

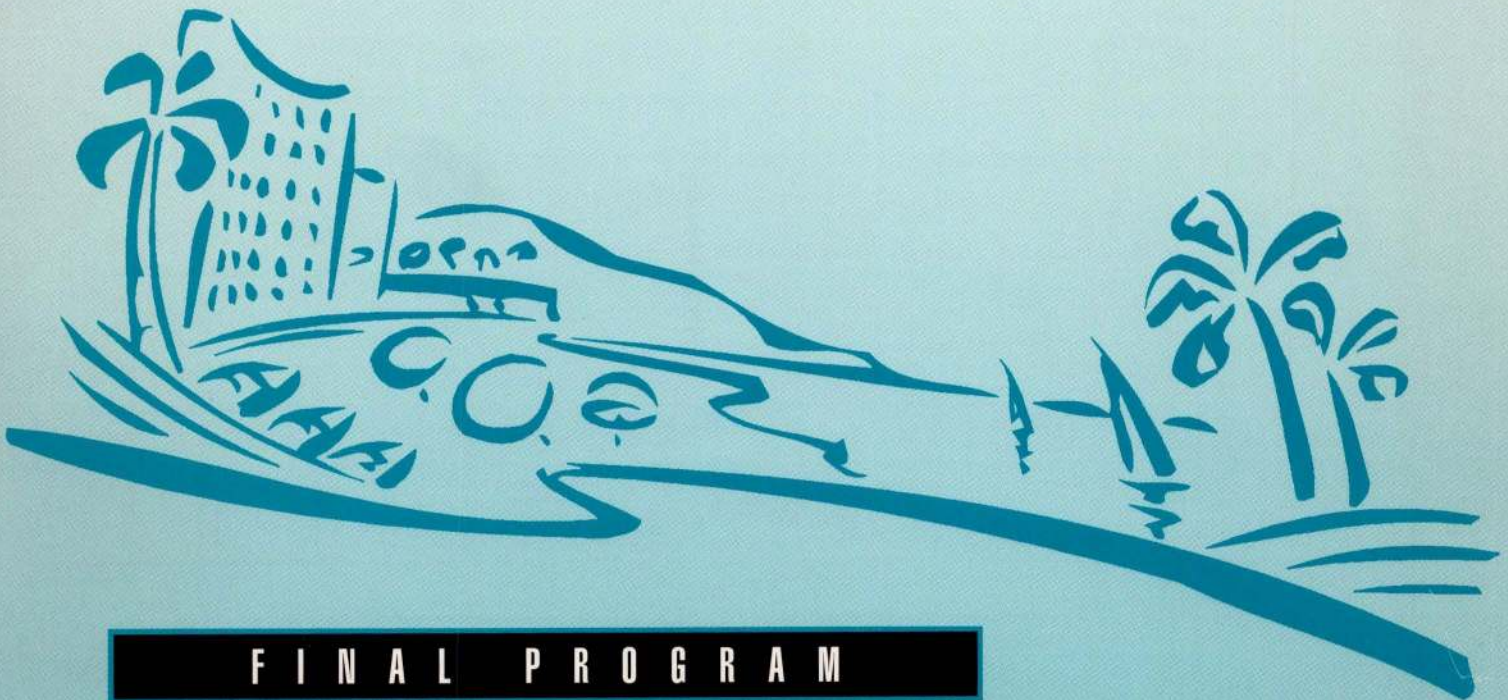
Mary S.

# San Diego

**informs**

Spring 1997, May 4-7

## Managing Services in the Next Millennium



FINAL PROGRAM

# INFORMS SAN DIEGO SPRING 1997 LOCAL COMMITTEE MEMBERS

## **General Co-Chair**

Feraidoon (Fred) Raafat  
San Diego State University  
San Diego, CA 92182-8234  
Office: 619.594.5685  
fred.raafat@sdsu.edu

## **General Co-Chair**

William R. Sherrard  
San Diego State University  
San Diego, CA 92182-8234  
Office: 619.594.4304

## **Program Co-Chair**

Soheila Jorjani  
CSU, San Marcos  
San Marcos, CA 92096-0001  
Office: 619.750.4271  
sjorjani@csusm.edu

## **Program Co-Chair**

Carlton Scott  
University of California, Irvine  
Irvine, CA 92717  
Office: 714.824.5336  
chscott@uci.edu

## **Contributed Papers**

David Jankowski  
CSU, San Marcos  
Office: 619.750.4235  
doctorj@csusm.edu

## **Invited Sessions**

Sheldon Lou  
CSU, San Marcos  
Office: 619.750.4272  
lou@csusm.edu

## **Sponsored Sessions**

Helio Yang  
San Diego State University  
Office: 619.594.6847  
helio.yang@sdsu.edu

## **Publication Chair**

Milton Chen  
San Diego State University  
Office: 619.594.2474

## **Publicity Co-Chair**

Reza Fadaei  
National University  
Office: 619.563.7437

## **Arrangements Chair**

Susan Fratamico  
San Diego Gas & Electric  
Office: 619.696.4994  
fratamic@imx.sdge.com

## **Teacher Program**

Danene Soares  
Office: 619.636.4994  
dsoares@wpsmtp.grossmont.k12.ca

---

Copies of papers abstracted in the Conference Program are available only from the authors. Requests for papers should be directed to the authors at the addresses shown in the Program.

Published twice a year prior to each National Meeting by the Institute for Operations Research and the Management Sciences. Individual issues of the Conference Program are available for \$15US per copy. Orders must be prepaid and sent to INFORMS, P.O. Box 64794, Baltimore, MD 21264-4794.

ISBN No. 0161-0295

# TABLE OF CONTENTS

Message from General Chair.....	F3
Letter from Governor of California.....	F4
Schedule of Special Events.....	F6
Schedule of Subdivision Business Meetings.....	F7
General Information.....	F9
Guest Program.....	F10
Special Events.....	F11
Technical Program.....	F11
• IS&T Conference.....	F11
• Invited Tutorials.....	F11
• Plant Tours & Session Codes.....	F14
• Reviewed Contributed Papers.....	F15
• Special Sessions.....	F15
26th Annual Franz Edelman Award Competition.....	F15
Edelman Award Presentation.....	F17
Navigating an INFORMS Meeting .....	F17
New Member Welcome & Workshop.....	F17
Keynote - James B. Hudak.....	F17
Plenary - Harry Markowitz.....	F17
• Teacher Program, Welcome & Workshops.....	F18
Software Demonstrations.....	F19
Invited Cluster Chairs.....	F20
Sponsored Session Chairs.....	F21
Future Meetings Calendar.....	F22
Scientific Program with Abstracts.....	1 - 109
Program Index.....	1 - 5
Participant Index.....	1 - 9
Daily Planner	

**San Diego  
Local  
Committee**



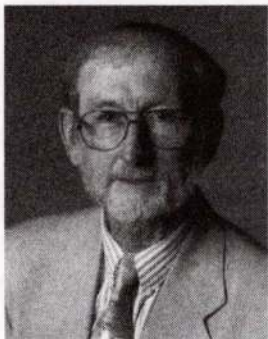
Feraidon (Fred) Raafat



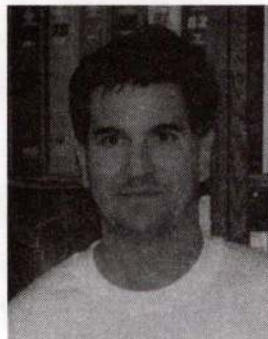
William R. Sherrard



Soheila Jorjani



Carlton Scott



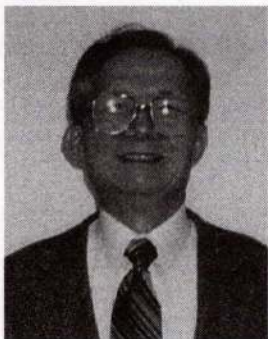
David Jankowski



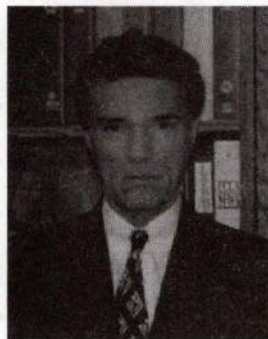
Sheldon Lou



Helio Yang



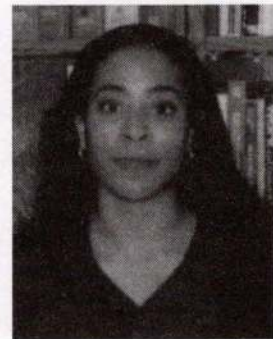
Milton Chen



Reza Fadaei

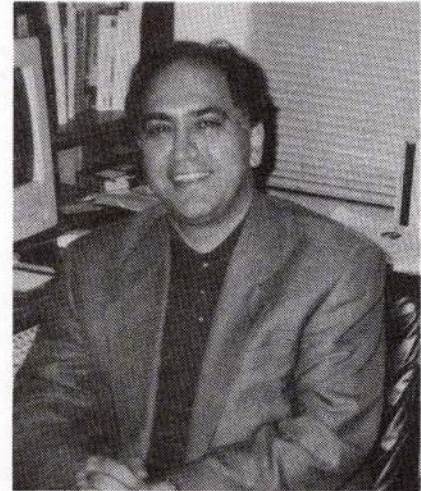


Susan Fratamico



Danene Soares

## Message from the General Chair Feraidoon (Fred) Raafat San Diego State University



On behalf of the INFORMS Spring 1997 organizing committee, it is my pleasure to welcome you to San Diego.

The theme of this meeting, "Managing Services in the Next Millennium," reflects the exciting and challenging opportunities that shape our future. In concert with this theme are the plenary session by Harry Markowitz and the keynote session by James Hudack. Moreover, many of the tutorials and several of the cluster sessions will reinforce the theme. The San Diego meeting contains more than 1,620 presentations, in over 450 sessions, including 16 invited tutorials, in 37 parallel tracks on all aspects of Operations Research, Management Science, Information Systems and related disciplines.

The Local Committee has been working hard over the last two years to make this meeting a success, and I am happy to say that we have succeeded in surpassing all of our goals. Soheila Jorjani and Carlton Scott had the daunting task of being the Program Co-Chairs; Bill Sherrard was not only the General Co-Chair, but took responsibility for financial administration. Helio Yang was responsible for interfacing with the INFORMS Colleges, and arranged the sponsored sessions. Soheila and Sheldon Lou organized the invited papers. The contributed papers were the responsibility of David Jankowski, who also created our WWW site. Graphic design for the home page, Call for Papers, and conference program was performed by Michael Wilde and CSUSM Development Office. Susan Fratamico took the challenging task of being the Arrangements Chair. Milton Chen was the Publication Chair, Reza Fadaei was Publicity Chair, and Danene Soares coordinated the Teacher Program. If you encounter any member of the local committee during the meeting, please take the time to let them know how much you appreciate their efforts. These meetings cannot be held without a great deal of volunteer effort, which largely goes unrewarded and unrecognized. Finally, the meeting preparation could not have been completed without the diligent and competent work of Julie Eldridge and Ginni McGee at the INFORMS National Office.

Some conference highlights include the concurrent meeting of the INFORMS Joint Conference on Information Systems & Technology (IS&T), a focused track on the management of medical technology, and many academic tutorials. For those who prefer to learn by doing, we have arranged plant tours of state-of-the-art production and assembly operations at Sony and the distribution system at the Naval Depot in San Diego. On-site registration will be available for these tours until they are filled and for new tours that were finalized after this program went to press.

It is our sincere hope that you will find the San Diego meeting to be intellectually stimulating and a conference that you will long remember. San Diego has plenty to offer and is, of course, a major tourist destination. Within a short drive from the conference hotel lies a diverse range of man-made and natural attractions, for which the area is well known. The San Diego Zoo, Wild Animal Park, and Sea World should be a must on everybody's list. Be sure to experience San Diego's Old Town, and wander to Seaport Village and Mission Bay to see the natural beauty of "America's Finest City".

Welcome to San Diego! For those of you who are attending your first INFORMS meeting, we hope that this will be the first of many to come. Enjoy!

GOVERNOR PETE WILSON

TO: INFORMS

It is with great pleasure that I extend my warm welcome to all those who have gathered for the annual meeting of the Institute for Operations Research and the Management Sciences, held in beautiful San Diego.

I am very pleased that such eminent professors and research scientists from around the world have chosen the State of California, and specifically, the charming city of San Diego in which to hold your annual meeting. I am sure that you will find it a productive and pleasant setting, and I trust that you will enjoy your stay with us.

Your detailed research, and subsequent findings, have enabled you to make numerous contributions to the world of science. The results have expanded and improved the fields of knowledge, and have benefited the economic and financial stability of nations, as well as the welfare of the world's people. Many are indebted to you, and you are to be commended for your valuable work.

Gayle joins me in welcoming you to San Diego, and wishing you success in your conference, and in all of your future endeavors.

Sincerely,

A handwritten signature in black ink that reads "Pete Wilson". The signature is fluid and cursive, with a large initial "P" and a long, sweeping underline.

PETE WILSON



# Member Application

**Member Dues  
and Benefits**

- |   |   |  |
|---|---|--|
| <input type="checkbox"/> <b>Regular \$85</b>  | <input type="checkbox"/> <b>Student \$21</b>  | <input type="checkbox"/> <b>Retired \$21</b>   |
| <ul style="list-style-type: none"> <li>• OR/MS Today</li> <li>• FREE choice of journal</li> <li>• discount on additional journals</li> <li>• membership directory</li> <li>• meeting registration discount</li> </ul> | <ul style="list-style-type: none"> <li>• OR/MS Today</li> <li>• OR/MS Tomorrow</li> <li>• 50% off journals</li> <li>• membership directory</li> <li>• FREE on-line job placement</li> <li>• FREE membership to one section/society</li> </ul> | <ul style="list-style-type: none"> <li>• OR/MS Today</li> <li>• 50% off journals</li> <li>• membership directory</li> <li>• meeting registration discount</li> </ul> |

Journals	1997	Non-member	Regular	Stu/Ret
<input type="checkbox"/> Information Systems Research	V. 8	\$75.00	\$46.00	\$23.00
<input type="checkbox"/> Interfaces (real world applications)	V.27	\$75.00	\$36.00	\$18.00
<input type="checkbox"/> Journal on Computing	V. 9	\$69.00	\$41.00	\$20.50
<input type="checkbox"/> Management Science	V.43	\$109.00	\$46.00	\$23.00
<input type="checkbox"/> Marketing Science	V.16	\$80.00	\$46.00	\$23.00
<input type="checkbox"/> Mathematics of Operations Research	V.22	\$75.00	\$36.00	\$18.00
<input type="checkbox"/> Operations Research	V.45	\$109.00	\$46.00	\$23.00
<input type="checkbox"/> Organization Science	V. 8	\$65.00	\$46.00	\$23.00
<input type="checkbox"/> Transportation Science	V.31	\$63.00	\$36.00	\$18.00

- Societies, Sections, Fora (non-member/regular/student-retired dues)**
- |   |  |
|---|--|
| <input type="checkbox"/> Decision Analysis Society (\$15/10/5)                  | <input type="checkbox"/> Military Applications Society (\$16/10/5)                 |
| <input type="checkbox"/> Accounting, Auditing, & Tax (\$7.50/5/5)               | <input type="checkbox"/> Management Control Systems (\$4.50/3/3)                   |
| <input type="checkbox"/> Applied Probability (\$15/10/5)                        | <input type="checkbox"/> Management of Productivity & Technology (\$4.50/3/3)      |
| <input type="checkbox"/> Artificial Intelligence (\$15/10/10)                   | <input type="checkbox"/> Manufacturing & Service Operations Management (\$10/10/5) |
| <input type="checkbox"/> Aviation Applications (\$10/5/5)                       | <input type="checkbox"/> Marketing (\$15/10/10)                                    |
| <input type="checkbox"/> Computer Science (\$7/7/1)                             | <input type="checkbox"/> Optimization (\$5/5/5)                                    |
| <input type="checkbox"/> CPMS, the Practice Section of INFORMS (\$22.50/15/15)  | <input type="checkbox"/> Organization Science (\$15/8/8)                           |
| <input type="checkbox"/> Energy, Natural Resources, & the Environment (\$5/2/1) | <input type="checkbox"/> Public Programs & Processes (\$6/4/4)                     |
| <input type="checkbox"/> Finance (\$0/0/0)                                      | <input type="checkbox"/> Railroad Applications (\$25/15/5)                         |
| <input type="checkbox"/> Group Decision & Negotiation (\$7.50/5/5)              | <input type="checkbox"/> Simulation (\$7.50/5/2)                                   |
| <input type="checkbox"/> Health Applications (\$20/10/5)                        | <input type="checkbox"/> Social Science Applications (\$5/4/2)                     |
| <input type="checkbox"/> Information Systems (\$15/10/10)                       | <input type="checkbox"/> Technology Management (\$22.50/15/10)                     |
| <input type="checkbox"/> Location Analysis (\$7.50/6/0)                         | <input type="checkbox"/> Telecommunications (\$7.50/5/5)                           |
| <input type="checkbox"/> Logistics (\$7.50/5/5)                                 | <input type="checkbox"/> Transportation Science (\$15/10/3)                        |
| <input type="checkbox"/> Pre-Collegiate Teachers' Forum (\$25/10/0)             | <input type="checkbox"/> Women in OR/MS Forum (\$10/10/5)                          |
| <input type="checkbox"/> Women in OR/MS Forum (\$10/10/5)                       | <input type="checkbox"/> Forum on Education (INFORMED) (\$0/0/0)                   |

NAME \_\_\_\_\_ JOB TITLE \_\_\_\_\_

EMPLOYER \_\_\_\_\_ (Students, please attach student i.d. or faculty certification)

ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_ STATE \_\_\_\_\_ ZIP \_\_\_\_\_ COUNTRY \_\_\_\_\_

PHONE \_\_\_\_\_ FAX \_\_\_\_\_ E-MAIL \_\_\_\_\_

Student: My free society/section is \_\_\_\_\_ Regular: My free journal is \_\_\_\_\_

Payment  Check Enclosed  Visa  MasterCard Acct.# \_\_\_\_\_ Exp. Date \_\_\_\_\_

SD.app Total Enclosed \$ \_\_\_\_\_ Signature \_\_\_\_\_

Please make checks payable to: INFORMS, P.O. Box 64794, Baltimore, MD 21264-4794  
<http://www.informs.org/> Phone: 1-800-446-3676 Fax: 410-684-2963

## SCHEDULE OF SPECIAL EVENTS

### SATURDAY, May 3

	LOCATION	FROM	TO
Organization Science Workshop	Sportee	8:00am	5:00pm
INFORMS Executive Committee Meeting	Stratford	2:00pm	6:30pm
Conference Registration	Mission Foyer	3:00pm	7:00pm

### SUNDAY, May 4

Conference Registration	Mission Foyer	7:30am	5:00pm
Introduction to Visual Basic in Excel Workshop I	Windsor South	8:00am	12noon
Organization Science Workshop	Sportee	8:00am	5:00pm
Franz Edelman Competition	Sheffield	8:00am	6:00pm
INFORMS Board Meeting	Tiki Hut	8:00am	5:00pm
INFORMS Online Meeting	Executive	10:00am	12noon
INFORMS New Member Welcome & Workshop	Le Sommet	1:00pm	2:30pm
Railroad SIG Roundtable	Sunset	1:00pm	5:00pm
The Selling of OR/MS Concepts & Analysis Workshop II	Windsor South	1:00pm	5:00pm
How to Navigate a National Meeting	Le Sommet	2:45pm	4:15pm
Subdivision Nominating Assembly Meeting - Div. B & E	Town & Country	5:00pm	6:00pm
Roundtable Reception/Dinner	Sunset	6:00pm	8:00pm
INFORMS Forum on Women in OR/MS Reception	Windsor South	7:00pm	8:00pm
MAS Council	Mtgs. Suite	7:00pm	10:00pm
Information Systems & Technology Conference Reception	Golden West	7:30pm	8:30pm
Student Reception	Sierra	7:30pm	9:00pm
Roundtable Meeting	Hampton	8:00pm	11:00pm

### MONDAY, May 5

INFORMS Board/Editors/Comm. Chairs Breakfast	Town & Country	7:00am	8:00am
Conference Registration	Mission Foyer	7:30am	5:00pm
Teacher Program	Sportee	8:00am	4:00pm
INFORMS Board Meeting	Tiki Hut	8:00am	5:00pm
Roundtable Meeting/Lunch	Sheffield	8:00am	5:00pm
Guest Breakfast	Atlas Foyer	8:30am	9:30am
Welcoming Session & Awards	Town & Country	10:00am	11:00am
<i>Journal on Computing</i> Editors Lunch	TBD	12noon	1:00pm
ACORD Lunch	Charley's	12noon	1:00pm
OR Area Editors Lunch	TBD	12noon	1:00pm
Transportation Science Lunch	TBD	12noon	1:00pm
Section/Society/Fora Meeting	Le Sommet	5:15pm	6:15pm
CPMS Isolated Practitioners Workshop	Sierra	6:15pm	7:15pm
INFORMS General Reception	Atlas Ballroom	7:30pm	9:30pm

### TUESDAY, May 6

Chapter Officers Breakfast	Sportee	7:00am	8:00am
Conference Registration	Mission Foyer	7:30am	5:00pm
Guest Breakfast	Atlas Foyer	8:30am	9:30am
Franz Edelman Award Presentation	San Diego	11:30am	12noon
Subdivision Committee Meeting	Sportee	11:30am	5:00pm
INFORMS Business Meeting	Sierra	7:30pm	8:30pm

### WEDNESDAY, May 7

Conference Registration	Mission Foyer	7:30am	2:00pm
Guest Breakfast	Atlas Foyer	8:30am	9:30am

## SCHEDULE OF SUBDIVISION BUSINESS MEETINGS

### SUNDAY, May 4

	LOCATION	FROM	TO
Section on Location Analysis	Executive	6:15pm	7:15pm
Section on Logistics	De Anza	6:15pm	7:15pm
Section on Mgmt. Control Systems	Council	6:15pm	7:15pm
Section on Mgmt. of Productivity & Technology	Adobe	6:15pm	7:15pm
Section on Microcomputers & MS	Chamber	6:15pm	7:15pm
Railroad Applications SIG	Sunrise	6:15pm	7:15pm
Technical Section on Telecommunications	Le Pavillon	6:15pm	7:15pm
College on Information Systems	San Diego	6:30pm	7:30pm

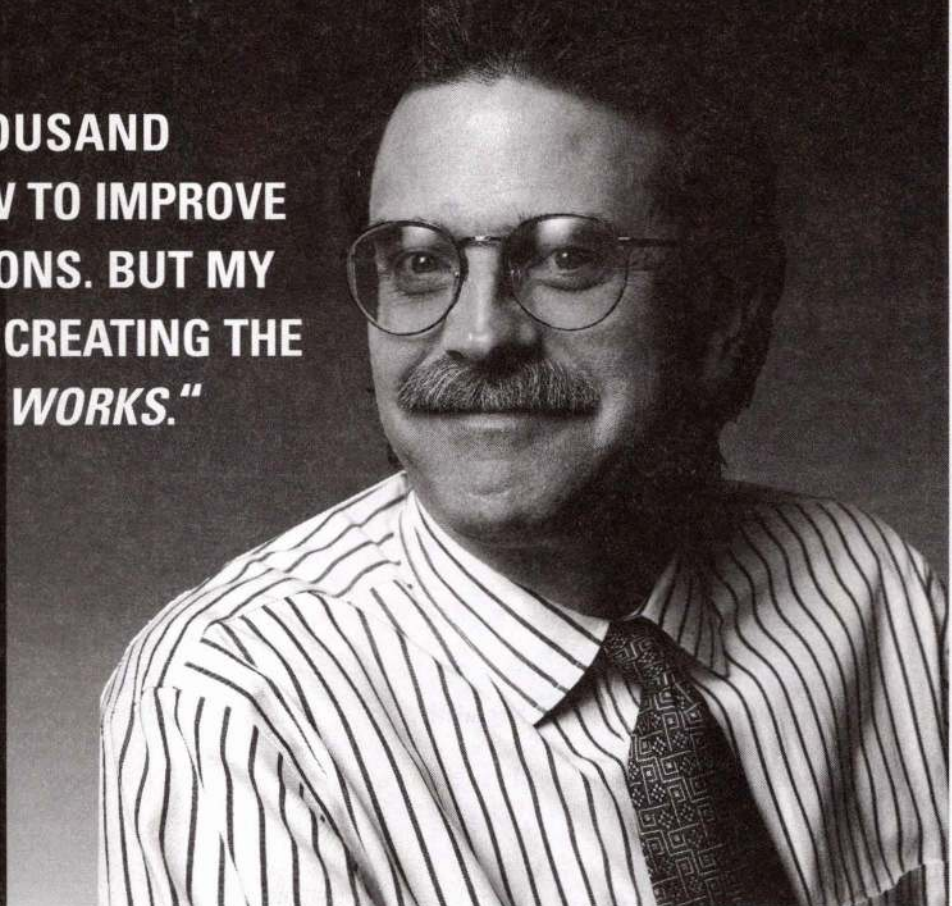
### MONDAY, May 5

Forum on Women in OR/MS	Windsor South	12noon	1:00pm
Section on Applied Probability	Windsor North	6:15pm	7:15pm
Section on Aviation Applications	Esquire	6:15pm	7:15pm
Computer Science Technical Section	Padre	6:15pm	7:15pm
Decision Analysis Society	Sheffield	6:15pm	7:15pm
Section on Finance	Council	6:15pm	7:15pm
Section Group Decision & Negotiation	Sunset	6:15pm	7:15pm
Technology Management Section	Adobe	6:15pm	7:15pm
Section on Manufacturing Management & Service Operations Management	Hampton	6:15pm	7:15pm
College on Marketing	Helix	6:15pm	7:15pm
Military Applications Society	Garden North	6:15pm	7:15pm
College on Organization Science	Chamber	6:15pm	7:15pm
Transportation Science Section	Towne	6:15pm	7:15pm

### TUESDAY, May 6

Section on Accounting, Auditing & Tax	Council	6:15pm	7:15pm
College on Artificial Intelligence	Esquire	6:15pm	7:15pm
Section on Energy, Natural Resources & the Environment	De Anza	6:15pm	7:15pm
College on Optimization	Sunset	6:15pm	7:15pm
Section on Public Programs & Processes	Chamber	6:15pm	7:15pm
College on Simulation	Congress	6:15pm	7:15pm
Section on Social Science Applications	Senate	6:15pm	7:15pm
Forum on Education	Cabinet	6:15pm	7:15pm

**"THERE ARE A THOUSAND THEORIES ON HOW TO IMPROVE BUSINESS DECISIONS. BUT MY JOB DEPENDS ON CREATING THE ONE MODEL THAT WORKS."**



When you watch a Franz Edelman Videotape, you see how leaders in OR/MS practice solve problems like yours. You get ideas on how to overcome technical and human obstacles. You see how an analyst sold their model to managers and users. You think about competing for the \$10,000 award yourself.

We hand-picked six of the best presentations, but you can order our free catalogue of over 80 Edelman finalist presentations to find more applications like your own.



**Please check beside the tapes you wish to receive:**

**96.01 South African National Defense Force: Guns or Butter:** Decision Support for Determining the Size and Shape of SANDF. SANDF teams with Deloitte and Touche to completely re-design defense force.

**96.05 National Car Rental, Inc. Revenue Management Program.** Amazing story of revenue management program turning record losses into record profits.

**95.01 Harris Corporation - Semiconductor Sector: IMPReSS, An Automated Production Planning and Delivery-Quotation System.** Solves serious problems with on-time delivery with cutting edge optimization techniques.

**95.03 Key Corp: Service Excellent Management.** Re-engineering and information systems improve customer service.

**94.01 Tata Iron and Steel, Co., Ltd.: Strategic and Operational Management with Optimization.** Winning model guides product mix decisions.

**93.01 AT&T: Operational Design for Inbound Call Centers.** Call Processing Simulator (CAPS) creates new efficiencies in AT&T's 800 market.

**new** Each 1989-1996 video will include a copy of the paper published in *Interfaces*. This provides you with clear visuals and technical detail.

Name: \_\_\_\_\_

Company: \_\_\_\_\_

Address: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Phone: \_\_\_\_\_

SD.edm

First Tape: ~~\$150.00~~ \$125.00  
 Additional tapes x ~~\$100.00~~ \$75.00 = \_\_\_\_\_  
 Shipping and Handling: \$15.00 (\$25.00 nonUS) = \_\_\_\_\_

**TOTAL = \_\_\_\_\_**

Check Enclosed Charge my:  VISA  MasterCard  
 Card #: \_\_\_\_\_ Exp. Date: \_\_\_\_\_

Allow 2-4 weeks for delivery. Make checks payable to INFORMS, 901 Elkridge Landing Rd, Linthicum, MD 21090

**FREE! Check here if you wish to receive our catalog with descriptions of complete Edelman videotape collection (1982-1996).**

**informs**

**CALL 1-800-446-3676 FAX (410) 684-2963**

Institute for Operations Research  
 and the Management Sciences  
 A Merger of ORSA and TIMS

## GENERAL INFORMATION

**Climate** - The temperature in San Diego during May can vary from 50° in the evening to the seventies or eighties during the day. Although you may need a sweater or jacket for evening wear, you'll be comfortable in a short-sleeved shirt or blouse during the day.

**E-mail Centers** - To stay in touch with the outside world, e-mail terminals will be set up Monday - Wednesday in the Exhibit Hall for attendees to check for messages.

**Exhibits** - Exhibits will be located in the Presidio Room in the Convention Center. Twenty leading software developers and publishers will showcase the latest software products, technical reference materials and specialized services. Software demonstrations on Tuesday and Wednesday will show how leading software systems can help you find solutions to complex problems. Exhibit hours will be:

Monday	9:00am - 5:00pm
Tuesday	9:00am - 5:00pm
Wednesday	9:00am - 12noon

Companies interested in exhibiting may contact Tammy Fielteau with Lionheart Publishing at 770-431-0867, ext. 217.

**Hotel Information** - The Town & Country Hotel is the official headquarters for the INFORMS Spring Meeting. A block of rooms has been reserved for attendees; conference rates are \$75, \$90 or \$105 single and \$85, \$100 or \$115 double. Space is limited and may not be available after the deadline; call 800-77-ATLAS or 800-772-8527 for reservations or fax the hotel reservation form to 619-291-3584.

**INFORMS Online** - The preliminary and final programs can be accessed on INFORMS Online at <http://www.informs.org>. Information will be updated periodically.

**Job Placement Center** - The INFORMS Job Placement Center, JPS, helps OR/MS professionals locate employment opportunities in academia, government and private industries. Employers from a wide variety of professional interest areas regularly participate in this program. It runs on a semi-annual basis, January-June and July-December.

The INFORMS JPS is now up and running for the Spring San Diego Meeting. Go to <http://www.informs.org/JPS/> and check out:

- On-line registration for applicants and employers;
- 24-hour access to job listings and applicant files;
- On-site interviewing facilities at national meetings;
- Hard copy booklets of all active participants;
- Low fees (free for student members).

To obtain additional information about this service, on-site interviewing arrangements or to obtain a paper copy application, you may contact our Customer Service Department at 800-446-3676 or by e-mail at [JPS@mail.informs.org](mailto:JPS@mail.informs.org).

**Professional Lounge** - Network and share experiences, ideas and solutions with other professionals - or, just relax. Refreshments will be available. The lounge, in the Presidio Room, will be open Monday and Tuesday from 9:00am - 5:00pm.

### Registration

• **Cancellation & Refunds** - Payments will be refunded **only** if a written cancellation is received in the INFORMS Rhode Island office **postmarked no later than April 30**. Cancellations may also be faxed to 401-274-3189 or e-mailed to [tanya.skorohod@informs.org](mailto:tanya.skorohod@informs.org) and **must** meet this deadline.

• **On-Site Registration** - Meeting registration will be located in the Mission Foyer during the following hours:

Saturday, 5/3	3:00pm - 7:00pm
Sunday, 5/4	7:30am - 5:00pm
Monday, 5/5	7:30am - 5:00pm
Tuesday, 5/6	7:30am - 5:00pm
Wednesday, 5/7	7:30am - 2:00pm

The registration fee allows admittance to all technical sessions, the General Reception and to the exhibit hall. Name badges **MUST** be worn to all INFORMS sessions, functions and events. Misplaced badges may be replaced at the registration desk by showing your receipt. Meals are not included in the registration fee. If you attend workshops or special paid functions, an additional fee is required. **ALL ATTENDEES, INCLUDING SPEAKERS AND SESSION CHAIRS, MUST REGISTER AND PAY THE REGISTRATION FEE.**

If you are presenting a contributed paper and have sent your abstract to the Rhode Island office in response to the Call for Papers, authors who paid the \$65 abstract submission fee may deduct this amount from the balance of their registration payment.

• **Pre-Registration** - Attendees are urged to pre-register for the conference; pre-registration is less

expensive, quicker and easier than on-site registration. Complete the pre-registration form and mail to INFORMS San Diego, 2 Charles St., Ste. 300, Providence RI 02904 on or before April 9. Fees may be paid by credit card (MC/VISA only - fax to 401-274-3189) or by check or money order, payable to INFORMS San Diego '97. Registration payments may also be made via the Web at <http://www.informs.org> using your credit card; this is a secure server. **The deadline for pre-registration will be strictly adhered to; all payments postmarked after the April 9 deadline will be charged the full, on-site registration fee.** Registration materials may be picked up in the registration area.

• Rates	Before 4/9	After 4/9
INFORMS Members	\$180	\$205
Non-Members	\$220	\$245
Student/Retired	\$65	\$65
Teachers	\$25	\$25
Guests	\$25	\$25

**Special Services/Assistance** - Attendees requiring special accommodations or services for hotel rooms, session rooms or special events may contact Cynthia J. Rinaldi at 800-343-0062, ext. 203, by fax at 401-274-3189 or via e-mail at [cynthia.rinaldi@informs.org](mailto:cynthia.rinaldi@informs.org) no later than two weeks prior to the meeting.

**Transportation** - San Diego is served by all major carriers. We have made arrangements for special air fares for attending this conference.

The Town & Country Hotel is 6 miles from the San Diego International Airport. Taxi fares to the hotel are approximately \$16-\$18. Cloud 9 Shuttle is offering discounted round trip shuttle service to and from the hotel. The cost is \$7 one way or \$14 roundtrip.

If you rent a car at the airport, take Harbor Drive East and follow signs to I-5 North. At the Interstate 8 interchange, take I-8 East to the second Hotel Circle exit. At the bottom of the exit, turn left and follow Hotel Circle South around in a U-shape to Hotel Circle North. Town & Country is at 500 Hotel Circle North. Rental cars are available at the airport; guests can also arrange for a rental car after checking into the hotel.

San Diego has both a bus and trolley system. The trolley goes as far south as Tijuana, Mexico and terminates at the train station near the docks in downtown San Diego. The bus system serves all of San Diego.

## GUEST PROGRAM

**Breakfast** - The Guest Program for San Diego includes a continental breakfast, Monday through Wednesday, as well as the General Reception on Monday for a \$25 registration fee. Guests may register by using the registration form in this Program. Continental breakfasts will be served from 8:30 - 9:30am, Monday through Wednesday. **The breakfasts are limited to registered guests only and guests must wear their name badges for admittance.**

### Tours

• **Behind the Scenes at the San Diego Zoo** - Come to the world famous San Diego Zoo for an exclusive, behind the scenes tour! Covering 100 acres of land, the zoo is home to the world's rarest collection of mammals, birds and reptiles with 5,000 species of exotic plants. In areas that are closed off to the general public, learn about the zoo's breeding efforts with endangered species, what the animals eat and how their ailments are treated. For those who dare, there can be a hands-on experience with some very unusual animals! In addition to this fascinating view of the zoo's daily operations, you will have an hour of free time to see the sights on your own. Buses leave the Town & Country Hotel at 9:00am and return at approximately 1:00pm.

**Minimum Participants: 15**

• **Tijuana Shopping with Lunch** - Come South of the Border and join us for an exotic shopping trip to colorful Mexico! With new shopping plazas and Tijuana's open-air bazaars to choose from, you can bargain for hand-made trinkets and treasures from Old Mexico. Don't miss the duty-free stores with unbeatable savings on glassware, china and perfume as well as name brand designer items. This tour includes a traditional Mexican lunch in an elegant hacienda. Buses leave the Town & Country Hotel at 9:00am and return at approximately 2:00pm.

*All US and Canadian citizens should carry identification to re-enter the United States; all others must have the correct documentation, i.e., green card, multi-entry visa, passport, etc. We recommend that guardians for minors without identification bring a birth certificate or picture ID.*

## SPECIAL EVENTS

### Forum on Women in OR/MS

• **Business Meeting & Luncheon** - The Business Meeting of the INFORMS Forum on Women in OR/MS will be held at lunchtime on Monday. Everyone interested in issues related to women professionals in OR/MS is invited to attend. Please bring a bag lunch and join us from 12noon - 1:00pm in the Windsor South Room.

• **Reception** - The Reception for the INFORMS Forum on Women in OR/MS will be held on Sunday, 7 - 8:00pm in the Windsor South Room. This is a good opportunity to meet women researchers and practitioners in OR/MS. Everyone is welcome. The reception is sponsored by the Operations Research Department of AT&T Labs.

**General Reception** - All participants and their registered guests are invited to attend the INFORMS General Reception Monday, May 5 in the Atlas Ballroom of the Town & Country Hotel, from 7:30 - 9:30pm. *For admittance, please present the ticket included in your registration packet.*

**Membership Meeting** - The INFORMS General Membership Meeting will be held in the Sierra Room from 7:30 - 8:30pm on Tuesday, May 6. Wine and cheese will be served and the INFORMS Board Members and Officers will make brief remarks.

