

MICHAEL OWEN BALL

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Institute for Systems Research
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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 Orkand Corporation Professor of Management Science; Robert H Smith School of Business and Institute for Systems Research, University of Maryland, College Park; Director of Research for Smith School (6/98 – pres); 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, the National Center of Excellence for Aviation Operations Research (5/96 – present).
- 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.
- 8/84-8/88 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*
The Boeing Company, Federal Aviation Administration, 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*
The Boeing Company, Los Angeles World Airports
- 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.

RESEARCH CONTRACTS AND GRANTS

- 10/2006-present 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-present 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-present "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; project leader for: "Advanced Concepts for Collaborative Decision Making", "Slot Auctions for U.S. Airports", "Next Generation Satellite Systems for Aeronautical Communications"; coordinate interactions with industry partners Metron Aviation and Federal Express.

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 (2nd 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 5th 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 6th 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 6th USA/Europe ATM 2003 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)

EDITORIAL ACTIVITIES

Associate Editor: *Networks* (82-pres); *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* (06-present); *Operations Research-Optimization* (7/92-12-95):

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).

Mathematical Programming Society.

Society for Industrial and Applied Mathematics.(90-99)

IEEE

Air Traffic Control Association.

CONFERENCE ORGANIZING

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 G. Donohue and K. Hoffman) *Workshop on Government, the Airline Industry and the Flying Public: a New Way of Doing Business*, Wye Woods, 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*, Wye Woods, 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 100 presentations delivered at national and international meetings.

Over 30 seminars delivered at universities in the United States, Canada and Europe.

"Optimization Based Tradeoff Analysis", Invited Semiplenary 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
- 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

ACADEMIC SERVICE

University of Maryland:

- Member of Applied Mathematics Faculty
- Member of Task Force to Redesign the Information Systems Curriculum
- Member of Division's Computer Advisory Board
- Chairman and Member of Faculty Search Committee in Information Systems
- Organizer of Management Science, Statistics and Information Systems Seminar Series
- Faculty Coordinator of MS Program
- Undergraduate Advisor for Decision and Information Sciences Option
- Chairman and Member of Various Tenure and Promotion Committees
- Member of Computer Integration Task Force
- Member of Academic Media, Technology and Telecommunications Advisory Committee
- Chairman of Computer Committee for College of Business and Management
- Acting Chairperson (Fall 1988) -- Information Systems Group
- Member and Chair of Executive Committee of the Institute for Systems Research

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 Queueing 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.

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. Saeks 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, "Locating Garages 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*, **5**, 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, Mingozi, 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.
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