Big Data Analytics Using Multiple Criteria Decision-Making Models

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Ramakrishnan Ramanathan
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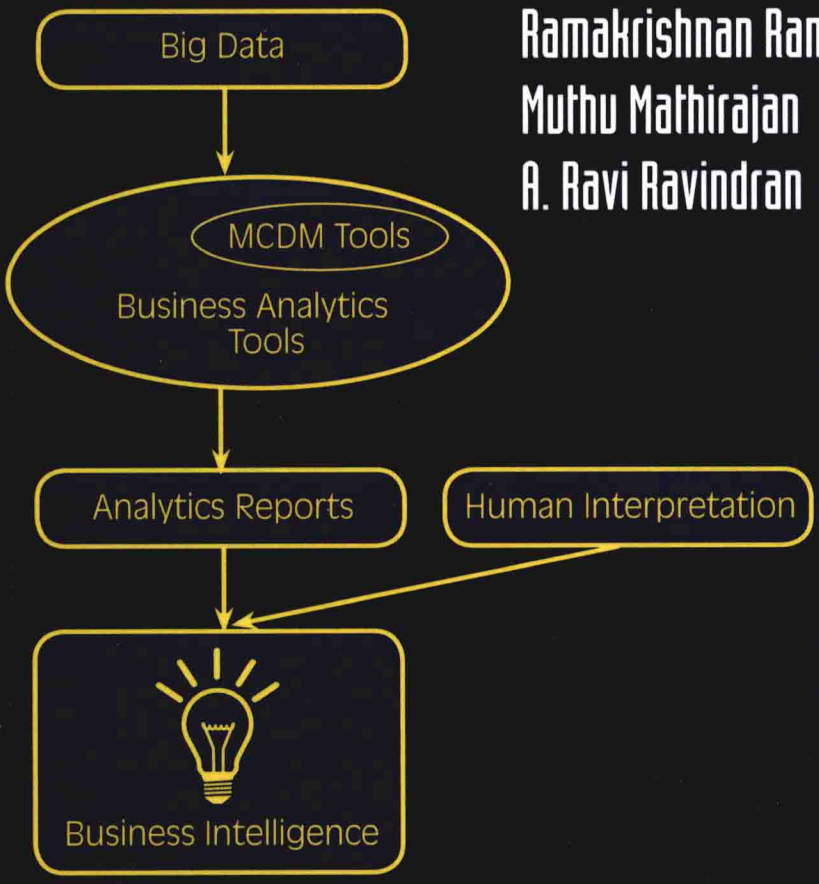

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Preface

The idea to produce this book originated in an International Symposium (http://www.ravisymposium.org/) organized in honor of Professor Ravi Ravindran in Bangalore during 12th–13th March 2015. The symposium was organized to commemorate 70th birthday of Professor Ravindran by his former doctoral students. The aim of the symposium was to create a platform and facilitate knowledge sharing on the applications of operations research (OR) in multiple criteria decision making, analytics, healthcare delivery systems, supply chain engineering, and project management. At the valedictory session, various themes for a book were brainstormed and it was decided to pursue the first two themes of the symposium, namely multiple criteria decision-making and analytics, in developing a book that would fittingly honor the extraordinary achievements of Professor Ravindran for a long time. It was also decided that the book will include chapters from Professor Ravindran's legacy—from his PhD students who are very successful academics/industrialists—in various parts of the world.

Multicriteria decision making (MCDM) is a subfield of operational research and is one of the so-called decision-making tools. A decision-making problem is characterized by the need to choose one or a few from among a number of alternatives. A good decision-making process should not only improve the clarity of the problem to the decision maker, but it should also shed new light into the problem by generating newer alternatives. The field of MCDM has been succinctly defined in the literature as making decisions in the face of multiple conflicting objectives. Chapter 2 of this volume provides a detailed description of the various MCDM models and also a comparative perspective on these models.