**Student Reception** - All registered students are invited to attend the Student Reception in the Sierra Room, Sunday, May 4 from 7:30 - 9:00pm. *For admittance, please present the ticket included in your registration packet.*

## TECHNICAL PROGRAM

### Information Systems & Technology Conference

The second INFORMS Joint Conference on Information Systems & Technology, IS&T, will be held in conjunction with the INFORMS San Diego Spring 1997 Meeting. The conference is sponsored by the College of Information Systems and the College on Artificial Intelligence.

This conference requires an additional conference registration fee as indicated on the registration form. Attendees will be able to

participate in all activities and sessions of the INFORMS San Diego Meeting.

The conference will provide a forum for all groups related to information systems and information technology to present and discuss their views, issues and research results.

Each day will begin with a keynote speaker. **Andrew Whinston** will speak on "*Electronic Commerce*" and

**Robert Hecht-Nielsen** will give a presentation entitled, "*Context Vectors: A Practical Approach for Automatically and Economically Acquiring Trillions of Real-World Factoids.*" Additionally, there will be two panels, one tutorial session and eight paper sessions. Each attendee will receive a proceedings containing the reviewed and accepted papers and extended abstracts. See the homepage at [www.cba.ufl.edu/dis/istc/](http://www.cba.ufl.edu/dis/istc/).

### Invited Tutorials

#### SA18 Health Care Information Systems

**Rema Padman**, Carnegie Mellon University

The explosive advances in medical and information technology in recent years combined with the current climate for health care

reform have created many challenges in developing, adapting, and integrating information systems for cost-effective health care administration and delivery. This tutorial will present an overview of the major information systems

methodologies and approaches in the delivery of modern health care systems. In particular, specific challenges, potential solutions, and linkages in the areas of clinical and administrative decision support,

and Internet based applications will be highlighted.

**SB18 Fair Division: From Cake-Cutting to Dispute Resolution**  
*Steven J. Brams, NYU*

Cutting a cake, dividing up property in an estate, determining the borders in an international dispute - these and other problems will be used to illustrate how constructive procedures can be applied to allocating goods, and deciding who wins on what issues, that satisfy such properties as envy-freeness, equitability and Pareto-optimality.

**SC18 Entropy Optimization and Mathematical Programming**  
*S.-C. Fang, North Carolina State University; J.R. Rajasekera, International University of Japan; H.-S.J. Tsao, University of California*

Although the word "entropy" has been around since 1865 in the literature of physics, it gained wider publicity with the work of Shannon's Information Theory in 1948. Later, Jaynes proposed the principle of maximum entropy and inspired its application to many areas, including management, finance, transportation, urban planning, OR and statistics.

**SE18 Selected Developments in Supply Chain Management**  
*Evan L. Porteus, Stanford University*

Supply chain management encompasses not only traditional operational management of multi-echelon production, inventory, and distribution systems, it includes the design of such systems, including the coordinating mechanisms and technologies that facilitate the flows between distinct people, locations, and organizations that comprise these systems. The area is too broad to warrant attempting a comprehensive tutorial, so this presentation will limit itself to

topics of particular interest to the speaker.

**MA18 Nonlinear Programming**  
*Leon Lasdon, University of Texas*

This tutorial will survey recent advances in NLP software, modeling languages, and applications. Software includes GRG and SQP solvers, and recent advances in interior point and SLP algorithms. Both algebraic languages and spreadsheets solvers are discussed. In applications, we consider financial models and new work in the optimization of simulations.

**MB18 Applied Conjugate Duality**  
*Thomas R. Jefferson, Sultan Qaboos University*

This presentation is intended for people interested in applying conjugate duality to gain insight into OR applications. Conjugate duality has its roots in mathematics; however it has been found to be valuable in understanding problems which can be modeled as convex programs. Initial applications were engineering oriented as nonlinear engineering models are quite common. To improve their accuracy, business models are increasingly incorporating nonlinear relationships. Here we explore the application of conjugate duality to a wide variety of models in the framework of a relatively easy methodology for its application.

**MC18 Geometric Programming**  
*K.O. Kortanek, University of Iowa*

Geometric programming as a next level of extension LP owes its origins to the arithmetic-geometric mean inequality. During the last 35 years, manifest applications have occurred in many fields, including engineering design, reliability, operations (project management and lot sizing), economics and marketing, statistical inference, entropy, and telecommunications.

Recent advances in interior point methods have led to efficient algorithms for solving both primal and dual (polynomial) GP - problems having enormous degrees of difficulty, simultaneously. A main goal of this tutorial is to demonstrate the wide applicability of GP and to increase the skills of the participants for recognizing opportunities for modeling otherwise intractable nonlinear problems as GPs. A review of the basic features of the new GP algorithms will be given together with recently developed (GP) large-scale problems which are becoming additions to libraries of GP test problems in several countries. Finally, recent approaches for numerically treating the nonconvex "signomial" GP or "reversed" GP will be surveyed, with a look towards the efficient use of recent LP and GP solvers in a necessarily global optimization approach for this class of problem, including the more familiar branch & bound methods.

**MD18 Operations Strategy in Service Management**  
*Uday S. Karmarkar, UCLA*

Just as with service operations, the special characteristics of services require novel approaches to the analysis of service competition. The absence of a tangible product means that traditional quantity based models of demand and supply, or of value and cost do not apply very well. Furthermore, the lack of a portable product naturally affects the structure of service chains. We present issues in the modeling of service competition and the implications for strategy development. The special features of information intensive industries, such as publishing, financial services and education, are discussed. The topics addressed include competitive models, operations and marketing

integration, service chains, service design and location.

**TA18 Service Operations Management: An Agenda for Normative and Empirical Analysis**

*Patrick T. Harker, University of Pennsylvania*

The service sector is not only the largest segment of all developed economies, but also consumes over 85% of information technology investment every year. As such, this segment provides tremendous opportunities for academic research and the application of OR/MS methodologies. This tutorial will review the state-of-the-art in the analysis of service operations in general, will provide a detailed analysis of these methods to financial services, and will provide a framework for the emerging discipline of service operations management.

**TB18 Bucket Brigades: An Example of Self-Organizing Logistic Systems**

*John J. Bartholdi, III, Georgia Institute of Technology; Donald D. Eisenstein, University of Chicago*

Social insects such as ants or bees operate logistics systems that are highly effective even without blue-print or management. Instead, global coordination emerges spontaneously, through the multiple interactions of many simple components. In a similar way, when workers on a flow line are organized into "bucket brigades," they can function as a self-organizing system that spontaneously achieves its own optimum configuration. We report on models and case studies in manufacturing and distribution.

**TC18 Fractional Programming, Generalized Convexity & Generalized Monotonicity**

*Siegfried Schaible, University of California*

In many models of management and economics, the rigid assumption of convexity can be relaxed to various types of generalized convexity without losing properties important for solving such models, for example, single- and multi-ratio fractional programs. More recently, the rigid assumption of monotonicity has been replaced by different kinds of generalized monotonicity, e.g., in complementary problems, variational inequality problems and the more general equilibrium problems in the sense of Blum Oettli. We survey concepts and uses of generalized convex functions and generalized monotone maps.

**TD18 Robust Discrete Optimization and Its Operations Management Applications**

*Panos Kouvelis, Washington University; Gang Yu, University of Texas*

This tutorial deals with decision making in environments of significant data uncertainty, with particular emphasis on operations and production management applications. For such environments, we suggest the use of the robustness approach to decision making, which assumes inadequate knowledge of the decision maker about the random state of nature and develop a decision that hedges against the worst contingency that may arise. Robust discrete optimization is a comprehensive mathematical programming framework for robust decision making. Our framework applies minimax regret criteria to

differentiate the performance of the various solutions over the given set of realizable scenarios and it is mostly developed for models with discrete decision variables using state of the art convex and combinatorial optimization techniques. We demonstrate the applicability of the framework to a variety of decision making environments such as resource allocation, scheduling, production planning, location, inventory, layout planning, and well known optimization models (assignment, knapsack, shortest paths, spanning trees, network design).

**TE18 Tabu Search for Discrete, Nonlinear and Stochastic Optimization**

*Fred Glover, James P. Kelly, Manuel Laguna, University of Colorado*

The hallmark of tabu search is an integrated collection of search strategies based on creating and exploiting adaptive memory structures. The flexibility of adaptive memory structures has long been emphasized as the key to the success of TS approaches. Such memory contrasts with the rigid memory structures of classic OR and artificial intelligence procedures such as branch and bound and its various tree search incarnations, and also contrasts with the "memory-less" designs of approaches such as multistart methods, simulated annealing and genetic algorithms. Enhanced forms of adaptive memory strategies in tabu search are yielding new "records" for solving optimization problems from a wide range of applications, including resource planning, telecommunications, VLSI design, financial analysis, scheduling, seismic inversion, space planning, molecular engineering, facility location,

neural network design and training, graph partitioning, transport planning, pattern classification, and general nonlinear and combinatorial problems with stochastic parameters. We review the basic principles of tabu search and survey its recent applications, and provide computer demonstrations of its performance. Included is a new software demonstration of a "proto-generic" tabu search procedure.

**WA18 Constraint Programming**  
*Carol Tretkoff, Ken McAloon,*  
*Brooklyn College*

Constraint programming supports constraints as first-class objects in programming systems. Those who attend will learn how to use constraint programming to build hybrid discrete and

continuous models to solve problems at the AI/OR interface. The problem solving methods presented and demonstrated will include constrained quadratic regression, the injury method, branching on the dual side, least discrepancy search and randomized shuffle algorithms. Available finite domain constraint libraries and the issue of libraries vs. languages will be discussed. The 2LP language, "Linear Programming & Logic Programming," will be used; it is a small system with C-like syntax easy to pick up.

**WB18 Structural Equation Modeling Using LISREL**  
*George Marcoulides, California State University*

Structural equation modeling (SEM) is concerned with testing

complex models for structure of functional relationships between observed variables and latent variables. The functional relationships are described by parameters that indicate the magnitude of the effect that independent variables have on dependent variables. As implemented in most computer packages, SEM includes as special cases such procedures as confirmatory factor analysis, multiple regression, path analysis, models for time-dependent data, recursive and non-recursive models for cross-sectional and longitudinal data, and covariance structure analysis. This tutorial will introduce SEM techniques via the LISREL (Version 8) computer program.

**Plant Tours**

• **Sony Manufacturing Plant, \$41** - Visit one of the largest TV plants in Southern California. The plant produces TVs for domestic and foreign consumption. The tour will cover steps in the manufacture of TV sets from the arrival of material at the receiving dock, through manufacturing to the shipping department where they are sent to foreign and domestic markets. Buses depart Monday, May 5 at 1:00pm; tours will last approximately 2 hours.

• **Defense Distribution Depot (Naval Supply Depot), \$41** - Visit the Defense Distribution Depot which supplies military establishments in Southern California and Yuma, Arizona. The tour will take you through the depot's storage facilities and shipping docks. Attendees are always amazed at the magnitude of the operations required to keep the military facilities supplied. Pants are required and long sleeve shirts and comfortable walking shoes recommended. Buses depart Tuesday, May 6 at 1:00pm; tours will last for approximately 2 hours.

**Session Codes**

The 2-letter codes for sessions indicate the day and time of each:

<b>SA - WA</b>	Sunday - Wednesday, 8 - 9:30am
<b>SB, TB, WB</b>	Sunday, Tuesday, Wednesday, 10 - 11:30 am
<b>MB</b>	Monday, 1 - 2:30pm
<b>SC, TC, WC</b>	Sunday, Tuesday, Wednesday, 1 - 2:30pm
<b>MC</b>	Monday, 2:45 - 4:15pm
<b>SD, TD, WD</b>	Sunday, Tuesday, Wednesday, 2:45 - 4:15pm
<b>MD</b>	Monday, 4:30 - 6:00pm
<b>SE, TE</b>	Sunday, Tuesday, 4:30 - 6:00pm

**Welcome Session - Monday, 10:00 - 11:00am, Plenary Session - Monday, 11:00am - 12noon**

**Reviewed Contributed Papers** - The INFORMS Board has begun a review process which hopefully will enhance the quality of presentations. Reviewed papers will be identified with an **R** in the program.

The purpose of the review process is to enhance the quality of the presentations rather than to review papers for contribution to the literature or originality of ideas. Attention is paid to content, organization, presentation and legibility. Complete copies of all reviewed papers will be available at the session. The following have been reviewed:

"Towards Finding Global Representations of the Efficient Set in Multiple Objective Mathematical Programming" **H.P. Benson, S. Sayin**

"Knowledge Acquisition & Presentation in a Student Model" **Q. Chen, A. Kumar**

"Constructing Complex Scales for Evaluating Alternative Combinations of Multiattribute Items"  
**C.-F. Chien, F. Sainfort**

"Computer-Based Tourism Information System: Need of Turkey" **B. Egeli, M. Ozturan** "Vulnerability Assessment of Hierarchies & Markets" **G.N. Kenyon, A. Talalayevsky**

"Effect of External & Internal Learning Rate Differences on Manufacturing Improvement" **B. Kim** "Effects of Incentive & Probabilistic Management Audit on Profit Center Managers' Transfer Price Negotiation Task" **S. Mahenthiran**

"Deterministic Chaos in the Capacity Expansion Race: A Study of the Airline Industry" **R. Rao, Y. I. Song, S. Rajagopalan**

"Efficiency Analysis of Markets in Pacific Rim Countries" **R. Singamsetti**

"Development & Use of a Dynamic Computable General Equilibrium Global Model in Evaluating Trade Reforms" **A. Somwaru, X. Diao**

"Identification of Strategic Groups Based on Strategic Interactions: A Network-Analytic Approach" **Y.I. Song**

---

## Special Sessions

### • 26th Annual Franz Edelman Award for Achievement in OR/MS Competition Presentations

Representing applications from fast food operations to railroad scheduling systems, 6 finalists will vie for the 1997 Franz Edelman Award for Achievement in Operations Research and the Management Sciences.

Stephen Strauss, Chair of the 1997 competition, announced the following finalists: Hewlett Packard, Nortel, Pacific Gas & Electric Company, Sabre Decision Technologies, Taco Bell Corporation and the US Department of Energy.

Finalist presentations for the 1997 competition will be given on Sunday, May 4, during the INFORMS San Diego meeting in the Sheffield Room, 8:00am - 6:00pm. Those interested in the practice of OR/MS are encouraged to attend the day-long presentation session. The cost is \$95 per person and includes lunch.

This is the 26th year that the prestigious \$15,000 competition has been held. The award is jointly sponsored by INFORMS and CPMS, the Practice Section of INFORMS. The Edelman Award recognizes outstanding implemented work that has had a significant positive impact on the performance of the client organization. The top finalist receives a \$10,000 first prize.

The work to be presented by this year's finalists covers a wide range of operations research applications. Finalist information follows:

**Hewlett Packard - M. Burman:**  
*"The Use of Operations Research Techniques to Improve the Design of a Hewlett Packard Printer Production Line."*

Hewlett Packard planned to build a large automated manufacturing system for Ink Jet printers. Originally, they planned to use a flow line design with multiple sub-assembly cells of more than 100 processes separated by virtually no buffers. The resulting system throughput proved to be inadequate. Since the system was already being built, individual machines could not be

changed without significant disruption to the product development cycle. It was decided that the best way to improve the throughput was to install limited buffers at strategic points. Within 1 week, recommendations were in place that promised to almost double the expected system throughput at a relatively low cost and with a minimum impact on the flow-time and WIP. This work led to a savings of several million dollars per month and was successfully applied to other projects within the division.

**Nortel - P.A. Brinkley, D. Carr, J. Folger, K. Haag, K. Liou, D. Stepto, K. Wang:** *"Redefining Factory Information Technology: An OR-Driven Approach."* A team of new graduate and experienced engineers was recruited to implement an enterprise information system for Nortel's new PCS1900 cellular equipment manufacturing operation. This system provides real-time access to production metrics relating to quality, inventory and cycle time, along with linked analysis tools providing real-time decision

support. These tools, including a simulation environment, expert systems and statistical product design analysis system, are accessible to production workers, managers and engineers through the intranet using Netscape. In addition, inexpensive real-time access to factory information from the desktop eliminated costly delays resulting from gathering, analyzing and transferring data. Normally requiring costly time consuming development by programmers and MIS specialists, this approach of using OR specialists resulted in a complete implemented network and decision support system in less than 1 year. This marked a major shift from traditional shop floor systems deployment within Nortel and the industry in general, and illustrates an opportunity for OR to assume a leadership role in system implementation in manufacturing operations.

**Pacific Gas & Electric Company** - C. Greif, R.B. Johnson, A.J. Svoboda, A. Vojdani, F. Zhuang: "*Pacific Gas & Electric Company's Hydro-Thermal Optimization Model.*" Since 1992, PG&E Company's Hydro-Thermal Optimization system has been the primary decision support tool for the short-term scheduling of its generation resources. HTO is a significant asset to PG&E in helping system operators and energy traders adjust competitively, especially in light of the impending deregulation of the industry. The model development group has also been able to act as an internal consulting group, quickly incorporating new operating considerations. The benefits of using the HTO model have been estimated at \$1 million per month, along with an estimated savings of \$3 million per year in its specific application to the voluntary curtailment of

qualifying facilities production during low energy cost periods.

**Sabre Decision Technologies - N. Ben-Kheder, J. Kintanar, C. Queille, W.K. Stripling:** "*Decision Support Scheduling Systems for SNCF.*" The national railroad of France, Societé Nationale des Chemins de Fer Français, and Sabre Decision Technologies teamed up to address the problem of train capacity allocation in SNCF's network of high-speed electric-powered Trains Grand Vitesse, which carry more than 50 million passengers per year among 140 cities in both France and Europe. Used to develop advance schedules and published timetables, *RailPlus* is composed of 5 modules: a workset manager, a profitability module, a feasibility module, a capacity allocation module and a routing module. The capacity allocation module utilizes a "sub-gradient" algorithm to solve an integer non-linear stochastic optimization problem, while the routing module was cited as being particularly robust. *RailCap* also uses a similar capacity allocation model to monitor the reservation activity for all trains and to add extra trains to the schedule when necessary. The implementation of the DSSs is credited with an overall profit increase of 3-5%, reductions in manpower and schedule development time and improvements in planning and scenario development.

**Taco Bell Corporation - J. Hueter, W. Swart:** "*An Integrated Labor Management System for Fast Food Operations.*" Following the introduction of the "value meal" in 1990, Taco Bell launched a major study to develop a labor management system in order to control labor costs. There were 3 model components to their

analysis: a demand forecasting model, a simulation model to determine the appropriate staffing to meet customer demand and an optimization model to perform the staff scheduling function. Data are collected periodically to allow for updates in model parameters, as well as changes in the model structure. Labor savings of 1 hour per day per company-owned store were achieved, yielding a savings of more than \$7.6 million per year.

**US Department of Energy - E. Schweitzer, D. von Winterfeldt:** "*An Assessment of Tritium Supply Alternatives in Support of the US Nuclear Weapons Stockpile.*" Nuclear weapons need to be serviced and maintained, and in particular, they require the periodic replacement of tritium. Since there currently exists no tritium production facility in the US, tritium supplies will fall below the required reserve level in 2011. To decide how to fill this projected gap, the Department of Energy conducted a major assessment of 10 tritium technology alternatives, including building a new reactor, purchasing commercial reactor(s) and building an accelerator. Each supply alternative involved risks of schedule overruns, production shortfalls, cost overruns and environmental impacts. These risks were analyzed using formal probability elicitations, event tree analyses and Monte Carlo simulations. A dynamic production simulation was developed that combined the results of the schedule and production risk analyses to predict the production of tritium for each alternative over a period of 40 years. The analysis formed the technical basis for the decision for the Secretary of Energy to pursue both the commercial reactor options and the accelerator option for producing tritium.

• **Edelman Award**

**Presentation** - The winners of the 26th Annual Franz Edelman Award for Achievement in OR/MS Competition will be announced on Tuesday, May 6, 11:30am - 12noon in the San Diego Room. Don't miss this prestigious award as it is presented to honor the best implementation of operations research and management science by the six noted finalists.

• **Navigating an INFORMS**

**Meeting** - When you look at the meeting program, do you feel confused and overwhelmed? With enough time, do you think you can probably find your way to the right session or do you maybe think it's just better to stick with one track and sit it out? What about all the non-technical program opportunities and special events?

What is valuable to you and how do you find it? This short workshop will help you understand the structure of the INFORMS meeting and develop your personal compass to help you navigate the meeting and maximize the return on your registration fee. We will help you find the technical papers, tutorials, workshops, subdivision meetings, receptions, parties, business meetings, free food, exhibits, jobs, wine and cheese and people.

Whether you are a new member or an experienced INFORMer, you will learn something new about the meeting. The workshop will be held on Sunday, May 4, 2:45 - 4:15pm in Le Sommet.

• **New Member Welcome & Workshop** - Are you interested in finding out more about INFORMS? Are you new to INFORMS? Do you know about our many journals?

How about our meetings and networking opportunities? Do you know about our individual member benefits such as life, disability and health insurance, credit card or job placement services? Do you know how to get to INFORMS On-Line and your virtual Institute? Do you want to know more about how to get involved in the Institute? Do you know about the chapters in your area, or the many sections and colleges that focus on a specific methodological or application interest? This workshop is directed to new members in order to give you a chance to meet some INFORMS leaders, to learn more about the Institute and to get answers to all your questions about the Institute. It is also a good way to get a discount coupon for many of the Institute's products. The workshop will be on Sunday, May 4, 1:00 - 2:30pm in Le Sommet.

**Keynote**

*James B. Hudak,  
Andersen Consulting,  
Wellesley, MA*

"Marketplace Issues: Health Care in the 21st Century"

This presentation will explore market positioning strategies that are emerging in the health care industry and will discuss how plans can overcome the barriers to establishing a competitive position in a changing and evolving health care marketplace.

James B. Hudak is a partner in the Boston office of Andersen Consulting with responsibility for directing the Health Services Practice for the eastern half of the US. His client relationships include Kaiser Permanente, Harvard Pilgrim Health Care Plan and Group Health Cooperative. Throughout his career, Mr. Hudak has consulted exclusively with managed care organizations, medical groups, hospitals, academic medical centers and public agencies.



**Plenary**

*Harry Markowitz,  
Harry Markowitz Co.,  
San Diego*

"Principles of Inference:  
In Theory & in Practice"

Decision making should be Bayesian, but classic (R.A. Fisher, Neyman-Pearson) inference can be highly misleading for Bayesians, as can the use of diffuse priors. Recommended procedures are illustrated using an important financial application. In particular, we consider how to bound Bayesian shifts in belief for compound hypotheses.

Dr. Markowitz has applied computer and mathematical techniques to various practical decision making areas. He presented what is now referred to as MPT, Modern Portfolio Theory, a standard topic in college courses and texts on investments and widely used by institutional investors and by some quantitative money managers for stock selection for equity portfolios. Dr. Markowitz received the John von Neumann Award from ORSA for his work in portfolio theory, sparse matrix techniques and SIMSCRIPT. In 1990, he shared the Nobel Prize in Economics for his work on Portfolio Theory. He is currently President of Harry Markowitz Company.



**Teacher Program** - The middle/high school and community college math and science teachers program will be composed of introductory OR and computer applications workshops. An introduction to OR/MS will be presented, followed by probability modeling, computer simulations, queuing or waiting line models and linear programming. Attendees are welcome to attend the general conference and each will receive copies of all program materials: videos, a subscription to *OR/MS Today* and copies of all software packages with instructions and teacher/student activity guide. The program will be held on Monday, May 5, 8:00am - 4:00pm in the Sportee Room. Lunch will be provided.

**Welcome** - Plan to attend the Welcoming Session in the Town & Country Room on Monday, May 5, 10:00 - 11:00am. This is the official start of the INFORMS San Diego Spring 1997 Meeting. Opening remarks will be made by **Arthur Geoffrion**, President of INFORMS and **Fred Raafat**, San Diego General Co-Chair, will bring the session to a close. The following awards and prizes will be given: the *George Nicholson Student Prize*, the *Philip McCord Morse Lectureship Award* and the *John von Neumann Theory Prize*.

## Workshops

• **CPMS Isolated Practitioners Workshop** - CPMS, the Practice Section of INFORMS, sponsors workshops on topics of interest to isolated practitioners, i.e., Lone Rangers, of OR/MS. The 10th workshop in this series will address timely issues affecting the growing isolated practitioner community. Wine and cheese will be offered and all are welcome to participate in the workshop and discussion on Monday evening, 6:15 - 7:15pm in the Sierra Room.

• **Introduction to Visual Basic in Excel**  
**Sunday, May 4, 8:00am - 12noon**  
**Windsor South**  
**Speaker: Anton Rowe, President - Episoft**

Visual Basic for Applications (included with all copies of Excel) can greatly enhance the power of the bare spreadsheet. But how do you get started? This workshop shows how to:

- record VBA programs from your keystrokes;
- write your own functions;
- create buttons, spinners, sliders and dialog boxes;
- hook Excel up to other software such as Mathematica and Matlab;
- and many more tricks and tips.

Each participant will receive a disk of example files.

• **The Selling of OR/MS Concepts & Analysis**  
**Sunday, May 4, 1:00 - 5:00pm**  
**Windsor South**  
**Speakers: Sam Savage, Karl Schmedders, Molly Stephens - Stanford University**

How often have you created a great OR/MS model that fell on deaf ears? This workshop provides some nuts and bolts for effectively presenting analytical concepts to a non-analytical audience. Topics include:

- power point primer;
- bad lighting and what to do about it;
- computer projectors and the fickle finger of fate;
- some persuasion skills that no one admits they need, but really do.

• **7th Annual Workshop on Computational & Mathematical Organizational Theory**  
**Saturday & Sunday, May 3-4, 8:00am - 5:00pm**  
**Sportee Room**

The purpose of this workshop is to explore advances in formal theories of organizational, new computational- or network-based analysis tools for studying organizations and empirical tests of computational, mathematical or logical models. Presentations will be

from a combination of invited and submitted papers. Participants need not present a paper. A special issue of the journal *Computational & Mathematical Organization Theory* will be published based on the best papers in this workshop.

**Rationale:** Organizations can be usefully characterized as constraint-based adaptive systems composed of intelligent adaptive agents and technology, whose ability to act and be acted upon are structurally,

culturally and cognitively constrained. Recent advances in cognitive science, artificial intelligence, complexity theory and social networks have provided us with richer and more precise models of intelligent agents, the processes they engage in and the structures in which they are embedded.

Organizational theorists, managers, engineers and social scientists interested in organizations and their performance now have the opportunity to combine these models with more traditional approaches to organizations. This combination allows the researcher to address issues where structural, adaptive and evolutionary issues are paramount; e.g., organizational communication, organizational evolution, market restructuring and organizational learning. These

opportunities are explored in this workshop, largely through the presentation and discussion of formal models and theories.

Topic areas for 1997 include: organizational adaptation, the evolution of organizational form, organizations in changing environments, complexity theory, organizational learning, dynamic systems, evolution of inter-organizational networks, formal models of technology, information diffusion within organizations, docking of computational models and model validation.

Invited speakers are: **Robert Axelrod, Michael Cohen, Rosario Conte, Steven Durlauf, Robert Hanneman, Raymond Levitt, Jim March, Bill McKelvey and Roy Radner.**

## SOFTWARE DEMONSTRATIONS

Several software demonstrations are scheduled on Tuesday and Wednesday. These presentations will show how leading software systems can help you find solutions to complex problems. The demonstrations will be complemented by exhibitors showcasing the latest software products, technical reference materials and specialized services.

### Exhibitors

#### Software

ALPHATECH, Inc.\*  
Applied Decision Analysis, Inc.\*  
COMPASS Modeling Solutions, Inc.  
CPLEX Optimization, Inc.\*  
F&H Simulations, Inc.  
IBM\*  
ILOG Inc.\*  
Imagine That, Inc.\*  
LINDO Systems, Inc.\*  
Maximal Software, Inc.\*  
Palisade Corporation\*  
PROMODEL Corp.\*  
ROI  
Thomas Sawyer Software

\* indicates software demo

#### Publishers

Baltzer Science Publishers  
Duxbury Press/ITP  
Elsevier Science  
Irwin/McGraw-Hill  
John Wiley & Sons, Inc.  
Kluwer Academic Publishers  
Prentice-Hall  
Sage Publications  
Springer-Verlag New York, Inc.  
Stockton Press

# INVITED CLUSTER CHAIRS

## **Aviation Applications**

Peter P. Belobaba, MIT, Rm.  
33-215, 77 Massachusetts Ave.,  
Cambridge, MA 02139,  
belobaba@mit.edu

## **Choice Engineering**

Jan-Peter Lechner, Universitat  
der Bundeswehr Hamburg,  
Fachbereich Wirtschaft-und  
Organisationswissenschaften,  
22039 Hamburg, Germany, jan-  
peter.lechner@unibw-amburg.de

## **Combinatorial Optimization**

Fred Glover, University of  
Colorado, School of Business,  
CB 419, Boulder, CO 80309,  
fred.glover@colorado.edu

## **Computational Mixed Integer Programming**

Eva Lee, Columbia University,  
School of Engineering,  
Department of IE/OR, New  
York, NY 10027, evakylee@  
ieor.columbia.edu

## **Discrete Time Queueing**

Alan Krinik, California State  
Polytechnic University, 3801 W  
Temple Ave., Pomona, CA  
91768, ackrinik@csupomona.edu

## **Estimation &**

### **Approximation in Queueing Systems**

Sudha Jain, University of  
Toronto, Dept. of Statistics,  
Toronto, Ontario, Canada M5S  
1A1, jainsu@utstat.utoronto.ca

## **Flexible Manufacturing Systems**

Kathryn Stecke, University of  
Michigan Business School, 701  
Tappan St., Ann Arbor, MI  
48109-1234, kstecke@umich.edu

## **Global Manufacturing Practice**

Panos Kouvelis, Washington  
University, Olin School of  
Business, St. Louis, MO 63130-  
4899

## **Global Optimization**

Panos Pardalos, University of  
Florida, Center for Applied  
Optimization & ISE Dept.,  
Gainesville, FL 32611-6595,  
pardalos@ufl.edu

## **Health Care Technology, Policy & Applications**

Rema Padman, Carnegie Mellon  
University, Heinz School of  
Policy & Management,  
Pittsburgh, PA 15213,  
rpadman+@andrew.cmu.edu

## **Integer Programming**

Monique Guignard-Spielberg,  
University of Pennsylvania,  
Wharton School, 1300 SH-DH,  
3620 Locust Walk, Philadelphia,  
PA 19104-6366, guignard@  
dantzig.wharton.penn.edu

## **Inventory Management**

Jeannette Song, Columbia  
University, IEOR Department,  
New York, NY 10027,  
song@ieor.columbia.edu

## **Linear Programming**

Katta G. Murty,  
katta\_murty@umich.edu

## **Location Analysis**

Zvi Drezner, California State  
University - Fullerton, 800 North  
State College Blvd., Fullerton,  
CA 92834,  
zdrezner@fullerton.edu

## **Management Information Systems**

Annette Easton and George  
Easton

## **Manufacturing & Service Management**

Chung-Yee Lee, Texas A&M  
University, Department of IE,  
College Station, TX 77843,  
cylee@acs.tamu.edu

## **Network Flows**

S. Thomas McCormick,  
University of British Columbia,  
Faculty of Commerce &  
Business Administration,  
Vancouver, BC, Canada V6T  
1Z2, stmv@adk.commerce.  
ubc.ca

## **New Product Development**

Rachel Yang, University of  
Illinois, Department of Business  
Administration, 1206 S. 6th St.,  
Champaign, IL 61820,  
ryang@uiuc.edu

## **Non-Linear Programming**

Patrice Marcotte, University of  
Montreal, DIRO, CP 6128,  
Succ. Centre-Ville, Montreal,  
Quebec, Canada, H3C 3J1,  
marcotte@iro.umontreal.ca

## **NSF Research Opportunities**

Robin Keller, University of  
California, Graduate School of  
Management, 401 GSM, Irvine,  
CA 92697-3125,  
lrkeller@uci.edu

## **Production Control with Uncertainty**

Suresh Sethi, University of  
Toronto, Faculty of  
Management, Toronto, Ontario,  
M5S 1A1 Canada,  
sethi@fmgmt.mgmt.utoronto.ca

**Project Management**

Bajis Dodin, University of California, Anderson Graduate School of Management, Riverside, CA 92521-0203

**Public Sector Applications**

Margaret L. Brandeau, Stanford University, IE/EM Department, Stanford, CA 94305-4024, brandeau@leland.stanford.edu

**Scheduling**

Moshe Dror, University of Arizona, College of Business & Public Administration, Tucson, AZ 85721

**Stochastic Programming**

Julia Higle, University of Arizona, Systems & Industrial Engineering, Tucson AZ 85721, julie@sie.arizona.edu

**Supply Chain**

M. Eric Johnson, Vanderbilt University, Owen Graduate School of Management, Nashville, TN 37203, johnsoem@ctrvax.vanderbilt.edu

**Telecommunications**

Ramayya Krishnan, Carnegie Mellon University, Heinz School, 5000 Forbes Ave.,

Pittsburgh, PA 15213, rk2x+@andrew.cmu.edu

**Tourism**

William Swart, New Jersey Institute of Technology, Newark College of Engineering, University Heights, Newark, NJ 07102-1982, swart@admin.njit.edu

**Trends & Critical Contents of a Core Operations Management Course for Fast-Changing Industrial & Economic Environments**

Sumer Aggarwal, Suffolk University, Boston, MA 02108

## SPONSORED SESSION CHAIRS

**Applied Probability**

Edward P. Kao, University of Houston, Department of Decision & Information Sciences, Houston, TX 77204-6282

**Artificial Intelligence**

Riyaz Sikora, University of Michigan-Dearborn, 213 FOB, IMSE Department, 4901 Evergreen Rd., Dearborn, MI 48129-1491, rsikora@umich.edu

**CSTS**

Robert Fourer, Northwestern University, Department of IE/MS, 2225 North Campus Dr., Evanston, IL 60208-3119, 4er@iems.nwu.edu

**Decision Analysis**

Adam Borison, Applied Decision Analysis, 2710 Sand Hill Rd., Menlo Park, CA 94025, aborison@adainc.com  
Bruce R. Judd, Strategic Decisions Group, 2440 Sand Hill

Rd., Menlo Park, CA 94025, bjudd@sdgnet.com

**Education**

Tom Grossman, University of Calgary, Faculty of Management, Calgary, Alberta, Canada T2N 1N4, grossman@mgmt.ucalgary.ca

**Energy, Natural Resources & Environments**

Shmuel S. Oren, University of California-Berkeley, Dept. of IE/OR, Berkeley, CA 94720, oren@ieor.berkeley.edu

**Environment**

Jack M. Kloeber, Dept. of the Air Force, AFIT/ENS, Bldg. 640, 2950 P St., Wright-Patterson AFB, OH, 45433-7765, jkloeber@afit.af.mil

**Group Decision & Negotiation**

Gregory E. Kersten, Carleton University, Ctr. for Computer Assisted Management, Calgary, Ottawa, Canada, gregory@business.carleton.ca

**Logistics**

Arthur Hsu, Carnegie Mellon University, Graduate School of Industrial Administration, Pittsburgh, PA 15213-3890, art@om.gsia.cmu.edu

**Manufacturing**

Christopher S. Tang, UCLA, Anderson School of Management, Los Angeles, CA 90095-1481

**Military Applications**

Philipp A. Djang, TRAC-White Sands, WSMR, NM 88002-5502, djang@trac.wsmr.army.mil

### **Public Programs & Processes**

Jonathan P. Caulkins, Carnegie Mellon University, The Heinz School, Rm. 2101 Hamburg Hall, 5000 Forbes Ave., Pittsburgh, PA 15213, caulkins@andrew.cmu.edu

### **OR/MS in Forestry**

Andrew F. Weintraub, Universidad de Chile, Facultad de Ciencias Fisicas Y Matematicas, Dept. de Ingenieria Industrial, Republica 701, Casilla 2777, Santiago, Chile, aweintra@dii.uchile.cl

### **Railroad Applications**

Bruce G. Schinelli, TTX Company, 101 North Wacker, Chicago, IL 60606, bgschinelli@ttxco.com

### **Simulation**

Michael R. Taaffe, University of Minnesota, Dept. of Operations & MS, Faculty of Scientific Computation, Minneapolis, MN 55455, taaffe@maroon.tc.umn.edu

### **Technology**

Jeffrey Liker, University of Michigan, Dept. of IE, IOE Building, 1205 Beal Ave., Ann Arbor, MI 48109-2117, liker@umich.edu

### **Telecommunications**

Kemal Altinkemar, Purdue University, Krannert Graduate School of Management, W. Lafayette, IN 47907, kemal@mgmt.purdue.edu

### **Transportation Science**

R. Jayakrishnan, University of California, Dept. of Civil & Environmental Engineering, Irvine, CA 92697

### **Women's Forum on OR/MS**

Cynthia Barnhart, MIT, Center for Transportation Studies, Room 1-229, Cambridge, MA 02139, cbarnhart@mit.edu

### **INFORMS New Member Workshops**

Robert Armacost, University of Central Florida, Dept. of IE & Management Systems, Orlando, FL 32816, armacost@pegasus.cc.ucf.edu

## Future Meetings Calendar

### **October 26 - 29, 1997**

INFORMS Dallas Fall 1997  
Hyatt Regency  
Dallas, TX  
General Chair: Paul Jensen  
University of Texas  
Austin, TX 78712  
Phone: 512-471-3071  
e-mail: paul.jensen@memail.me.utexas.edu

### **April 26 - 29, 1998**

INFORMS/CORS Montreal Spring 1998  
Queen Elizabeth Bonaventure Hilton  
Montreal, Quebec, Canada  
General Chair: Paul Mireault  
Ecole des HEC  
Montreal, Quebec, Canada  
H3T 1V6  
Phone: 514-340-6492  
e-mail: mireault@hec.ca

### **October 25 - 28, 1998**

INFORMS Seattle Fall 1998  
Washington State Convention & Trade Center  
Sheraton Seattle Hotel & Towers  
General Chair: Marisa Altschul  
Boeing Computer Services  
Seattle, WA 98124-0346  
Phone: 206-865-6955  
e-mail: marisa.altschul@boeing.com  
Co-Chair: Al Maimon

### **May 2 - 5, 1999**

INFORMS Cincinnati Spring 1999  
Omni Netherland Plaza  
Hyatt Regency  
General Chair: David F. Rogers  
University of Cincinnati  
Cincinnati, OH 45221-0130  
Phone: 513-556-7143  
e-mail: david.rogers@uc.edu

## Sunday 08:00-09:30

## SA04 DEA I

## Contributed Session

Chair: Liam O'Neill, PA State Univ., 303 Beam Bldg., University Park, PA 16802-1913, lxo7@psuvm.psu.edu

1) **An Alternative Criterion for Productivity Assessment in DEA**, *Liam O'Neill*, PA State Univ., 303 Beam Bldg., University Park, PA 16802-1913, lxo7@psuvm.psu.edu

We introduce an alternative multi-factor productivity measure in DEA which offers several advantages relative to established techniques. Performance is compared to that of superefficiency, cross-efficiency and cone-ratio models, using both empirical and simulated data.

