

# MICHAEL OWEN BALL

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Institute for Systems Research  
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Citations: <https://scholar.google.com/citations?user=5TnBvAEAAAAAJ&hl=en>

## PROFESSIONAL INTERESTS

Operations research.  
Transportation science, especially air traffic management.  
Supply chain management and revenue management.  
Network and combinatorial optimization.  
Network reliability analysis.

## EDUCATION

PhD Operations Research, Cornell University, 1977.  
MSE Operations Research, Johns Hopkins University, 1972.  
BES Engineering Science, Johns Hopkins University, 1972 (Phi Beta Kappa, Tau Beta Pi, general and departmental honors).

## ACADEMIC EXPERIENCE

8/90-present	Dean's Chair in Management Science, Robert H Smith School of Business, University of Maryland, College Park (9/12-present); Orkand Corporation Professor of Management Science (8/01-9/12); Interim Dean, Smith School (7/13-8/13); Senior Associate Dean, Smith School (12/13-present); Associate Dean for Faculty and Research, Smith School (8/10 – 12/13); Associate Dean for Research, Smith School (8/09 – 8/10); Director of Research, Smith School (6/98 – 8-09); Acting Director, Center for Knowledge and Information Management (6/98 – 6/00); Co-Chair of Decision and Information Technologies (5/98 - 5/99); Chair, Management Science and Statistics (1/96 - 5/98); Co-Director, NEXTOR/NEXTOR-II, the National Center of Excellence for Aviation Operations Research (5/96 – present).
8/15-8/16	Visiting Professor, Institute of Transportation Studies, University of California, Berkeley.
8/07-8/08	Visiting Professor, Institute of Transportation Studies, University of California, Berkeley.
8/92-7/93	Visiting Professor; Department of Operations Research, University of North Carolina at Chapel Hill.
8/88-7/90	Professor; College of Business and Management, University of Maryland, College Park.
8/88-present	Joint appointment: System Research Center/Institute for Systems Research, Clark School of Engineering
8/84-8/88	Associate Professor; College of Business and Management, University of Maryland, College Park.
8/84-8/85	Visiting Associate Professor; Department of Combinatorics and Optimization and Department of Management Sciences, University of Waterloo, Waterloo, Ontario.
8/79-8/84	Assistant Professor; College of Business and Management, University of Maryland, College Park.

- 9/78-8/79 Visiting Assistant Professor; College of Business and Management, University of Maryland, College Park.
- 9/75-9/76 Research Assistant; Center for Operations Research and Econometrics, University of Louvain, Louvain, Belgium.

## **INDUSTRIAL AND CONSULTING EXPERIENCE**

- 8/80-9/98 Co-founder of Distinct Management Consultants and its subsidiary Routesmart Technologies; held various offices within these organizations, including president; led several projects; the companies provided consulting services and developed routing and scheduling software products; the software products achieved significant market penetration in the sanitation and meter reading marketplaces; companies sold in 1998.
- 2/79-present Major Consulting Clients:
- Distribution and Transportation Systems*  
 GRC, United States Postal Service, Southern California Gas Co., Military Airlift Command, United Parcel Service, Roadnet Technologies, Inc., Sage Management Consultants, Norfolk and Western Railroad, Southeastern Pennsylvania Transit Authority, Blue Bell, Inc., Rohm and Haas Pharmaceutical Co.
- Telecommunications Systems*  
 Sprint International, CACI, Inc.
- Manufacturing Systems*  
 Simmons USA.
- Air Traffic Management*  
 Los Angeles World Airports, The Boeing Company, Federal Aviation Administration, GRA, Inc., Crown Consulting, The Port Authority of New York and New Jersey.
- 10/76-9/78 Member of Technical Staff; Bell Laboratories.
- 6/74-8/74 Scientific Programmer; Network Analysis Corporation.
- 6/73-8/73 Program Analyst; U.S. Environmental Protection Agency.

## **EXPERT PANELS AND COMMISSIONS**

- 12/16 – present Member of the Advisory Board of OR-MASTER (Mathematical Models and Algorithms for Allocating Scarce Airport Resources Project)
- 12/15- present Member of the Competition for Air Traffic Management (Compair) Advisory Board.
- 3/11 – 11/12 Member of the Independent Experts Operational Goals Group (IEOGG) of the Committee on Aviation Environmental Protection (CAEP). CAEP is part of the International Civil Aviation Organization, which is part of the United Nations.
- 7/08 - 5/10 Member of Academic Panel: Los Angeles World Airports; oversaw North Airfield Safety Study.
- 9/09 - 11/10 Member of Expert Panel: NextGen Flight Prioritization “Deep Dive”.
- 11/09 – 9/10 Member of National Research Council Panel: Review of Air Traffic Control Enroute Complexity Model.

## RESEARCH CONTRACTS AND GRANTS

- 9/15-present NASA: Decision Support Capabilities For Effective Application Of Collaborative Trajectory Options Programs”, PI: Hoffman (Metron Aviation), coPIs: Ball, Hansen (UC Berkeley), Smith (Ohio State); \$339,000 for 3 years (UMD portion).
- 8/14-12/18 NASA: “Similar Historical Days and Air Traffic Flow Management”; PI: Hansen (UC Berkeley), coPIs: Ball, Lovell, Schade (ATAC Corp); \$405,000 for 3 years (UMD portion)
- 5/11-present FAA: “NEXTOR-II: FAA Consortium in Aviation Operations Research”; Principal Investigator and co-Director; participating schools: U of MD, MIT, UC Berkeley, VPISU, George Mason University, Georgia Tech, Ohio State, Purdue; total funding: ~ \$2.5M per year; leader of several projects, especially in areas of traffic flow management and collaborative decision making.
- 10/2006-9/2010 NASA: “Dynamic, Stochastic Models for Managing Air Traffic Flows”, PI: Ball, coPIs: M. Hansen, R. Hoffman, D. Lovell, A. Odoni, H. Sherali; \$2,100,000 for 3 years
- 1/2006-12/2009 NSF; “Dynamic Real-Time Order Promising and Fulfillment for Global Make-to-Order Supply Chains”, PI: Ball, coPI: Fu; \$630,000 for 3 years.
- 5/2003-12/2004 Dell Computer Corporation; “Optimization Based Order Promising”, PI: Ball, coPI: Zhao; \$25,000 for 9 months.
- 7/2001-12/2005 NSF; “Rapid Response Electronic Markets for Time Sensitive Goods”, PI: Anandalingam, co-PIs: L. Ausubel, M. Ball, H. Lucas, V.S. Subrahmanian; \$2,000,000 for 3 years.
- 5/2001-2004 Toshiba Corporation; Research in Digital Manufacturing and Supply Chain Management – specific projects: 1) optimization-based production planning; 2) advanced available-to-promise; 3) production capability planning; 4) production loading; \$150,000 for 3 years.
- 9/2000-2004 NSF; “Combined Research and Curriculum Development in Systems Engineering”; PI: Baras, co-PIs: Austin, Hermann, Schmidt, Ball; \$500,000 for 3 years.
- 9/99-5/2001 NSF; “Formulating Redesign Strategies for Product Evolution: a Proactive Approach to Managing Technological Innovation”, PI: Gupta, co-Pis: Ball, Nau; \$285,056 for 3 years.
- 9/99-3/2001 NSF; “Scalable Supply Chain Infrastructures: Models and Analysis”, PI: Ball, co-PIs: S.Boyson, L. Raschid, V. Sambamurthy; \$945,237 for 3 years.
- 8/96-5/11 “NEXTOR: National Center of Excellence for Aviation Operations Research”; Co-principal Investigator and co-Director; center of excellence funded by Federal Aviation Administration and Industry; participating schools: U of MD, MIT, UC Berkeley, VPISU, George Mason University; total funding: \$2M -- \$5M per year; leader of several projects, especially in areas of traffic flow management, collaborative decision making and airport congestion management.
- 1/98-1/2002 Northrup Grumman Corp; “Design-to-Cost Optimization”; PI: Ball, co-PI: Nau; Amount: \$150,000 (3 years).
- 3/97-8/98 Northrup Grumman Corp; “Integrated Process and Product Design”; PI: Baras; co-PIs: Ball, Minis, Nau.; Amount: \$60,000 + state matching.
- 2/96-8/97 Participant in projects on network management funded by Army Research Laboratory through Army Federated Laboratory grant.