The field of MCDM assumes special importance in this era of big data and business analytics (BA). In the modern digital world, a wealth of so-called big data is being generated every minute, every second, even every nanosecond. Thanks to the astounding technological revolution, everything around us is being captured in someway or the other, stored in some form, and it is believed that this has the potential to make better business decisions. BA involves an appropriate use of analytic tools on big data to provide new predictive/prescriptive/descriptive insights that will allow businesses perform better. Since big data and BA are relatively recent phenomena, studies on understanding the power of big data and BA are rare with a few studies being reported in the literature. Chapter 3 of this volume is dedicated to address the basics of big data and BA. BA involves both modeling-based tools and statistics-based tools. The modeling-based tools involve use of operational research models. In this volume, the focus is primarily on

modeling-based tools for BA, with exclusive focus on the subfield of MCDM within the domain of operational research.

We believe that the two themes of the book, MCDM and big data, address a very valuable research gap. While there are several textbooks and research materials in the field of MCDM, there is no book that discusses MCDM in the context of emerging big data. Thus, the present volume addresses the knowledge gap on the paucity of MCDM models in the context of big data and BA.

There was an instant response from Professor Ravindran's students and colleagues for the call for contributions of the book. A total of 15 chapters were considered in the first round of review. Though all of them were of good quality, after careful review and evaluation for the fit for the theme of the book, it was decided to include 13 chapters in this volume. At least five of these chapters have been authored by students and close associates of Professor Ravindran. There are contributions from authors based in the United States (5 chapters), from the United Kingdom (2), and from India (6).

This volume starts with a fitting Festschrift in Honor of Professor Ravindran by Professor Adedeji B. Badiru. The rest of the volume is broadly divided into three sections. The first section, consisting of Chapters 2 and 3, is intended to provide the basics of MCDM and big data analytics. The next section, comprising Chapters 4 through 10, discusses applications of traditional MCDM methods. The last section, comprising the final three chapters, discusses the application of more sophisticated MCDM methods, namely, data envelopment analysis (DEA) and the analytic hierarchy process.

Due to the topical nature of the theme of big data, it has been a challenge to ensure that the contributions of this volume, from traditional MCDM researchers, had adequate treatment of big data. We believe that the chapters of this book illustrate how MCDM methods can be fruitfully employed in exploiting big data, and will kindle further research avenues in this exciting new field. We also believe that the book will serve as a reference for MCDM methods, big data, and linked applications.

Ramakrishnan Ramanathan
Muthu Mathirajan
A. Ravi Ravindran

Editors

Ramakrishnan Ramanathan is the Director of Business and Management Research Institute, in the Business School of the University of Bedfordshire, Luton, the United Kingdom. In the past, he has worked and taught in a number of countries, including the United Kingdom, Finland, the Netherlands, Oman, and India. He has taught basic and advanced courses on operations management, production systems management, supply chain management, optimization theory, DEA, management science, business statistics, simulation, energy and environment, energy and environmental economics, energy and transport economics, and others. His research interests include operations management, supply chains, environmental sustainability, economic and policy analysis of issues in the energy, environment, transport, and other infrastructure sectors. He works extensively on modeling using techniques such as optimization, decision analysis, DEA, and the analytic hierarchy process.

Ram has successfully completed a number of research projects across the world. He is on the editorial boards of several journals and in the technical/advisory committees of several international conferences in his field. He is an advisory board member of an innovative new online resource, *The Oxford Research Encyclopedia of Business and Management*. He is a member of ESRC Peer Review College in the United Kingdom. He has produced four books (including an introductory textbook on DEA), more than 119 research publications in journals, and more than 141 conference presentations. His research articles have appeared in many prestigious internationally refereed journals, including *Omega, Tourism Economics, International Journal of Production Economics, Supply Chain Management, International Journal of Operations & Production Management, European Journal of Operational Research, Transport Policy,* and *Transportation Research.*

More details about Professor Ramanathan are available at the following links:

Profile: http://www.beds.ac.uk/research-ref/bmri/centres/bisc/people/ram-ramanathan

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Facebook: http://www.facebook.com/ProfRamanathan
Twitter: @ProfRamanathan

Muthu Mathirajan has been working at the Department of Management Studies, Indian Institute of Science (IISc), Bangalore since April 1986 with various academic/faculty positions. Currently he is a Chief Research Scientist at IISc, Bangalore. He received MS (Engineering) degree by research in applied operations research area, and PhD degree in operations management area from the Faculty of Engineering, IISc, Bangalore. In addition, he holds an MSc degree in Mathematics of Madurai Kamaraj University, and Postgraduate Diploma in operations research (OR) of Anna University, Chennai.