2) **Stochastic Data Envelopment Analysis: A New Approach**, *Jati K. Sengupta*, Univ. of CA, Dept. of Econ., Santa Barbara, CA 93106-9210, sengupta@econ.ucsb.edu

A 2-step method based on the filtering of noise and fitting an optimal output distribution is developed and applied here for stochastic models of DEA. This method is shown to provide some robustness to the efficiency measures.

3) **Opportunistic Schemes for Computational Enhancements in DEA**, *Jose H. Dula*, Univ. of MS, Dept. of Comp. Sci., Oxford, MS 38677, jdula@olemiss.edu, *Betty L. Hickman*

Effective enhancements for computation in DEA result from observing certain DEA and LP properties of the model. We discuss how many of these plus one new one are related.

4) **Linking Operating Efficiency, Profitability & Quality of Bank Branches**, *Stavros A. Zenios*, Univ. of Cyprus, Dept. of Bus. Admin., Box 537, Kallipoleos 75, Nicosia, CY 1678, Cyprus, zenios@atlas.pba.ucy.ac.cy, *Andreas C. Soteriou*

We investigate the linkages of operating efficiency, profitability and quality of bank branches; we report results from an empirical study at a commercial bank.

## SA05 New Theoretical Developments in Linear &amp; Semi-Definite Programming

Cluster: Linear Programming  
Invited Session

Chair: Robert M. Freund, MIT, OR Ctr., Bldg. E40-149A, Sloan Sch., 77 Mass. Ave., Cambridge, MA 02139-3407, rfreund@mit.edu

1) **Properties of the Central Trajectory of a Linear Program in Terms of How Close is the Program to Becoming Degenerate**, *Manuel Nunez*, MIT, OR Ctr., 1 Amherst St., Rm. E40-194, Cambridge, MA 02139, manuneza@mit.edu

We study properties of several measures of how close is a data instance of an LP to becoming either primal or dual degenerate under data perturbations. Later, we relate these measures to the central trajectory of an LP by deriving bounds for its curvature in terms of these measures.

2) **Polynomial Convergence of Primal-Dual Algorithms for Semidefinite Programming**, *Renato D.C. Monteiro*, GA Inst. of Tech., Sch. of ISyE, Atlanta, GA 30332, monteiro@isye.gatech.edu

We establish the polynomial convergence of the class of primal-dual feasible interior-point algorithms for SDP based on Monteiro & Zhang family of search directions. Since this family of directions includes the Alizadeh, Haerberly & Overton direction, for the first time, we establish the polynomial convergence of algorithms based on this search direction.

3) **Graph Isomorphism & Semidefinite Programming**, *Motakuri V. Ramana*, Univ. of FL, 303 Weil Hall, ISE Dept., Gainesville, FL 32611, ramana@thalia.ise.ufl.edu

Results concerning the connections between graph isomorphism and semidefinite programming will be presented.

4) **Complexity of Iterative Algorithms for Linear & Semidefinite Programming Based on Condition Algorithms**, *Marina Epelman*, MIT, 1 Amherst St., OR Ctr. Bldg. E-40-194, Cambridge, MA 02139, mepelman@mit.edu, *Robert M. Freund*

We present variants of several iterative algorithms, i.e., von Neumann's algorithm, relaxation methods, reflection algorithms and perceptron algorithms, etc., for solving linear or semidefinite programming feasibility problems. We present a complexity analysis of these algorithms in terms of the inherent condition number of the feasible region.

## SA06 GRASP

Cluster: Combinatorial Optimization  
Invited Session

Chair: Mauricio G. C. Resende, AT&T Labs., 600-700 Mountain Ave., 2D-152, PO Box 636, Murray Hill, NJ 07974-0636, mgcr@research.att.com

1) **A Greedy Randomized Adaptive Search Procedure for a Feedback Vertex Set**, *Tianbing Qian*, Univ. of IA, Dept. of MS, Iowa City, IA 52246, tqian@dollar.biz.uiowa.edu, *Panos Pardalos*, *Mauricio G. C. Resende*

The FVS problem is a classic combinatorial optimization problem with applications in VLSI design and computer communications. Few metaheuristics have been applied to the FVS. We present a GRASP coupled with efficient problem reduction technique to solve the FVS. Computational results on large-scale datasets are reported.

2) **An Approximation Algorithm for the Three-Index Assignment Problem**, *L. S. Pitsoulis*, Univ. of FL, Ctr. of Appl. Opt., Ind. & Systems Eng., Gainesville, FL 32611, *N. Lidstrom*, *Panos Pardalos*

A GRASP is presented for computing approximate solutions to the NP-hard 3-index assignment problem, AP3. An implementation in Fortran of GRASP is tested on several different problem instances of the AP3. Computational results indicate that the GRASP heuristic provides good approximate solutions to a variety of AP3 instances as compared with other heuristic procedures.

3) **A Greedy Randomized Adaptive Search Procedure for Job Shop Scheduling**, *Mauricio G. C. Resende*, AT&T Labs., 600-700 Mountain Ave., 2D-152, PO Box 636, Murray Hill, NJ 07974-0636, mgcr@research.att.com, *S. Binato*, *W. Henry*, *D. L. Loewenstern*

We describe a GRASP for the job shop scheduling problem. The GRASP construction phase and local search phase are described. An implementation of the algorithm is tested on a set of standard test problems.

## SA07 Variational Inequalities

Cluster: Nonlinear Programming  
Invited Session

Chair: Stephen M. Robinson, Univ. of WI, Dept. of IE, 1513 University Ave., Madison, WI 53706-1572, smr@cs.wisc.edu

1) **Applications of Complementarity**, *Michael C. Ferris*, Univ. of WI, Comp. Sci. Dept., 1210 W Dayton St., Madison, WI 53706-1685, ferris@cs.wisc.edu

We show how several new applications can be recast and solved as mixed complementarity problems. Particular emphasis will be given to problems arising in structural engineering and stochastic planning formulated within the GAMS modeling language.

2) **On Penalization & Regularization for Variational Inequalities & Extensions**, *Franco Giannessi*, Univ. di Pisa, Dipt. di Matematica, Via F. Buonarroti, 2, Pisa, I-56127, Italy, giannessi@dm.unipi.it

Connections between penalization and regularity for variational inequalities are analyzed within the framework of separation of sets. As special cases, constrained optimization problems and complementarity systems are recovered. Comments are made on Minty's variational principle. Some extensions and applications to equilibrium problems are discussed.

3) **Merit Functions for Semi-Definite Complementarity Problems**, *Paul Tseng*, Univ. of WA, Dept. of Math., GN-50, Box 354350, Seattle, WA 98195, tseng@math.washington.edu

Many merit functions have been proposed for complementarity problems defined over the non-negative orthant. These functions play key roles in the development of solution methods. We study the extension of these merit functions to complementarity problems defined over the cone of symmetric block-diagonal positive semi-definite matrices.

## SA08 Meta-Heuristics for Solving Integer, Nonlinear &amp; Stochastic Problems

Cluster: Integer Programming  
Invited Session

Chair: Fred W. Glover, Univ. of CO, Sch. of Bus., CB 419, Boulder, CO 80309-0419, fred.glover@colorado.edu

1) **Hybrid Extreme Point Tabu Search**, *Kristin P. Bennett*, RPI, Math. Sci. Dept., Troy, NY 12180, bennek@rpi.edu, *Jennifer Blue*

A hybrid method combining extreme point TS and traditional descent algorithms successfully minimizes a function over the extreme points of a polyhedron. The

algorithm alternates between descending to local minima and moving to new search areas using TS. Strong results on classification and other problems are presented.

**2) A Robust Scheduling Model for Resource-Constrained Scheduling, Balu Rangaswamy**, Univ. of CO, Grad. Sch. of Bus., CB 419, Boulder, CO 80309, rangaswa@eddie.colorado.edu, *Manuel Laguna*

We propose a robust 2-stage scheduling model for the resource-constrained project scheduling problem with stochastic activity durations. The first stage determines the optimal resource mix subject to budget constraints for each scenario sub-problem. The second then provides a robust resource mix and schedule for the problem.

**3) Applying Tabu Search to Fixed Charge Transportation, Minghe Sun**, Univ. of TX, Div. of Mgmt. & Mktg., Coll. of Bus., San Antonio, TX 78249-0634, msun@lonestar.utsa.edu

The performance of a TS procedure for fixed charge transportation problems is computationally investigated when problem size, magnitude of fixed costs, magnitude of variable costs, tabu list length and length of search change. The performance is measured against that of another existing heuristic and substantial computational results are reported.

**4) Path Assignment for the Call Routing Problem: Issues, Bounds & Heuristic Solution Procedures, Erik Rolland**, Univ. of CA, Anderson Grad. Sch. of Mgmt., Riverside, CA 92521-0203, erik.rolland@uck.edu, *Ali Amiri, Reza Barkhi*

We look at issues related to path assignment for a version of the call routing problem. We introduce a bounding technique and discuss heuristic solution procedures. Computational results are presented.

**SA10 Production Scheduling I**

**Contributed Session**

**Chair:** Omer S. Benli, Univ. of MO, 223 Eng. Mgmt. Bldg., Rolla, MO 65409-0370, benli@umr.edu

**1) Lot Streaming in Production Scheduling, Omer S. Benli**, Univ. of MO, 223 Eng. Mgmt. Bldg., Rolla, MO 65409-0370, benli@umr.edu

Production planning models cannot easily accommodate sequencing decisions on the resources, whereas machine scheduling models cannot explicitly handle lot sizing. A generalized lot streaming model will be presented that provides a conceptual framework for the integration of lot sizing and machine scheduling.

**2) From Factory to Table: A Production Planning Model for the Optimal Flow of Chicken Products, Steven E. Butt**, Univ. of Auckland, Dept. of MS & IS, Private Bag 92019, Auckland, New Zealand, s.butt@auckland.ac.nz, *David M. Ryan*

We discuss a production planning model developed for the poultry division of a New Zealand food manufacturer. This optimization model consists of 2 flow networks: the first models the flow of chickens through the factories; the second models the transportation of products. We show that the model can be driven by bird supply and/or market demand and that it allows for experimentation.

**3) A Market-Based Approach to Job-Shop Scheduling, Suman Mallik**, Univ. of Pennsylvania, OPIM Dept., 1300 SH-DH, Wharton Sch., 3620 Locust Walk, Philadelphia, PA 19104, mallik84@wharton.upenn.edu, *Patrick T. Harker*

We propose a market-based approach to the JSP. In an abstract sense, a market is a system with locally interacting agents that achieve some global behavior. The machines are the agents who bid for jobs. We compare our results with available optimization-based benchmarks.

**4) The Economic Lot Scheduling Problem with Stabilization Period, Il-Kyeong Moon**, Pusan Natl. Univ., Dept. of IE, Pusan, 609-735, Korea, ikmoon@hyowon.pusan.ac.kr, *Ju-Ho Hahm, Chul Lee*

We apply the stabilization period concept to the economic lot scheduling problem. We first find an upper bound on the minimum cost using a common cycle approach. Then, we formulate the general problem and develop an algorithm to compute a lower bound. Finally, we devise a heuristic algorithm using a time-varying lot size approach.

**SA12 OR/MS Applications in Transportation Systems I**

**Sponsor: INFORMS CSTS**

**Sponsored Session**

**Chair:** Ram Pandit, Consolidated Freightways, Inc., Intelligent Systems Eng., Leland James Service, Corp., Portland, OR 97208-6696, ram@eniac.cnf.com

**1) Heuristics for the Airline Schedule Recovery Problem, Bhaskar Manda**, Univ. of IL, Dept. of Mech. & IE, 1206 W Green

St., Urbana, IL 61801, *Udatta S. Palekar*

We consider the problem of airline schedule recovery when take-off and landing capacity at an airport is affected by weather disruptions. We develop heuristics using Lagrangean relaxations and decomposition techniques. We will present mathematical formulations and computational results for randomly generated problems.

**2) Routing a Truck with Hazardous Materials in the Presence of a Weather System, Vedat Akgun**, SUNY, Dept. of IE, Buffalo, NY 14260, akgun@acsu.buffalo.edu, *Rajan Batta, Christopher M. Rump*

We consider the problem of routing a truck carrying hazardous materials in the presence of a weather system. The objective is to find the minimum risk path(s) on a network. Different objectives are also considered. Sensitivity analysis and GIS integration to the problem are discussed.

**3) The Railroad Blocking Problem, Harry N. Newton**, Air Force Acad., Colorado Springs, CO, *Hong Jin, Cynthia Barnhart, Dharma Acharya, Pamela Vance*

A typical shipment may pass through many classification yards on its route from O-D. To prevent shipments from being reclassified at every yard, several shipments may be grouped to form a block. The blocking problem is to determine which set of blocks should be used to minimize handling costs. We present a model, algorithm and results for the blocking problem of a major domestic railroad.

**4) A Service Station Location Problem, Ram Pandit**, Consolidated Freightways, Inc., Intelligent Systems Eng., Leland James Service, Corp., Portland, OR 97208-6696, ram@eniac.cnf.com

We consider the problem of locating service stations on a network to support transportation of freight via trucks. Trucks require frequent servicing while traveling. We need to determine a minimum number of stations on the network such that any point-to-point routing on the network can be facilitated. We model this as an IP problem and present a Lagrangean relaxation-based approach to solve it.

**SA13 Automatic Graph Drawing**

**Sponsor: INFORMS CSTS**

**Sponsored Session**

**Chair:** Petra Mutzel, Max-Planck-Inst. fuer Informatik, IM Stadtwald, Saarbrücken, 66123, Germany, mutzel@mpi-sb.mpg.de

**1) Angles in Planar Drawings, Franz-J. Brandenburg**, Univ. of Passau, Lehrstuhl fuer Informatik, Passau, 94030, Germany, *Andreas Stuebinger*

We consider straight-line drawings of planar graphs and aim at large angles between adjacent edges. This problem is NP-hard in general. We approach this problem by repeatedly solving systems of linear equations of simple consistency conditions, then constructing planar drawings by the spring embedder method. This gives nice planar drawings.

**2) Efficient Algorithms for Orthogonal Drawings, Michael Kaufmann**, Univ. Tuebingen, Inst. fuer Informatik, Sand 13, Tuebingen, D-72076, Germany, mk@informatik.uni-tuebingen.de, *Ulrich Foessmeier*

One of the most commonly used approaches for graph representation is to draw the graph orthogonally. We will present old and new techniques to optimize certain criteria such as area or number of bends in orthogonal drawings of planar and non-planar graphs.

**3) Orthogonal Graph Drawing, Ioannis G. Tollis**, Univ. of TX, Dept. of Comp. Sci., Richardson, TX 75083-0688, tollis@utdallas.edu

Many applications require human interaction during the design process. Interactive graph drawing allows the user to dynamically interact with the drawing. We present techniques for interactive orthogonal graph drawing. Our techniques preserve the mental map of the user, are efficient and yield drawing with few bends and small area.

**4) Drawing of Hierarchical Graphs, Petra Mutzel**, Max-Planck-Inst. fuer Informatik, IM Stadtwald, Saarbrücken, 66123, Germany, mutzel@mpi-sb.mpg.de

A common method for drawing directed graphs is to partition the vertices into a set of  $k$  levels and then permute the vertices within the levels such that the number of crossings is minimized. We suggest an alternative method for the second step.

**SA15 Organizational Theory****Contributed Session**

**Chair:** Adva Dinur, Temple Univ., Strategic Mgmt. Dept., Speakman Hall, Rm. 380, Philadelphia, PA 19122, adva@vm.temple.edu

**1) Intrafirm Knowledge Transfers in a Network Setting, Adva Dinur**, Temple Univ., Strategic Mgmt. Dept., Speakman Hall, Rm. 380, Philadelphia, PA 19122, adva@vm.temple.edu

We view organizations as networks that utilize existing knowledge in various locations by transferring best practices across the globe. The study aims at investigating the relationships between network and knowledge characteristics such as diversity, communication intensity and knowledge tacitness - and transfer process characteristics.

**2) Transformational Leadership Within a Broader Theoretical Context, Roberta D. Evans**, Univ. of MT, Dept. of Ed. Leadership, Missoula, MT 59812, revans@selway.umt.edu, **Gerald E. Evans**

Transformational leadership stands in clear contrast to transactional leadership and as such, requires a very different set of skills and inclinations. More than 100 professionals were administered a standard test for transformational leadership along with the MBTI and a preference scale for the competing values framework (R.E. Quinn, et al 1996).

**3) Information Entropy & the Evolution of Organizational Language, Robert A. Nehmer**, Berry Coll., Sch. of Bus., PO Box 495024, Mt. Berry, GA 30149-5024, mehmer@berry.edu

Information value reflects social value and both values are created by social organizing activities and reduced by entropy. The mediating factor in this process is the tension between the underlying organizational practices and the richness of the available institutional language. We model the organization as a manifold of diverse cultures whose interactions are bounded.

**4) Analysis & Intuition in Strategic Planning: The Role of Organizational Design, C. Chet Miller**, Baylor Univ., Hankamer Sch. of Bus., PO Box 998006, Waco, TX 76798, chet\_miller@baylor.edu

Both analytical and intuitive processes have been found to be beneficial for strategic planning. Thus, understanding factors that might inhibit either analysis or intuition is critical. Factors associated with organizational design are investigated. Executive diversity, industrial turbulence and firm size are used as control variables.

**SA16 Technology Management**

**Sponsor:** INFORMS Section on Technology Management

**Sponsored Session**

**Chair:** Dundar F. Kocaoglu, Portland State Univ., Eng. Mgmt. Program, Portland, OR 97207-0751, kocaoglu@emp.pdx.edu

**1) Supporting Software Process Improvement Using Process Models, David M. Raffo**, Portland State Univ., Sch. of Bus. Admin., Portland, OR 97207-0751, davidr@sba.pdx.edu

It was estimated that in 1995, software costs in the US exceeded \$250 billion. Despite this, difficulties still exist with delivering software within budget and on schedule. In addition, there are problems with software quality. The industry also faces increasing competition within the US and abroad. We develop a quantitative approach for analyzing software processes and quantitatively predicting process performance...

**2) Modeling the Performance of Software Processes Quantitatively, David M. Raffo**, Portland State Univ., Sch. of Bus. Admin., Portland, OR 97207-0751, davidr@sba.pdx.edu

We develop a method and supporting techniques to forecast the quantitative impact of potential improvements to software development processes. The approach is based on discrete event simulation models of each process alternative. Currently, a field study applying this method to a complex real-world process change problem at a leading software development firm is being conducted. Approach, techniques and results are reported.

**3) Cultural Risks & Team Management Strategy, Dragan Milosevic**, Portland State Univ., Eng. Mgmt. Program, Portland, OR 97207-0751, dragan@emp.pdx.edu, **Timothy R. Anderson, Mete Bayyigit, Aysun Coskun**

Could teams whose management strategies are less culturally risky outperform other teams with more culturally adapted management strategies? This question is central to our research project; specifically, we look at the relationship between the elements of team management strategy, cultural risk and the team's success factors.

**4) Technology Acquisition & It's Implications in the US**

**Electronics Industry, Tugrul Daim**, Portland State Univ., Engineering Mgmt. Program, Portland, OR 97207-0751, tugrul@emp.pdx.edu, **Dundar F. Kocaoglu**

We present initial findings of research conducted in the US electronics industry to identify the technology acquisition and evaluation practices and their implications. Initially, 2,000 companies were contacted. The results presented are based on the initial 200 responses received and indicate certain groups of companies with different technology acquisition practices yielding different impacts.

**5) New Product Development & Introduction in the High Technology Environments: A Case Study, Tugrul Daim**, Portland State Univ., Engineering Mgmt. Program, Portland, OR 97207-0751, tugrul@emp.pdx.edu

We present a preview of documented new product development and introduction literature identifying the trends and gaps in the current practices. We include recommendations for hi-tech companies to improve new product development and introduction practices, based on analysis of best practices. Results are reviewed by professionals responsible for new product development and introduction in high tech companies.

**SA17 Operations Management I****Contributed Session**

**Chair:** Octavio Richetta, Univ. of MA, MSIS Dept., 100 Morrissey Blvd., Boston, MA 02125-3393

**1) Using Influence Diagrams for PERT, Ali Jenzarli**, Univ. of Tampa, Coll. of Bus., 401 W Kennedy Blvd., Box 15F, Tampa, FL 33606, ali.jenzarli@resnet.fmh.usf.edu

We describe a new method for explicit modeling of decisions that bear on activity times in a project. This method extends the PERT belief network model to include decision variables. We call the resulting network PERT influence diagram, PID. We use a combination of stochastic dynamic programming and Gibbs sampling to solve PIDs.

**2) A Simulation Approach to the Assignment of Multi-Skill Service Technicians to Equipment/Service Territories, Octavio Richetta**, Univ. of MA, MSIS Dept., 100 Morrissey Blvd., Boston, MA 02125-3393

We present a service (repair) operations model that takes into consideration contractual obligations such as response time and hours of coverage, as well as personnel skills and work scheduled, travel and repair times. Simulation performance measures are used to improve the assignment of technicians to equipment/service territories.

**3) Conservative Modernization in a Brazilian Credit Card Company, Roberto Marx**, Univ. of Sao Paulo, Rua Sao Vicente de Paula, Sao Paulo, 01229010, Brazil, robemarx@usp.br, **Mauro Zilbovicus**

Credit card sales strongly increased in Brazil. Deep technological and organizational restructuring is needed. The major company analyzed showed that priority is given to data-driven instead of customer-driven technology and that process reorganizing and employees empowerment are less emphasized. As a result, "employee proof" process and organizational rigidity may not provide high quality customer service.

**4) A Parallel Pivot & Probe Algorithm for Network Flow Problems, Babita Gupta**, CA State Univ., 100 Campus Ctr., Bldg. 3, Seaside, CA 93955-8001, babita@seal.monterey.edu, **Jay E. Aronson, Lakshmi Iyer**

We present a new algorithm, P3NET, for solving capacitated, linear network flow large-scale problems using the forward network algorithm to break the large problems apart. The pivot and probe algorithm effectively reduces the problem size and solution CPU time by eliminating non-candidate arcs. We implement P3NET on the IBM Scalable PowerParallel System.

**SA18 TUTORIAL: Health Care Information Systems****Invited Session**

**Chair:** Rema Padman, Carnegie Mellon Univ., Heinz Sch. of Policy & Mgmt., Pittsburgh, PA 15213, rpadman+@andrew.cmu.edu

**1) TUTORIAL: Health Care Information Systems, Rema Padman**, Carnegie Mellon Univ., Heinz Sch. of Policy & Mgmt., Pittsburgh, PA 15213, rpadman+@andrew.cmu.edu

The explosive advances in medical and information technology in recent years combined with the current climate for health care reform has created many challenges in developing, adapting and integrating ISs for cost-effective health care administration and delivery. We present an overview of the major IS methodologies and approaches in the delivery of modern health care systems...

## SA20 Transportation I Contributed Session

**Chair:** Guy Desaulniers, GERAD, 5255 Decelles, Montreal, Quebec, H3T 1V6, Canada, gerad@crt.umontreal.ca

1) **Locomotive & Car Assignment for a Passenger Railway Company**, *Guy Desaulniers*, GERAD, 5255 Decelles, Montreal, Quebec, H3T 1V6, Canada, gerad@crt.umontreal.ca, *Jean-Francois Cordeau*, *Norbert Lingaya*, *Jacques Desrosiers*

We propose a column generation approach to solve this problem which consists of determining locomotive and car cycles to cover a set of trains at minimal cost. In this problem which includes maintenance requirements, availability and compatibility constraints, most car cycles differ from locomotive cycles since car demand varies from one train to another. Numerical results on real data are provided.

2) **Identical Traffic Streams Enhancement for the TRAF-CORSIM Simulation Model**, *Andrew Leu*, Information Dynamics, Inc., FHWA Traffic Res. Lab., 6862 Elm St., Ste. 700, McLean, VA 22101, andrew.lwu@fhwa.dot.gov, *Yanlin Li*, *Steven Chien*

The identical traffic streams enhancement in the TRAF-CORSIM model enables users to generate traffic streams that exhibit identical traffic patterns and other operational characteristics. This feature allows users to study the impact of traffic that results solely from changes in traffic controls, without consideration of any random effects of simulation.

3) **Ramp-Metering Controls in the TRAF-FRESIM Simulation Model**, *Yanlin Li*, Information Dynamics, Inc., FHWA Traffic Res. Lab., 6862 Elm St., Ste. 700, McLean, VA 22101, yanlin.li@fhwa.dot.gov, *Ping Liang*, *Andrew Leu*

We introduce an innovative enhancement to TRAF-FRESIM ramp-metering that allows users to employ occupancy ramp-metering controls. Our study also tests and identifies the deficiencies in the 4 existing ramp-metering strategies in TRAF-FRESIM.

4) **Speed Estimation Errors that Occur When Using Single-Loop Detectors on Freeways**, *Ping Liang*, Information Dynamics, Inc., FHWA Traffic Res. Lab., 6862 Elm St., Ste. 700, McLean, VA 22101, ping.liang@fhwa.dot.gov, *Yanlin Li*

We examine the estimation errors that occur when single-loop detectors are used to compute vehicle speeds from a data collection site. We explore the errors that occur as a function of the specified traffic patterns, the estimated average vehicle length and the designated time interval.

## SA21 Aviation Contributed Session

**Chair:** Francois Soumis, Ecole Polytech. & GERAD, 3000 Cote Ste-Catherine, Montreal, Quebec, H3T 2A7, Canada, soumis@crt.umontreal.ca

1) **The Operational Airline Crew Scheduling Problem**, *Mirela Stojkovic*, Ecole Polytech. & GERAD, 3000 Cote-Ste-Catherine, Montreal, Quebec, H3T 2A7, Canada, gerad@crt.umontreal.ca, *Francois Soumis*

This problem consists of modifying personalized planned blocks such that all tasks from the considered period of time are covered at minimal cost with available crew without violating a complex set of rules. A new approach which simultaneously solves the problem of the construction of pairings and the construction of personalized monthly blocks is implemented...

2) **Simultaneous Helicopter Routing & Crew Scheduling**, *Gilles Savard*, Ecole Polytech. & GERAD, 3000 Cote-Ste.-Catherine, Montreal, Quebec, H3C 3A7, Canada, gilles@crt.umontreal.ca, *Eric Rancourt*, *Guy Desaulniers*, *Norbert Lingaya*, *Jacques Desrosiers*

We consider the problem of simultaneously determining helicopter routes and aircrew schedules to perform mission and training flights in a military context. Synchronization, priority and availability constraints as well as aircrew minimal training requirements must be satisfied. We propose solving this problem using a column generation approach involving 2 types of subproblems...

3) **The Relationship Between DWIs & Job-Related Flying Performance**, *Kathleen L. McFadden*, Northern IL Univ., OMIS Dept., McMurry 205, DeKalb, IL 60115-2854, m10klm1@wpo.niu.edu

We deal with whether passengers are at an increased risk of involvement in a commercial air accident or incident when the pilot has a history of DWI convictions. The findings are based on the analysis of data obtained by the FAA on the flying performance of 70,164 airline pilots.

4) **A Probabilistic Bid Price Heuristic for Airline Network Revenue Management**, *Brian Monteiro*, Decision Focus Inc., 650

Castro St., Ste. 300, Mountain View, CA 94041, brianm@dfi.com, *Satish Krishnamurthy*

Bid price control schemes have revolutionized airline network revenue management. However, the commonly used bid price models suffer from drawbacks that are well recognized. We discuss the results of a simulation study, comparing the performance of the proposed probabilistic bid price heuristic with other well-known bid price heuristics.

5) **Probability Models for Access Security System Architectures**, *John E. Kobza*, Virginia Tech., 302 Whittemore Hall, ISE Dept., Blacksburg, VA 24061-0118, jkobza@vt.edu, *Sheldon H. Jacobson*

A security system architecture consists of device technologies and operational policies for inspecting objects, e.g., people, baggage, etc., entering a secured area in order to detect and prevent entry by threats, e.g., unauthorized personnel, firearms, explosives, etc. New architectures consisting of multiple devices and controlled sampling are proposed and analyzed.

## SA22 Flexible Manufacturing Systems I Contributed Session

**Chair:** Rachel Yang, Univ. of IL, Dept. of Bus. Admin., Champaign, IL 61820, ryang@uiuc.edu

1) **Manufacturing Strategy for Constructing a Flexible Manufacturing System**, *Rachel Yang*, Univ. of IL, Dept. of Bus. Admin., Champaign, IL 61820, ryang@uiuc.edu, *Kazumasa Ohashi*

We consider a system of pallets with different workpieces going through machining centers in an FMS. We examine problems of machining condition, job grouping and pallet scheduling. The system is analyzed under different criteria of elapsed time, production cost and order due date to explore strategic implications for manufacturers.

2) **Optimization of a Controlled Flexible Manufacturing System**, *Paulo Renato de Moraes*, INPE/LAC, CP 515, Sao Jose dos Campos, Sao Paulo, 12201-970, Brazil, prenatal@lac.inpe.br, *Marcia A. Monteiro*

An FMS consists of a flexible unit processing demand for 2 products and feeding 2 assembly lines. The flexible unit and the assembly lines have finite waiting areas. A Markov decision model is used to find an optimal policy for the acceptance/rejection of demands and for the production of parts for the assembly lines.

3) **The Optimal Joint Allocation of Work & Buffer Spaces in Serial Production Lines**, *Susan W. Juge*, Hughes Missile Systems Co., PO Box 11337, Bldg. 802, MS G1, Tucson, AZ 85734-1337, swjuge@ccgate.hac.com

We describe the optimal joint allocation of work and buffer spaces in serial production lines with variable processing times. The optimal allocation maximizes profit, which is defined as revenue from throughput less the cost of WIP inventory.

## SA23 Stochastic Scheduling & Performance Analysis of Manufacturing Systems

**Cluster:** Manufacturing & Service Management  
**Invited Session**

**Chair:** Tava Lennon Olsen, Univ. of MI, Dept. of IOE, Ann Arbor, MI 48109-2117, tlennon@engin.umich.edu

1) **Production Systems with Options & Long Kanbans**, *Abraham Seidmann*, Univ. of Rochester, Simon Grad. Sch. of Bus. Admin, Rochester, NY 14627, seidmannav@ssb-facstaff.ssb.rochester.edu, *Jishnu Hazra*, *Paul J. Schweitzer*

We study an automotive assembly manufacturing network producing a single platform model with different product options. The various sub-segments of the assembly line are coordinated with long kanbans. We present an effective (and accurate) sample-path algorithm for evaluating the key performance measures of such a system.

2) **Heavy Traffic Analysis of Reentrant Manufacturing Processes: Examples & Insights**, *Wendell G. Gilland*, Stanford Univ., Grad. Sch. of Bus., Stanford, CA 94305, pgilland@ecu.stanford.edu, *J. Michael Harrison*

Manufacturing systems that result in a job visiting particular pieces of highly utilized equipment multiple times can be labeled as reentrant processes in heavy traffic. We use insight from analogous Brownian models to guide the development of sequencing rules which enhance measures of system performance, i.e., idleness, WIP inventory, throughput times.

3) **Scheduling Maintenance Activities in a Single Server Queue**, *Hayriye Ayhan*, GA Inst. of Tech., Sch. of ISyE, Atlanta, GA 30332-

2005, hayhan@isye.gatech.edu, *Martin A. Wortman*

We consider a queue where the single server is subject to failures and deteriorates only when there is work in the system. The relationship between remaining life of the server and the stationary mean backlog is exposed through a qualitative result. This result aids in developing a preventive maintenance strategy.

**4) A Practical Scheduling Method for Multi-Class Production Systems with Setups, Tava Lennon Olsen**, Univ. of MI, Dept. of IOE, Ann Arbor, MI 48109-2117, tlennon@engin.umich.edu

We present a simple method for scheduling multi-class production systems with setups and a single server. The method performs well with respect to mean waiting time, waiting time variance and the outer percentiles of waiting time. An approximation method is given for the mean waiting time.

#### SA24 Decision Analysis I Contributed Session

**Chair:** Lotfy Lewiz Seffin, NEEASEA (Philips), PO Sidi Gaber (21523), Alexandria, Egypt

**1) An Overall Criteria for Competitiveness Evaluation, Lotfy Lewiz Seffin**, NEEASEA (Philips), PO Sidi Gaber (21523), Alexandria, Egypt

We address 3 issues, the first related to internal competencies, the second considers sectoral conditions and the third is for external environment. The proposed model opens the door for quantitative understanding of various factors, their effects, interactions and measurement. The concept of multiattribute utility is applied. A case study clarifies the concept.

**2) Decision Making Concerning Social Equity & Public Risk: Comparison Between the US & the People's Republic of China, Wen-Qiang Bian**, Univ. of CA, Grad. Sch. of Mgmt., 401 GSM, Irvine, CA 92697-3125, lrkeller@uci.edu, *L. Robin Keller*

We study people's attitudes and decisions concerning equity and public risks in the US and PRC through surveys. We found similarities in people's fairness perceptions and differences in people's decision patterns. An explanation based on a cultural model is provided and implications of the phenomena are discussed.

**3) Numerical Properties of Monte Carlo Reweighting Schemes for Calculating the Expected Value of Imperfect Information, Charles D. Linville**, CIESIN, 2917 Keswick Rd., Baltimore, MD 21211, clinvill@ciesin.org, *Paul S. Fischbeck*

The reuse of Monte Carlo simulations through the reweighting scheme of Hesterberg and others allows the efficient calculation of the EVII for complex models. The numeric limitations of the scheme must be well understood in order to interpret analytical results correctly.

**4) Decision Model to Purchase an MRI & CT Scan Machine for a Hospital, Steve D. Berlin**, US Military Acad., Dept. of Systems Eng., West Point, NY 10996-1779, x73653hl@cadetl.usma.edu, *Peter Bailey, Fernando Vaughn*

Currently, Keller Army Hospital sends its patients to a nearby clinic to obtain MRI and CT scans. Our decision model performs a cost/benefit analysis of financing the operation of a scanner at West Point vs. sending members of the West Point community to the local clinic.

#### SA25 Education I Contributed Session

**Chair:** Mohammad Z. Meybodi, IN Univ., 2300 S Washington St., Kokomo, IN 46904, mmeybodi@iukfsl.iuk.indiana.edu

**1) Using Principles of TQM to Improve the Teaching Process, Mohammad Z. Meybodi**, IN Univ., 2300 S Washington St., Kokomo, IN 46904, mmeybodi@iukfsl.iuk.indiana.edu

Teaching, like other service delivery systems, is a challenging service. A quality teaching service starts by focusing on customers and delivering service through the principles of added value and continuous improvement. The quality of a teaching service depends on a large number of factors such as knowledge, enthusiasm, communication, fairness and more. Some analysis of survey results will be presented.

**2) No Title Supplied, Farzin Heidari**, Texas A&M Univ., Campus Box 203, Kingsville, TX 78363

The growing diversity of today's work force includes an increase in handicapped persons entering the job market. The Americans with Disabilities Act requires that a person with a disability who meets the academic and technology standards cannot be denied admission or participation in educational programs. We review the barriers that students with disabilities face in

achieving their educational goals in laboratory settings...

**3) A Total Quality Curriculum Program: Five Years After, Arjang A. Assad**, Univ. of MD, Coll. of Business, College Park, MD 20742-1815, aassad@mbs.umd.edu

The University of Maryland has been running a joint engineering-business TQ program with IBM sponsorship for the last 5 years. This presentation considers the challenges and lessons learned and examines the implications of the Maryland experience for similar programs.

#### SA26 Optimization of Supply Chains

**Sponsor:** INFORMS Applied Probability Section  
**Sponsored Session**

**Chair:** Gerry Feigin, IBM Corp., PO Box 218, Yorktown Heights, NY 10510

**1) Resource Management in Assemble-to-Order Systems, Warren H. Hausman**, Stanford Univ., IE-EM Dept., Stanford, CA 94305-4024, *Erika Schraner*

We study the strategic decision of setting the planned level of capacity utilization in assemble-to-order environments. A periodic-review modeling framework is presented and a model with decentralized modified order-up-to policies is analyzed. We study the effect of reducing production capacity variability vs. reducing demand variability.

**2) Strategic Safety Stock Placement in Supply Chains, Stephen C. Graves**, MIT, Leaders for Mfg. Program, Cambridge, MA 02139-4307, *Sean Willems*

We consider a multi-stage production/distribution supply chain subject to stochastic, bounded demand. We formulate an optimization problem to determine where to place decoupling inventories, so-called strategic inventories, across the supply chain so as to minimize inventory holding costs subject to a service constraint for satisfying demand. We assume a deterministic lead time for each stage...