- 3/93-3/94 Loral; "Automated Fault Management"; co-principal investigators: George Atallah, Michael Ball and John Baras; Amount: \$130,000 + state matching.
- 3/92-3/93 Hughes Network Systems; "Next Generation Network Management Systems"; co-principal investigators: George Atallah, Michael Ball, John Baras, Catherine Plaisant, Nick Roussopoulos, Ben Shneiderman; Amount: \$140,000 + state matching.
- 8/92-8/95 IBM Corporation; "Topics in Network Design"; Amount: \$62,000.
- 8/90-8/97 Participant in projects in the areas of systems integration, network management and design and manufacturing funded by NSF through the Systems Research Center ERC grant.
- 1/88-8/90 United Parcel Service; "Parallel Algorithms for Routing and Scheduling"; co-principal investigators: Michael Ball and Lawrence Bodin; Amount: \$26,000.
- 4/85-12/87 U.S. Army Research Office; "The Development of a Computer Code for the Solution of Large Scale Network Reliability Problems"; Amount: \$106,000.
- 7/84-12/86 Westinghouse Electric Corporation; "Reliability Analysis of Command and Control Systems"; co-principal investigators: Arjang Assad, Michael Ball and Bruce Golden; Amount: \$42,000.
- 7/84-6/87 IBM Corporation; "Interactive Network Optimization, Routing and Scheduling", part of project FULCRUM (Facilities for Understanding Learning and Creative Research at the University of Maryland); co-principal investigators: Michael Ball and Lawrence Bodin; equipment grant.
- 10/80-4/84 Urban Mass Transportation Administration of U.S Department of Transportation; "Development of a Generalized Matching Code for Mass Transit System Planning"; co-principal investigators: Michael Ball and Lawrence Bodin; Amount: \$199,000.

## **AWARDS AND HONORS**

Systems Engineering Faculty Member of the Year (1996), Institute for Systems Research, University of Maryland.

Supervised thesis of Robert Hoffman, which was awarded Honorable Mention (2<sup>nd</sup> Place) in the INFORMS Transportation Science Dissertation Prize Competition (1997).

“Advanced Available-to-Promise” project funded by, and jointly carried out with, Toshiba Corporation received “the Outstanding Contribution to Business Performance Award” from the Director of Toshiba Corporate Manufacturing Engineering Center (CMC), June, 2003.

Best Paper in Traffic Flow Optimization at the 5<sup>th</sup> USA/Europe ATM 2003 R&D Seminar (paper co-authored with T. Vossen, R. Hoffman and M. Wambsganss).

Supervised thesis of Thomas Vossen, which was awarded first place in the INFORMS Transportation Science Dissertation Prize Competition (2003) and honorable mention in the INFORMS Aviation Applications Section Dissertation Prize Competition (2003).

Named INFORMS Fellow, October, 2004.

Best Paper in Traffic Flow Optimization at the 6<sup>th</sup> USA/Europe ATM 2005 R&D Seminar (paper co-authored with D. Lovell, R. Hoffman and A. Mukherjee).

Best Paper in Metrics and Performance Management at the 6<sup>th</sup> USA/Europe ATM 2005 R&D Seminar (paper co-authored with D. Lovell, A. Mukherjee, A. Odoni and G. Zerbib ).

Honorable Mention, INFORMS 2006 Transportation Science Best Paper Award (paper co-authored with T. Vossen)

Best Paper in Finance and Policy at the 9<sup>th</sup> USA/Europe ATM 2011 R&D Seminar (paper co-authored with A. Churchill, A.D. Donaldson and R.J. Hansman).

Best Paper in Advanced Modeling at the 2012 5<sup>th</sup> International Conference on Research in Air Transportation (paper co-authored with Rong Wong and David Lovell)

Honorable mention in 2012 INFORMS Section on Public Programs, Services and Needs (SPPSN) Best Paper Competition (paper co-authored with P. Swaroop).

Best Paper in Network Management Track at the 2014 6<sup>th</sup> International Conference on Research in Air Transportation (paper co-authored with James Jones and David Lovell)

Best Paper in the Performance Measurement and Management Track at the 12<sup>th</sup> USA/Europe 2017 ATM R&D Seminar (paper co-authored with Alex Estes and David Lovell).

## EDITORIAL ACTIVITIES

Associate Editor: *Networks (82-06); IEEE Transactions on Reliability (87-93); Operations Research Letters (91-98); Operations Research (00-pres); IIE Transactions (01-05); Naval Research Logistics (03 – 05), Transportation Science (03-pres).*

Area Editor: *Operations Research-Transportation (1/2006-12/2011); Operations Research-Optimization (7/1992-12-1995):*

Editor: Special Issue of *Transportation Science*, “Aviation Operations Research: Commemorating 100 Years of Aviation”, 2003.

Special Issue of *Networks*, “The Matching Problem: Theory, Algorithms and Applications”, 1983 (co-editor, U. Derigs).

Referee: *Operations Research, Management Science, Mathematical Programming, Operations Research Letters, Networks, Mathematics of Operations Research, SIAM Journal on Applied Mathematics, SIAM Journal on Algebraic and Discrete Methods, SIAM Journal on Computing, IEEE Transactions on Reliability, IEEE Transactions on Circuits and Systems, Decision Sciences, Zeitschrift fur Operations Research.*

Reviewer: National Science Foundation, Natural Science and Engineering Research Council of Canada, Office of Naval Research, Army Research Office, Air Force Office of Scientific Research.

## PROFESSIONAL MEMBERSHIPS

*Institute for Operations Research and the Management Sciences (INFORMS) and formerly Operations Research Society of America: Workshop Committee (member 1986-1990, chairman 1987-1990); Lanchester Prize Committee (member 1990-1991, chairman 1991); INFORMS Impact Prize (member 2004); Transportation Science and Logistics Society (member 1981-pres; Vice President 2007; President 2008); Special Interest Group on Computer Science (member 1981-1994); Special Interest Group on Telecommunications (member 1988-pres); Distinguished Lectureship Committee (member 1983-1984); Education Committee (member 1983-1985); member Optimization Society Khacian Award Committee (2015).*

Former member of: *Mathematical Programming Society*, *Society for Industrial and Applied Mathematics*, *IEEE*, *Air Traffic Control Association*.

## CONFERENCE ORGANIZING

Member of the Organizing Committee, INFORMS Transportation and Logistics Society First Triennial Conference, Chicago, July, 2017.

Chair of Organizing Committee, NEXTOR 20<sup>th</sup> Anniversary Workshop, University of Maryland, College Park, MD, September, 2016.

Member of the International Scientific Committee, *Triennial Symposium on Transportation Analysis (TRISTAN 9)*, Aruba, June, 2016.

Co-Chair, Global Challenges to Improve Air Navigation Performance, FAA-NEXTOR Workshop, Asilomar Conference Grounds, Pacific Grove, CA, February, 2015.

Member of the Scientific Committee: 4<sup>th</sup> INFORMS Transportation Science and Logistics Workshop, Berlin, July, 2015.

Member of the Program Committee: 11<sup>th</sup> USA/Europe Air Traffic Management R&D Seminar, Lisbon, June, 2015.

Member of the Program Committee: 6<sup>th</sup> International Conference on Research in Air Transportation, Istanbul, 2014.

Member of the Program Committee: 10<sup>th</sup> USA/Europe Air Traffic Management R&D Seminar, Chicago, June, 2013.

Member of the International Scientific Committee *Triennial Symposium on Transportation Analysis (TRISTAN 8)*, San Pedro de Atacama, Chile, June, 2013.

Co-organizer (with M. Florian and T. Lawphongpanich), *Congestion Management of Transportation Systems on the Ground and in the Air*, Inaugural INFORMS Transportation Science and Logistics Society Workshop, Asilomar Conference Grounds, Pacific Grove, CA, June 2011.

Member of the Program Committee: 9<sup>th</sup> USA/Europe Air Traffic Management R&D Seminar, Berlin, June, 2011.

Member of the International Scientific Committee: *Triennial Symposium on Transportation Analysis (TRISTAN 7)*, Tromso, Norway, June, 2010.

Member of the Program Committee: 8<sup>th</sup> USA/Europe Air Traffic Management R&D Seminar, Napa, CA, June, 2009.

Program Co-Chair (with G. Anandalingam) *INFORMS National Meeting*, Washington, DC, Fall, 2008.

