposed to a history of the origins and early development of

OR—how it evolved—all interwoven with personal backgrounds, tales, vignettes, and pictures. An alphabetical listing of the profiles follows:

Profiles		
Russell Lincoln Ackoff	Saul I. Gass	Hugh Jordan Miser
E. Leonard Amoff	Murray Aaron Geisler	Philip McCord Morse
Egon Balas	Ralph E. Gomory	Howard Raiffa
Evelyn Martin	Charles Frederick	Berwyn Hugh Patrick
Lansdowne Beale	Goodeve	Rivett
Anthony Stafford Beer	David Bendel Hertz	Bernard Roy
Richard E. Bellman	Ronald A. Howard	Thomas L. Saaty
Patrick Blackett	Ellis A. Johnson	Herbert A. Simon
Alfred Blumstein	Leonid Vital'evich	Jacinto Steinhardt
Seth Bonder	Kantorovich	Albert W. Tucker
Abraham Charnes	George E. Kimball	Steven Vajda
C. West Churchman	George Kozmetsky	Andrew Vazsonyi
William W. Cooper	Harold W. Kuhn	John von Neumann
George B. Dantzig	John D. C. Little	Harvey M. Wagner
Jay Wright Forrester	John F. Magee	Philip Starr Wolfe
D. Ray Fulkerson	Harry Markowitz	

The main table of contents is given by name in birth order, followed by a secondary table of contents by name in alphabetical order.

Two tables in the Appendix summarize key information about the profilees: Table 1-Profiles Background, and Table 2-Profiles Honors and Awards. In Table 1, we list date and place of birth, and the discipline and year of the associated highest earned academic degree. From the dates of birth, we note an interesting feature of the early years of OR: the majority of those profiled fall into a fairly narrow generational band. The dates of birth of 31 of the 43 profilees lie in the 20-year period from January 1912 to December 1931 (from Kantorovich to Wagner). This forms a fairly compact cluster of individuals who were between 14 and 33 years of age at the end of WWII. An even narrower band emerges if we consider the year of completion of their formal studies. Out of this group of 31 profilees, 23 completed their formal studies during the period 1945–1960. For the 43 individuals profiled, mathematics, not surprisingly, was the preponderate study area of 21 of the them. The first Ph.D. in OR was awarded in 1955.

In Table 2, we summarize the impressive achievements of the 43 profilees by citing their major honors and awards. Such recognition includes Nobel prizes, governmental medals, national scientific society memberships, and professional association medals and prizes.

Profiles in Operations Research has been written for OR practitioners, OR academics, students of OR, scientists from related fields, as well as the general public interested in the origins and accomplishments of an applied science. For this broad audience, we note that OR problems, OR techniques, and OR solutions are a part of everyone's daily life—when making an airline or hotel reservation, finding the desired products on a supermarket's shelves, joining a waiting line at a bank or post office, having Internet purchases arrive as scheduled, filling an auto's gas tank with the correctly blended fuel—all as a result of OR analyses.

The choice of the persons profiled was based on our collective knowledge of the field. Aiming for a single volume of reasonable size, we limited our initial selection to 50 subjects, all of whom had a seminal or major influence on the development and growth of OR. Over time, some of our original choices did not materialize because we could not identify suitable authors, or find sufficiently rich sources of information, or relax time constraints that precluded possible authors from participating.

The 43 profiles were written by 40 authors, including the two editors. We wish to thank and express our appreciation to the authors who worked with us over many, many months of editing, re-editing, and more re-editing. Each went the extra research mile when encountering comments and questions from the editors. We appreciate the personal perspectives they provided drawing upon their extensive and detailed knowledge of the individuals they profiled. In many cases, the authors were students or colleagues of the persons they profiled, who often collaborated on key research contributions that continue to shape OR theory and practice. While editing for some measure of uniformity, the authors were allowed to present the profiles their way.

We thank the many families and friends of the persons who are profiled for their help in answering queries from the authors and the editors, making source and other documents available, allowing us to quote from personal correspondence, and for the use of family pictures. Their cooperation is sincerely appreciated.

We thank Ron Gass for his editing of many of the profile pictures—he is an expert in obtaining blemish-free pictures while improving their clarity and color. We are especially appreciative to Kluwer Academic Publishers and its editor, Gary Folven, under whose guidance we contracted to write this book, and to Springer Science + Business Media, Inc. and Neil Levine, who became our Springer editor when Kluwer was incorporated into Springer. And, we thank Fred Hillier, the Kluwer/Springer OR series editor for his support.

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EPILOGUE

Early in our education, we, Arjang and Saul, developed an interest in the history of science driven by our own curiosity in the sciences, especially mathematics. We augmented our schooling by biographical tales from Eric Temple Bell's *Men of Mathematics*, the story of how mathematics developed across the centuries from Carl Boyer's *A History of Mathematics* and, later, we moved on to such works as Norbert Wiener's two-volume autobiography,

Ex-Prodigy and *I am a Mathematician*, and Constance Reid's *Hilbert*. Thus, by the time each of us entered into a research-oriented course of training, we had developed an appreciation of the value of such historical accounts in shaping our views of how one matures as a scientist. Our interest in this area continued as we read John Stillwell's *Mathematics and its History*, or the collection of interviews in *Mathematical People*, edited by Donald Albers and Gerald Alexanderson. As we examined historical or biographical sources in other sciences, notably the physical, biological, and computer sciences, and came to appreciate the wealth of such sources, we were struck by the paucity of studies devoted to the history of OR.

In the past, there have been a few articles that recounted the early history of OR; Joseph McCloskey's three papers that appeared in *Operations Research* in 1984 come to mind. More recently, we have Maurice Kirby's book, *Operational Research in War and Peace*, and our book, *An Annotated Timeline of Operations Research: An Informal History*. We are believers in the need for such historical accounts. By neglecting this need, the failure to chronicle our field will mean that important lessons will be lost to the coming generations of OR researchers, practitioners, and students.

In writing and compiling *Profiles in Operations Research*, we were often stymied in our quest for information about particular profilees—there was little they wrote about except what was contained in their technical papers and reports. It would have been valuable to have background information, the why and how of the rest of the story. In contrast, other profilees diligently recorded their stories in articles, interviews, and autobiographies. These historical treasures enabled the profile author(s) to describe a more detailed and integrated account of a profilee's OR contributions and personal background. We encourage the reader who is engaged in OR innovations and developments to do the same. There is a need for historical accounts of all aspects of OR; we welcome others to delve into this fascinating field.

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Quotations, References, and Sources

We have tried to be extra diligent in referencing material, especially the sources of quotes. U.S. English is used except for quotes and titles from a British English source. For a published book or article, quotes are cited by (author last name, year, page numbers); quotes from sources that are not paginated such as the Worldwide Web, letters, personal communications, and interviews, are cited by (author, year). Chapter reference formats: books are given by authors (last name first of initial author), year of publication, book title, publisher, city; papers (articles) are given by authors (last name first of initial author), year of publication, paper title, journal (or source), volume number, issue number in parentheses, followed by page numbers.

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Pioneers and Innovators

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