**3) Revenue Management in the Supply Chain, Garrett J. van Ryzin**, Columbia Univ., Grad. Sch. of Business, 412 Uris Hall, New York, NY 10027, gvanryzi@research.gsb.columbia.edu

One usually associates supply chain management with logistics but retail supply chains provide an equally important market clearing function. We discuss the role of pricing and revenue management in supply chains. Recent theoretical and empirical research in this area is presented.

**4) Inventory Analysis of Large Supply Chains Using a Supply Network Model, Markus Ettl**, IBM Corp., PO Box 218, Yorktown Heights, NY 10510, *Grace Lin, Gerry Feigin, David D. Yao*

We describe applications of a supply network model to analyze the inventory-service level tradeoff in large supply networks. We focus on insights gained through the use of the model as well as issues and challenges faced in deploying the model within a large manufacturing enterprise, including data collection and verification, user education and integration of the use of the model within existing business processes.

#### SA27 Marketing I Contributed Session

**Chair:** Jayprakash G. Patankar, Univ. of Akron, Dept. of Mgmt., Akron, OH 44325-4801, jpatankar@uakron.edu

**1) Warranty Practices Among Different Industries, Jayprakash G. Patankar**, Univ. of Akron, Dept. of Mgmt., Akron, OH 44325-4801, jpatankar@uakron.edu, *Amitava Mitra, Il-Woon Kim*

We explore the various warranty practices adopted by companies in a variety of industries. Issues addressed include the nature of warranty, cost of warranty service and the administration of warranty. Survey research was sponsored by the National Association of Service Managers. The data is analyzed by SIC codes of products.

**2) An Inventory-Theoretic Approach to Shelf-Space Allocation, Timothy L. Urban**, Univ. of Tulsa, QM/MIS Dept., 600 S College Ave., Tulsa, OK 74104-3189, qm\_tlu@centum.utulsa.edu

This research generalizes and integrates existing inventory-control and shelf-space allocation models. We first consider an inventory model in which the demand rate is a function of the display inventory level. We then investigate the shelf-space allocation problem by extending this model to the multi-item constrained environment.

**3) Computational Optimization Methods for Marketing Policy Determination, Ettore Di Lena**, Univ. "La Sapienza", Dept. of Stats., Piazza Aldo Moro 5, Rome, 00185, Italy, dilena@rosd.sta.uniroma1.it, *Giacomo Patrizi*

To determine optimal nonlinear marketing policies, algorithms which estimate

the response function and optimize the variables at the same time must be used. We present such an algorithm and give computational results, both for continuous and discrete marketing variables, by transforming the latter combinatorial problem into an equivalent continuous one.

**4) To Compare or Not to Compare: A Game Theoretic Analysis of Comparative Advertising**, *Wilfred Amaldoss*, Univ. of PA, Dept. of Mktg., Wharton Sch., 1490 SH-DH, Philadelphia, PA 19104, wilfred@marketing.wharton.upenn.edu, *Robert J. Meyer, Jagmohan S. Raju*

We propose a model to understand which brands may find it optimal to use comparative advertising. Our model explains when brands may choose to compare on the same attribute (head-on) instead of different product attributes (differentiate).

## SA29 Services Management I

### Contributed Session

**Chair:** Vijayan Sugumaran, Le Moyne Coll., Dept. of Bus. Admin., Syracuse, NY 13214, sugumara@maple.lemoyne.edu

**1) Intranet-Based Intelligent Agents for Organizational Process Modeling**, *Vijayan Sugumaran*, Le Moyne Coll., Dept. of Bus. Admin., Syracuse, NY 13214, sugumara@maple.lemoyne.edu

Organizational processes and their execution can be modeled as intelligent computerized agents. These agents can be distributed within the organization and can work cooperatively to automate some of the routine processes. We present an intranet-based agent model that simulates organizational processes and their execution.

**2) A Study of the Linkage Between Information Technology & Service Quality**, *Adam S. Huarng*, IN-Purdue Univ., Comp. Sci. Dept., Ft. Wayne, IN 46805-1499, huarng@cvax.ipfw.indiana.edu

Many organizations are seeking innovative ways to use IT for competitive advantage. One way to gain the competitive edge is to improve service quality. This study examines whether the customer's need is an important factor in the design of IT for competitive advantage and whether IT really improves service quality.

**3) Price Activity Mappings into Pattern Space Representations in Financial Markets & Stochastic Control of Trading Decisions**, *Dimitrios Laliotis*, Imperial Coll., Ctr. for Quant. Finance, Exhibition Rd., London, SW7 2BX, UK, d.laliotis.ic.ac.uk, *Gerry Salkin, Nicos Christofides*

We deal with mappings of intraday price activity into pattern spaces that reveal strong information asymmetries in financial markets. An optimal trading strategy is derived as the solution of an infinite horizon Markov decision problem and the results obtained suggest the existence of strategies with above average return characteristics.

## SA30 Modeling & Simulation without Validated Data

**Sponsor:** INFORMS Military Applications Society

### Sponsored Session

**Chair:** Lois Aymett, US Army Missile Command, Attn: AMSMI-RD, Redstone Arsenal, AL 35898-5240, aymett-lh@ccsmtmp.redstone.army.mil

**1) Virtual Reality**, *Rick Tolliver*, SRI Intl., 810 Regal Dr., SW, Ste. A, Huntsville, AL 35801, rick\_tolliver@wm.sri.com

No abstract available.

**2) Extending the Boundaries for Validation & Confidence Building to Complex Large Scale Simulations**, *Willard Holmes*, Smart Systems, Inc., 1725 Drake Ave., Huntsville, AL 35802, wholmes@traveller.com

Computer-based simulations are typically developed to provide insight to a physical system's operations. Developing confidence in data generated by the simulation model requires the application of identified validation methodologies. At issue is, "How can the model developer express a degree of confidence in simulation model generated data when the total model cannot be validated in the traditional sense?"...

## SA31 Manpower Analysis

**Sponsor:** INFORMS Military Applications Society

### Sponsored Session

**Chair:** Steven P. Wilcox, GRC Intl., Inc., 1900 Gallows Rd, Vienna, VA 22182, swilcox@grci.com

**1) The Manpower Planning System: An Object-Oriented Model for the PC**, *Denis Rochette*, GRC Intl., Inc., 1900 Gallows Rd.,

Vienna, VA 22182, drochette@grci.com

The manpower planning system is a robust object-oriented inventory projection model which achieves flexibility and extensibility. Based solely on input data one may flexibly model different populations, dimensions and transactions, extend the model's suite of transaction types and vary the dimensions and level of detail of the tracking matrix.

**2) The Importance of Multilevel Modeling for Accurate Inference in Military Personnel Studies I**, *Steven P. Wilcox*, GRC Intl., Inc., 1900 Gallows Rd, Vienna, VA 22182, swilcox@grci.com, *Brian Gruber, Mark Topolski*

Methods such as logistic regression require homogeneity assumptions that are seldom met in real life. Using standard regression methods can create misleading inferences. In military manpower analyses, the statistical significance of economic predictors can be greatly exaggerated and can lead to significant prediction errors. The solution is multilevel statistical modeling.

**3) The Importance of Multilevel Modeling for Accurate Inference in Military Personnel Studies II**, *Steven P. Wilcox*, GRC Intl., Inc., 1900 Gallows Rd, Vienna, VA 22182, swilcox@grci.com, *Brian Gruber, Mark Topolski*

We present new results from a statistical study of enlisted reenlistment and expiration of term loss rates in the Air Force. The model estimates the relative effects of demographic, occupational and economic variables, using a multilevel logistic regression model.

**4) A Force Tailoring Tool**, *Michael R. Anderson*, TRADOC Analysis Ctr., ATTN: ATRC SAA, 255 Sedgewick, Ft. Leavenworth, KS 66027-2345, andersml@trac.army.mil

The force tailoring tool, a mathematical optimization application, is used by military planners to derive the unit compositions for military forces most nearly approaching desired levels of lethality, survivability, sustainability and deployability. Fuzzy set and simulation techniques are used to capture the synergistic effects of various combinations of units.

## SA32 Network Design

**Sponsor:** INFORMS Technical Section on Telecommunications

### Sponsored Session

**Chair:** Kemal Altinkemer, Purdue Univ., Krannert Grad. Sch. of Mgmt., W Lafayette, IN 47907, kemal@mgmt.purdue.edu

**1) Routing & Pricing in ATM Networks with Multiple Fibers**, *Indranil Bose*, Purdue Univ., Krannert Grad. Sch. of Mgmt., 1310 Krannert Bldg., W Lafayette, IN 47906, bosei@vm.cc.purdue.edu, *Kemal Altinkemer*

Routing on ATM networks where parallel fibers exist between nodes is modeled as an M/D/k/N network of queues with priorities. The model is described and solution methods explained.

**2) Hierarchical Centralized Network Design with Multipoint Sub-Networks**, *Rakesh Gupta*, OK State Univ., Telecommunications Mgmt., Dept. of Mgmt. 343 Bus. Bldg., Stillwater, OK 74078, rgupta@magnus.acs.ohio-state.edu, *Hasan Pirkul*

Topological design of centralized computer-communication networks is an important issue that has been investigated extensively in the past. Typically, a large number of terminals, each of which could be a cluster of computers, is connected by low- or medium-speed lines to concentration sites, which are then connected to a central computing site by high-speed lines...

**3) Augmented Lagrangean Method for Time Restricted Routing in ATM & Frame Relay Networks**, *Kemal Altinkemer*, Purdue Univ., Krannert Grad. Sch. of Mgmt., W Lafayette, IN 47907, kemal@mgmt.purdue.edu, *Bezael Gavish*

Time restricted routing in ATM and frame relay is modeled as M/D/1 network of queues with priorities. The first priority has time restrictions, that is they have to be delivered to their destination within a certain time guarantee. An augmented Lagrangean method is applied as a solution procedure.

## SA34 Accounting for Human Inference Characteristics in Developing Methods & Systems for Decision Support

**Cluster:** Choice Engineering

### Invited Session

**Chair:** Jan-Peter Lechner, Univ. der Bundeswehr Hamburg, FB WOW, Hamburg, 22039, Germany, jan-peter.lechner@unibw-hamburg.de

**1) How to Design a Cooperative System: A Case Study**, *Camille Rosenthal-Sabroux*, Univ. de Paris Dauphine, LAMSADE, Place du

Marechal de Lattre, Paris, F-75016, France, sabroux@lamsade.dauphine.fr

We propose a shift in the way the design of ISs is viewed, so that the system and potential users will be in harmony right from the design stage. In designing, distributed intelligence about the situation in terms of interactions and cooperative partners is considered. A case study is presented.

**2) Reduction of Pairwise Comparisons in Decision Making via a Duality Approach, Evangelos Triantaphyllou**, LA State Univ., Dept. of Ind. & Mfg. Eng., 3128 CEBA Bldg., Baton Rouge, LA 70803-6409, letrian@isuvmlsncc.lsu.edu

We introduce a dual formulation to a given MCDM problem which can significantly alleviate the problems caused since comparisons quadratically increase with the number of the entities to be compared. Mitigation is possible if the number of alternatives exceeds the number of decision criteria by one.

**3) Reducing the Cognitive Load & Recognizing Judgmental Error in Applications of Multiattribute Utility Theory Using Simulation, John C. Butler**, Univ. of TX, MSIS Dept., CBA 5.202 (B6500), Austin, TX 78712-1175, jbutler@utsvs.cc.utexas.edu, **Jianmin Jia, James S. Dyer**

We present a simulation approach for multiattribute decision making using different information regarding attribute weights, probabilities and utilities (or values). This approach can reduce the number of required assessments and avoid some of the problems that can arise in applications, particularly when a group is responsible for the decision.

**4) Right-Sizing the Information Supply, Jan-Peter Lechner**, Univ. der Bundeswehr Hamburg, FB W0W, Hamburg, 22039, Germany, jan-peter.lechner@unibw-hamburg.de

With respect to increasingly powerful general data access and retrieval systems, more attention should be paid to pre-processing of information, i.e., condensing, selecting or expressing by different descriptive means. Experiences from application of decision analytic software tools are reported and a framework considering media dependent information processing capacity outlined.

### SA37 George E. Nicholson Student Paper Prize Competition I

#### Prize Session

**Chair:** Jeffrey I. McGill, Queen's Univ., Sch. of Bus., Kingston, Ontario, K7L 3N6, Canada

**1) George E. Nicholson Student Paper Prize Competition I, Jeffrey I. McGill**, Queen's Univ., Sch. of Bus., Kingston, Ontario, K7L 3N6, Canada

This session features selected finalists in the Nicholson Student Paper Prize Competition. It represents an opportunity for faculty, professionals and especially other students to see some of the best research being performed by students. Everyone is welcome to attend.

### Sunday 10:00-11:30

#### SB04 DEA II

##### Contributed Session

**Chair:** Robert E. Stanford, Univ. of AL, Dept. of Econ., Birmingham, AL 35294-4460

**1) Benchmarking Medical Treatment Processes, Robert E. Stanford**, Univ. of AL, Dept. of Econ., Birmingham, AL 35294-4460

We consider the use of DEA for the benchmarking of performance of hospitals engaged in the treatment of acute myocardial infarction by the application of 1 or more particular processes of care. The DEA benchmarks are then compared to benchmarks produced by the more commonplace process of percentile ranking of utilization rates.

**2) A DEA-Based Framework for Strategic Group Analysis: Empirical Investigation in the Hospital Industry, Lily M. Adu**, Univ. of IA, 2425 Bartelt Rd., Apt. 1B, Iowa City, IA 52246-2709, ladu@uiowa.edu, **Dennis Bricker, Thomas S. Gruca**

DEA is a valuable research methodology that can be used to establish an objective and viable framework by which the strategic group concept may be systematically operationalized. Such a framework would serve to arrest the operational ambiguity surrounding the strategic group concept and hopefully reduce consistent findings regarding the key assertions of strategic group theory.

**3) DEA in Performance Measurement in UK Universities: The Institutional Perspective, Claudia S. Sarrico**, Univ. of Warwick, Warwick Bus. Sch., Coventry, CV4 7AL, UK, c.s.sarrico@warwick.

ac.uk, **Robert G. Dyson**

On one side, universities need to attract students; and, on the other, need to be increasingly accountable to external funding bodies, while pursuing their own mission and objectives. DEA provides targets and benchmarks that point to possible directions to improve performance regarding the internal and external demands imposed on universities.

**4) Efficiency Analysis of Markets in Pacific Rim Countries (R), Rao Singamsetti**, Univ. of Hartford, 200 Bloomfield Ave., W Hartford, CT 06117, singamset@uhavax.hartford.edu

The Pacific basin region gained importance because of the fast growth in terms of GDP, population, resource endowment, trade share and industrial capacity. An attempt is made to measure and compare the efficiencies of markets in selected Pacific Rim countries. DEA is applied to macro data as published by the World Bank. Efficiency measures in the years 1983 and 93 are computed and compared.

### SB05 Recent Developments in Linear Programming Software & Its Applications

#### Cluster: Linear Programming

##### Invited Session

**Chair:** Samer Takriti, IBM, TJ Watson Res. Ctr., PO Box 218, Yorktown Heights, NY 10598, takriti@watson.ibm.com

**1) Automatic Structure Identification in Linear Programming, Michael C. Ferris**, Univ. of WI, Comp. Sci. Dept., 1210 W Dayton St., Madison, WI 53706-1685, ferris@cs.wisc.edu, **Jeffrey D. Horn**

We are interested in generating and exploiting block angular structure for GLP problems. The resulting LPs are solved using a decomposition approach. We will describe the graph algorithms that are used to determine the structure and how the identification can be carried out directly from MATLAB or the GAMS modeling language. Comparisons to standard codes will be given.

**2) The Use of Interior Point Methods within Decomposition, Jacek Gondzio**, Univ. of Geneva, Sec. of Mgmt. Studies, Logilab, 102 Bd Carl Vogt, Geneva, CH-1211, Switzerland, gondzio@divvsun.unige.ch

In decomposition applications, IPMs are employed to solve the sequence of restricted master problems and/or to solve subproblems (if their sizes are considerable). We discuss specific issues arising in such applications: use of central prices, exploiting problem structure, warm start of IPMs. Numerical results are given.

**3) Out-of-Core Methods for Interior Point Linear Programming, Edward E. Rothberg**, Silicon Graphics Computer Systems, 2011 N Shoreline Blvd., Mountain View, CA 94043, rothberg@sgi.com, **Rob Schreiber**

While interior point methods often require much less time than the simplex method, their memory requirements can be prohibitive. We describe out-of-core sparse factorization methods tailored to interior point LP matrices. These methods keep the vast majority of the factor matrix on disk while incurring only a moderate performance degradation.

### SB06 Cooperative Search Applied to Combinatorial Optimization

#### Cluster: Combinatorial Optimization

##### Invited Session

**Chair:** Michel Toulouse, Univ. of Montreal, CRT, CP 6128, Succ. Center-ville, Montreal, Quebec, H3C 3J7, Canada, toulouse@crt.umontreal.ca

**1) Evolutionary Methods for Cooperative Parallel Tabu Search, Teodor Gabriel Crainic**, Univ. de Montreal, CRT, CP 6128, Succ. Centre-Ville, Montreal, Quebec, H3C 3J7, Canada, theo@crt.umontreal.ca

We study cooperative parallel tabu search methods and apply them to the fixed cost, multicommodity, capacitated network design problem. We use the "elite" solutions exchanged by the individual search threads to start an evolutionary process which continuously generates new information for the tabu search while receiving new elements from the parallel process...

**2) Generalized Cybernetic Optimization by Simulated Annealing, Mark Fleischer**, Old Dominion Univ., Dept. of Eng. Mgmt., Norfolk, VA 23529-0248, maf100f@engr.enma.odu.edu, **Sheldon H. Jacobson**

We present a generalization of the method of cybernetic optimization by SA for continuous variable problems. Scaling properties, use of secondary feedback mechanisms affecting candidate generation and tabu intensification strategies permit an efficient search of the configuration space. Theoretical and

experimental results on convergence in the continuous domain are discussed.

**3) Evolving Cellular Automata with Genetic Algorithms, Wim Hordijk**, Sante Fe Inst., 1399 Hyde Park Rd., Sante Fe, NM 87501, wim@santafe.edu

We study how GAs can evolve cellular automata to perform computations requiring global coordination. The evolving cellular automata framework is an idealized means for studying how evolution (natural or computational) can produce systems that perform emergent computation, in which the actions of simple components with local interactions only give rise to coordinated global information processing.

**4) Self-Organization Behavior of Cooperative Search, Michel Toulouse**, Univ. of Montreal, CRT, CP 6128, Succ. Center-ville, Montreal, Quebec, H3C 3J7, Canada, toulouse@crt.umontreal.ca

Cooperative search is a parallelization strategy where search processes exchange and reuse information semantically related to the optimization problem. We show that the interaction among threads may develop into a self-organization behavior aiming to reduce the entropy of the parallel searches rather than converging towards good solutions to the optimization problem.

## SB07 Data Mining, Estimation & Search

**Cluster: Nonlinear Programming**

**Invited Session**

**Chair: Olvi L. Mangasarian**, Univ. of WI, Comp. Sci. Dept., 1210 W Dayton St., Madison, WI 53706-1685, olvi@cs.wisc.edu

**1) Geometry in Learning, Kristin P. Bennett**, RPI, Math. Sci. Dept., Troy, NY 12180, bennek@rpi.edu

The learning problem of classifying points from 2 sets is examined geometrically. The dual of the problem of finding the 2 closest points from the convex hulls of 2 sets provides a unifying perspective on linear classification methods. The resulting methods are compared empirically on data mining problems.

**2) The MINCPS Problem & Piecewise Linear Model Estimation, Edoardo Amaldi**, Cornell Univ., Sch. of OR & Theory Ctr., 237 Rhodes Hall, Ithaca, NY 14853, amaldi@cs.cornell.edu, **Marco Mattavelli**

The fundamental problem of piecewise linear model estimation can be formulated as that of partitioning an inconsistent linear system into a minimum number of consistent subsystems. We describe a greedy algorithm based on a relaxation-like method and demonstrate its performance on some challenging problems in image and signal processing.

**3) Hybrids of Genetic Algorithms with Local Searching, Richard K. Belew**, Univ. of CA, Comp. Sci. & Eng. Dept., La Jolla, CA 92093, rik@cs.ucsd.edu

GAs are useful in finding global optima. Just as iterated restart methods use Monte Carlo distributions over starting values combined with local search techniques, hybrids of GAs with local search methods ranging from neural networks to conjugate gradient to non-gradient methods such as pattern search will be described.

**4) Mining Medical Databases, Olvi L. Mangasarian**, Univ. of WI, Comp. Sci. Dept., 1210 W Dayton St., Madison, WI 53706-1685, olvi@cs.wisc.edu, **Paul S. Bradley, W. Nick Street**

A fast k-median clustering algorithm, based on minimizing a piecewise-linear concave function, is used to extract information from medical databases without supervision. For example, clinically important distinct survival curves that give estimates of percent surviving cancer patients at a given time, are constructed for different clusters of point representing patients.

## SB08 Advances in Mixed-Integer Programming

**Cluster: Integer Programming**

**Invited Session**

**Chair: Ignacio E. Grossmann**, Carnegie Mellon Univ., Dept. of Chem. Eng., Pittsburgh, PA 15213, ig0c.andrew.cmu.edu grossman@cmu.edu

**1) Parallel Solution of Large-Scale Mixed Integer Problems in Scheduling, Hans Georg Bock**, Univ. of Heidelberg, Interdisp. Ctr. Sci. Computing, Im Neuenheimer Feld 368, Heidelberg, D-69120, Germany, bock@iwr.uni-heidelberg.de, **Gerhard Reinelt**

No abstract supplied.

**2) Worst Case & Probabilistic Analyses for a Class Multiperiod MILPs, M. L. Liu**, Univ. of IL, Dept. of Mech. & IE, 1206 W Green St., Urbana, IL 61801, nikos@uiuc.edu, **Nick Sahinidis**

Certain capacity expansion problems can be formulated as multiperiod MILPs. We present worst case and probabilistic analyses of the LP relaxation of these models and an LP-based heuristic. As the number of time periods increases, the heuristic is proved asymptotically optimal.

**3) Computational Experience with Generalized Nonlinear Disjunctive Programs, Ignacio E. Grossmann**, Carnegie Mellon Univ., Dept. of Chem. Eng., Pittsburgh, PA 15213, ig0c.andrew.cmu.edu grossman@cmu.edu, **Aldo Vecchiotti**

We report computational results with an outer-approximation algorithm for solving nonlinear discrete optimization problems that are formulated as disjunctive programs. Comparisons are also presented when some of these problems are formulated as mixed-integer NLPs and solved with generalized benders, outer-approximation and extended cutting plane algorithms.

**4) Convergence Properties of an Algorithm for Solving Quasi-Convex MINLP Problems, Tapio Westerlund**, Abo Akademi Univ., Process Design Lab., Biskopsgatan 8, Abo, FIN 20500, Finland, twesterl@ra.abo.fi, **Claus Still, Goran Hognas**

We study more closely the convergence properties of the alpha-extended cutting plane method. This method can be used to solve a class of non-convex problems and we will show that the algorithm has global convergence properties for quasi-convex MINLP problems.

## SB10 Production Scheduling II

**Contributed Session**

**Chair: Mark P. Van Oyen**, Northwestern Univ., IE/MS Dept., 2225 N Campus Dr., Evanston, IL 60208-3119, vanoyen@iems.nwu.edu

**1) Lot Splitting in Bottleneck Constrained Production Systems, Robert A. Ruben**, NM Inst. of Mining & Tech., Socorro, NM 87801, ruben@mailhost.nmt.edu, **Farzad Mahmoodi**

Computer simulation is utilized to study the impact of lot splitting in bottleneck constrained production systems, under a variety of experimental conditions. We hypothesize that when the number of setups are increased at non-bottleneck stations, there will be a richer mix of products of bottleneck resources. This leads to better tardiness performance with only slight deterioration of flow time performance.

**2) Forming Serial Assembly Cells in a JIT Factory, Wilson Price**, Univ. Laval, FSA/OSD (43-07), Quebec, Quebec, G1K 7P4, Canada, pricew@fsa.ulaval.ca, **Marc Gravel**

For a JIT factory making complex products, we describe an algorithmic procedure for creating balanced manufacturing cells. From current product data, we seek frequently used operation sequences. Our procedure assigns machines to cells and loads them. We present numerical experiments with varying conditions and describe the performance.

**3) Application of Genetic Algorithms to the Single Machine Early/Tardy Problem with Sequence Dependent Setup Times, Ghaith Rabadi**, Univ. of Central FL, 1617 Cricket Club Cir., #303, Orlando, FL 32828, ghaith@ists.engr.ucf.edu, **Mansoor Mollaghasemi**

GAs are applied to the single machine early/tardy problem with a large number of jobs with sequence dependent setup times. To verify the proposed methodology, the solution obtained from this methodology was compared to the optimum solution obtained from LP techniques for small problems.

**4) Heuristic Scheduling of Finite-Capacity Polling Systems, Mark P. Van Oyen**, Northwestern Univ., IE/MS Dept., 2225 N Campus Dr., Evanston, IL 60208-3119, vanoyen@iems.nwu.edu, **Eungab Kim**

We design single-server scheduling policies for make-to-order systems with holding costs, set-up times and finite capacity buffers both with and without rejection costs for lost demands. We use DP to analyze the performance of our heuristics compared with another as well as the optimal performance.

## SB12 OR/MS Applications in Transportation Systems II

**Sponsor: INFORMS CSTS**

**Sponsored Session**

**Chair: Ram Pandit**, Consolidated Freightways, Inc., Intelligent Systems Eng., Leland James Service, Corp., Portland, OR 97208-6696, ram@eniac.cnf.com

**1) A Model for Optimizing the Linehaul Portion of Intermodal Rail-Truck Operations, Alexandra M. Newman**, Univ. of CA, Dept. IE/OR, 4135 Etcheverry Hall, Berkeley, CA 94720, newman@ieor.berkeley.edu, **Alan Erera**

Although rail intermodal transportation has been gaining popularity in recent

years, a significant number of shippers complain about lengthy transit times. We have begun investigating means of increasing the operating efficiency of intermodal freight trains. The mathematical methods we propose should bring reduced operating costs, improved level-of-service, or both...

**2) A Warehouse Location Model: Trade-Off Between Risk-Pooling & Warehouse Overhead, Yafeng Du**, Consolidated Freightways, Inc., Leland James Service Corp., PO Box 6696, Portland, OR 97208-6696, yafeng@eniac.cnf.com

It is well known that the risk of pooling effect of a warehouse can reduce lower level safety stock. However, this effect has been ignored by the research of stochastic warehouse location problems. We present a warehouse location model that includes the risk pooling effect.

**3) Scheduling of Timed Transfer Bus Terminals Using Intelligent Transportation Systems Technologies, Maged M. Dessouky**, Univ. of Southern CA, Dept. of Ind. & Systems Eng., Los Angeles, CA 90089-0193, maged@rcf.usc.edu, **Randolph W. Hall, Ali Nowroozi**

A timed transfer exists when multiple bus routes are scheduled to arrive on or about the same time at a transit terminal, with the goal of enabling short waiting times when transferring between buses. We study the impact of different holding and control strategies for buses at the terminal on total bus and passenger delay. Some strategies studied make use of ITS technologies.

### SB13 Graph Drawing Systems

Sponsor: INFORMS CSTS

Sponsored Session

Chair: Petra Mutzel, Max-Planck-Inst. fuer Informatik, IM Stadtwald, Saarbruecken, 66123, Germany, mutzel@mpi-sb.mpg.de

**1) Graph Layout Toolkit, Brendan Madden**, Tom Sawyer Software, 804 Hearst Ave., Berkeley, CA 94710, bmadden@tomsawyer.com

Tom Sawyer Software's GLT is a suite of portable C++ libraries to add graph layout technology into graphics applications. Hierarchical layout applies in production planning and scheduling. Orthogonal layout applies in business reengineering and database design. Circular and symmetric layout enhance visualization of information networks. GLT's navigational mechanisms manage many graphs for large hierarchical systems...

**2) Graphlet: A System for Drawing Graphs, Michael Himsolt**, Univ. Passau, Inst. fuer Informatik, Inrstrasse 33, Passau, D94032, Germany, himsolt@fmi.uni-passau.de

Graphlet is a portable, object-oriented toolkit for graph editors and graph drawing algorithms. Graphlet uses LEDA, a C++ library for data structures and algorithms. The customizable user interface is written in LedaScript, a new language for algorithms based on Tcl/Tk. Both UNIX and Microsoft Windows versions are available.

**3) Graph Visualization with GraVis, Harald Lauer**, Univ. of Tuebingen, Wilhelm-Schickard Inst., Sand 13, Tuebingen, D-72076, Germany, lauer@informatik.uni-tuebingen.de, **Michael Kaufmann**

GraVis is a system for the visualization of graphs, designed to be able to efficiently handle big graphs. GraVis can be extended with visualization components at runtime; therefore, provides the flexibility to satisfy the needs of many application domains. The system is implemented in Eiffel and is portable on many Univ/X11 platforms...

### SB14 Product Innovation & Introduction

Cluster: New Product Development

Invited Session

Chair: Rachel Yang, Univ. of IL, Dept. of Bus. Admin., Champaign, IL 61820, ryang@uiuc.edu

**1) Marketing Research vs. Production: A Resource Allocation Approach, Marilyn T. Lucas**, Univ. of IL, Dept. of Bus. Admin., 1206 S 6th St., Champaign, IL 61820, **James Hess**

We analyze the traditional way by which firms improve their knowledge about the market, which has been to devote resources to marketing research in order to reduce demand uncertainty. Through a simple optimization model, we assess the impact of marketing research on resource allocation in production capabilities.

**2) Speed to Market with Modular Product Design, Lillian C. Wright**, Univ. of IL, Dept. of Bus. Admin., 1206 S 6th St., Champaign, IL 61820, **Russell W. Wright**

We explore the relationship between modularity in product design and speed to market in high velocity environments. Isolation of evolving modules from stable

modules across product generations can shorten development cycles. We describe the role of modular product design in the race to market in the PC industry.

**3) Technology Advancement Strategies: Timing & Extent of Advancement, D. Sudharshan**, Univ. of IL, Dept. of Bus. Admin., 339 Commerce W Bldg., Champaign, IL 61820, **Ben Liu**

A market in which 2 different firms compete based on not only horizontal and vertical differentiation but also on technological differentiation is considered. Using a stylized model, we solve the optimal advancement strategies theoretically. We also provide specific measurement methods to calibrate the market parameters on which the optimal strategies depend.

**4) Product Design Strategies from Total Differentiation to Fashion Cycles, Y. Stephen Chiu**, Chinese Univ. of Hong Kong, Fac. of Bus. Admin., Shatin NT, Hong Kong, **Rachel Yang**

Consumer preference for variety may lead to a firm's product differentiation strategy but product indivisibility decides intertemporally dependent preferences that drive fashion cycles. A firm's product design position from total differentiation to fashions is examined from the firm's production cost, market segmentation and industry competition.

### SB15 Production Planning Methods & Applications

Cluster: Production Control with Uncertainty

Invited Session

Chair: Sherman X. Bai, Univ. of FL, Dept. of Ind. & Sys. Eng., Gainesville, FL 32611-6595, bai@ise.ufl.edu

**1) Optimal Production & Capacity Planning with Piecewise Constant Demand, Houmin Yan**, Chinese Univ. of Hong Kong, Dept. of IE & Eng. Mgmt., Shatin NT, Hong Kong, yan@se.cuhk.hk, **Mohsen El Hafsi, Sherman X. Bai**

We consider the production and capacity planning problem for a single-product manufacturing facility. The planning horizon is finite, consisting of  $N$  intervals of different lengths. The demand is constant in each interval and may vary from one interval to another. The system capacity remains constant during an interval and may be changed between intervals, subject to a capacity change cost.

**2) Analysis of Poisson Driven Assembly Systems, Hayriye Ayhan**, GA Inst. of Tech., Sch. of ISyE, Atlanta, GA 30332-0205, hayhan@isye.gatech.edu

We consider a class of assembly operations with Poisson input process. Under certain assumptions, the dynamic of assembly systems can be captured by a set of difference equations. We derive a Taylor series expansion for the mean cycle time using these difference equations. When processing times are deterministic, all coefficients of the expansion can be obtained in closed form.

**3) Service Facility Startup & Capacity Decisions in Finite-Horizon, Two-Stage Queueing Systems, Hongtao Zhang**, Hong Kong Univ. of Sci. & Tech., Dept. of Info. & Mgmt., Clear Water Bay, Kowloon, Hong Kong, imhzhang@usthk.ust.hk, **Lode Li**

We present a finite-horizon, 2-facility tandem queueing system with general variability. We derive equations that describe the dynamics of the system and show that 3 performance measures, the expected waiting, tardiness and operating costs, have desirable convexity properties with respect to the 4 control variables.

### SB16 PANEL: Publishing Outlets for Research on the Management of Innovation

Sponsor: INFORMS Section on Technology Management

Sponsored Session

Chair: Michael K. Badawy, VA Polytech. Inst. & State Univ., Dept. of Mgmt., Pamplin Coll., 2990 Telestar Ct., Falls Church, VA 22042

**1) PANEL: Publishing Outlets for Research on the Management of Innovation, Thomas P. Hustad**, IN Univ., **Robert M. Mason**, Case Western Reserve Univ., **Michael K. Badawy**, VA Polytech. Inst. & State Univ.

No abstract supplied.

### SB17 Operations Management II

Contributed Session

Chair: Grisselle Centeno, Univ. of Central FL/Lucent Tech., 8215 Sun Spring Cir. #72, Orlando, FL 32825, gcenteno@lucent.com

**1) Parallel Machine Scheduling in Semiconductor Manufacturing, Grisselle Centeno**, Univ. of Central FL/Lucent

Tech., 8215 Sun Spring Cir. #72, Orlando, FL 32825, gcenteno@lucent.com, **Robert L. Armacost**

We present a heuristic algorithm for minimizing maximum lateness in a parallel machine environment with release date, machine eligibility and sequence dependent setup times. Computational results are included for wafer test operations.

2) **Facility Layout of Irregular Shaped Departments**, *Cerry M. Klein*, Univ. of MO, E3437 Eng. Bldg. East, Columbia, MO 65211, klein@risc1.ecn.missouri.edu, *Alan R. McKendall, Jr.*, *James S. Noble*

Irregular shapes such as L-shapes, O-shapes and U-shapes are investigated for facility layout. The problem is shown to be equivalent to solving the nested facility layout problem. Solution techniques are developed and the problem is shown to efficiently lay out workstations, storage areas and other departments within departments while minimizing flow cost.

3) **A Zero-One Model for Scheduling Pickup & Delivery of Full Truckloads with Time Windows**, *Ruth A. Wassermann*, Clemson Univ., Dept. of Math. Sci., Clemson, SC 29634-1907, rwasser@clemson.edu, *P. M. Dearing*

We present a 0-1 linear model for scheduling pickup and delivery of full truckloads with time windows. The model allows additional constraints such as limiting route drive time. Computational experience is discussed.

4) **Geographic Expansion of LTL Service Under Competition**, *Hal A. Bowman*, Morgan State Univ., 4600 Waterfall Ct., Apt. C, Owings Mills, MD 21117, bowman1@mail.bcpl.lib.md.us

We present the construction of a decision support tool for evaluating potential markets and network configurations for an expanding LTL service provider.

## SB18 TUTORIAL: Fair Division - From Cake-Cutting to Dispute Resolution

Invited Session

Chair: Steven J. Brams, NYU, Dept. of Politics, 715 Broadway - 4th Fl., New York, NY 10003

1) **TUTORIAL: Fair Division - From Cake-Cutting to Dispute Resolution**, *Steven J. Brams*, NYU, Dept. of Politics, 715 Broadway - 4th Fl., New York, NY 10003

Cutting a cake, dividing up property in an estate, determining the borders in an international dispute - these and other problems will be used to illustrate how constructive procedures can be applied to allocating goods, and deciding who wins on what issues, that satisfy such properties as envy-freeness, equitability and Pareto-optimality.

## SB20 Transportation II

Contributed Session

Chair: Maria P. Boile, Lafayette Coll., Dept. of Civil & Environ. Eng., Easton, PA 18042-1775, boilem@lafayette.edu

1) **An Intermodal Commuter Network Equilibrium Model**, *Maria P. Boile*, Lafayette Coll., Dept. of Civil & Environ. Eng., Easton, PA 18042-1775, boilem@lafayette.edu, *Lazar N. Spasovic*

The model deals with the choice of mode between auto and transit, type of access to the selected mode and actual route for a trip on a commuter network. The demand side of the formulation utilizes a nested logit model to perform mode and access type choice. The supply side models the choice of actual route within each mode as a routing problem.

2) **A New Algorithm for the Vehicle Routing Problem with Stochastic Demands**, *Eleni Hadjicostantinou*, Imperial College, Mgmt. Sch., 53 Prince's Gate, Exhibition Rd., London, SW7 2PG, UK, eah@ic.ac.uk, *Daron Roberts*

The VRP with stochastic demands involves designing minimum-cost routes for a fleet of vehicles to serve customers with stochastic demands. A new paired tree-search algorithm will be presented based on the computation of 2 bounds. Computational results are given for problems involving up to 20 customers.

3) **Advances in Airline Crew Rescheduling**, *Ladislav Letovsky*, USAir Inc., The OR Group, 2345 Crystal Park Dr., Arlington, VA 22227, USA, ladisla@usair.com, *Ellis L. Johnson*, *George L. Nemhauser*

We discuss issues associated with real-time crew rescheduling when disruptions occur. We present heuristics to reduce the complexity and size of the problem before a column generation approach is applied to an integer set covering problem. A solution framework with pre-processing techniques and branching strategies is presented...