Co-organizer (with M. Savelsbergh) *Symposium in Honor of Seventieth Birthday of George Nemhauser*, Atlanta, July, 2006.

Co-organizer (with K. Hoffman and M. Hansen) *Allocation and Exchange of Airport Access Rights*. workshop sponsored by the FAA, Aspen Institute, Wye River, Maryland, June 2007.

Co-organizer (with G. Donohue and K. Hoffman) *Workshop on Government, the Airline Industry and the Flying Public: a New Way of Doing Business*, workshop sponsored by the FAA, Aspen Institute, Wye River, Maryland, June, 2004.

Member of the International Scientific Committee: *Triennial Symposium on Transportation Analysis (TRISTAN 5)*, Guadeloupe, June, 2004.

Member of the Program Committee: *EURO/INFORMS Joint International Meeting*, Istanbul, July, 2003.

Co-organizer (with G. Donohue and K. Hoffman) *Workshop on National Airspace System Resource Allocation: Economics and Equity*, workshop sponsored by the FAA, Aspen Institute, Wye River, Maryland, March, 2002.

Member of the Advisory Committee: *Triennial Symposium on Transportation Analysis (TRISTAN 4)*, Azores, June, 2001.

Co-organizer (with A. Odoni): *Workshop on Airline and National Strategies for Dealing with Airport and Airspace Congestion*, College Park, MD, March, 2001.

Member of the Program Committee, *First International Conference on Telecommunications and Electronic Commerce (ICTEC)*, November, 1998.

Member of Organizing and Program Committee: *1998 International Meeting of INFORMS*, Tel Aviv, June, 1998.

Member of the Advisory Committee: *Triennial Symposium on Transportation Analysis (TRISTAN 3)*, Puerto Rico, June, 1998.

Member of the Advisory Committee: *Symposium on Combinatorial Optimization*, London, March, 1996.

Member of the Advisory Committee: *Triennial Symposium on Transportation Analysis (TRISTAN 2)*, Capri, June, 1994.

Member of the Advisory Committee: *Triennial Symposium on Transportation Analysis (TRISTAN 1)*, Montreal, July, 1991.

Member of the Organizing Committee: *Fifth International Workshop on Computer Aided Planning in Public Transport*, Montreal, August, 1990.

Member of the Organizing Committee: *Fourth International Workshop on Computer Aided Planning in Public Transport*, Hamburg, West Germany, July, 1987.

Member of the Organizing Committee: *Interdisciplinary Workshop on Network Reliability*, Stevens Institute of Technology, August, 1983.

Co-Organizer with L. Bodin and K. Hoffman: *Symposium on the Matching Problem: Theory, Algorithms and Applications*, National Bureau of Standards, October, 1981.

Co-Organizer with L. Bodin, B. Golden and S. Gass, *Workshop to Investigate Future Directions in Routing and Scheduling of Vehicles and Crews*, University of Maryland, College Park, June, 1979.

Track Chairman: "Network Scheduling and Routing", *ORSA/TIMS Joint National Meeting*, Miami, October, 1986.

## **PRESENTATIONS**

Over 150 presentations delivered at national and international meetings.

Over 50 seminars delivered at universities in the United States, Canada and Europe.

“Improving Air Transportation System Performance through Coordinated Speed Control”, **Keynote Address**, Global Workshop on Aviation System Performance, Tianjin, China, July 2016.

“Air Transportation Operations Research: a Bit of History and Recent Trends”, **Keynote Address** at the Annual Meeting of Operations Research Society – Israel (ORSIS), June 2016.

“Model Decomposition and Integration: Case Studies from Urban Transit and Airline Planning Problems”, **Plenary Address**, 4<sup>th</sup> INFORMS Transportation Science and Logistics Workshop, July 2015.

“Collaborative Decision Making in Air Traffic Management”, **Plenary Address**, *Triennial Symposium on Transportation Analysis (TRISTAN 8)*, San Pedro de Atacama, Chile, June, 2013.

“Recent Airport Congestion Management Initiatives in the United States”, **Keynote Address**, SPADE-2 World-Wide Conference, Las Palmas de Gran Canaria, Spain, November, 2009.

“How to Eliminate Air Transportation Delays”, **Keynote Address**, INFORMS Manufacturing and Service Operations Management Annual Meeting, University of Maryland, College Park, MD, June, 2008.

“How to Fix a Broken Timetable: Collaborative Mechanisms for Managing Airport Capacity Reductions in the U.S.”, **Keynote Address**, The 7th International Conference on the Practice and Theory of Automated Timetabling, Montreal, August, 2008.

“Optimization Based Tradeoff Analysis”, **Invited Semi-plenary Lecture** delivered to *the Annual Conference of DGOR and GMOOR* (the two German Operations Research Societies), Braunschweig, Germany, September, 1996

“Using GIS to Support Route Planning and Facility Location”, Invited Lecture delivered in the *Symposium on Managing the Supply Chain* (part of *The Northwestern University Manufacturing Management Symposium Series*) Evanston, IL, May, 1996

"Design and Analysis of Reliable Networks", delivered as a major address at three different meetings:

- plenary address: Optimization Days, Montreal, May, 1993.
- semi-plenary address: Joint Meeting of DGOR and SVOR (2 German OR societies), September, 1993.
- tutorial, ORSA/TIMS Joint National Meeting, Phoenix, November, 1993.

"Using Geographic Information Systems as a Platform for Operations Research", all day workshop presented at the ORSA/TIMS Joint National Meeting, San Francisco, November, 1992, joint with L. Bodin, G. Fagan and E. Ziering.

"Vehicle Routing and Scheduling with Special Emphasis on Commercial Vehicle Routing Systems for Microcomputers", all day workshop presented at the ORSA/TIMS Joint National Meeting, Atlanta, November, 1985, with A. Assad, L. Bodin and B. Golden.

"The Routing and Scheduling of Vehicles and Crews", all day workshop presented at the ORSA/TIMS Joint National Meeting, Orlando, November, 1983, joint with A. Assad, L. Bodin and B. Golden.

## COURSES TAUGHT

University of Maryland:

- Advanced Networks and Combinatorics
- Decision Analysis and Modeling
- Distributed Data Processing
- Economics of Information Systems



Integer Programming  
Introduction to Database Systems  
Introduction to Management Science  
Introduction to Optimization  
Management Information Systems  
Management of Telecommunications Networks  
Pricing and Revenue Management  
Security and Control of Information Systems  
Seminar on Computational Complexity  
Supply Chain Modeling and Analysis

**Ranked in top 15% of undergraduate instructors in College of Business and Management -- Fall 1982.**

**Ranked in top 15% of MBA instructors in College of Business and Management -- Spring 1983, Fall 1986, Spring 1988.**

University of Waterloo:  
Combinatorial Computing  
Seminar on Routing and Scheduling

University of North Carolina:  
Theory of Reliability

University of California, Berkeley:  
Systems Analysis for Civil Engineers  
Systems Analysis in Transportation

## **PERSONAL**

US Citizen; married, three children, born July 20, 1950 in Washington, DC.

## **THESES SUPERVISED**

A. Roberts, "A Graph Partitioning Approach to Air Crew Scheduling", MS – Business & Management, U. of Maryland, December, 1983.

R. Taverna, "Solving Matching Problems with a Single Generalized Upper Bound Side Constraint", MS – Business & Management, U. of Maryland, May, 1984.

S. Cherng, "Solving the Single Depot Vehicle Scheduling Problem in a Micro-Computer Environment", MA – Applied Mathematics, U. of Maryland, May, 1984.

M. Max, "A Micro-Computer Based Decision Support System for Capital Budgeting", MS – Business & Management, U. of Maryland, December, 1986.

E. Cameron, "Efficient Implementation of Network Reliability Analysis Algorithms", MAS – Management Science, U. of Waterloo, June, 1986.

H. Benoit, "A Lagrangian Relaxation Based Heuristic for the Urban Transit Crew Scheduling Problem", MAS – Management Science, U. of Waterloo, June, 1986.

V. Jeffs, "Availability and Cost Evaluation System for Micro-Computers", MS – Business & Management, U. of Maryland, May, 1987.

J. Greenberg, "Dual Ascent Using Valid Inequalities for the Directed Steiner Tree Problem", MS – Business & Management, U. of Maryland, May, 1988.

F. Lin, "Reliability Constrained Integer Programming Models with Applications to Facility Location", PhD – Business & Management, U. of Maryland, May, 1992.