During May 2008–May 2010, Dr. Mathirajan was with Anna University of Technology, Tiruchirappalli, on deputation, and he was the Professor of Planning and Development at the University level and he was also the Professor and Head of the Department of Management Studies of the Anna University of Technology, Tiruchirappalli.

Dr. Mathirajan was a postdoctoral fellow at Singapore MIT Alliance (SMA) of Nanyang Technological University, Singapore. He was also a visiting consultant at Sultan Qaboos University (SQU), Oman. Dr. Mathirajan was selected and nominated as young Indian representative of Operational Research Society of India (ORSI) to present a paper in the 1999 Fall Annual Conference of ORSJ, Tokyo, Japan.

Dr. Mathirajan's PhD thesis was adjudged as best thesis for "M. N. Gopalan Award of 2002—Annual Convention of ORSI." Dr. Mathirajan's research interests are in the development of mathematical modeling and heuristic methods for the problems related to industrial engineering, operations, logistics and supply chain management in manufacturing, service, and container terminal management areas. He has published over 155 research articles and 3 books.

He has guided a number of graduate and postgraduate projects. So far seven dissertations were awarded PhD degree under his guidance in IISc, Bangalore. Currently, he has been guiding two doctoral research students at IISc; and he has examined several PhD theses from various higher learning Institutes (such as IITs, IIM, NITs) and Universities (such as Anna University Chennai, Gandhigram Rural University, Madurai Kamaraj University, Bharathiar University, Delhi University, Dr. MGR University).

A. Ravi Ravindran is a Professor and past Department Head of Industrial and Manufacturing Engineering at the Pennsylvania State University since 1997. Formerly, he was a faculty member in the School of Industrial Engineering at Purdue University for 13 years (1969–82) and at the University of Oklahoma for 15 years (1982–97). At Oklahoma, he served as the Director of the School of Industrial Engineering for 8 years and as the Associate Provost of the university for 7 years with responsibility for budget, personnel, and

space for the academic area. He holds a BS in Electrical Engineering with honors from BITS, Pilani, India. His graduate degrees are from the University of California, Berkeley, where he received an MS and a PhD in Industrial Engineering and Operations Research.

Dr. Ravindran's area of specialization is operations research with research interests in multiple criteria decision making, financial engineering, healthcare delivery systems, and supply chain optimization. He has published seven books (*Operations Research: Principles and Practice, Engineering Optimization: Methods and Applications, Handbook of Operations Research and Management Science, Operations Research Methodologies, Operations Research Applications, Supply Chain Engineering: Models and Applications, Multiple Criteria Decision Making in Supply Chain Management*) and over 150 journal articles in operations research. His recent text book on *Supply Chain Engineering* received the Institute of Industrial Engineers *Book of the Year Award* in 2013.

Dr. Ravindran is a *Fulbright Fellow* and a *Fellow* of the Institute of Industrial Engineers (IIE). In 2001, he was recognized by IIE with the *Albert G. Holzman Distinguished Educator* award for significant contributions to the industrial engineering profession by an educator. In 2013, he received the *Outstanding Teaching Award* in the College of Engineering from the Penn State Engineering Alumni Society. He also received the *Outstanding Faculty Award* from the IE Graduating Seniors in spring 2014. He has been a consultant to AT&T, CNH America, General Motors, IBM, Kimberly Clark, General Electric, U.S. Department of Transportation, the Cellular Telecommunications Industry Association, and the U.S. Air Force.

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Acknowledgments

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Next, we would like to thank the authors, who have worked diligently in producing the book chapters that are comprehensive, concise, and easy to read, bridging the theory and practice. The development and evolution of this book have also benefitted substantially from the advice and counsel of our colleagues and friends in academia and industry, who are too numerous to acknowledge individually.

Finally, we would like to thank Cindy Carelli, senior acquisition editor and Ashley Weinstein, project coordinator at CRC Press for their help from the book's inception until its publication.

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