4) **USAir's Weekend Fleet Assignment Production Model**, *Suresh K. Acharya*, USAir, OR Group, 2345 Crystal Dr., Arlington, VA 22227, suresh@usair.com, *Spyros Kontogiorgis*

The OR group has produced an extended fleet assignment technology to provide automated decision support to USAir's schedule planners on the assignment of aircraft to weekend flights. An event-activity model maximizes profit, using weekend forecasts of passenger traffic while maintaining continuity and operational consistency with the weekday schedule.

5) **Principal Component Analysis for Forecasting**, *Anupama Narayanan*, SABRE Decision Tech., 1 E Kirkwood Blvd., MD 7390 TSG, Southlake, TX 76092, anu@sdt.com

For any future flight departure, forecasts are created several times before departure. These forecasts should use all available data from other departures of the same flight. With the large number of variables, some data-reduction is required. We illustrate the use of principal component analysis to forecast demand.

## SB21 National Center of Excellence for Aviation OR

Cluster: Aviation Applications

Invited Session

Chair: Tony Vanchieri, FAA Headquarters, ASD-430, 800 Independence Ave. SW, Washington, DC 20591, avanchieri@mail.hq.faa.gov

1) **Real-Time Decision Support for Integration of Airline Flight Cancellations & Delays**, *Adib Kanafani*, Inst. of Transport. Studies, University of CA, Berkeley, CA 94270-1720, *Jia-Ming Cao*

Airline flight schedules and aircraft assignments often have to be adapted to unforeseen perturbations in an established schedule by delaying some flights and cancelling others. We present a quadratic programming model for the integrated decision problem, which takes into account the different costs of delay and flight cancellation.

2) **Simplicity/Reliability Tradeoffs in Fast-Time Simulation: The Case of SIMMOD**, *Mark Hansen*, Inst. of Transport. Studies, University of CA, Berkeley, CA 94270-1720

Users of simulation tools must make tradeoffs between the level of detail and precision of the input data and the accuracy and reliability of results. We report on a study to characterize these tradeoffs, in the context of SIMMOD, so that users can better judge the appropriate level of input definition.

3) **Human Error Analysis Strategies for the Flight Deck/ATC Environment**, *Geoffrey D. Gosling*, University of CA, Inst. of Trans. Studies, Berkeley, CA 94270-1720

We present the results of a technical review of existing analytical methods to address human error and the development of a strategic plan to address the analysis of human error in the flight deck/ATC system within the context of the recently announced global analysis and information network.

4) **Use of the Integration Tool for Flight Crew Error Analysis**, *James Blanchard*, Embry-Riddle Aeronautical Univ., Ctr. Aviation/Aerospace Res., Daytona Beach, FL 32114-3900

Using a data integration tool developed for the FAA, we examine the use of proprietary incident data as an indicator of hazards that lead to accidents and incidents. The data was collected over a 1-year period and represents more than 100,000 hours of general aviation operations.

## SB22 Flexible Manufacturing Systems II

Contributed Session

Chair: Kenichi Futamura, AT&T, 101 Crawfords Corner Rd., Rm. 3K-312, Holmdel, NJ 07733-3030, futamura@qpc2.att.com

1) **The Effect of Coefficient of Variation on the Throughput of a Production Line**, *Kenichi Futamura*, AT&T, 101 Crawfords Corner Rd., Rm. 3K-312, Holmdel, NJ 07733-3030, futamura@qpc2.att.com

Though production lines have changed society, much is still unknown, especially concerning variance. We examine the effect of the CV of the service-time distribution on throughput. In particular, we allow CV to differ from station to station.

2) **Capacity Planning of Flexible Manufacturing via Spreadsheet/Optimization Modeling**, *Jienjou Lin*, Purdue Univ., Sch. of IE, W Lafayette, IN 47907, linji@ecn.purdue.edu, *Joseph J. Talavage*

A DSS using integrated spreadsheet/optimization modeling is developed to support the capacity planning/analysis of FMSs. It will help to select machines/servers with capacity and cost constraints and allocate processing capacity under various objectives. This DSS can be applied to systems with

regular and multi-functional servers.

**3) Analysis of Scheduling Approaches in a Stochastic Manufacturing Environment, Ihsan Sabuncuoglu, Bilkent Univ., Dept. of IE, Ankara, 06533, Turkey, sabun@bilkent.edu.tr, Suleyman Karabuk**

We analyze the scheduling/rescheduling problem in a multi-resource environment of FMSs. The performance of the system is measured for both mean tardiness and makespan criteria. The relationships between the scheduling frequency and other scheduling factors are also investigated.

**4) A Framework for an Interactive FMS Design with Multiple Objectives, Taeho Park, San Jose State Univ., One Washington Sq., San Jose, CA 95192-0070, park\_t@cob.sjsu.edu**

We present a framework for designing FMSs with multiple performance objectives by interactively resolving conflicted objectives using compromise programming. The framework includes statistical analysis methods of design of experiments and a polynomial regression model to derive objective functions. It also integrates model valuation processes into the statistical analysis methods.

**SB23 New Practices in Yield Management**

**Cluster: Manufacturing & Service Management  
Invited Session**

**Chair: Guillermo Gallego, Stanford Univ., Grad. Sch. of Bus., L 375, Stanford, CA 94305, ggallego@leland.stanford.edu**

**1) Stochastic Approximation & Distribution Free Yield Management, Garrett J. van Ryzin, Columbia Univ., Grad. Sch. of Business, 412 Uris Hall, New York, NY 10027, gvanryzi@research.gsb.columbia.edu, Jeffrey I. McGill**

We discuss the application of stochastic approximation to the problem of distribution-free estimation of optimal booking levels in yield management systems.

**2) Combined Pricing & Inventory Control Under Uncertainty, Aliza Scachter, Columbia Univ., Grad. Sch. of Bus., New York, NY 10027, Awi Federgruen**

We address a general class of single-item stochastic models for the combined determination of pricing and inventory strategies. We characterize the structure of optimal policies in finite and infinite horizon settings, develop efficient value-iteration methods and report on a numerical study based on actual retail data.

**3) Simultaneously Optimizing Pricing & Yield Management Decisions, Robert Phillips, Decision Focus Inc., 650 Castro St., Ste. 300, Mountain View, CA 94041-2055, bobp@dfi.com**

Typically, airline yield management decisions are made assuming that prices are fixed. Similarly, pricing decisions are often made without considering the implications of yield management. We consider some simple models for simultaneously optimizing price and yield management decisions with an emphasis on using "feedback" from yield management to improve pricing.

**4) A New Demand Model for Yield Management, Guillermo Gallego, Stanford Univ., Grad. Sch. of Bus., L 375, Stanford, CA 94305, ggallego@leland.stanford.edu**

We develop a simple deterministic model to shed light on the pricing and market segmentation decisions faced by airline managers that accounts for demand diversion and demand recapture. We give precise conditions to guarantee the optimality of the low-to-high fare structure and give lower and upper bounds on the optimal revenue.

**SB24 Decision Analysis II**

**Contributed Session**

**Chair: Kiriakos Vlahos, London Bus. Sch., Regents Park, London, NW1 4SA, UK, kvlahos@lbs.london.ac.uk**

**1) Integrating Optimization Models within Decision Analysis, Kiriakos Vlahos, London Bus. Sch., Regents Park, London, NW1 4SA, UK, kvlahos@lbs.london.ac.uk, Derek W. Bunn, Peter Bolland**

DA applications often require interaction with detailed optimization-based models. In these cases, extensive form solution turns out to be very time consuming. We investigate a number of alternatives based on a model-of-model approach whereby a number of optimization runs are undertaken and form a database which can then be used via interpolation techniques...

**2) A Model for Justification of Adopting Advanced Technologies, Sharon M. Ordoobadi, KS State Univ., Dept. of IMSE, Durland Hall, Manhattan, KS 66506-5101, sharon@ie.taylor.ksu.edu**

A model is developed for the justification of adopting advanced technologies.

The 3-stage process includes strategy analysis, economic analysis and utility analysis. A unique feature of the model is that it considers not only the direct impacts of such adoptions but the secondary and indirect impacts as well.

**3) Fallacy of Causality: Inducing Cooperation in the Prisoners' Dilemma, Moti Levi, Univ. of PA, The Wharton Sch., 1341 SH-DH, Philadelphia, PA 19104-6366, moti@opim.wharton.upenn.edu**

We examine the much researched but not solved question of why people cooperate in the prisoners' dilemma. The main reason is the "fallacy of causality." The same subjects would play differently depending upon the payoffs. The reason for the behavior change is due to change in the reasoning used triggered by the change in payoffs.

**SB25 Education II**

**Contributed Session**

**Chair: Qiyang Chen, Montclair State Univ., Dept. of Info. & Dec. Sci., Upper Montclair, NJ 07043, chenq@saturn.montclair.edu**

**1) Knowledge Acquisition in a Tutorial System (R), Qiyang Chen, Montclair State Univ., Dept. of Info. & Dec. Sci., Upper Montclair, NJ 07043, chenq@saturn.montclair.edu, Arun Kumar**

We present an approach for modeling students' domain knowledge in intelligent tutorial systems. A set of associative memories is used to infer students' domain knowledge. This approach can be expected to overcome some inherent problems of the conventional stereotyping approaches in terms of pattern recognition and classification.

**2) A Proposal for In-Context Learning of Quantitative Methods, Melanie L. Lenard, Boston Univ., Sch. of Mgmt., 595 Commonwealth Ave., Boston, MA 02215, mlenard@bu.edu**

Advances in IT can be exploited to provide business students with in-context learning of quantitative methods. Students can be given access to primary data sources and context-sensitive help on relevant methodologies as they tackle real business tasks, e.g., forecasting sales for a new product.

**3) From Technician to Advisors: The CPA in Transition, Paul P. Hoppe, Golden Gate Univ., 536 Mission St., San Francisco, CA 94105, phoppe@aol.com/phoppe@ggu.edu**

Objectives for CPAs in the 21st century include moving and broadening skills from technicians to business advisors. CFOs' relationship with senior management is moving to a more integrative role with firm leadership in producing value. The CPA curriculum must include more understanding of the operations of the firm and its product lines as well as MS, statistics and IT...

**4) Statistics for Engineers, Joe Sachitano, US Military Acad., PO Box 0219, West Point, NY 10097-1779, x85673c4@cadet2.usma.edu**

Factorial analysis allows people to do research without the complications due to tests done on different days and different factors. Our project uses a 2-level factorial analysis and falls under the heading of "design of experiments." Cadets will explain how they learned and applied these concepts using a systems engineering design process unique to USMA.

**SB26 PANEL: Some Perspectives on Queueing Theory**

**Sponsor: INFORMS Applied Probability Section**

**Sponsored Session**

**Chair: U. Narayan Bhat, SMU, Dept. of Statistical Sci., Dallas, TX 75275-0240**

**1) PANEL: Some Perspectives on Queueing Theory, Carl M. Harris, George Mason Univ., Daniel P. Heyman, Belcore, Marcel F. Neuts, Univ. of AZ**

On this 90th anniversary year of the birth of queueing theory, the panel will review its status with reference to its past, present and the future. Each member of the panel has made a mark on its development and is in a unique position to look at the crystal ball.

**SB27 Marketing II**

**Contributed Session**

**Chair: Mika Raulas, Helsinki Sch. of Econ., Runeberginkatu 14-16, Helsinki, 00100, Finland, raulas@hkkk.fi**

**1) Targeting Heuristics for Integrated Marketing Communications, Mika Raulas, Helsinki Sch. of Econ., Runeberginkatu 14-16, Helsinki, 00100, Finland, raulas@hkkk.fi, Ari Vepsäläinen**

Our promotions portfolio model can be used to determine the ways marketers can cost-effectively interact with their customers on a 1-to-1 basis. We demonstrate several heuristics for targeting promotion channels and derive dynamic strategies for managing the risks in marketing communications.

**2) Matching Postponement & Value-Added Strategies with Distribution Structure, Aino J. Inkilainen**, Helsinki Sch. of Econ., Runeberginkatu 14-16, Helsinki, 00100, Finland, inkilain@hkkk.fi, *Ari Vepsalainen*

We assess the feasibility of postponed assembly and value-added logistics services for different distribution channels, including direct and multi-echelon structures with varying degrees of centralization. The heuristic matching method is demonstrated in several case studies.

**3) Growing a Franchise System: Structure & Strategy, Manish Kacker**, PA State Univ., 707M BAB, Smeal Coll., University Park, PA 16803, mxk28@psu.edu, *Anne T. Coughlan*

A multi-period game-theoretical model is solved to obtain equilibrium solutions for strategy and structure decisions faced by a franchisor as it seeks to establish and grow its franchise system over time. Predictions from this model are empirically tested using data collected from a survey of American and Canadian food franchisors.

**4) The Optimal Market-Mix for a Large Canadian Bank, Jean-Francois Larochelle**, GERAD & Ecole Polytech de Montreal, 3000 Cote-Ste-Catherine, Montreal, Quebec, H3T 2A7, Canada, jeanfran@crk.umontreal.ca, *Brunilde Sanso*

For many years, banks have designed their promotional efforts to aim at the broadest market in the hope of recruiting new clients. But with the increasing market segmentation and the number of new products, it is very difficult to find the market mix that presents the best current and future opportunity for profit.

**5) Some Issues for the Globalization of Product Innovation, Binshan Lin**, LA State Univ., Dept. of Mgmt. & Mktg., Shreveport, LA 71115, blin@pilot.lsu.edu

Too often we examine markets on a national rather than on a cultural basis and this limits our ability to formulate appropriate strategies and to detect marketing opportunities. We try to explore the relevance of culture-based value factors and the influence of culture on strategic constructs in a product innovation.

**SB29 Service Management II**  
Contributed Session

**Chair:** Jack C. Hayya, PA State Univ., 303 Beam BAB, University Park, PA 16802, jch@psu.edu

**1) Analysis of Service Measures, Jack C. Hayya**, PA State Univ., 303 Beam BAB, University Park, PA 16802, jch@psu.edu, *Xin X. He, Amy Z. Zeng*

The 3 most popular service measures in research and practice are the probability of stockout in an inventory cycle, the fill rate and the ready rate. We examine these measures under different circumstances and study their use in different industries in order to gain insight into their appropriate application.

**2) Staffing an Inbound Call Center, Zeynep O. Aksin-Karaesmen**, INSEAD, Tech. Mgmt. Area, Blvd. de Constance, Fontainebleau Cedex, 77305, France, aksin@smtp1.insead.fr, *Patrick T. Harker*

We study a staffing problem for inbound call centers with multiple call types. The staffing problem seeks to allocate servers in a call center where performance is determined by its server allocation as well as its telecommunication and IT resources; profit maximization is the objective.

**3) A Labor Scheduling Problem in a Service Industry, Sal R. Agnihotri**, Binghamton Univ., Sch. of Mgmt., Binghamton, NY 13902-6015, agni@binghamton.edu, *Elena Katok*

We address the problem of daily and weekly labor scheduling with work breaks and multiple employee types. We discuss the model formulation and application of the model in a service industry.

**4) Improving Policing Service Quality via New Technologies, Mohan Gopalakrishnan**, Concordia Univ., Dept. DS & MIS, 1455 de Maisonneuve Blvd. W, Montreal, Quebec, H3G 1M8, Canada, mogopal@vax2.concordia.ca, *Kevin Laframboise*

Through the adoption of recently developed crime prevention and detection technologies, police forces from Canada have improved the quality of service. A series of interviews and a search of the literature reveal how the management of these technologies fits with similar policing initiatives elsewhere.

**SB30 PANEL: The Future of Military Operational Analysis**

**Sponsor:** INFORMS Military Applications Society  
Sponsored Session

**Chair:** Eugene P. Visco, Office of the Dep. Undersecretary of the Army for OR, SAUS-OR, Rm. 1E643, The Pentagon, DC 22030, viscoop@hqda.army.mil

**1) PANEL: The Future of Military Operational Analysis, Eugene P. Visco**, Office of the Dep. Undersecretary of the Army for OR, viscoop@hqda.army.mil, *Peter Cherry*, Vector Research Inc.

Resolved: Military Operational Analysis Will Henceforth Be Known as Military Modeling. A discourteous, rambunctious debate - not following the proper, sedate debating rules of the Oxford Union - featuring multiple views of the future of military operational analysis. The present and the direction of military operational analysis is heavily invested in a very large set of digital computer representations of military operations analysis...

**SB31 Mobility Modeling**

**Sponsor:** INFORMS Military Applications Society  
Sponsored Session

**Chair:** Richard E. Rosenthal, Naval Postgrad. Sch., OR Dept., Monterey, CA 93943-5000, rosenthal@nps.navy.mil

**1) Facing Up to Uncertainty in Military Transportation Problems, Sam L. Savage**, Stanford Univ., OR Dept., Terman Eng. Ctr., Stanford, CA 94305, savage@leland.stanford.edu

Because these problems are so complex, it is tempting to approximate uncertain quantities with point estimates; 10 tanks are needed at point A, 2 C5's per hour can get through field B. The inaccuracy wrought by such assumptions may be negligible or devastating depending on the model. Modelers should learn to recognize both extremes.

**2) A Temporal Cascade Approach for Staircase Linear Programs with an Application to Air Force Mobility Optimization, Steven F. Baker**, Naval Postgrad. Sch., OR Dept., Monterey, CA 93943, sbaker@wposmtp.nps.navy.mil

We present a method for approximating and bounding temporal staircase LP. Sequential solution of overlapping subsets of the model's time periods produces a feasible approximation, which is bounded by Lagrangian relaxation. A USAF mobility LP provides a case study.

**3) Selective Transload as a Force Multiplier for Airlift, Tom White**, USAF, HQ Air Mobility Command SAF, 402 Scott Dr., Unit 3L3, Scott AFB, IL 62225-5307, whitetp@hqamc.safb.af.mil

The current paradigm for strategic airlift is single handling of cargo from airport of embarkation of airport of debarkation. Selective use of enroute transloading is investigated with a network simulation. Potential advantages include increases in aircraft utilization and tons delivered, concentration of infrastructure resources and simplification of crew staging.

**SB32 Traffic Management for Integrated Services**

**Sponsor:** INFORMS Technical Section on Telecommunications  
Sponsored Session

**Chair:** Raif Onvural, IBM, 309 Heathridge Ln., Cary, NC 27513, onvural@vnet.ibm.com

**1) Multipoint Route Computation for Delay Sensitive Traffic, Erol Gelenbe**, Duke Univ., Dept. of Elec. & Comp. Eng., Durham, NC 27708-0291, erol@ee.kuke.edu, *Anoop Ghanwani*

High speed networks such as the B-ISDN are expected to provide an integrated transport mechanism for diverse traffic types having different quality of service requirements. It is therefore necessary to develop efficient route computation algorithms which recognize and account for these requirements. We focus on multipoint routing for traffic which needs end-to-end delay guarantees...

**2) A Method for Estimating End-to-End Delays in ATM Networks, Sridhar Seshadri**, NYU, 1 Washington Sq. Village, Apt. 15, New York, NY 10012, *Vijay Srinivasan*

We propose a method for obtaining the first 2 moments of delay in ATM networks which can then be used to provide soft delay guarantees. The bounds are based on a scheduling rule called fair processor sharing, FPS. To obtain these bounds, we show that under a FPS, a multiclass open queueing network can be decomposed into a collection of tandem queues.

**3) Buffer Management Policies in Shared Buffer ATM Switches, Ioannis Viniotis**, NC State Univ., candice@eos.ncsu.edu

Buffer management is critical in shared buffer ATM switch architectures. We investigate control policies for such architectures. For a 2x2 switch, a static threshold type buffer management policy is shown to optimize cell loss measures, under D-MAP traffic models. The policy is described in terms of tabu probabilities...

**4) Practical Issues in Meeting the QoS Demands of Applications in High Speed Networks, Raif Onvural**, IBM, 309 Heathridge Ln.,

Cary, NC 27513, onvural@vnet.ibm.com

There are various architectural proposals to address the service requirements of applications with different traffic and QoS characteristics in an integrated network. We will discuss the implementation issues associated with different scheduling algorithms.

### SB34 Conceptual Aspects of Decision Aid

Cluster: Choice Engineering

Invited Session

Chair: Philippe G. H. Vincke, Univ. Libre de Bruxelles, Service de Math. de la Gestion, Boulevard du Triomphe, Brussels, 1050, Belgium, pvincke@ulb.ac.be

1) **A General Framework for the Aggregation of Preferences**, *Marc Pirlot*, Fac. Polytech. de Mons, Dept. of Math. & OR, Rue de Houdain, Mons, B-7000, Belgium, pirlot@mathro.fpms.ac.be, *Denis Bouyssou*

We propose an axiomatized model which encompasses most preference aggregation rules (weighted sum, majority, maxmin, ...); in such a framework, the standard opposition of compensatory vs. non-compensatory methods can be analyzed and it can be shown that the transition from purely compensatory to purely non-compensatory methods is gradual.

2) **On the Generalization of the Concordance-Discordance Principle in MCDA**, *Alexis Tsoukias*, Univ. de Paris Dauphine, LAMSADE- CNRS, Place Marechal de Lattre, Paris Cedex 16, F 75775, France, tsoukias@lamsade.dauphine.fr

The concept of concordance and discordance has been introduced in MCDA to capture the difference between positive reasons supporting a decision and negative reasons against it. We present a formalism giving a theoretical foundation for such a concept and a generalization which can be applied to preference modeling and/or aggregation.

3) **What Are Robust Conclusions in Decision-Aid?**, *Philippe G. H. Vincke*, Univ. Libre de Bruxelles, Service de Math. de la Gestion, Boulevard du Triomphe, Brussels, 1050, Belgium, pvincke@ulb.ac.be

Decision-aid procedures are inevitably based on the choice of more or less subjective and imprecise parameters and of more or less arbitrary manipulations of the data. It is therefore important to determine what robust conclusions are. We propose a theoretical framework for this question.

### SB37 George E. Nicholson Student Paper Prize Competition II

Prize Session

Chair: Jeffrey I. McGill, Queen's Univ., Sch. of Bus., Kingston, Ontario, K7L 3N6, Canada

1) **George E. Nicholson Student Paper Prize Competition II**, *Jeffrey I. McGill*, Queen's Univ., Sch. of Bus., Kingston, Ontario, K7L 3N6, Canada

This session features selected finalists in the Nicholson Student Paper Prize Competition. It represents an opportunity for the faculty, professionals and especially other students to see some of the best research being performed by students. Everyone is welcome to attend.

## Sunday 13:00-14:30

### SC04 Optimization & Decision Analysis at Sandia

Cluster: Public Sector Applications

Sponsor: INFORMS Section on Public Programs & Processes

Sponsor/Invited Session

Chair: Laura A. Painton, Sandia Ntl. Lab., MS 0746, Albuquerque, NM 87185, lapaint@somnet.sandia.gov

1) **A Survey of Optimization Research at Sandia National Labs**, *William Hart*, Sandia Ntl. Lab., Dept. 6613, MS 0746, Albuquerque, NM 87185, wehart@cs.sandia.gov

We present an overview of optimization research at Sandia National Laboratories. We describe a variety of application areas in which optimization is actively being applied, including engineering sciences, risk and reliability and agile manufacturing. We also outline Sandia's algorithmic research in optimization in the areas of NLP, global optimization and combinatorial optimization.

2) **Optimization Under Uncertainty: Shifting of Maximum Vulnerability Point Due to Uncertain Failure Thresholds**, *Vicente Romero*, Sandia Ntl. Lab., Dept. 6613, MS 0746, Albuquerque, NM

87185, *Laura A. Painton, Michael Eldred*

Optimization is used in conjunction with a nonlinear 3-D finite element thermal model to find the heating configuration that most threatens safety-critical components in a fire. Uncertain component failure criteria leads to a "fuzzy" objective function which affects the optimal solution, depending upon how handled.

3) **New Technology Investment Strategies to Defeat Terrorist Nuclear Attacks: A Case Study in Applying Decision Analysis Techniques**, *Roger Cox*, Sandia Ntl. Lab., Dept. 6613, MS 0746, Albuquerque, NM 87185, *Ryan Stone, William A. Wallace*

We present a decision aid for investment decision making for DoE's Nuclear Energy Search Team. The model embedded in the aid has 2 parts: a pre-processor which utilizes IP and genetic heuristics to narrow the selection to a set of feasible, non-dominated, "good" portfolios; and a human-machine interface in MS Excel where the user can set a variety of ranges on the objectives...

4) **Reliability Analysis & Optimization in System Evaluation**, *Laura A. Painton*, Sandia Ntl. Lab., MS 0746, Albuquerque, NM 87185, lapaint@somnet.sandia.gov

We present a variety of system reliability modeling activities at Sandia. Methods used include fault trees, uncertainty analysis, math programming and GAs. Applications of our work have been mainly industrial and include reliability analysis of semiconductor manufacturing equipment, electronics, medical equipment, machine tools and automobile emissions diagnostics.

### SC05 Approximation by LP

Cluster: Linear Programming

Invited Session

Chair: Rakesh Vohra, OH State Univ., Fisher Coll. of Bus., Haggerty Hall, 1775 College Rd, Columbus, OH 43210, vohra.1@osu.edu

1) **LP-Based Performance Bounds in Deterministic & Stochastic Scheduling**, *Andreas S. Schulz*, Tech. Univ. at Berlin, Fachbereich Mathematik, MA6-1, Strasse des 17. Juni 136, Berlin, D-10623, Germany, schulz@math.tu-berlin.de

For quite a few stochastic and deterministic scheduling problems, we present linear inequalities that the feasible regions satisfy. We analyze the quality of these relaxations and show how optimal LP-solutions (which are often achieved by a combinatorial algorithm) can be used to design the best approximation algorithms in several settings.

2) **Approximate DP & Facility Location**, *Rakesh Vohra*, OH State Univ., Fisher Coll. of Bus., Haggerty Hall, 1775 College Rd, Columbus, OH 43210, vohra.1@osu.edu, *Dimitris Bertsimas, C. P. Teo*

Many combinatorial optimization problems can be expressed as DPs. This reformulation proves impractical for most problems. What if one were to solve the DP approximately? We propose a method for approximating DPs. While it can be applied to any problem, we focus on its application to location problems. We provide analytical and computational evidence to suggest that the solutions returned by the method are close to optimal.

3) **Geometry of Fractional Stable Matchings & Its Applications**, *C. P. Teo*, MIT, OR Ctr., Cambridge, MA 02139, *V. S. Jayachandran*

We study the classic stable marriage and stable roommates problems using a polyhedral approach. We propose a new LP formulation for the stable roommates problem, which is non-empty if and only if the underlying roommates problem has a stable matching. Furthermore, for certain special weight functions on the edges, we construct a 2-approximation algorithm for the optimal stable roommates problem...

### SC06 Integer Programming

Cluster: Combinatorial Optimization

Invited Session

Chair: Hanif D. Sherali, VA Polytech. Inst. & State Univ., Dept. of Ind. & Systems Eng., Blacksburg, VA 24061-0118, hanifs@vt.edu

1) **Solving Asset Packaging Problems**, *E. Andrew Boyd*, TX A&M Univ., Dept. of IE, College Station, TX 77843-3131, boyd@marvin.tamu.edu, *Vincent Li*

Asset packaging problems consist of optimally grouping assets into packages that can be assigned to complete a collection of specific tasks. An integer programming formulation is presented, problem specific devices for solving large problem instances are discussed and computational results presented.

**2) Robust Planning in the Transportation Industry: Models & Algorithms, Cynthia Barnhart, MIT, Ctr. for Transport. Studies, Rm. 1-229, Cambridge, MA 02139, cbarnhar@mit.edu, Francisco Jauffred**

We consider the problem of developing planning tools for carriers in the transportation industry. Our objective is to develop robust plans, that is, plans that have a high probability of being executed. We describe our modeling and algorithmic approach to this problem and analyze our results.

**3) Tightening the Formulation of the Precedence Constrained Asymmetric Traveling Salesman Problem, Patrick J. Driscoll, US Military Acad., Dept. of Math. Sci., West Point, NY 10996, driscoll@euler.math.usma.edu, Hanif D. Sherali**

We apply the special structure reformulation-linearization technique of Sherali, Adams & Driscoll (1995) to the class of ATSP with precedence constraints to produce significantly tighter LP relaxations. Results for test problems obtained from the TSPLIB are also presented to demonstrate the computational effectiveness of this approach.

**4) A Hierarchy of Semidefinite Relaxations & Convex Nonlinear Valid Inequalities for Mixed 0-1 Convex Programming, Robert A. Stubbs, Northwestern Univ., Apt. 102, Naperville, IL 60563-0105, Sanjay Mehrotra**

A hierarchy of semidefinite relaxations for mixed 0-1 convex programs is presented. In addition, it is shown that separation problems can be solved over these higher dimensional semidefinite relaxations to compute convex nonlinear valid inequalities in the original space. Computational results of a lift-and-project cutting plane method that utilizes these cuts are presented.

**SC07 Variational Problems**

**Cluster: Nonlinear Programming  
Invited Session**

**Chair: Jong-Shi Pang, Johns Hopkins Univ., Dept. of Math. Sci., Baltimore, MD 21218-2689, jsp@vicp1.mts.jhu.edu**

**1) An Incremental Path Loading Method for Solving Network Equilibrium Problems, Thomas L. Magnanti, MIT, OR Ctr., Rm. E40-147, Cambridge, MA 02139-4307, magnanti@mit.edu, Georgia Perakis**

We examine an incremental path loading method for solving network equilibrium problems. Our procedure progressively generates a set of used network paths by incrementally loading demand onto a new path and the previously generated paths. We also study a variant of the method which incorporates a binary search procedure.

**2) Error Bounds for Nondifferentiable Convex Inequalities Under a Strong Slater Constraint Qualification, Olvi L. Mangasarian, Univ. of WI, Comp. Sci. Dept., 1210 W Dayton St., Madison, WI 53706-1685, olvi@cs.wisc.edu**

Simple global error bounds are given on relative and absolute distances between an arbitrary point and its projection on a convex set determined by convex inequalities. The relative bound is very simple and requires only the Slater CQ while the absolute bound requires only modest strengthening of this CQ.

**3) A New Algorithm for Mixed Complementarity Problems, Christian Kanzow, Univ. of Hamburg, Inst. of Appl. Math., Bundesstrasse 55, Hamburg, D-20146, Germany, kanzow@math.uni-hamburg.de**

We present a new algorithm for the solution of mixed complementarity problems which is a modification of the so-called SEMISMOOTH method. Due to these modifications, we are able to establish both stronger local and stronger global convergence results than the SEMISMOOTH. We also report some numerical results.

**4) Search Directions & Infeasible Path-Following Methods for the Monotone Semi-Definite LCP, Paul Tseng, Univ. of WA, Dept. of Math., GN-50, Box 354350, Seattle, WA 98195, tseng@math.washington.edu**

We study the existence and uniqueness of search directions for and the global and local convergence rate of some infeasible (predictor-corrector) path-following methods for the monotone LCP defined over the space of symmetric block-diagonal positive semi-definite matrices.

**SC08 Integer Programming by Branch & Cut I**

**Cluster: Integer Programming  
Invited Session**

**Chair: Manfred Padberg, NYU, Stern Sch. of Bus., 44 W 4th St., Ste. MEC 8-68, New York, NY 10012-1126, mpadberg@rd.stern.nyu.edu**

**1) Experiments with Cutting Plane & Column Generation Algorithms, Stefan Thienel, Univ. zu Koeln, Inst. fuer Informatik, Pohlstr. 1, Koeln, 50969, Germany, thienel@informatik.uni-koeln.de**

Cutting plane and column generation algorithms embedded in a B&B framework are a powerful tool for solving hard integer and combinatorial optimization problems. We present new results obtained with the B&C framework ABACUS.

**2) Exact Solutions for the Betweenness Problem for Mapping Genes, Gerhard Reinelt, Univ. of Heidelberg, Interdisc. Ctr. Sci. Computing, Im Neuenheimer Feld 368, Heidelberg, D-69120, Germany, gerhard.reinelt@iwr.uni-heidelberg.de, Thomas Christof, Michael Juenger, John Kecocioglu, Petra Mutzel**

We consider the problem of constructing physical maps on the target DNA from hybridization data between unique probes and clones of genomic fragments under the assumption of errors. The problem of constructing a total order of the probes such that the number of errors is minimized turns out to be a linear ordering problem with additional betweenness constraints...

**3) Exact Solution of the Ground State of the Ising Spin Glasses By Branch & Cut, Giovanni Rinaldi, IASI - CNR, Viale Manzoni 30, Rome, 00185, Italy, rinaldi@iasi.rm.cnr.it**

The ground state of Ising spin glasses can be computed exactly by finding a maximum weight cut in a weighted graph. Since for most of the relevant instances of this combinatorial optimization problem, no polynomial time algorithm is known, in the statistical physics literature, the ground state is commonly computed approximately, using heuristic algorithms. We describe a B&C algorithm...

**SC09 Scheduling in Computer & Manufacturing Systems**

**Cluster: Scheduling  
Invited Session**

**Chair: Jacek Blazewicz, Inst. Informatyki Politech. Poznanska, ul. Piotrowo 3A, Poznan, 60-695, Poland, blazewic@poczni.v.tup.edu.pl**

**1) Scheduling Tasks & Vehicles in the Multistage FMS, Jacek Blazewicz, Inst. Informatyki Politech. Poznanska, ul. Piotrowo 3A, Poznan, 60-695, Poland, blazewic@poczni.v.tup.edu.pl, Gerd Finke, Grzegorz Pawlak**

A problem of scheduling tasks in the multistage cyclic FMS is studied. A transportation delay of AGV is taken into account. Algorithms for minimizing schedule length for different subcases are discussed.

**2) Parallel Machine Scheduling with Additional Continuous Resource: Mean Completion Time Results, Jan Weglarz, Poznan Univ. of Tech., Inst. of Comp. Sci., ul. Piotrowo 3A, Poznan, 60-965, Poland, Joanna Jozefowska**

Problems of scheduling independent, nonpreemptable jobs on identical parallel machines are studied when each job additionally requires a continuous resource from a given interval for its processing. Properties of optimal schedules are studied for the mean completion time as optimization criterion.

**3) Machine Grouping in Cellular Manufacturing, Erwin Pesch, Univ. Bonn, Inst. Gesellschaft/Wirtschaft, Adenauerallee 24-42, Bonn, 53113, Germany, e.pesch@uni-bonn.de**

A new method of machine grouping and part type selection in FM is introduced. The objective of workload balancing is combined with a new measure of similarity which depends on the current machine groups. The number and size of the groups are considered as decision variables.

**4) Scheduling on Semi-Identical Processors, Guenter J. Schmidt, Univ. of Saarland, Info. & Tech. Mgmt. Dept., Postfach 151150, Saarbruecken, D-66041, Germany, Eric Sanlaville**

We will discuss the problem of scheduling independent tasks on parallel processors which are working with the same speed but in different intervals of availability (profile scheduling). We will investigate performance measure related to flow time, lateness and tardiness and present polynomial algorithms.

**SC10 Production Scheduling III**

**Contributed Session**

**Chair: Scott W. Hadley, Numetrix Ltd., 655 Bay St., Ste. 1200, Toronto, Ontario, M5G 2K4, Canada, scoth@tor.numetrix.com**

**1) Vertically Integrated Production Planning & Scheduling, Scott W. Hadley, Numetrix Ltd., 655 Bay St., Ste. 1200, Toronto, Ontario, M5G 2K4, Canada, scoth@tor.numetrix.com, Edward Sitarski**

Significant cost savings can be achieved by intelligently integrating planning and scheduling systems. The planning level can emphasize cost optimization on an enterprise-wide basis. The planner allocates production targets to the lower level (usually single facility) scheduler which addresses operational feasibility. We discuss one commercially available planning and scheduling solution.

**2) Coordination of Production/Distribution with Unbalanced Leadtimes, Julien D. Bramel, Columbia Univ., Columbia Bus. Sch., 406 Uris Hall, New York, NY 10027, jbramel@groucho.gsb.columbia.edu, Shobhna Goyal, Paul H. Zipkin**

We investigate multi-product multi-location production/distribution networks with deterministic stationary demands. When general leadtimes are assumed, scheduling the reorder intervals becomes a non-trivial problem. We discuss effective heuristics with good worst-case performance bounds.

**3) Production Rescheduling: A Review, Can Akkan, Koc Univ., Cayir Cad No. 5, Istinye, Istanbul, 80860, Turkey, cakkan@ku.edu.tr**

The problem of production rescheduling, with approaches by 2 schools of thought, OR and AI, is reviewed. The main issues, identified as evaluation criteria, events triggering rescheduling, limiting disruption (ripple effect), rescheduling strategies and tactics, are discussed. The limitations of the research reviewed and potential areas for future research are put forward.

**4) Heuristic Search in Steel Ingot Processing, Bajis M. Dodin, Univ. of CA, Anderson Grad. Sch. of Mgmt., Riverside, CA 92521-0203, bajis.dodin@uck.edu, Erik Rolland**

Steel ingot processing is known to be a complex process. It involves heavy machinery requiring large capital investment. Consequently, utilization of each segment of the process is very important. Uniform and high utilization of all segments increase the throughput, saves energy and reduces the cycle time of the products...

## SC12 Neural Networks I

Sponsor: INFORMS CSTS

Sponsored Session

Chair: Bruce L. Golden, Univ. of MD, Coll. of Bus. & Mgmt., College Park, MD 20742, bgolden@umdacc.umd.edu

**1) Performance Assessment of Classifiers in Neural Network Models, Thomas J. Downey, Partek Inc., 5988 Mid Rivers Mall Dr., St. Charles, MO 63304, Rumi Kato Price, D. J. Meyer, Edward L. Spitznagel**

We show how ROC analysis is applied to neural models and demonstrate its utility in the diagnosis of psychiatric illness. Benefits of this approach include a more robust description of the network's predictive ability to tune the trained network using differential costs of misclassification.