S. Su, "The General Postman Problem -- Models and Algorithms", PhD – Business & Management, U. of Maryland, August, 1992.

H. Gun, "Polyhedral Structure and Efficient Algorithms for Certain Classes of the Directed Rural Postman Problem", PhD – Applied Mathematics, U. of Maryland, December, 1993.

A. Datta, "Database Environments for Decision Support and Control Systems", PhD – Business & Management, U. of Maryland, May, 1994.

A. Vakhutinsky, "Fault Tolerant Rerouting in Broadband Multiclass Networks", PhD – Business & Management, U. of Maryland, December, 1996.

R. Hoffman, "Integer Programming Models for Ground Holding in Air Traffic Flow Management", PhD – Applied Mathematics, U. of Maryland, December, 1997.

J. Splain, "A User Interface For Discrete Optimization-Based Tradeoff Analysis", MSSE – Systems Engineering, U. of Maryland, May, 1998

T. Butler, "Optimization Model with Fairness Objective for Air Traffic Management", MA – Applied Mathematics, U. of Maryland, August, 1998.

V. Trichur, "Integer Programming Models for Product Design", PhD – Business & Management, U. of Maryland, December, 1999.

T. Inniss, "Stochastic Models for Determining Airport Arrival Capacity Distributions", PhD – Applied Mathematics, U. of Maryland, December, 2000.

N. Bhogadi, "Modeling Demand Uncertainties during Ground Delay Programs", MSSE – Systems Engineering, U. of Maryland, August, 2002.

J. Burke, "Implementing and Evaluating Alternate Airspace Rationing Methods", MSSE – Systems Engineering, U. of Maryland, August, 2002.

B. Chandran, "Predicting Airspace Congestion Using Approximate Queuing Models", MS – Business & Management, U. of Maryland, August, 2002.

T. Vossen, "Fair Allocation Methods in Air Traffic Management", PhD – Business & Management, U. of Maryland, December, 2002.

C-Y Chen, "Optimization Based Available to Promise", PhD – Business & Management, U. of Maryland, December, 2003

J. McNeil, "Order Assignment and Resource Reservation: an Optimization Model and Policy Analysis", MSSE – Systems Engineering, U. of Maryland, May, 2005

F. Faber, "An Extensible Order Promising and Revenue Management Testbed", MSSE – Systems Engineering, U of Maryland, May, 2005

M. Chen, "Coordinating Demand Fulfillment with Supply across a Dynamic Supply Chain", PhD – Business & Management, May, 2006.

Y. Tu, "Air Transportation System Performance: Estimation and Comparative Analysis of Departure Delays", PhD – Business & Management, U of Maryland, December, 2006.

B. Subramanian, "Aggregate Statistical Models for National Airspace System Performance", MSSE – Systems Engineering, August, 2007.

H. Gao, "Analysis of Distribution Free Methods for Revenue Management", PhD -- Business & Management, U of Maryland, December, 2008 (co-advisor, I. Karaesmen).

Y. Lan, "Robust Revenue Management with Limited Information: Theory and Experiments", PhD – Business & Management, U of Maryland, August, 2009 (co-advisor, I. Karaesmen).

N. Vakili, "Preference-Based Fair Allocation of Limited Airspace Resources", PhD – Electrical Engineering, U of Maryland, December, 2009, (co-advisor, S. Marcus).

C. Glover, "Computationally Tractable Integer Programming Models for Air Traffic Flow Management", PhD – Applied Mathematics, August, 2010.

P. Swaroop, "Problems and Models in Strategic Air Traffic Flow Management", PhD – Business & Management, U of Maryland, August, 2013.

## BOOKS

Ball, M., Magnanti, T., Monma, C. and Nemhauser, G., eds, 1995, *Handbook of Operations Research and Management Science: Network Models*, Elsevier, Amsterdam.

Ball, M., Magnanti, T., Monma, C. and Nemhauser, G., eds, 1995, *Handbook of Operations Research and Management Science: Network Routing*, Elsevier, Amsterdam.

## PAPERS IN REFEREED JOURNALS

Ball, M. O., R. Van Slyke, I. Gitman and H. Frank, 1976, "Reliability of Packet Switching Broadcast Radio Networks", *IEEE Transactions on Circuits and Systems*, **CAS-23**, 806-813.

Ball, M. O. and R. Van Slyke, 1977, "Backtracking Algorithms for Network Reliability Analysis", *Annals of Discrete Mathematics I: Studies in Integer Programming*, P. L. Hammer and E. L. Johnson, B. H. Korte and G. L. Nemhauser, eds., (North Holland, New York), pp. 49-64.

Ball, M. O., W. Bialas and D. Loucks, 1978, "Planning the Location and Capacity of Flood Control Structures", *Water Resources Research*, **14**, 62-66.

Golden, B. and M. O. Ball, 1978, "Shortest Paths with Euclidean Distances: An Explanatory Model", *Networks*, **8**, 297-314.

Ball, M. O., 1979, "Computing Network Reliability", *Operations Research*, **27**, 823-838.

- Ball, M. O. and G. L. Nemhauser, 1979, "Matroids and a Reliability Analysis Problem", *Mathematics of Operations Research*, **4**, 132-143.
- Ball, M. O., 1979, "The Complexity of Network Reliability Computations", *Networks*, **10**, 153-165, reprinted in *The World of Large Scale Systems*, J. Palmer and R. Sacks eds., IEEE Press, John Wiley, New York, 1982, pp 185-190.
- Ball, M. O. and M. Magazine, 1981, "The Design and Analysis of Heuristics", *Networks*, **11**, 215-219.
- Golden, B., M. O. Ball and L. Bodin, 1981, "Current and Future Research Directions in Network Optimization", *Computers and Operations Research*, **8**, 71-81.
- Ball, M. O. and J. S. Provan, 1981, "Bounds on the Reliability Polynomial for Shellable Independence Systems," *SIAM Journal on Algebraic and Discrete Methods*, **3**, 166-181.
- Ball, M. O., L. Bodin and R. Dial, 1983, "A Matching Based Heuristic for Scheduling Mass Transit Crews and Vehicles", *Transportation Science*, **17**, 4-31.
- Ball, M. O., B. Golden, A. Assad and L. Bodin, 1983, "Planning for Truck Fleet Size in the Presence of a Common Carrier Option", *Decision Sciences*, **14**, 103-120.
- Ball, M. O. and J. S. Provan, 1983, "Calculating Bounds on Reachability and Connectedness in Stochastic Networks", *Networks*, **13**, 253-278.
- Bodin, L., B. Golden, A. Assad and M. Ball, 1983, "The State of the Art in the Routing and Scheduling of Vehicles and Crews", *Computers and Operations Research*, **10**, 63-211.
- Provan, J. and M. Ball, 1983, "The Complexity of Counting Cuts and Computing the Probability that a Graph is Connected", *SIAM Journal on Computing*, **12**, 777-788.
- Ball, M. O. and U. Derigs, 1983, "Analysis of Alternate Strategies for Implementing Matching Algorithms", *Networks*, **13**, 517-549.
- Ball, M. O., A. Assad, L. Bodin, B. Golden and F. Spielberg, 1984, "Garage Location for an Urban Mass Transit System", *Transportation Science*, **18**, 56-75.
- Provan, J. and M. Ball, 1984, "Computing Network Reliability in Time Polynomial in the Number of Cuts", *Operations Research*, **32**, 516-526.
- Ball, M. O. and A. Roberts, 1985, "A Graph Partitioning Approach to Air Crew Scheduling", *Transportation Science*, **19**, 107-126.
- Ball, M. O., 1986, "Computational Complexity of Network Reliability Analysis: An Overview", *IEEE Transactions on Reliability*, **R-35**, 230-239.
- Ball, M. O. and R. Taverna, 1986, "Sensitivity Analysis for the Matching Problem and its Use in Solving Matching Problems with a Single Side Constraint", *Annals of Operations Research*, **4**, 25-56.
- Dror, M., M. Ball and B. Golden, 1986, "A Computational Comparison of Algorithms for the Inventory Routing Problem", *Annals of Operations Research*, **4**, 3-23.
- Ramesh, A., M. O. Ball and C. Colbourn, 1987, "Bounds for All-Terminal Reliability in Networks", *Annals of Discrete Mathematics*, **33**, 261-273.

- Dror, M. and M. O. Ball, 1987, "Inventory Routing: Reduction from an Annual to Short Period Problem", *Naval Research Logistics Quarterly*, **34**, 891-905.
- Assad, A., M. O. Ball, B. L. Golden and V. Jeffs, 1988, "An Interactive Tool for Reliability Analysis on a Micro-Computer", *American Journal of Mathematical and Management Sciences*, **8**, 59-91.
- Ball, M. O. and J. S. Provan, 1988, "Disjoint Products and Efficient Computation of Reliability", *Operations Research*, **36**, 703-715.
- Ball, M. O. and M. Magazine, 1988, "Sequencing of Insertions in Printed Circuit Board Assembly", *Operations Research*, **36**, 192-201.
- Ball, M. O., Golden, B. L. and Vohra, R., 1989, "Finding the Most Vital Arcs in a Network", *Operations Research Letters*, **8**, 73-76.
- Ball, M. O., U. Derigs, C. Hilbrand and A. Metz, 1990, "Matching Problems with Generalized Upper Bound Side Constraints", *Networks*, **20**, 703-721.
- Ball, M. O., J. S. Provan and D. Shier, 1991, "Reliability Analysis of Path Covering Systems", *Networks*, **21**, 345-357.
- Ball, M. O. and F. L. Lin, 1993, "A Reliability Model Applied to Emergency Service Vehicle Location", *Operations Research*, **41**, 18-36.
- Haritsa, J., Ball, M., Roussopoulos, N., Datta, A. and Baras, J., 1993, "MANDATE: MANaging Networks using DAtabase TEchnology", *IEEE J. on Selected Areas in Communications*, **11**, 1360-1371.
- Ball, M. O. and J. G. Shanthikumar, 1994, "Bounding a Probability Measure over a Polymatroid with an Application to Transportation Problems", *Mathematics of Operations Research*, **19**, 112-120.
- Ball, M. O., J. Hagstrom, and J. S. Provan, 1995, "Threshold Reliability of Networks with Small Failure Sets", *Networks*, **25**, 101-115.
- Ball, M. O. and F. Lin, 1995, "Reliability, Covering and Balanced Matrices", *Operations Research Letters*, **17**, 1-8.
- Ball, M. O., Vakhutinsky, A, Chimento, P., Gun, L and Tedijanto, T., 1996, "Distributed Call Rerouting in Multiclass Broadband Networks", *Journal of Network and Systems Management*, **3**, 381-404.
- Ball, M. O. and A. Datta, 1997, "Managing Operations Research Models for Decision Support Applications in a Database Environment", *Annals of Operations Research*, **72**, 151-182.
- Ball, M. O., Kaku, B. and Vakhutinsky, A., 1998, "Network-Based Formulations for the Quadratic Assignment Problem", *European Journal of Operations Research*, **104**, 241 – 249.
- Ball, M.O., J. Hagstrom and J.S. Provan, 1998, "Two-path Subsets: Efficient Counting and Applications to Performability Analysis", *Discrete Applied Mathematics*, **85**, 25 – 45.
- Hoffman, R. and Ball, M.O., 2000, "A Comparison of Formulations for the Single-Airport Ground-Holding Problem with Banking Constraints", *Operations Research*, **48**, 578-590.
- Bodin, L, Mingozzi, A., Baldacci, R. and Ball, M.O, 2000, "The Rollon-Rolloff Vehicle Routing Problem", *Transportation Science*, **34**, 271-288.

- Nau, D., Ball M.O., Baras, J., Chowdhury, A., Lin, E., Meyer, J., Rajamani, R. Splain, J. and Trichur, V., 2000, "Generating and Evaluating Designs and Plans for Microwave Modules." *AI in Engineering Design and Manufacturing*, **14**, 273-288.
- Hoffman, R. and M.O. Ball, 2000, "Measuring Ground Delay Program Effectiveness Using the Rate Control Index", 2000, *Journal of Air Traffic Control*. **42**, 19-23.
- Vossen, T., Ball, M.O., Lothem, A. and Nau, D., 2001, "Applying Integer Programming to AI Planning", *Knowledge Engineering Review*, **16**, 85-100.
- Chen, C-Y. , Zhao, Z. and Ball, M.O, 2001, "Quantity and Due Date Promising Available to Promise", *Information Systems Frontiers*, **3**, 477-488.
- Hoffman, R. and Ball, M.O., 2001, "The Rate Control Index for Traffic Flow Management", *IEEE Transactions on Intelligent Transportation Systems*, **2**, 55-62.
- Ball, M.O. and Vakhutinsky, A., 2001, "Fault Tolerant Virtual Path Layout in ATM Networks", *INFORMS J. on Computing*. **13**, 76-94.
- McAree, P., L. Bodin and M.O. Ball, 2002, "Models for the Design and Analysis of a Large Package Sort Facility", *Networks*, **39**, 107-120.
- Chen, C-Y. , Zhao, Z. and Ball, M.O., 2002, "A Model for Batch Available-to-Promise", *Production and Operations Management*. **11**, 424 - 440
- Raghavan, S., Ball, M.O. and Trichur, V., 2002, "Bicriteria Product Design Optimization: an Efficient Solution Procedure Using AND/OR Trees", *Naval Research Logistics*, **49**, 574-592.
- Ball, M.O., Hoffman, R., Odoni, A. and Rifkin, R., 2003, "A Stochastic Integer Program with Dual Network Structure and its Application to the Ground-Holding Problem", *Operations Research*. **51**, 167 – 171
- Ball, M.O., Chen, C-Y. and Zhao, Z., 2003, "Material Compatibility Constraints for Make-To-Order Production Planning", *Operations Research Letters*, **31**, 420-428.
- Vossen, T., Ball, M.O., Hoffman, R. and Wambsganss, M., 2003, "A General Approach to Equity in Traffic Flow Management and its Application to Mitigating Exemption Bias in Ground Delay Programs", *Air Traffic Control Quarterly*, **11**, 277-292. (a preprint was published in *Proceedings of 5<sup>th</sup> USA/Europe Air Traffic Management R&D Seminar*, 2003).
- Ball, M.O. and G. Lulli, 2004, "Ground Delay Programs: Optimizing over the Included Flight Set Based on Distance", *Air Traffic Control Quarterly*, **12**, 1 – 25.
- Ercetin, O., M. Ball and L Tassiulas, 2004, "Next generation satellite systems for aeronautical communications", *International journal of satellite communications and networking*, **22**, 157-179
- Souza, G., Z. Zhao, M. Chen, and M. Ball, 2004, "Coordinating Sales and Raw Material Discounts in a Global Supply Chain," *Production and Operations Management*, **13**, 34-45.
- Inniss, T. and Ball, M.O., 2004, "Estimating One-Parameter Airport Arrival Capacity Distributions for Air Traffic Flow Management", *Air Traffic Control Quarterly*, **12**, 223-252.
- Zhao, Z., M. Ball and M. Kotake, 2005, "Optimization-Based Available-to-Promise and Multi-Stage Resource Availability", *Annals of Operations Research*, **135**, 65 – 85.