**2) A Quasi-Parallel Tabu Search Approach, Patrick Soriano, Ecole des HEC & CRT, Univ. of Montreal, Montreal, Quebec, H3C 3J7, Canada, Michel Gendreau**

We present a TS heuristic with a variable number of parallel search threads for sequential computers. Only 1 thread is activated at a time; threads are terminated and cloned on the basis of fitness and diversity, reminiscent of GAs. The method is applied to the maximum clique problem.

**3) Modeling First-Day Returns of Initial Public Offerings with Neural Networks, Steven J. Robertson, Price Waterhouse LLP, 1616 N Ft. Myer Dr., Arlington, VA 22209, Bruce L. Golden, George C. Runger, Edward A. Wasil, Kathleen Hanley**

We construct effective neural network models that predict first-day returns of IPOs. Our data set consists of the first-day returns for 1,075 firms and information that we gathered on 16 predictor variables. We segment the data set and construct 3 models for each segment.

## SC13 Hybrids of Heuristic Techniques with Artificial Intelligence for Combinatorial Optimization

Sponsor: INFORMS CSTS

Sponsored Session

Chair: Raymond A. Patterson, Univ. of TX, Sch. of Mgmt., PO Box 830688, MS J043, Richardson, TX 75083-0688, rpatters@utdallas.edu

**1) Linkages Between GIS & Combinatorial Optimization, Rakesh Gupta, OK State Univ., Telecommunications Mgmt., Dept. of Mgmt. 343 Bus. Bldg., Stillwater, OK 74078, rgupta@magnus.acs.ohio-state.edu, Erik Rolland**

GISs derive some of their problem solving power from engaging combinatorial optimization algorithms to find real-time solutions to large and complex spatial location problems. Proper visualization of the problem data and solutions

promotes a glass box rather than a black box view of combinatorial problem solving.

**2) Heuristic Algorithms Hybridized with Memory Functions for the Capacitated Minimum Spanning Tree, Erik Rolland, Univ. of CA, Anderson Grad. Sch. of Mgmt., Riverside, CA 92521-0203, erik.rolland@uck.edu, Raymond A. Patterson, Hasan Pirkul**

The Esau-Williams solution technique is combined with memory functions, i.e., TS, which typically finds better solutions than found with other published techniques for solving the capacitated minimum spanning tree problem. Memory functions include remembering which choices to prohibit as well as which choices should not be prohibited.

**3) Building Heuristic Algorithms into Neural Network Topologies for the Capacitated Minimum Spanning Tree Problem, Raymond A. Patterson, Univ. of TX, Sch. of Mgmt., PO Box 830688, MS J043, Richardson, TX 75083-0688, rpatters@utdallas.edu, Hasan Pirkul**

Heuristic algorithms for the capacitated minimum spanning tree problem are integrated into the topological design of the neural network. This design change jump-starts the neural network solution with the knowledge contained in the heuristic technique. Neural network improvements beyond the integrated heuristic are then made.

## SC14 Materials Management

Contributed Session

Chair: Gary W. Clendenen, 3800 Cameron Ave., Tyler, TX 75701

**1) No Title Supplied, Gary W. Clendenen, 3800 Cameron Ave., Tyler, TX 75701**

Fundamental features of MRP and kanban are modeled using a nonlinear feedback production rule based on the restoration concept. The model is applied to a specific manufacturing network and conclusions are drawn regarding optimal levels of both inventory and safety stock. Results are compared to a global optimal solution.

**2) Simulation Modeling, Jason Mrochek, US Military Acad., PO Box 2557, West Point, NY 10996-1779, x74415f2@cadet1.usma.edu**

The Army's supply system is a very complex system involving a continuous stream of requests for material and resupply of material. To manage this system is a huge task. This study simulates the requests and distribution of Class IX material (spare parts) and petroleum, oil and lubricants using the software ProModel.

**3) On the Variance of Three-Stage Two-Buffer Transfer Lines, Cemal M. Dincer, Bilkent Univ., Dept. of IE, Ankara, 06533, Turkey, dincer@bilkent.edu.tr, Bahar Deler**

Research done on the performance of the production lines is limited only to the first moment of the measures and it is sparse, especially concerning the variance. We propose an approach to estimate both the mean and the variance of the throughput for 3-stage finite buffer transfer lines. We provide computational comparisons of the suggested approach and other approaches to the problem.

## SC15 Production Control of Manufacturing Systems

Cluster: Production Control with Uncertainty

Invited Session

Chair: James R. Perkins, Boston Univ., Dept. of ME, 15 St. Mary's St., Boston, MA 02215, perkins@bu.edu

**1) Hedging Policies for Machines with Non-Exponential Downtime Distributions, R. Srikant, Univ. of IL, Coordinated Sci. Lab., Dept. of General Eng., Urbana, IL 61801, rsrikant@uiuc.edu, James R. Perkins**

We derive optimal hedging policies for failure-prone machines with non-exponential downtime distributions. Explicit expressions for the hedging point are obtained when the downtimes are either Erlang-distributed or deterministic. We also show that the conditions for the optimality of JIT depend on the downtime distribution only through the mean.

**2) Adaptive Control of Some Stochastic Manufacturing Systems, Bozenna Pasik-Duncan, Univ. of KS, Math. Dept., Lawrence, KS 66045, bozenna@kuhub.cc.ukans.edu**

The adaptive production planning of failure-prone manufacturing systems is considered. In real manufacturing systems, product demand is usually not known a priori. One major task in production scheduling is to estimate and predict the demand. An algorithm is given to define a family of estimates for unknown demand processes. Based on this family of estimates, adaptive controls are constructed which are shown to be asymptotically optimal.

**3) Enforcing Liveness in Petri Net Models of Manufacturing Systems via Hierarchical Supervisory Policies, Rama Sreenivas,** Univ. of IL, Coordinated Sci. Lab., Dept. of General Eng., Urbana, IL 61801, sree@deds.csl.uiuc.edu

We consider hierarchical petri net models of manufacturing systems where a transition at a particular level of the hierarchy could represent an entire subnet in an immediately lower level. We derive necessary and sufficient conditions for the existence of a hierarchical supervisor policy that enforces liveness in such models.

**4) How Good are Corridor Policies, Carlos Humes, Jr.,** Univ. of Sao Paulo, Comp. Sci. Dept., Inst. of Math & Stats., Sao Paulo, Brazil, humes@ime.usp.br

We discuss the performance of linear corridor policies in the case of separable average criteria. Alternate policies are discussed as well as the impact of the results in the hierarchical approach.

## SC16 Global Networked Entrepreneurship

Sponsor: INFORMS Section on Technology Management

Sponsored Session

Chair: David Gibson, Univ. of TX, IC2 Inst., 2815 San Gabriel, Austin, TX 78705, davidg@icc.utexas.edu

**1) Implementing the National Oceanic & Atmospheric Administration's Center for Technology Innovation, Earle N. Buckley,** Coastal Technology Services, NOAA, 1990 Hobson Ave., Charleston, SC, ebuckley@csc.noaa.gov

The NOAA is implementing a Center for Technology Innovation in Charleston, SC. We discuss the challenges to designing and implementing CTI to facilitate the spinning technologies into and out-of NOAA and the Charleston area such as setting up a locally-based venture fund, acquiring appropriate technologies and going global.

**2) Linking the Instituto Superior Tecnico Globally Through Technology Innovation, Manuel V. Heitor,** Inst. Superior Tecnico, Av. Rovisco Pais, Lisboa, 1096, Portugal, mheitor@termcomb.istul.pt, **Pedro Concelcao**

The IST, Lisbon, Portugal is implementing a Leaders In Engineering Masters Course which focuses on results-oriented engineering and technology commercialization through its affiliated technology innovation center. One topic of presentation will be the IST sponsored Management, Assessment, Commercialization, Application and Organization of Science and Technology Conference to be held in Macau, China, July 2-4, 1997.

**3) Polo International & Global Software Marketing, Mark Pinheiro,** Polo International-Austin, 3925 W Braker Ln., Ste. 409, Austin, TX 78759-5321, mark@polo.austin.com

Polo International is a software development company located in Curitiba, Brazil. They have assigned a Brazilian representative to the Austin Technology Incubator, Austin, Texas and a US marketing expert to a new software park in Curitiba. This presentation focuses on implementing these global linkages to the benefit of small software enterprises with niche markets.

**4) The Challenges to Implementing a Technology Transfer & Innovation Center in Izmaylovo Science Park, Moscow, Nikolay Rogalev,** Moscow Power & Eng. Inst., Krasnokazarmennaya St. 14, Moscow, E-250, Russia 111250, chief@izmaylovo.msk.su, **Alexey Kapsky**

In 1993, Moscow Power Engineering Institute initiated a Technology Transfer and Innovation Center in Izmaylovo Science Park, Moscow. Primary challenges have been locating capital and developing business know-how and entrepreneurial talent and linking these resources with available technology at research universities and institutes. We discuss creative and innovative ways these challenges have been mitigated.

## SC17 Operations Management III

Contributed Session

Chair: Theodore D. Klastorin, Univ. of WA, Dept. of MS, Box 353200, Seattle, WA 98195-3200, tedk@u.washington.edu

**1) Stochastic Scheduling with Weather Interruptions, Mark Cutler,** Univ. of WA, Dept. of MS, Box 353200, Seattle, WA 98195-3200, mcutler@u.washington.edu, **Theodore D. Klastorin**

We analyze a single phase queueing system to determine optimal scheduling rules which minimize the sum of earliness and lateness costs. At random intervals, weather may disrupt service, although arrivals continue. We compare the results of our models with real-world and simulation data.

**2) Component Commonality: Costs & Benefits in the Long Run,**

**Mark S. Hillier,** Univ. of WA, Dept. of MS, Box 353200, Seattle, WA 98195, mhillier@u.washington.edu

A dynamic programming model with normal demand distributions for the final products will be used to show that replacing unique components with more expensive common components is more costly in the long run, despite risk-pooling benefits.

**3) Forecasting & Inventory Management for PC Manufacturers Using Retail Sales Channel, Nikhil T. Jain,** Univ. of TX, Dept. of Mgmt., Austin, TX 78712, nikhil@uts.cc.utexas.edu, **Hirofumi Matsuo**

Orders placed by retailers are seen as demand by PC manufacturers using retail sales channel. Retailers' orders distort the demand pattern of the final customers. We characterize the demand pattern and inventory policy of these manufacturers and compare inventory-related costs with the case when a direct sales channel is used.

**4) Component Commonalization: An Engineering Design Perspective, Therani N. Madhusudan,** Carnegie Mellon Univ., Grad. Sch. of IA, 5000 Forbes Ave., Pittsburgh, PA 15213, madhu@cs.cmu.edu, **Dajun Zeng**

For a given engineering design problem, selection from a variety of feasible designs is based on economic evaluations considering supplier characteristics such as cost, lead-time and demand variations. Further, multiple design alternatives may be selected based on establishing common components across products with ensuing economic benefits.

## SC18 TUTORIAL: Entropy Optimization & Mathematical Programming

Invited Session

Chair: S.-C. Fang, NC State Univ., OR Dept., PO Box 7913, Raleigh, NC 27695-7913

**1) TUTORIAL: Entropy Optimization & Mathematical Programming, S.-C. Fang,** NC State Univ., OR Dept., PO Box 7913, Raleigh, NC 27695-7913, **Jay R. Rajasekera, H.-S. J. Tsao**

Although the word "entropy" has been around since 1865 in the literature of physics, it gained wider publicity with the work of Shannon's Information Theory in 1948. Later, Jaynes proposed the Principle of Maximum Entropy and inspired its application to many areas, including management, finance, transportation, urban planning, OR and statistics.

## SC20 Route Guidance in Urban Traffic Networks

Sponsor: INFORMS Transportation Science Section

Sponsored Session

Chair: Hani S. Mahmassani, Univ. of TX, Dept. of Civil Eng., Austin, TX 78712

**1) Path Comparisons for A Priori & Time-Adaptive Route Selection in Stochastic, Time-Dependent Networks, Elise D. Miller-Hooks,** Univ. of TX, Dept. of Civil Eng., Austin, TX 78758, **Hani S. Mahmassani**

Travel times in congested transportation networks are time-varying and uncertain quantities. In such networks, 1 or more pareto-optimal least time paths may exist. Conditions for determining Pareto-optimality for both a priori and time-adaptive route selection in stochastic, time-dependent networks are presented. These form the basis for search procedures to identify such paths.

**2) On-Line Route Guidance Through Feedback Control in Congested Traffic Networks with Multiple Information Sources, Srinivas Peeta,** Purdue Univ., Sch. of Civil Eng., W Lafayette, IN 47907-1284, **Srinivas Bulusu**

We propose a feedback control model for on-line route guidance/advisory in congested traffic networks with multiple information sources under ATMIS. Motivated by on-line consistency and control issues, our objective is to achieve optimal system performance while ensuring consistency between information provision and behavior of equipped and non-equipped users...

**3) Real-Time Dynamic Route Guidance: Robustness of Predictive & Reactive Strategies Under Stochastic Demands, Yaser Hawas,** Univ. of TX, Dept. of Civil Eng., Austin, TX 78712, **Hani S. Mahmassani**

Two strategies for real-time route guidance of equipped motorists in a congested traffic network are compared in terms of effectiveness and robustness under stochastic O-D demands. The first consists of a global system optimal assignment algorithm implemented in a rolling horizon-framework with predicted O-D demands. The second consists of simpler locally-oriented strategies that react to measured conditions...

**SC21 Revenue Management Forecasting & Optimization Issues**

**Cluster:** Aviation Applications  
**Invited Session**

**Chair:** Larry R. Weatherford, Univ. of WY, Coll. of Bus., PO Box 3275, Laramie, WY 82071-3275, lrw@uwyo.edu

1) **A Review of Optimization Modeling Assumptions in Perishable-Asset Revenue Management Situations**, *Larry R. Weatherford*, Univ. of WY, Coll. of Bus., PO Box 3275, Laramie, WY 82071-3275, lrw@uwyo.edu

Three common assumptions that drive most airline seat optimization models are reviewed. We test 3 scenarios: fares are random as opposed to deterministic, demand forecasts are misestimated either high or low and average fares by fare class are misestimated. Revenue impacts of each scenario are reported.

2) **Bid Price Control: Asymptotic Theory & Practical Insights**, *Garrett J. van Ryzin*, Columbia Univ., Grad. Sch. of Business, 412 Uris Hall, New York, NY 10027, gvanryzi@research.gsb.columbia.edu, *Kalyan Talluri*

We present details on an asymptotic analysis of bid price controls. The analysis supports the near-optimality of a bid price policy, yields several practical insights into the behavior of bid price controls and suggests a new class of computational approaches.

3) **Competitive Impacts of Origin-Destination Control**, *Peter P. Belobaba*, MIT, 77 Mass. Ave., Room 33-215, Cambridge, MA 02139, belobaba@mit.edu, *Craig A. Hopperstad*

We use the passenger O-D simulator to evaluate the revenue impacts of O-D seat inventory control in a hypothetical network with 2 competing airlines. While our findings confirm that certain O-D methods can increase revenues for the implementing airline, they can also create unexpected revenue gains for the competitor.

4) **A Bootstrap Test for Correlation Between Demands in Different Fare Classes**, *Jeffrey I. McGill*, Queen's Univ., Sch. of Bus., Kingston, Ontario, K7L 3N6, Canada

Passenger demand data for transportation services are usually "censored" by the presence of booking limits. While it is possible to fit demand models to such data, it is difficult to obtain exact tests for such parameters as the correlation between demands. We discuss a bootstrapping approach to this problem.

**SC22 Marketing - Manufacturing Coordination**

**Sponsor:** INFORMS Section on Manufacturing & Service Operations Management  
**Sponsored Session**

**Chair:** Teck H. Ho, UCLA, Anderson Grad. Sch. of Mgmt., 110 Westwood Plaza, Los Angeles, CA 90095-1481, teho@anderson.ucla.edu

1) **Coordination Mechanisms in Decentralized Supply Chains**, *Fangruo Chen*, Columbia Univ., Columbia Bus. Sch., Uris Hall, New York, NY 10027, *Awil Federgruen*, *Yu-Sheng Zheng*

A manufacturer produces 1 product and sells it to independent retailers. The manufacturer determines the wholesale price and the production plan, while the retailers are responsible for replenishing their inventories and setting retail prices. We show how the manufacturer and retailers can cooperate to maximize the channel profit.

2) **Managing the Manufacturing/Marketing Fault Zones**, *Warren H. Hausman*, Stanford Univ., IE-EM Dept., Stanford, CA 94305-4024, *David B. Montgomery*, *Aleda V. Roth*

We study manufacturing/marketing conflict and its impact on profitability, competitive position and morale. The model is estimated on 1 data set and validated on an independent data set.

3) **On the Implication of Using Past Sales or Customer Satisfaction Surveys to Allocate Scarce Capacity to Dealers**, *Gerard Cachon*, Duke Univ., Fuqua Sch. of Bus., Box 90120, Durham, NC 27708-0120, *Martin Lariviere*

When capacity is scarce for hot selling models, auto manufacturers must determine how to allocate available production to dealers. In turn-and-earn systems, used by almost all manufacturers, cars are allocated based on past sales. Recently, manufacturers have begun to use a customer satisfaction-based allocation scheme. We compare supply chain, manufacturer and dealer profits under the different systems.

**SC23 The Design & Control of Furniture Manufacturing Systems**

**Cluster:** Manufacturing & Service Management  
**Invited Session**

**Chair:** Christopher R. Houck, NC State Univ., Dept. of IE, Box 7906, Raleigh, NC 27695

**Co-Chair:** Jeffrey A. Joines

1) **Improved Forecasting to Support Demand Activated Furniture Manufacturing**, *Rahul H. Patel*, NC State Univ., Dept. of IE, Box 7906, Raleigh, NC 27695, *Russell E. King*, *Thom J. Hodgson*

In the furniture industry, product life cycles are decreasing and competition is increasing. Due to the production lead times, in order to be competitive, companies must better match inventories to demand. We present an innovative forecasting tool that takes advantage of initial market demand and related historical data.

2) **A Scheduling Procedure to Satisfy Due-Dates in Large Job Shops**, *Andrew Zozom, Jr.*, NC State Univ., Dept. of IE, Box 7906, Raleigh, NC 27695, ajzozon@eos.ncsu.edu, *Alexander J. Weintraub*, *Denis Cormier*, *Thom J. Hodgson*

Using recursive real-time simulation, optimal (or near-optimal) sequencing of jobs on machines is determined for a large multi-machine job shop scheduling problem where the objective is to minimize Lmax. The procedure ensures maximum utilization of plant resources and identifies potential problems so that corrective action can be taken opportunistically...

3) **Extensions to the Lumber Kiln Dry Scheduling Problem**, *Arman R. Yaghubian*, NC State Univ., Dept. of IE, Box 7906, Raleigh, NC 27695, aryaghub@eos.ncsu.edu, *Jeffrey A. Joines*, *Thom J. Hodgson*

A dry kiln scheduling problem from the furniture manufacturing industry is considered. Factory-specified due dates, kiln availability, kiln capacity and travel time from the kilns to the factories are all incorporated in the IP model. Because of the computational complexity of the problem, a heuristic approach is employed which determines high quality solutions in near real time.

4) **Utilizing Hybrid-GAs to Solve the Manufacturing Cell Formation Problem**, *Jeffrey A. Joines*, NC State Univ., Dept. of IE, Box 7906, Raleigh, NC 27695, jjoine@eos.ncsu.edu, *Russell E. King*, *C. Thomas Culbreth*

A stochastic global optimization technique utilizing GAs and LIPs is developed to solve the CFP and is shown to improve the performance of the GA. The concepts of this hybrid technique can be extended to other variations of the cell formation problem as well as to other LIPs. A specific furniture application is described.

**SC24 Decision Analysis III  
Contributed Session**

**Chair:** Robert F. Nau, Duke Univ., Fuqua Sch. of Bus., Durham, NC 27708-0120, rnau@mail.duke.edu

1) **Incomplete Models & the Rationality of Group Decision**, *Robert F. Nau*, Duke Univ., Fuqua Sch. of Bus., Durham, NC 27708-0120, rnau@mail.duke.edu

Rational choice theory rests on the assumption that decision makers have complete models of the relevant states, consequences and acts. Real decision models are typically incomplete and individuals therefore benefit by involving others in their decision processes, which explains various puzzles and limitations of DA and economic theory.

2) **Investments in Protective Activities: An Intertemporal Choice Problem Under Uncertainty**, *Ayse Onculer*, Univ. of PA, OPIM, 1300 SH-DH, Wharton Sch., 3620 Locust Walk, Philadelphia, PA 19104, oncul69@opim.wharton.upenn.edu, *Howard Kunreuther*, *Paul Slovic*

We investigate the effect of time horizons on investment decisions in protective activities through an experimental approach. The data supports 2 major biases in intertemporal choice problems: myopia and time insensitivity. On the basis of these results, a prescriptive guideline is proposed for improving decision processes.

3) **The Decision Tree Polytope & its Application to Sequential Decision Problems**, *Art R. Warburton*, Simon Fraser Univ., Fac. of Bus. Admin., Burnaby, BC, V5A 1S6, Canada, warburto@sfu.ca

This presentation characterizes decision tree strategies as vertices of a 0-1 polytope. The characterization yields powerful methods for finding strategies that are optimal in the presence of side conditions and for computing tradeoffs between strategies. The method can handle large problems and can be

implemented using standard mathematical programming software.

**4) Pareto Analysis as an Adjunct to Roll-up in Multiattribute Utility, Alan J. Brothers**, Battelle Pacific NW Ntl. Lab., PO Box 999, MSIN K8-07, Richland, WA 99352, [ajbrothers@pnl.gov](mailto:ajbrothers@pnl.gov)

An evaluation of alternatives for consolidating nuclear waste used Pareto analysis of selected pairs of objectives to enhance confidence and understanding beyond that provided by the usual value model. Risk played a role similar to cost as the price paid to achieve performance objectives.

**SC25 PANEL: Trends & Critical Contents of a Core Operations Management Course for Fast Changing Ind. & Econ. Environments**  
Invited Session

**Chair:** Sumer Aggarwal, Suffolk Univ., Boston, MA 02108

**1) PANEL: Trends & Critical Contents of a Core Operations Management Course for Fast-Changing Industrial & Economic Environments, Bela Gold**, Claremont Grad. Sch., **Sumer Aggarwal**, Suffolk Univ., **Kazuho K. Yoshimoto**, Waseda Univ.

Panelists will discuss why certain specific topics must be included. How such contents will help managers in improving the competitive strengths of their companies. How much emphasis needs to be placed on performance measures and continuous monitoring. The panelists will also present results of a 1996-97 nation-wide research survey.

**SC26 Queueing Systems - Numerical Approaches**

**Sponsor:** INFORMS Applied Probability Section

**Sponsored Session**

**Chair:** Hans Blanc, Tilburg Univ., Dept. of Econometrics, PO Box 90153, Tilburg, 5000 LE, The Netherlands, [blanc@kub.nl](mailto:blanc@kub.nl)

**1) Fluid Simulation for High Speed Networks, Wei-Bo Gong**, Univ. of MA, Dept. of Elec. & Comp. Eng., Amherst, MA 01003, [gong@ecs.umass.edu](mailto:gong@ecs.umass.edu)

We propose using fluid model-based discrete time simulation to simulate high speed networks. We prove that the discretization error is within a deterministic bound regardless of the network size. We show that fluid simulation offers the flexibility to trade accuracy for efficiency and it is easy to parallelize.

**2) Numerical Transform Inversion for Queueing Models, Gagan Choudhury**, AT&T Labs., 101 Crawfords Corner Rd, Rm. 1L-238, Holmdel, NJ 07733, [gagan@buckaroo.ho.att.com](mailto:gagan@buckaroo.ho.att.com)

We describe an effective scaling procedure for inverting single and multidimensional continuous/discrete transforms that numerically solves tail probabilities in statistical multiplexing models, sojourn times in product-form closed queueing networks and delay distributions in large polling models.

**3) The Power-Series Algorithm & Tandem Queues, Hans Blanc**, Tilburg Univ., Dept. of Econometrics, PO Box 90153, Tilburg, 5000 LE, The Netherlands, [blanc@kub.nl](mailto:blanc@kub.nl)

We will give a general introduction to the concepts of the power-series algorithm. Further, we will discuss a specific application of this algorithm to queues in series with a Markovian arrival process and independent phase-type service times at the consecutive stations.

**SC27 Simulation**

**Contributed Session**

**Chair:** Jimmie D. Woods, Hartford Grad. Ctr., 392 Wheeler Rd., Stonington, CT 06378, [woods@hgc.edu](mailto:woods@hgc.edu)

**1) The Tower of Babel Revisited: Teaching Simulation in an OR Course, Jimmie D. Woods**, Hartford Grad. Ctr., 392 Wheeler Rd., Stonington, CT 06378, [woods@hgc.edu](mailto:woods@hgc.edu)

The many different ways that simulation is presented in the first OR course are reviewed. The strengths and weaknesses of each are discussed. After sharing some of the opinions of colleagues, personal views based upon 20 years of teaching OR and specific recommendations for improvement are set forth.

**2) Computer Simulation in Financial Analytics: Management Games & Related Educational Issues, Robert R. Trippi**, Univ. of CA, IR/PS MC 0519, La Jolla, CA 92093-0519, [rtrippi@ucsd.edu](mailto:rtrippi@ucsd.edu)

Computer simulation is often the only feasible means of evaluating complex corporate finance and investment management strategies. In this context, we explore the increasing role of simulation in finance research, approaches to teaching these versatile techniques to analysts and novel software-based management games designed to improve financial management skills.

**3) Errors of Simulated Regional Economic Models, Shapoor**

**Vali**, Fordham Univ., 113 West 60th St., New York, NY 10023, [vali@mary.fordham.edu](mailto:vali@mary.fordham.edu)

The design of simulation studies requires the resolution of the methodological issue of "generalization": how to extend results of a study conducted with a model of specific size to circumstances involving models of different magnitude? Design and results of simulation study of volume and direction of errors of multiregional economic models, due only to model size, will be presented.

**SC28 Location**

**Contributed Session**

**Chair:** Trevor S. Hale, TX A&M Univ., 734 Clarion Dr., Pueblo West, CO 81007, [thale@tam.u.edu](mailto:thale@tam.u.edu), [thale@uscolo.edu](mailto:thale@uscolo.edu)

**1) Expected Distance Functions & the Single Facility Location Problem, Trevor S. Hale**, TX A&M Univ., 734 Clarion Dr., Pueblo West, CO 81007, [thale@tam.u.edu](mailto:thale@tam.u.edu), [thale@uscolo.edu](mailto:thale@uscolo.edu), **Leslie C. Hale**

It is often necessary to estimate the distance between random points in a given area. Such is the case when investigating facility location of point resources with respect to dimensional demands. This research proposes a new facility location methodology that has computational complexity advantages over traditional aggregation facility location techniques.

**2) Genetic Algorithm & the Conditional Covering Problem, Henry E. Waldron**, Rutgers Univ., 9 Covington Ln, Voorhees, NJ 08043, [hwaldron@rutcor.rutgers.edu](mailto:hwaldron@rutcor.rutgers.edu), **Sohail S. Chaudhry**

The conditional covering problem is to locate minimum number of facility sites that will cover not only the given demand points but also one another. We show that GA-based software can be used to solve this problem in a spreadsheet environment. We also report on our computational experience.

**3) Dynamic Location Modeling in Stackelberg-Nash-Cournot, Tan Miller**, Warner-Lambert, 201 Tabor Rd., Morris Plains, NJ 07950, **Terry L. Friesz**, **Roger L. Tobin**

We formulate a dynamic facility location model for a firm locating on a network. This firm acts as the leader in an industry characterized by Stackelberg leader-follower competition. Using sensitivity analysis within a hierarchical mathematical programming approach, we develop reaction function-based models to optimize the Stackelberg firm's location decision.

**4) A p-Center Grid-Positioning Aggregation Procedure, M. Brenda R. Rayco**, Univ. of Arizona, Systems & IE Dept., Coll. of Eng. & Mines, Tucson, AZ 85721, [rayco@sie.arizona.edu](mailto:rayco@sie.arizona.edu), **Richard L. Francis**, **Arie Tamir**

We present an algorithm for aggregating p-center demand points such that the resulting aggregate set imposes a grid structure on the plane consisting of identical diamonds of specified dimensions. The grid is positioned so that a well-defined upper bound on the objective function error is smallest.

**SC29 Service Management III**

**Contributed Session**

**Chair:** Chi Ip, Alamo Rent A Car, Inc., The 110 Tower, 110 SE 6th St., PO Box 22776, Ft. Lauderdale, FL 33335, [cip@alamo.e-mail.com](mailto:cip@alamo.e-mail.com)

**1) A Pricing Model for Perishable Asset Revenue Management, Lefteris Iakovou**, Univ. of Miami, Dept. of IEN, PO Box 248294, Coral Gables, FL 33124, [lefteris@eng.miami.edu](mailto:lefteris@eng.miami.edu), **Chi Ip**, **Christos P. Koulamas**

A Markovian decision model is proposed to manage the pricing policy of a perishable asset, e.g., hotel rooms, airline seats, etc. The methodology is capable of determining the actual prices given the number of price breakpoints and the portion of the inventory to be allocated at each pricebreak.

**2) The Influence of Capacity Strategy on Service Networks, Madeleine E. Pullman**, CO State Univ., 224 Rockwell Hall, Dept. of Mgmt., Ft. Collins, CO 80523, [mpullman@lamar.colostate.edu](mailto:mpullman@lamar.colostate.edu), **Gary Thompson**, **Bill Moore**

We examine the impact of alternative capacity strategies on waiting times for customers in a service network. A simulation model is developed to test different types of strategies. The objective is to determine the optimal capacity strategy which allows the maximum number of customers to experience a desired peak waiting time limit.

**3) An Application of Yield Management for Internet Service Providers, Suresh K. Nair**, Univ. of CT, Sch. of Bus. Admin., U-41 IM, Storrs, CT 06269-0241, [nair@uconnvm.uconn.edu](mailto:nair@uconnvm.uconn.edu), **Ravi Bapna**, **Lin Brine**

We develop a model for optimally utilizing an ISP's network capacity when are

faced with stochastic requests for logging onto the network. We use yield management and forecast horizon techniques to help the ISPs manage this operation and improve service quality.

**4) Delivery Time & Price Competition for Service Firms, *Kut C. (Rick) So*, Hong Kong Polytech. Univ., Dept. of Mgmt., Hung Hom Kowloon, Hong Kong, msrickso@polyu.edu.hk, *Jeannette Song***

Our previous work develops a single-firm model for studying the interrelationship between the pricing, delivery time guarantees and capacity selection decisions for service firms. We extend our previous model to a multiple-firm setting and illustrate how the differences in firm characteristics would affect their optimal decisions.

**SC30 Military Economics**

**Sponsor:** INFORMS Military Applications Society  
**Sponsored Session**

**Chair:** Keith Womer, Univ. of MS, 301 Conner Hall, Dept. of Econ. & Finance, University, MS 38677, womer@bus.olemiss.edu

**1) The Valuation of Land Associated with Base Closures, *Allen Doggett*, MITREtek Systems, McLean, VA 22102, *Arlene R. Wusterbarth***

Recently, the US DoD initiated techniques such as economic development conveyances to determine economic prices for land released from military use by base closures. These techniques determine the alternative value of military base lands.

**2) The Cost of Process Change Opportunities, *John A. Long*, TASC, Inc., 2555 University Blvd., Fairborn, OH 45324**

Recently the cost of using hazardous materials in manufacturing and maintenance processes has become an item of interest. As more and more substances are banned or restricted in their use, it has become more important to examine the true cost of using hazardous materials.

**3) Analysis of Cost Performance Report Data, *Keith Womer*, Univ. of MS, 301 Conner Hall, Dept. of Econ. & Finance, University, MS 38677, womer@bus.olemiss.edu**

The DoD has made use of contractor's cost performance reports for many years. Nevertheless, recent papers suggest that little more than ad hoc techniques have been used to analyze this data. This presentation will relate cost performance reports.

**SC31 Evaluation of Military Telemedicine Applications**

**Sponsor:** INFORMS Military Applications Society  
**Sponsored Session**

**Chair:** George Miller, Vector Research, Inc., PO Box 1506, Ann Arbor, MI 48106, millerg@vrinet.com

**1) Job Analysis at Military Telemedicine Sites, *Sigrd Gustafson*, VA Polytech. Inst. & State Univ., Dept. of Psychology, Blacksburg, VA 24061-0436, sbg@vt.edu, *Dan Gower***

Focusing on data from job analyses conducted at various telemedicine sites, we address issues concerning the types of positions and organizational structures most crucial to the success or failure of telemedicine efforts from a human resources perspective. The results from a variety of job analysis techniques will be evaluated.

**2) Assessing Shipboard Telemedicine, *John Silva*, Naval Health Research Ctr., 271 Catalina Blvd., Bldg. 331, Rm. 213, San Diego, CA 92152, silva@nhrc.navy.mil, *Diana Pearsall*, *Paul Melavin***

The US Navy has incorporated new telecommunications technology to benefit the operations and practice of health care delivery aboard ships. The Naval Health Research Center is conducting a study to assess the impact of this technology aboard the USS George Washington during its recent 6-month deployment. Preliminary results are presented.

**3) Analysis of Costs & Benefits of Telemedicine in Bosnia, *George Miller*, Vector Research, Inc., PO Box 1506, Ann Arbor, MI 48106, millerg@vrinet.com, *Sam Clark***

The US deployment of troops to Bosnia included medical support incorporating telemedicine capabilities. This presentation describes the methodology and results of a study to measure the costs and benefits of this use of telemedicine and to infer from the Bosnia experience the potential utility of telemedicine in future deployments.

**4) Experimenting with Telemedicine in Alaska: Successes & Lessons Learned, *Emma Forkner*, 840 Sunrise Trail, Spring Branch, TX 78070, *Timothy Reardon***

Alaska's vast area, low population, doctor shortage and high medical costs make it an ideal test location for telemedicine. A telemedicine initiative at

Elmendorf Air Force Base has yielded valuable lessons on the effective use of low-cost technology, while also producing unexpected changes in the way health care was delivered.

**SC32 Economic Issues in Telecommunications**

**Sponsor:** INFORMS Technical Section on Telecommunications  
**Sponsored Session**

**Chair:** Joakim Kalvenes, Univ. of TX, Sch. of Mgmt., PO Box 830688, Richardson, TX 75083-0688, kalvenes@utdallas.edu

**1) Strategic Commitments & the Principle of Reciprocity in Interconnection Pricing, *Glenn Woroch*, Univ. of CA, Dept. of Economics, Berkeley, CA 94720, glenn@econ.berkeley.edu, *Nicholas Economides*, *Giuseppe Lopomo***

We examine the effects of strategic commitments and network size on equilibrium interconnection fees between competing networks. The dominant network sets the interconnection fee before its competitor allows it to execute a "price squeeze." In that case, enforcement of "reciprocity" will eliminate the first-mover's strategic advantage. In fact, interconnection charges for symmetric networks will be 0...

**2) Integration & Divestiture of Network Firms, *Glenn Woroch*, Univ. of CA, Dept. of Economics, Berkeley, CA 94720, glenn@econ.berkeley.edu, *Nicholas Economides***

A simple model of network equilibrium assesses the private and social incentives of network firms to merge and divest network components. Divestiture tends to reduce consumer welfare by causing double marginalization. Special attention is given to "gateways" interconnecting 2 networks. We find that owners of such facilities profit by selling them to 3rd parties while overall industry profits and consumers surplus fall...

**3) Regulation & Deregulation of the Telephone Industry: The Lessons from Railroads, *Lawrence J. White*, NYU, Stern Sch. of Bus., New York, NY 10012, lwhite@stern.nyu.edu**

Railroads and telephones possess similar network characteristics and have had somewhat similar histories of regulation. Railroads have now had 15 years of experience of deregulation. The lessons of that experience are summarized and applied to the telephone industry's current process of deregulation.

**4) Pricing Information Goods: New Strategies for the Digital Economy, *Erik Brynjolfsson*, MIT, Rm. E53-313, Cambridge, MA 02139, ebrynj@mit.edu, *Yannis Bakos***

We analyze optimal pricing strategies for digital information goods such as those increasingly available via emerging telecommunications infrastructures. We find that, under certain assumptions, selling information goods in bundles instead of individually can increase allocative efficiency as the number of goods in the bundle grows, while simultaneously increasing seller's profits...

**SC34 Risk & Perception**

**Cluster:** Choice Engineering  
**Invited Session**

**Chair:** Hans Wolfgang Brachinger, Univ. of Fribourg Suisse, Seminaire de Stats., Av. de Beauregard 13, Fribourg, CH 1700, Switzerland, hanswolfgang.brachinger@unifr.ch

**1) A Comparison of the Descriptive Fit of Different Measures of Risk, *Elke U. Weber*, OH State Univ., Dept. of Psychology, 1885 Neil Ave., Columbus, OH 43210, eweber@magnus.acs.ohio-state.edu, *Sunhee Lee***

We compare the fit of 3 widely discussed measures of risk, 2 modified expected exponential models (M. Weber, 1990, Jia & Dyer, 1994) and the conjoint expected model of risk (Luce & Weber, 1986), to judgments of the riskiness of money and time risks made by business students in 4 different countries.