- Ercetin, O, M Ball and L Tassioulas, 2005, "Modeling study for evaluation of aeronautical broadband data requirements over satellite networks" *IEEE Transaction on Aerospace and Electronic Systems*, **41**, 361-370
- Vossen, T. and Ball, M.O., 2006, "Slot Trading Opportunities in Collaborative Ground Delay Programs", *Transportation Science*, **40**, 29 - 43.
- Vossen, T. and Ball, M.O., 2006, "Optimization and Mediated Bartering Models for Ground Delay Programs", *Naval Research Logistics*, **53**, 75 – 90.
- McAree, P, L.D. Bodin, M.O. Ball and J. Segars, 2006, "Design of the Federal Express Large Package Sort Facility", *Annals of Operations Research*, **144**, 133-152.
- Tu, Y., M.O. Ball and W. Jank, 2008, "Estimating Flight Departure Delay Distributions: a Statistical Approach with Long-term Trend and Short-term Pattern" *Journal of the American Statistical Association*, **103**, 112-125.
- Lan, Y., H. Gao, M.O. Ball and I. Karaesmen, 2008, "Revenue Management with Limited Demand Information", *Management Science*, **54**, 1594-1609.
- Ball, M.O. and M. Queyranne, 2009, "Robust Revenue Management: a Competitive Analysis of Online Booking", *Operations Research*, **57**, 950-963.
- Ball, M.O., G. Dahl and T. Vossen, 2009, "Matchings in Connection with Ground Delay Program Planning", *Networks*, **53**, 293-306.
- Ball, M. O. and R. Halper, 2009, "Scramble Teams for the Pinehurst Terrapin Classic," *Journal of Quantitative Analysis in Sports*, **5** (2), Article 10. DOI: 10.2202/1559-0410.1180 Available at: <http://www.bepress.com/jqas/vol5/iss2/10>
- Tien, S-L., A. Churchill and M. Ball, 2009, "Quantifying the Relationship between Airline Load Factors and Flight Cancellation Times", *Transportation Research Record* #2106, 38-46.
- Ganji, M., D. Lovell, M. Ball and A. Nguyen, 2009, Resource Allocation in Flow-Constrained Areas with Stochastic Termination Times, *Transportation Research Record* #2106, 90-99.
- Ball, M.O., R. Hoffman and A. Mukherjee, 2010, "Ground Delay Program Planning under Uncertainty Based on the Ration-by-Distance Principle", *Transportation Science*, **44**, 1-14.
- Gao, H., M. Ball and I. Karaesmen, 2010, "Competitive Seat Inventory Control Decisions under the Regret Criterion", *Journal of Revenue and Pricing Management*, **9**, 49-65.
- Churchill, A., D. Lovell, and M. Ball, 2010, "Flight Delay Propagation Impact on Strategic Air Traffic Management", *Transportation Research Record: Journal of the Transportation Research Board*, 2177, 105-113.
- Lan, Y, M. Ball and I. Karaesmen, 2011, "Overbooking and Fare-Class Allocation with Limited Information", *Manufacturing and Service Operations Management*, **13**, 194 – 226.
- Ball, M.O., 2011, "Heuristics Based on Mathematical Programming", *Surveys in Operations Research and Management Science*, **16**, 21-38.
- Gao, L., S. Xu and M. Ball, 2012, "Managing an Available-to-Promise Assembly System with Dynamic Short-Term Pseudo-Order Forecast", *Management Science*, **58**, 770-790.
- Yoon, Y., M. Hansen and M. Ball, 2012, Optimal route decision with a geometric ground-airborne hybrid model under weather uncertainty, *Transportation Research, Part E*, **48**, 34-49.

- Swaroop, P. and M. Ball, 2012, "Consensus Building Mechanism for Setting Service Expectations in Air Traffic Management", *Transportation Research Record: Journal of the Transportation Research Board*, 2325, 87-96.
- Swaroop, P., B. Zou, M. Ball and M. Hansen, 2012, "Do More U.S. Airports Need Slot Controls? A Welfare Based Approach to Determine Slot Levels", *Transportation Research, Part B*, **46**, 1239-1259
- Glover, C. and M. Ball, 2013, "Stochastic Optimization Models for Ground Delay Program Planning with Equity-Efficiency Tradeoffs", 2013, *Transportation Research, Part C*, **33**, 196-202.
- Glover, C. and M. Ball, 2013, "Sparse Monge Matrices Arising from Scheduling Problems", *OR Letters*.41, 246-248
- Churchill, A., D. Lovell, A. Mukherjee and M. Ball, 2013, "Determining the Number of Airport Arrival Slots", *Transportation Science*, 47, 526-541
- Lan, Y., M. Ball, I. Karaesmen, J. Zhang and G. Liu, 2015, "Analysis of Seat Allocation and Overbooking with Hybrid Information", *European Journal of Operational Research*, 240, 493-504.
- Barnett, A., M. Ball, G. Donohue, M. Hansen, A. Odoni and A. Trani, 2015, "Collision Course? The North Airfield Safety Study at Los Angeles International Airport (LAX)", *Transportation Research, Part A*, **77**, 14-34.
- Gao, H, M. Ball and I. Karaesmen, 2016, Distribution free methods for multi-period, single-leg booking control, *Journal of Revenue and Pricing Management*. 15, 425-453
- Jones, J., D. Lovell and M. Ball, 2017, Stochastic optimization models for transferring delay along flight trajectories in order to reduce fuel usage", *Transportation Science*, Published online in Articles in Advance 24 Feb 2017  
<https://doi.org/10.1287/trsc.2016.0689>
- Ball, M., F. Berardino and M. Hansen, 2017, The use of auctions for allocating airport access rights. In press, *Transportation Research, Part A*, Published online at <https://doi.org/10.1016/j.tra.2017.09.026>

## **PAPERS SUBMITTED**

- Yan, C., P. Swaroop, M. Ball, C. Barnhart and V. Vaze, "Applying Majority Judgment over a Polyhedral Candidate Space".
- Estes, A., D. Lovell and M. Ball, "Decision Support through the Identification of Representative Traffic Management Initiatives".
- Estes, A., M. Ball and D. Lovell, "Data Exploration with Representative Data Points".

## **ARTICLES IN EDITED VOLUMES**

- Ball, M. O., L. Bodin and R. Dial, 1981, "Experimentation with a Computerized System for Scheduling Mass Transit Vehicles and Crews", in *Computer Scheduling of Public Transport*, A. Wren ed., 313-336.
- Ball, M. O., L. Bodin and J. Greenberg, 1985, "Enhancements to the RUCUS-II Crew Scheduling System", in *Computer Scheduling of Public Transport: 2*, J. Rousseau, ed. (North Holland, New York), 279-294.
- Dahl, R., J. Greenberg, J. Sanburn, C. Skiscim, M. Ball and L. Bodin, 1985, "A Relational Database Approach to Vehicle and Crew Scheduling in Urban Mass Transit Systems", in *Computer Scheduling of Public Transport: 2*, J. Rousseau, ed. (North Holland, New York), 279-294.
- Bodin, L., M. Ball, R. Duguid and M. Mitchell, 1985, "The Vehicle Scheduling Problem with Interlining", in *Computer Scheduling of Public Transport: 2*, J. Rousseau, ed. (North Holland, New York), 327-342.



- Ball, M. O., 1988, "Allocation/Routing: Models and Algorithms", in *Vehicle Routing: Methods and Studies*, A. Assad and B. Golden, eds., North Holland, Amsterdam, pp. 199-221.
- Ball, M. O., W. Liu and W. R. Pulleyblank, 1989, "Two-Terminal Steiner Tree Polyhedra", in *Contributions to Operations Research and Economics: the Twentieth Anniversary of CORE*, MIT Press, Cambridge, Mass, pp 251-284.
- Ball, M. O., Colbourn, C. and Provan, J. S., 1995, "Network Reliability", *Handbook of Operations Research and Management Science: Network Models*, M. Ball, T. Magnanti, C. Monma and G. Nemhauser, eds., Elsevier, Amsterdam, pp. 673-762.
- Ball, M.O. and Vakhutinsky, A., 1998, "Fault Tolerant Virtual Path Layout: Optimization Models", in *Telecommunications Network Planning*, B. Sanso and P. Soriano editors, Kluwer Academic, pages 201-217.
- Ball, M.O., C. Chen, R. Hoffman and T. Vossen, 2001, "Collaborative Decision Making in Air Traffic Management: Current and Future Research Directions", in *New Concepts and Methods in Air Traffic Management*, L. Bianco, P. Dell'Olmo and A. Odoni, eds, Springer-Verlag, Berlin, pp 17-30 (a preprint appeared in *Proceedings of ATM'99, Workshop on Advanced Technologies and Their Impact on Air Traffic Management in the 21<sup>st</sup> Century*, 1999)
- Ball, M.O., R. L. Hoffman, D. Knorr, J. Wetherly and M. Wambsganss, 2001, "Assessing The Benefits Of Collaborative Decision Making In Air Traffic Management", in *Air Transportation Systems Engineering*, G. Donohue and A. Zellweger, eds., American Institute of Aeronautics and Astronautics, Inc., Reston, VA., pp 239-250 (a preprint appeared in *Proceedings of 3<sup>rd</sup> USA/Europe air Traffic Management R&D Seminar*, 2000).
- Sniezek, J., L. Bodin, L. Levy and M.O. Ball, 2002, "Capacitated Arc Routing Problem with Vehicle-Site Dependencies: the Philadelphia Experience", in *The Vehicle Routing Problem*, P. Toth and D. Vigo, eds., SIAM, Philadelphia, pp 287-308.
- Zhao, Z., M. Ball and C.-Y. Chen, 2003, "A Scalable Supply Chain Infrastructures Research Test-Bed", in *Scalable Enterprise Systems: An Introduction to Recent Advances*, Prabhu, V., S. Kumara, M. Kamath, eds., Kluwer Academic Publishers, Boston, pp 217-248.
- Ball, M. O., C.-Y. Chen and Z.-Y. Zhao 2004, "Available to Promise", in *Handbook of Quantitative Supply Chain Analysis: Modeling in the E-Business Era*, Simchi-Levi, D., D. Wu, and M. Shen, eds., Kluwer Academic Publishers, Boston, pp 447-484.
- Ball, M.O., G. Donohue and K. Hoffman, 2005, "Auctions for the Safe, Efficient and Equitable Allocation of Airspace System Resources", in Cramton, P., Y. Shoham and R. Steinberg, eds. *Combinatorial Auctions*, MIT Press, Cambridge, pp 507-538.
- Ball, M.O., C. Barnhart, G. Nemhauser and A. Odoni, 2007, "Air Transportation: Irregular Operations and Control", *Handbook of Operations Research and Management Science: Transportation*, C. Barnhart and G. Laporte, eds, Elsevier, Amsterdam, pp 1-67.
- Ball, M. O., 2012, "Air Traffic Management", in *Encyclopedia of Operations Research and Management Science*, 3<sup>rd</sup> ed., S. Gass and M. Fu eds., Springer Science + Business Media, LLC.
- Ball, M.O., M. Hansen, P. Swaroop and B. Zou, 2013, "Design and Justification for Market-Based Approaches to Airport Congestion Management: the US Experience", in Zografos, Andreatta and Odoni, eds, *Modeling and Managing Airport Performance*, John Wiley and Sons, Chichester, pp 253 – 274.

## PROCEEDINGS AND LETTERS

- Golden, B. and M. O. Ball, Letter to the Editor, 1979, *International Journal of Mathematical Education, Science and Technology*, 10, 303-304.

- Ball, M. O., L. Bodin and R. Dial, 1980, "Scheduling of Drivers for Mass Transit Systems Using Interactive Optimization", *Proceedings of World Conference on Transport Research*, London.
- Assad, A., M. O. Ball, L. Bodin and B. Golden, "Combined Distribution Routing and Scheduling in a Large Commercial Firm", *Proceedings of Northeast AIDS Conference*, R. Pavan and P. Anderson, eds., Boston, 99-102.
- Ball, M. O. and J. Provan, 1984, "Properties of Systems which Lead to Efficient Computation of Reliability", *Proceedings of IEEE Global Telecommunications Conference*, Atlanta, pp. 866-870.
- Ball, M. O. and E. Cameron, 1986, "Experiments with Network Reliability Analysis Algorithms", in *Modeling and Simulation: Proceedings of the Seventeenth Annual Pittsburgh Conference*, W. G. Vogt and M. H. Mickle eds., **17**, 1799-1803.
- Ball, M. O. and J. S. Provan, 1987, "Computing K-Terminal Reliability in Time Polynomial in the Number of (s,K)-Quasicuts", *Transactions of the Fourth Army Conference on Applied Mathematics and Computing*, 901-907.
- Ball, M. O. and Jeffs, V. J., 1987, "ACES: A System Structure, Cost and Reliability Design Tool", *Proceedings of IBM ACIS University Conference*, Boston, pp. 442-451.
- Provan, J. S. and M. O. Ball, 1988, "Efficient Recognition of Matroids and 2-Monotonic Systems", in *Applications of Discrete Mathematics*, R. Ringeisen and F. Roberts eds., SIAM, Philadelphia, pp. 122-134.
- Ball, M. O. and H. Benoit, 1988, "A Lagrangian Relaxation Based Heuristic for the Urban Transit Crew Scheduling Problem", *Computer Aided Transit Scheduling of Public: Proceedings of Fourth International Workshop on computer-Aided Scheduling of Public Transport*, J. Daduna and A. Wren, eds., Springer-Verlag Lecture Notes in Economics and Mathematical Systems #308, Heidelberg, pp. 54-67.
- Ball, M. O., 1992, "Locating Competitive New Facilities in the Presence of Existing Facilities", *Proceedings of the 5th United States Postal Service Advanced Technology Conference*, pp. 1169-1177.
- Haritsa, J., Ball, M., Roussopoulos, N. and Datta, A., 1993, "Design of the MANDATE MIB", *Integrated Network Management III*, H.G. Hegering, Y. Yemini, eds., North Holland, pp. 85-96.
- Nau, D., Ball, M., Gupta, S., Minis, I. and Zhang, G., "Design for Manufacture by Multi-Enterprise Partnerships: Current Status and Future Directions", *ASME Winter Annual Meeting*, 1994.
- Nau, D., Ball, M., Minis, I and Zhang, G., "Virtual Factories for Electro-Mechanical Device Manufacturing", to appear in *NSF Design and Manufacturing Grantees Meeting*, January 1995.
- Ball, M., "Book Review: Network Flows, by Ahuja, Magnanti and Orlin", *SIAM Review*, **37**, 115-116 1995.
- Ball, M., Baras, J., Bashyam, S., Karne, R. and Trichur, V., "On the Selection of Parts and Processes during Design of Printed Circuit Board Assemblies", *1995 INRIA/IEEE Symposium on Emerging Technologies and Factory Automation*, vol. 3, pp. 241-248 (1995).
- Assad, A., Ball, M. and Dahl, R., "Sleeping Beauties: Scheduling the Production of Mattresses with Sequence-Dependent Set Ups", *1995 INRIA/IEEE Symposium on Emerging Technologies and Factory Automation*, vol. 3, pp. 229-239 (1995)
- Baras, J. R.K. Karne, M.O. Ball, S. Bashyam, M. Townsley, F. Huang, V.S. Trichur, M. Karir, H. Xie and A. Inbar, "Decision Making Assistant for Integrated Product and Process Design Environment", *Symposium on Timely Realization of Affordable Military Systems Through Enhanced Manufacturing Technology*, Albuquerque, NM, October 18-20 (1995).

- Trichur, V. S., Ball, M. O., Baras, J. S., Hebbar, K., Minis, I., Nau, D. S., Smith, S. J. J., "Integrating Tradeoff Analysis and Plan-Based Evaluation of Designs for Microwave Modules", *Proceedings of the Agile and Intelligent Manufacturing Symposium*, Rensselaer Polytechnic Institute, Troy, NY. October (1996)
- Baras, J., Ball, M., Karne, R., Kelley, S., Jang, K., Plaisant, C., Roussopoulos, N., Stathator, K., Vakhutinaky, A., Valluri, J. and Whitefield, D., "Integrated Network Management of Hybrid Networks", *Proceedings of First Conference on Commercial Development of Space Part One*, pp. 345-350, Albuquerque, New Mexico, January 7-11 (1996).
- Baras, J., M. Ball, R.K. Karne, S. Kelley, K. Jang, C. Plaisant, N. Rossopoulos, K. Stathatos, A. Vakhutinsky, J.B. Valluri and D. Whitefield, "Hybrid Network Management", *Proceedings of the AIAA: 16th International Communications Satellite Systems Conference and Exhibit*, Part 1, pp. 490-500, Washington, D.C., February 25-29, (1996).
- Vakhutinsky, A. and Ball, M.O., "Fault-Tolerant Virtual Path Layout in ATM Networks", *Proceedings of the International Teletraffic Congress (ITC)*, eds V. Ramaswami and P.E. Wirth, **15** Washington, DC, June, pp 1031-1041, (1997).
- Baras, J., M. Ball, S. Gupta, P. Viswanathan and P. Shah, "Automated network fault management", MILCOM 97 Proceedings, November, 1997.
- Vossen, T., Ball, M.O., Loten, A. and Nau, D., "Integer Programming Models in AI Planning: Preliminary Experimental Results", *AIPS'98 Workshop on Planning as Combinatorial Search*, (1998).
- Nau, D., Ball, M., Gupta, S., Minis, I. and Zhang, G., "Design for Manufacture by Multi-Enterprise Partnerships", in D.R. Rehak, K.H. Lay and J.H. Garrett, Jr., eds, *Bridging the Generations: the Future of Computer-Aided Engineering*, 1999, pp 163-168.
- Ball, M.O., C-Y. Chen, R. Hoffman and T. Vossen, "Collaborative Decision Making in Air Traffic Management: Current and Future Research Directions", in *Proceedings of ATM'99, Workshop on Advanced Technologies and Their Impact on Air Traffic Management in the 21<sup>st</sup> Century*, 1999.
- Vossen, T., Ball, M.O., Lotem, A. and Nau, D., "On the Use of Integer Programming Models in AI Planning", *IJCAI-99*, pp. 304-309, 1999.
- Ball, M.O., Boyson, S., Raschid, L. and Sambamurthy, V., "Scalable Supply Chain Infrastructures: Models and Analysis", in *Proceedings of the 2000 NSF Design & Manufacturing Research Conference*, Vancouver, 2000.
- Ball, M.O., Fleisher, M. and Church, D., "A Product Design System Employing Optimization-Based Tradeoff Analysis", in *Proceedings of 2000 ASME Design Engineering Technical Conference*, 2000.
- Ball, M.O., Boyson, S., Chen, C-Y., Rabinovich, E., Raschid, L., Sambamurthy, V. and Zadorozhny, V. "Scalable Supply Chain Infrastructures and Their Impact on Organizations", in *Proceedings of the 2001 NSF Design & Manufacturing Research Conference*, Tampa, 2001.
- Ball, M.O., Vossen, T. and Hoffman, R., "Analysis of Demand Uncertainty in Ground Delay Programs", in *Proceedings of 4<sup>th</sup> USA/Europe Air Traffic Management R&D Seminar*, 2001.
- Ball, M.O., Chen, C.-Y., Chen, M., Raschid, L., and Zhao, Z., "Scalable Supply Chain Infrastructures: System Integration and Embedded Decision Models", in *Proceedings of the 2002 NSF Design & Manufacturing Research Conference*, Puerto Rico, 2002.
- Ball, M.O., Ma, M., Raschid, L. and Zhao, Z., "Scalable Supply Chain Infrastructures: System Integration and Embedded Decision Models", *ACM Sigmod Record*.