**2) Gender Aspects of Risk Perception: Experimental vs. Psychometric Approaches, *Renate Schubert*, ETH Zurich, Inst. fur Wirtschaftsforschung, Weinbergstrasse 35, Zurich, CH-8092, Switzerland, schubert@reok.ethz.ch, *Hans Wolfgang Brachinger***

Experimental and psychometric approaches are used in order to construct risk functions. Risk functions indicate how individual risk perception depends on different variables. The construction of risk functions is essential for describing and analyzing gender differences in risk perception. The explicative power of both approaches is explored.

**3) Are Women More Risk Averse?, *Nancy Jianakoplos*, CO State Univ., Dept. of Econ., Ft. Collins, CO 80523-1771, njianakoplos@vines.colostate.edu**

We examine stated and revealed gender differences in financial risk taking. Based on a representative sample of the US population in 1989, women are

more likely to verbally indicate that they are more risk averse than men and the allocation of financial assets indicates greater risk aversion among women than men.

**4) Measures of Discounted Risk, Hans Wolfgang Brachinger, Univ. of Fribourg Suisse, Seminaire de Stats., Av. de Beauregard 13, Fribourg, CH 1700, Switzerland, hanswolfgang.brachinger@unifr.ch**

Two dimensions appear to determine perceived risk in many problems in economics and business: amount of potential loss and probability of occurrence of loss. We address the issue of how perceived risk can be measured when potential losses may occur at different times.

#### SC36 INFORMS New Member Welcome & Workshop

Sponsor: INFORMS Membership & Member Services Committee  
Sponsored Session

Chair: Robert L. Armacost, Univ. of Central FL, Dept. of IE & Mgmt. Systems, Orlando, FL 32816, armacost@pegasus.cc.ucf.edu

Co-Chair: Julia Pet-Edwards

**1) INFORMS New Member Welcome & Workshop, Robert L. Armacost, Univ. of Central FL, Dept. of IE & Mgmt. Systems, Orlando, FL 32816, armacost@pegasus.cc.ucf.edu, Julia Pet-Edwards**

This workshop focuses on exploring the benefits of INFORMS membership and how members can become more involved in the Institute.

### Sunday 14:45-16:15

#### SD04 Threats to Life & Limb

Cluster: Public Sector Applications

Sponsor: INFORMS Section on Public Programs & Processes  
Sponsor/Invited Session

Chair: Arnold Barnett, MIT, Sloan Sch. of Mgmt., OR Ctr., E53-379, Cambridge, MA 02139-4307, abarnett@sloan.mit.edu

**1) Can Difficult-to-Reuse Syringes Reduce the Spread of HIV Among IDUs?, Jonathan P. Caulkins, Carnegie Mellon Univ., The Heinz Sch., Rm. 2101, Hamburg Hall, 5000 Forbes Ave., Pittsburgh, PA 15213, caulkins@andrew.cmu.edu, Edward H. Kaplan, Peter Lurie, Thomas O'Connor, Sung-Ho Ahn**

Reuse of needles by injection drug users is the leading cause of HIV transmission in the US. Some have proposed developing needles that are difficult to reuse. This presentation shows why such needles would likely increase, not decrease, HIV transmission.

**2) Airline Safety: Another Decade, Arnold Barnett, MIT, Sloan Sch. of Mgmt., OR Ctr., E53-379, Cambridge, MA 02139-4307, abarnett@sloan.mit.edu**

We say practically everything that can be said about the passenger mortality risk of commercial air travel over the years 1987-96 and the entire world.

**3) What Now to Improve Infant Health?, Harold Pollack, Univ. of MI, Sch. of Public Health, harold.pollack@yale.edu**

Since 1970, US infant mortality has significantly declined but the incidence of many fetal morbidities has not similarly improved. My presentation explores the role of substance abuse policies and expanded Medicaid entitlements in addressing these concerns. It computes accompanying cost-effectiveness measures and considers appropriate social valuation of nonfatal threats to infant health.

**4) Factors Contributing to Recent Trends in US Homicide Rates, Alfred Blumstein, Carnegie Mellon Univ., Heinz Sch. Public Policy/ Mgmt., Pittsburgh, PA 15213, ab0q@andrew.cmu.edu**

US homicide rates, which have oscillated around a flat trend for more than 2 decades, have been declining recently. We examine the countervailing contributions to these trends of different demographic groups, different city-size groups and changes in incarceration policy (through incapacitative effects).

#### SD05 Linear Programming

Cluster: Linear Programming  
Invited Session

Chair: Tamas Terlaky, Delft Univ. of Tech., PO Box 5031, Dept. of OR, Fac. of Tech. Math. & Info., Delft, 2600 GA, The Netherlands, t.terlaky@twi.tudelft.nl

**1) Linear Programming Approach for the Data Association Problem in Multiple Target Tracking, X. Li, Univ. of Hamilton,**

Communications Res. Lab., Hamilton, Ontario, L8S 4M1, Canada, **Zhi-Quan Luo, K. N. Wong, E. Bosse**

The multiple scan DAP in multiple target tracking is formulated as a 0-1 integer program which can be solved by a Lagrangean relaxation algorithm and by an LP relaxation algorithm. Real-time simulations are carried out to compare the computational complexities, solution qualities and association performances of the 2 algorithms.

**2) Logarithmic Barrier Decomposition Methods for Semi-Infinite Programming, Tamas Terlaky, Delft Univ. of Tech., PO Box 5031, Dept. of OR, Fac. of Tech. Math. & Info., Delft, 2600 GA, The Netherlands, t.terlaky@twi.tudelft.nl, John A. Kaliski, David J. Haglin, C. Roos**

A computational study of some logarithmic barrier decomposition algorithms for semi-infinite programming is presented. We propose using linear cuts to solve large-scale difficult real world problems. This algorithm uses both static and dynamic enumerations of the parameter space and allows for multiple cuts to be simultaneously added for larger/difficult problems.

**3) On the Condition Numbers for Polyhedra Expressed in Karmarkar's Standard Form, Levent Tunçel, Univ. of Waterloo, Dept. of Comb. & Optimization, Waterloo, Ontario, N2L 3G1, Canada, ltuncel@math.uwaterloo.ca**

We consider various condition measures for polyhedra including those introduced by Ye, Vavasis & Ye. We formulate optimization problems over signed subspaces so that the optimum values represent these condition numbers. Finally, we discuss the consequences of these formulations in studying the condition numbers.

#### SD06 Applications of Combinatorial Optimization

Cluster: Combinatorial Optimization  
Invited Session

Chair: Jennifer M. Ryan, US WEST Technologies, 4001 Discovery Dr., Boulder, CO 80303

**1) Optimal STP Location & Capacity in an SS7 Network, Xiaorong Sun, Lucent Bell Labs., 101 Crawfords Corner Rd., Holmdel, NJ 07733, xsun@lucent.com, Jining Liu, Pyng Wang**

We consider the problem of building an optimal SS7 network, given the locations of SPs and traffic between them. A non-linear integer programming model for optimal STP locations and capacities will be presented. Exact and heuristic solution methods will be discussed.

**2) A Facility Location Problem on Trees for Fiber-to-the-Curb Planning, Tami Carpenter, BELLCORE, 445 South St., Morristown, NJ 07960-6438, Leslie A. Hall, David Mazur**

We consider placing facilities at nodes and assigning customers to facilities so as to assure that each customer is within a prescribed distance of its facility and the capacities of facilities are not exceeded. We describe ongoing experiments with various computational approaches and discuss their performance.

**3) A Math Programming Approach to Linear Discriminant Analysis, Mark Parker, Eastern OR State Coll., Math. & Comp. Sci. Program, La Grande, OR 97850-2899, parkerm@eosc.osshe.edu, Jennifer M. Ryan**

When 2 data sets are linearly inseparable, the problem of finding the hyperplane which minimizes the number of misclassified points is the same as finding the maximum cardinality feasible subsystem of an inconsistent set of linear inequalities. We develop a constraint generation IP approach to this problem and discuss its generalization.

**4) Optimizing SS7 Networks after Deregulation, Victoria Corlew Okeson, US WEST Advanced Tech., Inc., 4001 Discovery Dr., Ste. 220, Boulder, CO 80303, vcorlew@uswest.com, Steve Y. Chiu**

Due to recent regulatory changes, regional Bell operating companies and other providers of common channel signaling services will have the opportunity to rearrange their SS7 networks into more efficient and cost-effective configurations. We discuss optimization issues, models and solution strategies for these reconfigurations.

#### SD07 Recent Advances in Complementarity & Related Problems

Cluster: Nonlinear Programming  
Invited Session

Chair: Christian Kanzow, Univ. of Hamburg, Inst. of Appl. Math., Bundesstrasse 55, Hamburg, D-20146, Germany, kanzow@math.uni-hamburg.de

**1) Identification of Zero-Variables in Complementarity Problems, Andreas Fischer, Tech. Univ. of Dresden, Inst. of**

Numerical Math., Dresden, D-01062, Germany, fischer@math.tu-dresden.de

For particular classes of complementarity problems, including linear ones, it will be shown that, given a vector sufficiently close to the solution set of the complementarity problem, those variables can be identified which are 0 for all solutions.

**2) A Hybrid Method for Solving Constrained Equations, Jong-Shi Pang**, Johns Hopkins Univ., Dept. of Math. Sci., Baltimore, MD 21218-2689, jsp@vics1.mts.jhu.edu

Motivated by applications in frictional mechanics, we describe a hybrid method for solving systems of nonlinear equations satisfying additional constraints. The method combines ideas from an interior point method and the B-differentiable Newton method. Convergence and computational results are reported. This work is joint with colleagues from the Linköping Institute of Technology.

**3) Smooth Methods of Multipliers for Monotone Complementarity Problems, Jonathan Eckstein**, Rutgers Univ., RUTCOR, Fac. of Mgmt., PO Box 5062, New Brunswick, NJ 08903-5062, jeckstei@rutcor.rutgers.edu

Each iteration of these new multiplier and proximal multiplier methods for monotone complementarity requires approximately solving a differentiable nonlinear equation system, without the stepsize and conditioning issues arising in barrier methods. The analysis combines an approximate Bregman-based proximal algorithm with a Fenchel duality framework for monotone operators.

## SD08 IP Column Generation Methods

**Cluster:** Integer Programming

**Invited Session**

**Chair:** Jacques Desrosiers, GERAD & Ecole des HEC, 5255 Decelles, Montreal, Quebec, H3T 1V6, Canada, jacques.desrosiers@hec.ca

**1) Column Generation for Integer Programs, Jacques Desrosiers**, GERAD & Ecole des HEC, 5255 Decelles, Montreal, Quebec, H3T 1V6, Canada, jacques.desrosiers@hec.ca, **Pierre Hansen, Brigitte Jaumard, Francois Soumis, Daniel Villeneuve**

We generalize the Dantzig-Wolfe decomposition principle to linear and nonlinear integer programs. We then show that for a problem solved by using a column generation scheme, there exists a compact formulation on which one can apply the decomposition principle according to that scheme. B&C strategies can then easily be derived on the variables of this compact formulation.

**2) Express Shipment Service Design, Cynthia Barnhart**, MIT, Ctr. for Transport. Studies, Rm. 1-229, Cambridge, MA 02139, cbarnhar@mit.edu, **Daeki Kim, Gregory R. Reinhardt, Keith Ware**

Express air shipment service design, requiring that shipments be picked up and delivered within very tight time windows, involves the determination of aircraft routes and schedules, ground vehicles movements and shipment flows. Using our new model and solution approach, we solve real applications of the express shipment service design problem...

## SD09 Scheduling in Transportation Systems

**Cluster:** Scheduling

**Invited Session**

**Chair:** Jonathan F. Bard, Univ. of TX, OR Group, Dept. of Mech. Eng., ETC 5.160, Austin, TX 78712-1063, jbard@mail.utexas.edu

**1) Optimization Models & Algorithms for Airline Crew Management During Irregular Operations, Guo Wei**, Univ. of TX, Dept. of MSIS, Grad. Sch. of Bus., Austin, TX 78712, guowei@ccwf.cc.utexas.edu, **Mark Song, Gang Yu**

Optimization models are developed for managing crew during irregular operations. These models are network-based with side constraints and placed on space-time dimensions. Efficient algorithms are devised to solve the problem. Some initial computational results will be reported.

**2) An Algorithm for the Scheduling of Drivers at the Breakbulk of Less-than-Truck-Load Operators, Kishore Sarathy**, Northern Telecom, 2201 Lakeside Blvd., MS D0320, Richardson, TX 75082-4399, sarathy@nortel.ca

Given a set of drivers available at the breakbulk and associated satellites facilities, and the origin, destination and time window for a set of loads, the objective is to find minimum cost driver schedules and load assignments. A set partitioning type model and a column generation scheme are presented.

**3) Real-Time Dispatch Applications in the Telecommunications & Utilities Industries, George Kontoravdis**, Univ. of TX, Grad. Program in OR, ETC 5.160, Austin, TX 78712-1063, condor@acm.

org

The telecommunications and utilities industries have been experiencing major changes recently due to increasing competition and evolving legislation. We present an overview of a real-time dispatch system that provides efficient technician field dispatching and resource utilization.

**4) Solution Methods for Rescheduling Commercial Aircraft During Irregular Operations, Michael Arguello**, Univ. of TX, Grad. Program in OR, ETC 5.160, Austin, TX 78712-1063, arguello@mail.utexas.edu, **Jonathan F. Bard, Gang Yu**

A GRASP that concentrates on neighborhood search generates new aircraft schedules in response to the unexpected grounding of aircraft. An approximation model based on the discretization of the time horizon provides a lower bound to which the GRASP solutions may be compared.

## SD10 Production Scheduling IV

**Contributed Session**

**Chair:** S. K. Goyal, Concordia Univ., 1455 de Maisonneuve Blvd. W, Montreal, Quebec, H3G 1M8, Canada, sgoyal@vax2.concordia.ca

**1) Cyclic Scheduling with Limited Shelf Life, S. K. Goyal**, Concordia Univ., 1455 de Maisonneuve Blvd. W, Montreal, Quebec, H3G 1M8, Canada, sgoyal@vax2.concordia.ca

This presentation deals with the problem of obtaining an economic feasible repetitive manufacturing schedule for a number of products produced on a single manufacturing facility. Various approaches for obtaining feasible schedules will be presented.

**2) Analysis of Serial Production Line Systems for Interdeparture Time Variability & Average Inventory, Erdal Erel**, Bilkent Univ., Fac. of Bus. Admin., Ankara, 06533, Turkey, erel@bilkent.edu.tr, **Ihsan Sabuncuoglu, A. Gurhan Kok**

We examine the relationship between the interdeparture time variability and some design factors of paced and asynchronous production lines. The analysis of the results reveals several important findings on the interdeparture time variability and average WIP inventory. We also confirm and strengthen some of the previous findings on throughput.

**3) Optimal Lot-Size for the General Interrupted Geometric Yield, Shoshana Anily**, Columbia Univ./Tel Aviv Univ., Grad. Sch. of Business, New York, NY 10027, sa204@columbia.edu, **Avraham Beja, Amit Mendel**

When production yields are random and demand is rigid, several lots may be required to fulfill a given demand. Assume the yield's pdf is interrupted (generalized) geometric. We minimize the expected total production cost of the lots that consist of a setup and variable costs. We characterize the sets of optimal lot-sizes for any demand level and prove their convergence to a specific set of at most 2 consecutive integers.

**4) An Optimal Production Cycle & Inspection Schedules in a Deteriorating Machine, Yushin Hong**, POSTECH, San 31, Hyoja, Pohang, 790-784, Korea, yhong@postech.ac.kr, **Chang-Hyun Kim**

We present an extended EMQ model which determines an optimal production cycle and inspection schedules simultaneously in a deteriorating machine. An optimal solution and a minimum average cost as well as unique properties are derived. Numerical experiments are carried out to investigate the behavior of the proposed model.

## SD12 Neural Networks II

**Sponsor:** INFORMS CSTS

**Sponsored Session**

**Chair:** Theodore B. Trafalis, Univ. of OK, Sch. of IE, 202 W Boyd, Rm. 124, Norman, OK 73019, trafalis@mailhost.ecn.uoknor.edu

**1) Structure Determination in Feedforward Neural Networks, Luke E. K. Achenie**, Univ. of CT, Dept. of Chem. Eng., U-22, Storrs, CT 06269, achenie@eng2.uconn.edu

We will look at structure determination for feedforward neural networks. That is, how do we optimally determine the topology of a feedforward neural network? Our approach uses a mixed integer mathematical programming formulation.

**2) Training of Feedforward Neural Networks via Primal-Dual Interior Point Method for Nonlinear Programming, Theodore B. Trafalis**, Univ. of OK, Sch. of IE, 202 W Boyd, Rm. 124, Norman, OK 73019, trafalis@mailhost.ecn.uoknor.edu, **Nicolas P. Couellan**

We propose a new training algorithm for feedforward supervised neural networks based on a primal-dual interior point method for NLP. Computational

results are also presented.

3) **Unsupervised Neural Network Training via a Potential Reduction Approach**, *Theodore B. Trafalis*, Univ. of OK, Sch. of IE, 202 W Boyd, Rm. 124, Norman, OK 73019, trafalis@mailhost.ecn.uoknor.edu, *Tamas Terlaky, J. P. Warners*

A new training algorithm based on an interior point potential reduction method is presented. The network architecture is based on Linsker's model. Specifically, at each neuron, we solve a convex maximization problem, maximizing the variance of its output. We also report on computational experience with randomly generated problems.

### SD13 Heuristics in Combinatorial Optimization

Sponsor: INFORMS CSTS

Sponsored Session

Chair: Daniel Solow, Case Western Reserve Univ., Dept. OR, 604 Enterprise Hall, Weatherhead Sch. of Mgmt., Cleveland, OH 44106, dxs8@pyrite.som.crwu.edu

1) **Almost Universal Properties of Local Search**, *Craig Tovey*, GA Inst. of Tech., Sch. of ISyE, Atlanta, GA 30332, ctovey@isye.gatech.edu

We use properties of graph expanders to show that in an abstract setting of local search for combinatorial optimization, almost all neighborhoods lead to exponentially bad worst-case and polynomially good average-case time bounds for finding a local optimum.

2) **Using a Maximum Matching to Find a Minimum Point Cover in a Graph**, *Daniel Solow*, Case Western Reserve Univ., Dept. OR, 604 Enterprise Hall, Weatherhead Sch. of Mgmt., Cleveland, OH 44106, dxs8@pyrite.som.crwu.edu, *Jung-Huei Shu*

Preliminary theoretical results are presented for using Edmond's maximum-matching algorithm as the basis for finding the minimum point cover in an undirected graph.

3) **Generalized Hill Climbing Algorithm Results for Discrete Optimization Problems**, *Sheldon H. Jacobson*, VA Polytech. Inst. & State Univ., Dept. of Ind. & Systems Eng., 302 Whittemore Hall, Blacksburg, VA 24061-0118, jacobson@tioli.ise.vt.edu, *Alan W. Johnson*

A new general heuristic strategy for intractable discrete optimization problems, GHC algorithms, is presented. SA and thresholding acceptance, among others, are formulated as particular GHC algorithms. Convergence conditions for a particular class of GHC algorithms are presented.

4) **Scheduling Jobs with Sequence Dependent Setups on Coupled Lines**, *Edward C. Sewell*, Southern IL Univ., Dept. of Math. & Stats., Edwardsville, IL 62026-1653, esewell@daisy.siue.edu

We introduce the problem of scheduling a set of jobs with sequence dependent setup times on a machine with a pair of lines that must be operated simultaneously. We present an IP formulation of the problem, a TS and computational results on real-world problems.

### SD14 Planning

Contributed Session

Chair: Derek P. Bennett, Univ. of CA, Dept. of IE/OR, Berkeley, CA 94706, bennett@ieor.berkeley.edu

1) **Decomposition Approach to a Multiobjective Process Planning Problem in Environmentally Conscious Manufacturing**, *Derek P. Bennett*, Univ. of CA, Dept. of IE/OR, Berkeley, CA 94706, bennett@ieor.berkeley.edu, *Candace Arai Yano*

We present a processing planning problem in ECM where decisions are made about production alternatives, the process path, process parameters and waste mitigation. The formulation is multiobjective and has a multicommodity network structure with additional nonlinearities and binary decisions. We discuss interactive methods and decomposition solution procedures for the problem.

2) **Managing Army Installations into the 21st Century**, *Raul Romero*, US Military Acad., PO Box 3192, West Point, NY 10997, x74577f2@cadet1.usma.edu

Military installations form the basis of the US Army's ability to project force around the world. Improving and managing these installations is a complex problem and presents many challenging requirements. The undergraduate Engineering Management majors at USMA have studied and analyzed this problem and this presentation addresses the results of my analysis.

3) **The Effect of Project Risk on Capital Rationing Under Uncertainty**, *Martin I. Kusy*, Concordia Univ., 1455 de

Maisonneuve St. W, Sch. of Grad. Studies, Montreal, Quebec, H3G 1M8, Canada, kusy@vax2.concordia.ca, *Dennis Kira, Ian Rakita*

This presentation considers the impact of varying levels of project risk on a firm's capital budgeting decision. A stochastic LP approach is employed that specifically incorporates the uncertain nature of available funds. A numerical problem highlights the benefits of the approach as compared with a similar deterministic treatment.

4) **Optimal Oil Well Drilling & Production Planning**, *Ramaswamy R. Iyer*, Carnegie Mellon Univ., Dept. of Chem. Eng., Pittsburgh, PA 15213, ri07@andrew.cmu.edu, *Ignacio E. Grossmann, Sriram Vasanthrajan, A. S. Cullick*

An MILP formulation is presented for optimal sequencing and production planning of oil wells over a planning horizon. The decision variables include choosing which wells are drilled in a time period and the amount of oil produced. A decomposition approach is presented that enables the solution of problems containing up to 2000 binary variables.

### SD15 Scheduling & Logistics

Cluster: Production Control with Uncertainty

Invited Session

Chair: Jean-Marie Proth, INRIA-Lorraine, Technopole Metz 2000, 4 rue Marconi, Metz, 57070, France, jean-marie.proth@ilm.loria.fr

1) **A Neural Network for Solving Job Shop Scheduling Problems**, *A. Abada*, Ecole Genie Industrielle, Lab. d'Automatique, Saint martin d'heres, BP 4638400, France, assia@lag.grenet.fr, *Z. Binder, P. Ladet*

The job shop scheduling problem is a resource allocation problem subject to satisfying precedence constraints and resource constraints. We deal with a combination of SA and neural networks to give stochastic parallel solution which is encoded in a specific neural network.

2) **A Systems Engineering Approach to the Design of a Decision Support System to the Planning & Control of a Spinning Unit**, *Joao Tasso Borges de Sousa*, Univ. do Porto, ISR, Rua dos Bragas, Porto Codex, 4099, Portugal, jtasso@garfield.fe.up.pt, *Gil Manuel Goncalves, Fernando Lobo Pereira*

We describe the process of systems engineering involving the mapping of a conceptual planning and control receding-horizon hierarchic architecture for the production planning and control system of a spinning unit supported by dynamic optimization techniques into a DSS. This mapping resulted in user-oriented and technically-oriented projects.

3) **Management of a Pool of Self-Serviced Cars**, *Jean-Marie Proth*, INRIA-Lorraine, Technopole Metz 2000, 4 rue Marconi, Metz, 57070, France, jean-marie.proth@ilm.loria.fr, *Nevine Hafez, Nathalie Sauer*

We analyze a problem in large companies where cars are at the disposal of employees who have to move to various plants of the company in order to perform tasks, i.e., maintenance, adjustment of resources, etc. The goal is to introduce a self-service operation mode: the employee uses the car from the initial site to his destination, and places the car at the disposal of employees at his destination as soon as he arrives...

4) **Optimal Release Times in Manufacturing Systems: Optimality Conditions & Numerical Algorithms**, *Yorai Wardi*, GA Inst. of Tech., Sch. of Elect. & Comp. Eng., Atlanta, GA 30332, ywardi@ee.gatech.edu, *M. Gazarik*

Given products due dates and processing times in a manufacturing system, we determine the optimal parts release times so as to minimize the sum of tardiness and earliness costs. The methodology developed is based on optimal-control theory and gives the optimal release times in a state-feedback form.

### SD16 PANEL: Publishing in IEEE Transactions on Engineering Management

Sponsor: INFORMS Section on Technology Management

Sponsored Session

Chair: Dunder F. Kocaoglu, Portland State Univ., Eng. Mgmt. Program, Portland, OR 97207-0751, kocaoglu@emp.pdx.edu

1) **PANEL: Publishing in IEEE Transactions on Engineering Management**, *R. Balachandra*, Northeastern Univ., *Frederick Betz*, NSF, *Burton V. Dean*, San Jose State Univ., *Richard C. Dorf*, Univ. of CA, *George F. Farris*, Rutgers Univ., *Cheryl Gaimon*, GA Inst. of Tech., *Eliezer Geisler*, Univ. of WI, *Donald Gerwin*, Carleton

Univ., *David Gibson*, Univ. of TX

The editor-in-chief, department editors and special issue editors of IEEE Transactions on Engineering Management will discuss publication strategies and emerging research issues in engineering and technology management. Brief presentations will be followed by a Q&A period.

### SD17 Operations Management IV Contributed Session

**Chair:** Alan Scheller-Wolf, Carnegie Mellon Univ., Grad. Sch. of IA, 5000 Forbes Ave., Pittsburgh, PA 15213, awolf@andrew.cmu.edu

**1) Reducing Cash-Flow Variance in International Multi-Echelon Inventory Systems Through Contractual Minimum Order Quantities, Alan Scheller-Wolf**, Carnegie Mellon Univ., Grad. Sch. of IA, 5000 Forbes Ave., Pittsburgh, PA 15213, awolf@andrew.cmu.edu, *Sridhar R. Tayur*

We investigate the mean/variance trade-off a supplier faces when prescribing minimum order levels and reducing item price, keeping his foreign distributor's expected cost constant. We establish the distributor's optimal policy under fixed minimum and maximum orders, and when order size flexibility depends on the quantity pre-committed...

**2) Modeling Manufacturing Technology Choice Under Learning and Forgetting Conditions, Timothy L. Smunt**, Wake Forest Univ., Babcock Grad. Sch. of Mgmt., Box 7659, Reynolds Station, Winston-Salem, NC 27109-7659, tim\_smunt@mail.mba.wfu.edu, *Jack R. Meredith*

We model flexible automation and labor-intensive processes in a batch production environment to illustrate conditions where firms should choose either process type. We show that as product life cycles get shorter, the optimal choice of manufacturing process can be labor-intensive, although the production of the total expected demand should be completed in 1 large- or a few medium-sized batches...

**3) Price Negotiation & Market Expansion in Wholesaling, Rajesh Tyagi**, Univ. of Northern IA, Dept. of Mgmt., Cedar Falls, IA 50614, tyagi@uni.edu, *Chandrasekhar Das*

Wholesalers compete with other wholesalers and their own manufacturers for a share of the business. In this environment, bargaining for markets and prices often turns out to be a complex phenomenon that involves exchanging information between many parties on many issues. We develop a 2-stage heuristic method that utilizes MIP models for this purpose.

**4) Modeling Different Production Capacity Strategies in Declining Environments, Pawel Mensz**, Univ. of New Haven, 300 Orange Ave., West Haven, CT 06516

In an expanding/producer market, the producer has significant control over demand. In declining or more competitive markets, capacity is not representing major constrain. This calls for entirely different approaches in managing capacity. The effectiveness of different scenarios will be examined using statistical modeling.

### SD20 Incident Detection Algorithms

**Sponsor:** INFORMS Transportation Science Section  
Sponsored Session

**Chair:** Stephen G. Ritchie, Univ. of CA, Dept. of Civil & Env. Eng., Irvine, CA 92697

**1) Sensor Fusion for Incident Detection, Karl Petty**, Univ. of CA, Elect. Eng. & Comp. Sci., Berkeley, CA 94720, *Alex Skabardounis, Pravin Varaiya*

We propose a novel algorithm for detecting freeway incidents using loop detector data and information from cellular phones and other mobile reporting sources. These 2 diverse sources are combined using data fusion techniques to enhance the decision-making capabilities of our incident detection algorithm. Tests using the I-880 database indicated it produces better results than conventional loop-based detection algorithms.

**2) The Cumulative Sum Algorithm for Freeway Incident Detection, Hua-Liang Teng**, Purdue Univ., Dept. of Civil Eng., W Lafayette, IN 47907, *Samer M. Madanat*

We present an improved detection algorithm, CUSUM, based on a formulation of freeway incident detection as a change-point problem. Its performance functions are derived analytically and used to evaluate it against state-of-the-art freeway incident detection algorithms. Preliminary results show that CUSUM achieves significant reduction in mean detection time for a given false alarm.

**3) The Role of Traffic Flow Profiles in Incident Detection, K. Larry Head**, Univ. of AZ, SIE Dept., Tucson, AZ 85721, *Pitu B.*

### Mirchandani

Freeway incident detection algorithms are generally based on time-average measures such as occupancy. Incidents are identified when the underlying processes deviate from the assumed stationary process. Surface street traffic is interrupted by traffic signals. We discuss surface street incident detection algorithms that consider these interruptions.

**4) Universality of Freeway Incident Detection Systems: Beyond the Neural Network, Bahar Abdulhai**, Univ. of CA, Civil & Env. Eng., Irvine, CA 92697, *Stephen G. Ritchie*

Development of a universal freeway incident detection algorithm is a task that remains unfulfilled despite promising approaches that have been recently explored. Incident detection researchers are now realizing that an operationally successful incident detection framework needs to fulfill all components of a set of recognized needs. We introduce and define a universal detection framework...

### SD21 Airline Pricing & Yield Management

**Cluster:** Aviation Applications  
Invited Session

**Chair:** Theodore C. Botimer, Continental Airlines, 2929 Allen Parkway, Ste. 1217, Houston, TX 77019, tbotim@revmgt.flyco.com

**1) The Impact of Sales on Revenue Management, Theodore C. Botimer**, Continental Airlines, 2929 Allen Parkway, Ste. 1217, Houston, TX 77019, tbotim@revmgt.flyco.com

Inability to incorporate the effects of pricing impedes the performance of revenue management. In particular, recurring sales offer a moving target for demand forecasts and other factors. This research seeks to identify the impact of sales on revenue management. Issues of forecasting, fare bucketing and O-D control are addressed.

**2) Evaluation of Competitive Fare Structures, Peter P. Belobaba**, MIT, 77 Mass. Ave., Room 33-215, Cambridge, MA 02139, belobaba@mit.edu, *Alex Y. Lee*

The passenger O-D simulator is used to assess the traffic and revenue impacts of different airline fare structures in a market with 2 competitors. We examine the use of different advance purchase restrictions on the propensity of passengers to "sell up" to higher fares or choose the competing carrier.

**3) Dealing with Trade-Up in Revenue Management Models, William G. Brunger**, Continental Airlines, 2929 Allen Parkway, Ste. 1200, Houston, TX 77019

"Trade-up" refers to the phenomenon that a (surprisingly small) percentage of passengers will pay (slightly) more than the lowest applicable price if the lowest fare is unavailable, particularly during peak travel periods. The author will define terms, survey alternative modeling techniques and suggest approaches for taking advantage of trade-up behavior.

**4) A Case Study of Pricing Strategy for a European Shuttle Operation, Hugh Dunleavy**, 2302 Mill Lake Dr., Kingwood, TX 77339

The traditional operations of the European flag carriers have been undergoing significant change in recent years, as they attempt to redefine themselves as leaner and more cost-efficient. We present a case study of 1 attempt by a European airline to implement a self-contained, low-cost, high frequency shuttle operation.

### SD22 Product Variety Management

**Sponsor:** INFORMS Section on Manufacturing & Service Operations  
Management  
Sponsored Session

**Chair:** Teck H. Ho, UCLA, Anderson Grad. Sch. of Mgmt., 110 Westwood Plaza, Los Angeles, CA 90095-1481, teho@anderson.ucla.edu

**1) Marketing Operations Models for Product Positioning, Fangruo Chen**, Columbia Univ., Columbia Bus. Sch., Uris Hall, New York, NY 10027, *Josh Eliashberg, Paul H. Zipkin*

A firm is planning to offer a line of products to a heterogeneous market. Consumer preferences are described on an attribute-price space. The products are produced in a single facility and distributed through a conventional channel. We present several models for positioning the products on the attribute-price space.

**2) The Impact of Product Variety on Consumer Choice, Juin Chong**, 3275 N Elm Circle, Brea, CA 92821, *Teck H. Ho, Christopher S. Tang*

Using shopping data from more than 548 households over a 2-year period, we

investigate how customers' SKU and brand choice behaviors change when new extensions are introduced into and existing products are eliminated from an existing product category. Our results provide insights for retailers to better manage the breaths of their existing product categories.

**3) Some Operational Origins of the Cost of Complexity with Fixed Assets, William Lovejoy, Univ. of MI, Bus. Sch., Ann Arbor, MI 48109-1234, Kannan Sethuraman**

We analyze 3 potential sources of complexity costs with fixed assets: congestion, human error and system capability. Identifying the significant root cause(s) of complexity costs is important since the appropriate prescriptions vary among them. We propose a model that captures interdependencies among these causes, which is a necessary first step in mapping causes to financial effects...

**SD23 Management of Paced Assembly Systems**

Cluster: Manufacturing & Service Management

Invited Session

Chair: George Vairaktarakis, Marquette Univ., Coll. of Bus. Admin., Milwaukee, WI 53201-1881, vairaktarakis@vms.csd.mu.edu

**1) Worker Training for Synchronous Assembly Lines, Janice Kim-Winch, Pace Univ., Sch. of Bus., One Pace Plaza, New York, NY 10038, George Vairaktarakis**

We consider a paced assembly line with a cross-trained workforce where each worker can handle a number of stations. Given a set of jobs with various workforce requirements, we describe methods to find the sequence of jobs which minimizes the number of workers required over all production cycles.

**2) Stochastic Paced Assembly Lines with WIP Holding Costs, Chung-Lun Li, Washington Univ., Olin Sch. of Bus., 1 Brookings Dr., St. Louis, MO 63130, lichung@olin.wustl.edu, Hau L. Lee, Meir J. Rosenblatt**

We consider a design problem on stochastic paced assembly lines with WIP holding costs. A series of activities are performed on each product unit in the various workstations. Activity times are stochastic and after each activity, the value of the product is increased. We optimize expected profit per unit time.

**3) Stochastic Programming Applications in Optimal Pacing of a Flexible Assembly System with Random Yield, John J. Liu, Univ. of WI, Sch. of Bus., Milwaukee, WI 53201, jjl@csd.uwm.edu**

The periodic pacing problem of a flexible assembly system with random yield is formulated as a dynamic programming model. With variable processing rates and product failure rates at each stage, the overall capacity of the system can be significantly affected by the pacing (or buffering) at each stage.

**4) Workforce Planning in Paced Assembly Systems, George Vairaktarakis, Marquette Univ., Coll. of Bus. Admin., Milwaukee, WI 53201-1881, vairaktarakis@vms.csd.mu.edu, X. Q. Cai, Chung-Yee Lee**

We consider a paced assembly system where each job visits a subset of the assembly stations. Each job operation requires a known number of workers in order to be completed within a production cycle. We want to minimize the total workforce required for a given length of the production horizon.

**SD24 Decision Analysis IV**

Contributed Session

Chair: Robert W. Lawler, The Boeing Co., 17513 155th Ave. SE, Renton, WA 98058, robert.w.lawler@boeing.com

**1) Decision Analysis for Next Generation Airspace Management, Robert W. Lawler, The Boeing Co., 17513 155th Ave. SE, Renton, WA 98058, robert.w.lawler@boeing.com**

We discuss the progress in the use of DA to evaluate the effectiveness of satellite and IT alternatives in increasing the capacity and efficiency of managed airspace. Evaluation includes technical and political risk in transition from the current centralized control concept to a more autonomous concept.

**2) Decision Analysis & Market Studies: A Case of Quality & Purity of Observations, Roberto Ley-Borras, Inst. Tecnológico Orizaba, Oriente 9 No. 852, Orizaba Veracruz, 94320, Mexico, roley@bestit.dgit.seit.mx**

In a DA framework, a market study is an observation about probabilistic variables that can be characterized by its quality (accuracy) and purity (absence of side effects). I explore several types of market studies.

**3) Another Look at the Multiattribute Utility Scaling Constant, Jennifer L. Meyer, Strategic Decisions Group, 2440 Sand Hill Rd., Menlo Park, CA 94025-6900, jmeyer@sdgnet.com, Richard M.**

**Bradford**

In a multiattribute utility function, the overall scaling constant  $k$  captures information about attribute substitutability as well as about utility indifference curve convexity. Convexity information can be useful when making multiattribute assessments, particularly when preferences are plotted in what we call  $p$ -space. We present some insights available using that approach.

**4) Measures of Perceived Risk, Jianmin Jia, Chinese Univ. of Hong Kong, Dept. of Mktg., Shatin NT, Hong Kong, jjia@cuhk.edu.hk, James S. Dyer, John C. Butler**

We present measures of perceived risk by considering a 2-dimensional structure, the mean of a lottery and its standard risk. Our risk measurement models unify a large body of empirical evidence and can be incorporated into preference models, i.e., based on risk-value tradeoffs, in a clear fashion.

**SD25 The Use of Spreadsheets in Teaching OR/MS**

Sponsor: INFORMS Forum on Education

Sponsored Session

Chair: Thomas A. Grossman, Univ. of Calgary, 2500 University Dr. NW, Fac. of Mgmt., Calgary, Alberta, T2N 1N4, Canada, grossman@mgmt.ucalgary.ca

**1) Beyond What If, Jeffrey D. Camm, Univ. of Cincinnati, Dept. of Quant. Analysis & OM, PO Box 210130, Cincinnati, OH 45221-0130, jeff.camm@uc.edu**

The advantages of spreadsheet models in the instruction of MS have been well discussed. We will discuss and demonstrate a major advantage that has received little attention: the integrative power of OR in spreadsheets, namely seamless combination of data management, forecasting, simulation, optimization and report generation.