- Ball, M.O., Lovell, D., Hoffman, R. and Mukherjee, A., “Response Mechanisms for Dynamic Air Traffic Flow Management”, in *Proceedings of 6<sup>th</sup> USA/Europe Air Traffic Management R&D Seminar*, 2005.
- Mukherjee, A., Lovell, D., Ball, M., Odoni A. and Zerbib, G., “Modeling Delays and Cancellation Probabilities to Support Strategic Simulations”, in *Proceedings of 6<sup>th</sup> USA/Europe Air Traffic Management R&D Seminar*, 2005
- Ball, M.O., L. Ausubel, F. Berardino, P. Cramton, G. Donohue, M. Hansen and K. Hoffman, “Market-Based Alternatives for Managing Congestion at New York’s LaGuardia Airport”, *Proceedings of Airneth Annual Conference: Optimal Use of Scarce Airport Capacity*, The Hague, April, 2007.
- Hoffman, R. J. Burke, T. Lewis, A. Futer, and M. Ball, Resource Allocation Principles for Airspace Flow Control, *Proceeding of AIAA Guidance, Navigation, and Control Conference and Exhibit*, August 2005, San Francisco, CA.
- Hoffman, R., Mukherjee A. and Ball, M., “Ration-by-Distance with Equity Guarantees: a New Approach to Ground Delay Program Planning and Control”, in *Proceedings of 7<sup>th</sup> USA/Europe Air Traffic Management R&D Seminar*, 2007.
- Lovell, D., Churchill, A., Odoni, A., Mukherjee, A. and Ball, M., “Calibrating Aggregate Models of Flight Delays and Cancellation Probabilities at Individual Airports”, in *Proceedings of 7<sup>th</sup> USA/Europe Air Traffic Management R&D Seminar*, 2007.
- Churchill, A., Lovell, D. and Ball, M., “Examining the Temporal Evolution of Propagated Delays at Individual Airports: Case Studies”, in *Proceedings of 7<sup>th</sup> USA/Europe Air Traffic Management R&D Seminar*, 2007.
- Tien, S-L., B. Subramanian and M. Ball, “Constructing a Passenger Trip Delay Metric: An Aggregate-level Approach”, in *Proceedings of 2008 ICRAT Meeting*, George Mason University, Fairfax, VA, June, 2008.
- Churchill, A., Lovell, D., and Ball, M., “Evaluating a New Formulation for Large-Scale Traffic Flow Management”, in *Proceedings of the 8<sup>th</sup> USA/Europe Air Traffic Management R&D Seminar*, 2009.
- Ganji, M., Ball, M. and Lovell, D., “Resource Allocation in Flow-Constrained Areas with Stochastic Termination Times: Optimistic Approach”, in *Proceedings of the 8<sup>th</sup> USA/Europe Air Traffic Management R&D Seminar*, 2009.
- Vakili, N. and Ball, M., “Equitable Allocation of Enroute Airspace Resources”, in *Proceedings of the 8<sup>th</sup> USA/Europe Air Traffic Management R&D Seminar*, 2009.
- Churchill, A., M. Ball, A.D. Donaldson and R.J. Hansman, “Integrating best-equipped best-served principles in ground delay programs” in *Proceedings of the 9<sup>th</sup> USA/Europe Air Traffic Management R&D Seminar*, 2011.
- Ball, M., C. Glover and D. Lovell, “Collaborative Approaches to the Application of Enroute Traffic Flow Management Optimization Models” in *Proceedings of the 9<sup>th</sup> USA/Europe Air Traffic Management R&D Seminar*, 2011.
- Jones, J., D. Lovell and M. Ball, “Enroute Speed Control Methods for Transferring Terminal Delay”, in *Proceedings of the 10<sup>th</sup> USA/Europe Air Traffic Management R&D Seminar*, 2013.
- Jones, J., D. Lovell and M. Ball, “An Equitable Approach for Transferring Terminal Delay with Enroute Speed”, in *Proceedings of the 6<sup>th</sup> International Conference on Research in Air Transportation 2014*.
- Ayhan, S., B. Fruin, F. Yang and M. Ball, “NormSTAD flight analysis: visualizing air traffic patterns over the United States”, in *IWCTS '14, Proceedings of the 7th ACM SIGSPATIAL International Workshop on Computational Transportation Science*, pp 1-10, 2014.
- Jones, J., D. Lovell and M. Ball, “Combining Control by CTA and Dynamic Enroute Speed Adjustment to Improve Ground Delay Program Performance”, in *Proceedings of the 11<sup>th</sup> USA/Europe Air Traffic Management R&D Seminar*, 2015.

Ball, M, P Swaroop, C Barnhart, C Yan, M Hansen, L Kang, Y Liu and V Vaze, “Service Level Expectation Setting for Air Traffic Flow Management: Practical Challenges and Benefits Assessment”, in *Proceedings of the 12<sup>th</sup> USA/Europe Air Traffic Management R&D Seminar*, 2017.

Estes, A, M. Ball and D. Lovell, “Predicting Performance of Ground Delay Programs”, in *Proceedings of the 12<sup>th</sup> USA/Europe Air Traffic Management R&D Seminar*, 2017.

Liu, Y., M.Hansen, C. Chuang, D. Lovell, M. Ball and John Gulding, “Causal Analysis of En Route Flight Inefficiency – the US Experience” in *Proceedings of the 12<sup>th</sup> USA/Europe Air Traffic Management R&D Seminar*, 2017.

## **PATENTS**

Nemirovsky, P., M. Ball and R. Dahl, 1992, Method for efficient distributed data communications network access network configuration, US Patent 5079760.

Nemirovsky, P., M. Ball and M. Post, 1993, Method for routing data in a near-optimal manner in a distributed data communications network, US Patent 5253161.

Nemirovsky, P, M Ball and R Dahl, 1993, Method for efficient distributed data communications network backbone node location, US Patent 5,216,591.

Nemirovsky, P., M. Ball and M. Post, 1995, System for identifying candidate link, determining underutilized link, evaluating addition of candidate link and removing of underutilized link to reduce network cost, US Patent 5404451.

Nemirovsky, P. and M. Ball, 1995, Method and computer system for selecting and evaluating data routes and arranging a distributed data communication network, US Patent 5426674.

Nemirovsky, P., M. Ball and R. Dahl, 1997, Method and apparatus for aggregating terminals into clusters to assist in the construction of a distributed data communication network, US Patent No. 5652841.