**2) Teaching OR Using Spreadsheets: Making the Transition from the Traditional Approach, Thomas A. Grossman, Univ. of Calgary, 2500 University Dr. NW, Fac. of Mgmt., Calgary, Alberta, T2N 1N4, Canada, grossman@mgmt.ucalgary.ca**

The fact that one can do OR in spreadsheets is well-known and is receiving extensive promotion. We discuss benefits and costs of using a spreadsheet vs. an algebraic representation of OR models. We share lessons learned regarding the needs of business students and challenges for instructors when making the transition to teaching with spreadsheets.

**SD26 Applied Probability**

Sponsor: INFORMS Applied Probability Section

Sponsored Session

Chair: Soren Asmussen, Univ. of Lund, Dept. of Math. Stats., Lund, Sweden

**1) A Markov Modulated Multiperiod Model for Prices in Financial Markets, Mogens Bladt, IIMAS-UNAM, Apt. Postal 20-726, 01000 DF, Mexico**

We present a general multiperiod financial model in discrete time that allows for changes in the risk-free interest rate over time. The idea is to let a Markov chain govern the present interest rate so changes in the interest rate are made accordingly to transition probabilities. This makes it possible to study the consequences that phenomena have on the pricing on securities and derivative securities...

**2) Moments for Steady-State Delay in Generalized Jackson Networks, Karl Sigman, Columbia Univ., Dept. of IE/OR, New York, NY 10027, Alan-Scheller Wolf**

We present a proof that finite moments of delay and sojourn times in stable generalized Jackson networks have finite  $k$ -th moment if service times at each node have finite  $k+1$  th moments. This complements known moment results for total queue length.

**3) Rare Events Simulation for Heavy-Tailed Distributions, Soren Asmussen, Univ. of Lund, Dept. of Math. Stats., Lund, Sweden**

For light-tailed distributions, rare events simulation is usually performed using importance sampling via exponential change of measure. This approach can be justified from the principle of simulating from a distribution close to the conditional distribution given the rare event, as described for example by large deviations limit results...

**4) Solutions of a Nonpreemptive Priority Multiserver Queue with Multiple Servers & Multiple Priority Classes, Edward P. C. Kao, Univ. of Houston, Dept. of Dec. & Info. Sci., Houston, TX 77204-6282, Sandra D. Wilson**

We consider a Markovian queue with multiple servers and multiple priority classes. A higher priority customer has nonpreemptive priority over lower

priority customers. We consider alternative methods for modeling and solving the problem; i.e., state reduction, the power-series approach and use of generation function. We discuss issues concerning implementation and relative merits.

### SD27 Analysis of Stochastic Systems Using Simulation

Sponsor: INFORMS College on Simulation

Sponsored Session

Chair: Sigrun Andradottir, GA Inst. of Tech., Sch. of ISyE, Atlanta, GA 30332-0205

#### 1) On Finite Exponential Moments & Simulation-Based Derivative Estimation in GSMPs, *Marvin Nakayama*, NJIT, Dept. of Comp. & Info. Sci., Newark, NJ 07102, marvin@cis.njit.edu, *Perwez Shahabuddin*

One condition that ensures the validity of the likelihood ratio method of derivative estimation for finite time GSMPs requires that it have finite moment generating function in some neighborhood of 0. Using the theory of branching processes, we formally prove the fact that this is the case for a large class of GSMPs.

#### 2) Towards Automating Efficiency Improvements in Stochastic Simulation, *Shane Henderson*, Univ. of MI, Dept. of IOE, Ann Arbor, MI 48109-2117, shaneioe@engin.umich.edu

Because some expert knowledge is required to effectively implement efficiency improvement techniques, including variance reduction methods in simulation, their use is not widespread. We discuss the new approximating Markov process method and outline our approach for moving towards the goal of automatic efficiency improvement in commercial simulation software.

#### 3) Applying Bayesian Ideas in Simulation, *Sigrun Andradottir*, GA Inst. of Tech., Sch. of ISyE, Atlanta, GA 30332-0205, *Vicki M. Bier*

We explore the incorporation of prior distributions into the analysis of simulation results. Specifically, we study the use of Bayesian statistics for simulation validation, for output analysis and for quantifying the effects of input uncertainties. We believe the Bayesian approach will yield improved analyses when the prior distributions are reliable.

### SD28 Continuous Location Problems

Cluster: Location Analysis

Invited Session

Chair: Atsuo Suzuki, Nanzan Univ., Dept. Info. Sys. & Quant. Sci., 18 Yamazato-Cho, Showa-ku, Nagoya, 466, Japan, atsuo@iq.nanzan-u.ac.jp

#### 1) Decision Analysis in Facility Location, *Zvi Drezner*, CA State Univ., Grad. Sch. of Mgmt., Irvine, CA 92697, zdrezner@fullerton.edu

A location problem with future uncertainties about the data is considered. Several possible scenarios about the future values of the parameters are postulated. However, it is not clear which of these scenarios will actually happen. We find the location that will best accommodate the possible scenarios. The solution for the squared Euclidean distance is explicitly found.

#### 2) Voronoi Diagram as a Tool for Space Analysis, *Kokichi Sugihara*, Univ. of Tokyo, Dept. Math. Eng./Info. Phys., 7-3-1 Hongo, Bunkyo-ku, Tokyo, 113, Japan, sugihara@simplex.t.u-tokyo.ac.jp

The concept of the Voronoi diagram, various kinds of its generalizations and the methods for computing them are surveyed from a user point of view. Particular emphasis is placed on the Voronoi diagrams on a sphere, which will be useful for facility layout on a global scale.

#### 3) On the Voronoi Heuristics for the p-Median Problem on the Sphere, *Atsuo Suzuki*, Nanzan Univ., Dept. Info. Sys. & Quant. Sci., 18 Yamazato-Cho, Showa-ku, Nagoya, 466, Japan, atsuo@iq.nanzan-u.ac.jp, *Asuka Kondo*

A heuristic method for the p-median problem on the sphere is presented. An effective algorithm to construct the Voronoi diagram on the sphere is used for the heuristic method. We show that by the heuristic method, a p-median problem of practical size is solved approximately with reasonable computational time.

#### 4) A Computational Method for Optimizing the Hierarchy & Spatial Configuration of Successively Inclusive Facilities on a Plane, *Tsutomu Suzuki*, Univ. of Tsukuba, Inst. of Policy/Planning Sci., 1-1-1 Ten-nodai, Tsukuba, Ibaraki, 305, Japan, tsutomu@shako.sk.tsukuba.ac.jp, *Atsuyuki Okabe*, *Kei-ichi Okunuki*

We show a computational method for optimizing a system of successively

inclusive hierarchical facilities on a continuous plane. The system is optimized with respect to not only the configuration of ranked facilities but also its hierarchical structure. Numerical experiments will be also shown.

### SD29 Service Management IV

Contributed Session

Chair: Jukka Kallio, Helsinki Sch. of Econ., Runeberginkatu 14-16, Helsinki, 00100, Finland, jkalli@hkkk.fi

#### 1) Value Added Services for Competing with Payment Systems in Retail Banking, *Jukka Kallio*, Helsinki Sch. of Econ., Runeberginkatu 14-16, Helsinki, 00100, Finland, jkalli@hkkk.fi, *Timo O. Saarinen*, *Ari Vepsäläinen*

Based on the efficiency measurements of payment services of 3 major banking groups in Finland, options for additional competitive services are analyzed and feasible service packages are identified for different types of customer groups.

#### 2) Combining Dominant Value Disciplines: Perspective from the Financial Services Industry, *Diana L. Watts*, De Baak Mgmt. Ctr., Koningsin Astridboulevard 23, Noordwijk, 2202BJ, The Netherlands, ile@debaak.nl, *Ellen Cristiaanse*

Information-intensive service industries such as banks and insurance companies, due to increasingly competitive global markets, confront 2 significant challenges: to restructure their back office processes for more efficiency and to simultaneously convert their front office processes into more customer-oriented delivery systems (Zaheer & Venkatraman, 1993)...

#### 3) The Overbooking Problem in Hotels with Multiple Tour-Operators, *George C. Hadjinicola*, Univ. of Cyprus, Dept. of Public & Bus. Admin., kallipoleos 75, Nicosia, CY1678, Cyprus, bageorge@atlas.pba.ucy.ac.cy

We examine the overbooking policy of hotels which allocate their capacity to tour-operators, who through the vacation packages they offer, fill the hotel's capacity. We show that an overbooking policy gives better cost savings when applied at the hotel level than the operator level.

#### 4) The Competition Between Letter Mail & Electronic Communication Services, *Heikki Nikali*, Helsinki Sch. of Econ., Finland Post PO Box 5, Helsinki, 00011, Finland, heikki.nikali@posti.telebox.fi

Competition will be considered using demand models and factors affecting the choice of communication form. The extent to which the volume of letters has already been substituted by electronic communication has been estimated by econometric means. The modes under consideration are letters, ePOST, telefax machines, e-mail, EDI and Internet.

### SD30 Manpower & Personnel

Sponsor: INFORMS Military Applications Society

Sponsored Session

Chair: Ben Buclatin, Navy Personnel R&D Ctr., 53335 Ryne Rd., San Diego, CA 92152, buclatin@nprdc.navy.mil

#### 1) Class Scheduling Algorithms for Navy Training Schools, *Jeffery L. Kennington*, SMU, CSE Dept., PO Box 750122, Dallas, TX 75275-0122, jlk@seas.smu.edu

Based on the forecast demand for courses, the manager of a Navy school develops a schedule of class offerings. Until recently, this was done manually. We present an empirical evaluation of new algorithms for creating good class schedules for both C-schools and A-schools.

#### 2) Navy Mobilization Manpower Model, *Michael R. Shoecraft*, Navy Personnel R&D Ctr., 53335 Ryne Rd., San Diego, CA 92152

The Navy Personnel R&D has developed a large minimum cost network flow model to match the Navy's peacetime work force and the mobilization manpower needs. We present results from the application of this model to several mobilization scenarios.

#### 3) Improving Navy's Personnel Assignment Process Using Optimization Algorithms, *Ben Buclatin*, Navy Personnel R&D Ctr., 53335 Ryne Rd., San Diego, CA 92152, buclatin@nprdc.navy.mil

Many complex, frequently conflicting and often changing rules and policies drive the Navy's enlisted personnel assignment process. Short-term readiness goals, e.g., skill utilization and filling high priority jobs in the Fleet, usually conflict with long-term readiness objectives, e.g., retaining high performing sailors by satisfying their geographic location preferences...

#### 4) Assignment of Naval Personnel: Integrating Mathematical Programming Models, *Agha Iqbal Ali*, Univ. of MA, Dept. of Finance & OM, Sch. of Mgmt., Amherst, MA 01003, ali@ece.umass.edu

A factor contributing to the complexity of assigning naval personnel to available jobs is the unavoidable presence of potentially conflicting goals. Multicriteria assignment models can be used to assess trade-offs existing among goals and aid in making assignments. We focus on the use of mathematical programming models to provide information that facilitates making assignments...

### SD31 Managing Change in a Turbulent Environment

Sponsor: INFORMS Military Applications Society

Sponsored Session

Chair: James H. M. Malley, Sanders, a Lockheed Martin Co., MS PTP02-C001, PO Box 868, Nashua, NH 03061-0868, jmalley@sanders.com

1) **Optimization of Air Defense Engagements/Weapons to Target Allocation**, *Robert Schiemann*, Sanders, a Lockheed Martin Co., MS NHQ01-0423, PO Box 868, Nashua, NH 03061-0868, rschiema@mailgw.sanders.lockheed.com

We discuss and present results of applying classic non-linear, DP techniques to the complex problem of optimizing the allocation of weapons/munitions to multiple-type air targets. The discussant will demonstrate how the various considerations/parameters associated with air defense are factored into the analysis; i.e., air target types (TBM, high and low altitude cruise missiles)...

2) **Consortium Leadership & Management for the Army Federated Laboratory**, *James H. M. Malley*, Sanders, a Lockheed Martin Co., MS PTP02-C001, PO Box 868, Nashua, NH 03061-0868, jmalley@sanders.com

The US Army, in response to the separate requirements to improve the capabilities of Force XXI to win the information war by digitization of the battlefield and to significantly improve the performance and relevancy of Army research capabilities has undertaken a unique initiative under the leadership of the US Army Research Laboratory...

### SD32 Network Design Aspects about SONET

Sponsor: INFORMS Technical Section on Telecommunications

Sponsored Session

Chair: Moshe Rosenwein, AT&T, 101 Crawfords Corner Rd., Rm.3J-321, PO Box 3030, Holmdel, NJ 07733-3030, mbr@gpc2.att.com

1) **Design of Robust Transport Networks with SONET/SDH Toolkit**, *Iraj Saniee*, BELLCORE, 445 South St., MCC1A-328B, Morristown, NJ 07960

SONET Toolkit is an optimization-based software for the design of large-scale survivable transport networks used by several RBOCs as well as IXCs and PSTN planners outside the US since 1992. We report on the general methodology of this tool and summarize experiences of its users on a variety of design scenarios.

2) **ATM Network Design & Reliability**, *Brunilde Sanso*, GERAD & Ecole Polytech. de Montreal, CRT, 3000 Cote-Ste.-Catherine, Montreal, Quebec, Canada H3C 3A7, bruni@crt.umontreal.ca, *Stephane Krau*

The literature of ATM networks and reliability does not show a clear consensus on what to do in the event of failures and what is the most cost-effective way to protect the system from such an event. We provide a critical overview on this issue.

3) **The Problem of Redesigning Local Access Networks**, *Linos F. Frantzeskakis*, AT&T Labs., 101 Crawfords Corner Rd., Rm. 3K-320, PO Box 3030, Holmdel, NJ 07733-3030, *Hanan Luss*

We demonstrate a network flow model that allows for the representation of an embedded network with multiple source nodes and a single sink node, and 2 types of facilities exhibiting economies-of-scale. This model can be used to redesign local access telecommunication networks in light of new demands, new homing arrangements or new costs.

4) **Topological Network Design for SONET Ring Architecture**, *Moshe Rosenwein*, AT&T, 101 Crawfords Corner Rd., Rm.3J-321, PO Box 3030, Holmdel, NJ 07733-3030, mbr@gpc2.att.com, *Hanan Luss*, *Richard T. Wong*

We describe a heuristic approach, based on a set covering formulation for designing a SONET ring network comprised of interconnected rings. This network can ensure instantaneous restoration of service in case of a single link or single node failure. We present computational results for realistic-size telecommunication networks.

### SD34 Consistency & the Analytic Hierarchy Process

Cluster: Choice Engineering

Invited Session

Chair: Jonathan Barzilai, Tech. Univ. of Nova Scotia, PO Box 1000, Halifax, Nova Scotia, B3J 2X4, Canada, barzilai@tuns.ca

1) **Normative & Behavioral Implications of Traditional, Linking Pin & Multiplicative AHP**, *Bertram Schoner*, Simon Fraser Univ., Fac. of Bus. Admin., Burnaby, BC, V5A 1S6, Canada, bertram.schoner@sfu.ca, *Eng Ung Choo*, *William C. Wedley*

Linking pin AHP and multiplicative AHP have been introduced to address problems with traditional AHP. Nevertheless, the issues of which, if any, of the 3 approaches yields correct, i.e., consistent with DMs' preferences, priorities remains contentious. We examine the behavioral implications of these approaches and comments on their intuitive rationality.

2) **Measures of Inconsistency for Ratio Judgment Matrices**, *David Budesu*, Univ. of IL, Dept. of Psychology, 603 E Daniel St., Champaign, IL 61820, dbudesu@s.psych.uiuc.edu, *Bradley D. Crouch*

Tests of inconsistency for ratio judgment matrices rely upon measures linked to specific scaling algorithms and assume uniformity of random judgments. These tests are inaccurate under other plausible distributions. New measures that are independent of the solution method and are sensitive to the observed distributions are proposed.

3) **Geometric-Mean Aggregation & the Relative Importance of the Criteria in the Multiplicative AHP**, *Freerk A. Lootsma*, Delft Univ. of Tech., Fac. of Tech. Math & Info., Mekelweg 4, Delft, 2628 CD, The Netherlands, f.a.lootsma@twi.tudelft.nl

We base the geometric-mean aggregation rule of the multiplicative AHP upon the argument that the decision makers weigh the tradeoffs between benefits and losses along an indifference curve, not in an absolute sense, but in proportion to the actual levels of benefits and losses.

4) **Consistency Measures for Pairwise Comparison Matrices**, *Jonathan Barzilai*, Tech. Univ. of Nova Scotia, PO Box 1000, Halifax, Nova Scotia, B3J 2X4, Canada, barzilai@tuns.ca

We propose new measures of consistency of additive and multiplicative pairwise comparison matrices. These measures have clear algebraic and geometric interpretation and properties and are related to one another by the theorem of Pythagoras through the decomposition of comparison matrices into their consistent and error components.

### SD36 How to Navigate a National Meeting

Sponsor: INFORMS Membership & Member Services Committee

Sponsored Session

Chair: Robert L. Armacost, Univ. of Central FL, Dept. of IE & Mgmt. Systems, Orlando, FL 32816, armacost@pegasus.cc.ucf.edu

Co-Chair: Julia Pet-Edwards

1) **How to Navigate a National Meeting!**, *Robert L. Armacost*, Univ. of Central FL, Dept. of IE & Mgmt. Systems, Orlando, FL 32816, armacost@pegasus.cc.ucf.edu, *Julia Pet-Edwards*

This workshop helps to unravel the perceived mystery of national meetings for first time attendees. Particular focus is given to handy ways to find the right sessions and meetings.

### Sunday 16:30-18:00

#### SE04 Criminal Justice & Drug Policy

Cluster: Public Sector Applications

Sponsor: INFORMS Section on Public Programs & Processes

Sponsor/Invited Session

Chair: Jonathan P. Caulkins, Carnegie Mellon Univ., The Heinz Sch., Rm. 2101, Hamburg Hall, 5000 Forbes Ave., Pittsburgh, PA 15213, caulkins@andrew.cmu.edu

1) **Providing Technical Assistance to City Police Departments Using Artificial Intelligence Case-Based Retrieval Techniques**, *Michael Redmond*, Rutgers Univ., Comp. Sci. Dept., Camden, NJ 08102, redmond@crab.rutgers.edu, *Alok Baveja*

Advanced algorithms from computer science research in CBR are used to identify similar communities in terms of economics, crime, police resources, etc., for police officials, helping them to develop colleague networks. Police derive a variety of important benefits by sharing and learning from other cities'

experiences.

2) **Modeling Street-Level Illicit Drug Markets**, *Jacqueline Cohen*, Carnegie Mellon Univ., The Heinz Sch., 5000 Forbes Ave., Pittsburgh, PA 15213, jc63+@andrew.cmu.edu, *Wilpen Gorr*, *Andreas Olligschlaeger*

We apply GISs and spatial econometrics in modeling illegal firearm use in urban areas. Of particular interest are incidents involving youths, the ecology of crime and the impacts of enforcement. Base data include individual 911 calls and police incident reports, parcel-level land use data and census data.

3) **Measuring the Cost-Effectiveness of Drug Prevention**, *Jonathan P. Caulkins*, Carnegie Mellon Univ., The Heinz Sch., Rm. 2101, Hamburg Hall, 5000 Forbes Ave., Pittsburgh, PA 15213, caulkins@andrew.cmu.edu, *Peter Rydell*, *Susan Everingham*

Drug use by youth fell steadily and substantially between 1979 and 1992 but has risen very dramatically in the last 4 years, stimulating considerable interest in drug prevention. Is drug prevention effective? This presentation seeks to answer that question by modeling "careers" of drug use.

## SE05 Linear Programming & Decision Making

Cluster: Linear Programming

Invited Session

Chair: H. F. Wang, Ntl. Tsing Hua Univ., Dept. of IE, Hsinchu, Taiwan, ROC, hfwang@ie.nthu.edu.tw

Co-Chair: S.-C. Fang

1) **Decision Procedure in Project Management**, *H. F. Wang*, Ntl. Tsing Hua Univ., Dept. of IE, Hsinchu, Taiwan, ROC, hfwang@ie.nthu.edu.tw

We took an economic viewpoint to analyze different operation strategies in project management and proposed a general procedure to schedule, control, monitor and evaluate a project when inflation is either considered with linear or ladder type or without.

2) **Spare Capacity Planning for Network Restoration: Tabu Search Approach**, *U. P. Wen*, Ntl. Tsing Hua Univ., Dept. of IE, Hsinchu, Taiwan, ROC, upwen@ie.nthu.edu.tw

Since finding an optimal deployment of network spare capacity by LP approach is NP-hard, the TS algorithm is proposed to find an approximate optimal solution. Several cases from Telecommunication Lab, Taiwan, will be tested and discussed.

3) **Linear Optimization with Fuzzy Relation Equations**, *G. Li*, NC State Univ., OR Dept., Box 7913, Raleigh, NC 27695-7913, gli2@eos.ncsu.edu

An optimization model with a linear objective function subject to a system of fuzzy relation equations is presented. The basic theory and a solution procedure are provided.

4) **Solving Fuzzy Inequalities with Concave Membership Functions**, *C. F. Hu*, NC State Univ., Dept. of OR, Raleigh, NC 27695-7913, chul@eos.ncsu.edu

We show that a system of of fuzzy inequalities with concave membership functions can be converted to a regular convex programming problem. A method of centers with entropic regularization techniques is proposed for solving such a problem.

## SE06 Sequential Diagnosis

Cluster: Combinatorial Optimization

Invited Session

Chair: Endre Boros, Rutgers Univ., RUTCOR, PO Box 5062, New Brunswick, NJ 08903-5062, boros@rutcor.rutgers.edu

1) **Optimal Sequential Inspection of Complex Reliability Systems with Uncertain Structure Functions & Component Reliabilities**, *Tony Cox*, Cornerstone Consulting, 999 18th St., Denver Place S Tower Ste. 3220, Denver, CO 80202, tonycox@cnrstn.com, *Steve Y. Chiu*, *Xiaorong Sun*

Consider a k-out-of-n reliability system in which k is a random variable with a known PDF,  $Pr(k)$  and component failure probabilities are random variables. It costs  $c(i)$  to inspect component  $i$ . What inspection strategy minimizes the expected cost of identifying failed components? We present a solution and its generalizations.

2) **Optimal Sequential Inspections of Reliability Systems Subject to Parallel-Chain Precedence Constraints**, *Xiaorong Sun*, Lucent Bell Labs., 101 Crawfords Corner Rd., Holmdel, NJ 07733,

xsun@lucent.com, *Steve Y. Chiu*, *Louis A. Cox, Jr.*

We consider optimal sequencing of inspections in a coherent system with precedence constraints. Optimal inspection strategies are presented for certain k-out-of-n systems when there are parallel-chain precedence constraints among the possible component inspections.

3) **Optimal Diagnosis Procedures for Doubly-Regular Systems**, *Tonguc Unluhurt*, Rutgers Univ., RUTCOR, PO Box 5062, New Brunswick, NJ 08903-5062, tonguc@rutcor.rutgers.edu, *Endre Boros*

Generalizing k-out-of-n systems, we consider doubly-regular systems and present an algorithm which outputs a testing strategy in polynomial time, minimizing the average testing cost of such a system.

## SE07 Computation of Economic Equilibria

Cluster: Nonlinear Programming

Invited Session

Chair: Anna Nagurney, Univ. of MA, Sch. of Mgmt., Amherst, MA 01003

1) **Computational Methods for Dynamic, Stochastic Infinite Horizon General Equilibrium Models**, *Kenneth L. Judd*, Hoover Inst., Stanford, CA 94305

We present a model of dynamic general equilibrium with uncertainty with a finite number of agents, each of which lives forever, with a finite number of assets and a finite number of goods. We illustrate ways to solve for the competitive equilibrium of such models, methods which can be implemented on desktop computer. We apply these methods to policy analyses...

2) **Computing Equilibria in the General Equilibrium Model with Incomplete Asset Markets & Transaction Costs**, *B. Curtis Eaves*, Stanford Univ., Dept. of OR, Stanford, CA 94305, bceaves@soe.stanford.edu, *Karl Schmedders*

We develop a homotopy algorithm for the computation of equilibria in the GEI model with linear transaction costs. Using this algorithm, we can address important questions regarding transaction costs such as their impact on asset innovation.

3) **Projected Dynamical Systems Modeling & Computation of International Financial Equilibria**, *Anna Nagurney*, Univ. of MA, Sch. of Mgmt., Amherst, MA 01003, *Stavros Siokos*

We present a projected dynamic systems model of international financial equilibrium. Stability analysis results are given along with a discrete time algorithm for computational purposes with convergence results. Numerical examples are also provided.

## SE08 OR/MS in Forestry I

Cluster: Integer Programming

Invited Session

Chair: Andres F. Weintraub, Univ. of Chile, Dept. of IE, PO Box 2777, Santiago, Chile, aweintr@dii.uchile.cl

1) **Combinatorial Algorithms in Spatial Forest Problems**, *Andres F. Weintraub*, Univ. of Chile, Dept. of IE, PO Box 2777, Santiago, Chile, aweintr@dii.uchile.cl, *Monique Guignard*, *Rafael Epstein*

Important problems in forest planning have spatial characteristics in harvesting patterns, road building and machine location. This leads to combinatorial models. We discuss proposed solution approaches which include heuristic algorithms such as TS, SA and random search and mathematical models solved via Lagrangean relaxation and column generation.

2) **Medium Term Stand Level Planning: Objective Function & Optimization**, *Eldon A. Gunn*, Tech. Univ. of Nova Scotia, Dept. of IE, PO Box 1000, Halifax, Nova Scotia, B2Y 3M5, Canada, gunn@risc.ie.tuns.ca, *Evelyn Richards*

We examine the problem of which stands to harvest (and when) so as to get the harvest volumes prescribed by upper level models in the hierarchy while maximizing biological productivity and minimizing road building costs. We use a tradeoff curve approach to deal with these incommensurable objectives and a TS algorithm for the optimization.

3) **Forest Planning & Steiner Tree Extensions**, *Alan T. Murray*, Queensland Univ. of Tech., Fac. of Built Environ. & Eng., GPO Box 2434, Brisbane Queensland, 4001, Australia, a.murray@qut.edu.au, *Richard L. Church*

This presentation deals with a forest planning problem which must locate tower units for harvesting timber and plan access roads connecting the tower units to exit locations on a grid surface. This problem is an extension of the Steiner tree problem. We have modeled the problem as a network flow problem and solve it

using Lagrangian relaxation.

**4) Solving Spatial Adjacency Optimization by Use of Simulated Annealing & Linear Programming in Forest Management Planning, Peter Tarp, Royal Veterinary & Agri. Univ., Dept. of Econ. & Agri., 57 Thorvaldsensvej, Copenhagen, DK 1871, Denmark, peter.tarp@flec.kvl.dk, Finn Helles**

Forest management planning comprises selection among treatment alternatives in area units. A combined SA adjacency and LP model based on observation of adjacency constraints and net present value maximization is presented delineating optimal final felling strategies. The model contributes to reducing damage costs and improves the reliability of planning.

**SE09 Scheduling with Due Dates or Deadlines**

Cluster: **Scheduling**  
Invited Session

Chair: Valery Gordon, Inst. of Eng. Cybernetics, Academy of Sci. of Belarus, 6 Surganov Str., Minsk, 22001, Belarus, gordon@newman.basnet.minsk.by

**1) Scheduling a Flowshop with Arbitrary Precedence Constraints & Due Dates, Joanna Jozefowska, Poznan Univ. of Tech., Inst. of Comp. Sci., ul. Piotrowo 3A, Poznan, 60-695, Poland, jjozef@pozn.v.put.poznan.pl, Arkadiusz Zimniak**

A flow shop consisting of  $m$  stages with arbitrary precedence constraints between tasks is considered. The optimization criterion is maximum lateness. Solutions obtained by heuristic algorithms developed for this NP-hard problem have been compared with the optimal ones for reasonably-sized problems. A polynomially solvable special case has been presented.

**2) Recent Developments in the Single Machine Total Tardiness Problem Area, Włodzimierz Szwarz, Univ. of WI, Sch. of Bus. Admin., PO Box 742, Milwaukee, WI 53201, wmr@csd.uwm.edu, Federico Della Croce**

We discuss the most recent research conducted by several authors to develop algorithms that efficiently handle problems with well over 100 jobs. The algorithms presented are based on a variety of decomposition techniques.

**3) Single Machine Scheduling with Due Date Assignment, Valery Gordon, Inst. of Eng. Cybernetics, Academy of Sci. of Belarus, 6 Surganov Str., Minsk, 22001, Belarus, gordon@newman.basnet.minsk.by**

Single machine scheduling problems are considered with given processing times of jobs. Due dates are supposed to be assigned. The objective functions are maximal tardiness (preemptive case of the problem) or the weighted number of late jobs (nonpreemptive and preemptive cases).

**SE10 Production Scheduling V**

Contributed Session

Chair: Anindya Datta, Univ. of AZ, MIS Dept., 430 McClelland Hall, Tucson, AZ 85721, adatta@loochi.bpa.arizona.edu

**1) Modeling Queues in Real-Time Systems, Anindya Datta, Univ. of AZ, MIS Dept., 430 McClelland Hall, Tucson, AZ 85721, adatta@loochi.bpa.arizona.edu, Anand Iyer**

We present a queuing model for real-time systems where jobs arrive with deadlines for service completion.

**2) A Production Planning & Control System for the Brewing & Beverage Industry, Mark Scharbrodt, TU Muenchen, Inst. for Brewery Installation, Freising-Weißenstephan, Bavaria, 85350, Germany, scharbro@blv.blm.tu-muenchen.de**

We present a conception of a production planning and control system for the brewing and beverage industry. The main ingredient is a tool for machine scheduling which operates closely linked to the production process. We discuss how scheduling will be affected by the system architecture and by production constraints.

**3) An Integrated Scheduling Methodology for a Two-Stage Manufacturing Operation, Neale R. Smith, GA Inst. of Tech., 1700 Golden Gate Dr., Apt. H3, Atlanta, GA 30309, nsmith@isy.gatech.edu, Paul M. Griffin, Christos Alexopoulos**

A heuristic approach is presented for scheduling production through 2 linked manufacturing stations. The first station cuts stock to be packaged in the same sequence at the second. The heuristic seeks a minimum cost solution, taking into account the cutting stock requirements and sequence dependent costs at both stations.

**4) Scheduling from a Manager's Perspective, Patricia M. Snyder, Univ. of WA, 917 Pacific Ave., Ste. 501, Tacoma, WA 98402,**

pmsnyder@u.washington.edu, William M. Marshall

We treat scheduling from the managerial perspective of seeking to reduce both labor and scrap material cost. Problem complexities include sequence dependent changeover times, product specific material costs and a commitment to meeting due dates. Our software system uses both explicit enumeration and SA to provide a good schedule.

**SE12 Neural Networks: Applications**

Sponsor: **INFORMS CSTS**

Sponsored Session

Chair: Xiaoyun Sun, BehavHeuristics Inc., 7240 Parkway Dr., Ste. 170, Hanover, MD 21076, sxun@glue.umd.edu

**1) Extracting Symbolic Rules from Multi-Layered Networks, S. Monica Lam, CA State Univ., MIS Dept., 6000 J St., Sacramento, CA 95819-6088, lamsm@csus.edu**

An algorithm RE is proposed to extract symbolic classification rules from trained, feedforward and arbitrarily configured neural networks. The input to RE is a set of connection weights from a trained neural network, the output is classification rules which can be used to predict new cases and to explain the classification procedure.

**2) Commodity Trading Using Neural Networks: Models for the Gold Market, Judith Dayhoff, Univ. of MD, Inst. for Systems Research, College Park, MD 20742, dayhoff@isr.umd.edu, Erik Brauner, Xiaoyun Sun**

A realistic trading model to evaluate forecasting performance is essential to building a good financial forecasting model. Using gold trading for our test bed, we present a trading model which gives a profit measurement based on forecasts of gold prices 1 day in advance. With this as our basis, we present a number of novel approaches to training neural networks to predict the price of gold...

**3) A Neural Network Model for Rain Rate Prediction, Xiaodong Guan, Univ. of MD, Inst. of Systems Research, Dept. of Math., College Park, MD 20742, guan@math.umd.edu, Benjamin Kedem, Eric Slud, David Short**

A probabilistic classification neural network model and its learning algorithms are proposed. The model is applied to the rain rate time series combined with the partial likelihood concept in statistics. It successfully predicts the level of the rain rate based on NASA data.

**4) Novel Training Schemes for Large-Scale Neural Networks in Airline Forecasting, Xiaoyun Sun, BehavHeuristics Inc., 7240 Parkway Dr., Ste. 170, Hanover, MD 21076, sxun@glue.umd.edu, Erik Brauner**

Good forecasting of future passenger demand for tickets is essential to good revenue management in the airline industry. BehavHeuristics has pioneered the use of large scale neural networks for this purpose, frequently using networks with over 30,000 nodes. Training such large networks to identify complicated behavior such as seasonality effects, holiday effects and traffic patterns requires novel approaches...

**SE13 Data Mining**

Sponsor: **INFORMS CSTS**

Sponsored Session

Chair: Kristin P. Bennett, RPI, Math. Sci. Dept., Troy, NY 12180, bennek@rpi.edu

**1) Searching for Patterns & Anomalies in an Audit Log of Clinical Events, Richard J. Gallagher, Columbia Univ., Dept. of Medical Informatics, 161 Ft. Washington Ave., New York, NY 10032, gallric@cucis.cis.columbia.edu, Soumitra Sengupta, Randolph C. Barrows, George Hripcsak, Paul D. Clayton**

At Columbia Presbyterian Medical Center, we log and analyze usage of computer applications that are used to enter, read and modify patient records in order to monitor whether users are accessing only information for which they have legitimate needs. We present the methods for and results of these activities.

**2) Mining Service Maintenance Data: What to Look For, Ozden Gur Ali, General Electric R&D, K1-5C10A, PO Box 8, Schenectady, NY 12301, gurali@crd.ge.com, Pratap Khedkar**

We give examples of data mining analyses that we have found to be useful when dealing with service/maintenance data. We will outline the generic service/maintenance data model and different business purposes this data can be utilized to support.

**3) Searching Large Hypothesis Spaces: A Genetic Algorithm for Investigating the Desert Storm Syndrome, Hemant K. Bhargava, Naval Postgrad. Sch., Code SM-BH, 555 Dyer Rd., Monterey, CA**

93943, bhargava@cs.nps.navy.mil, *David L. Jacobson*

The Desert Storm conflict left as a legacy a medical mystery known as the Desert Storm Syndrome. Large amounts of medical data now exist but analysis of the data effectively involves searching a space of trillions of hypotheses. We develop a GA to select, combine and compute various candidate hypotheses.

**4) A Hybrid Analysis for Data Mining Problems via Neural Networks, Decision Trees & Statistics, Kristin P. Bennett, RPI, Math. Sci. Dept., Troy, NY 12180, bennek@rpi.edu, Mark Embrechts, Madabhushi Raghavachari**

A general methodology for integrating neural network, decision tree and statistical classification approaches is proposed. The results of each are used iteratively to improve the other, then the results are combined. A case study illustrates the hybrid methodology applied to a DSS for database marketing.

**5) Mining Nielsen Data to Support Prime Time Television Programming, William A. Wallace, RPI, Dec. Sci. & Eng. Systems, Sch. of Eng., Troy, NY 12180-3590, Mark Cannon**

Network TV ratings are computed by Nielsen Media Research using a population sample of about 15,000 viewers. Using these data for decision support for program scheduling, promo placement, etc., requires the storage and retrieval of large quantities of data, about 2,000 Mbytes per year and the presentation of these data from a variety of graphical and tabular perspectives...

## SE14 Logistics I

### Contributed Session

**Chair:** James L. Bander, Univ. of MI, 200 Eng. Programs Bldg., 2609 Draper St., Ann Arbor, MI 48109-2140, jim.bander@umich.edu

**1) Risks & Turns in Global Transportation, Jyripekka Hiltunen, Helsinki Sch. of Econ., Runeberginkatu 14-16, Helsinki, 00100, Finland, jhiltune@hkkk.fi, Ari Vepsäläinen**

We analyze the trade-offs between fast turnaround and the risks emanating from geopolitics and infrastructure in the face of Finnish timber exports to Japanese markets. The risks and turns of the delivery process are compared when Trans-Siberian Railway and Trans-Oceanic Shipping are the alternative transport routes.

**2) Scenario-Based Production Planning, Feng Cheng, IBM Corp., PO Box 218, Yorktown Heights, NY 10598, fcheng@watson.ibm.com**

One useful technique often used to deal with uncertainty is the scenario-based analysis. By performing optimization runs against different scenarios, one can gain the insight needed to plan effectively for an uncertain future. A scenario-based production planning tool is developed to improve the performance of MRP systems in an uncertain demand environment.

**3) Information Technology & Trucking, James L. Bander, Univ. of MI, 200 Eng. Programs Bldg., 2609 Draper St., Ann Arbor, MI 48109-2140, jim.bander@umich.edu, Chelsea C. White, III**

We address trends, issues and opportunities affecting the use of IT in trucking. We pay special attention to the usage of ITs by trucking firms including decision-making, adoption and effects of IT applications.

**4) A Vehicle Routing Application for Hospital Waste Collection in Fortaleza, Francisco Negreiros Gomes, Univ. Federal do Espírito Santo, R. Gil Veloso, 1710 Apto. 601, Vila Velha ES, 29101-011, Brazil, negreiro@inf.ufes.br, Marcos Jose Negreiros**

We show a VRP application for hospital waste collection that uses a stochastic and periodic heuristic procedure. Some results were obtained from the field that improved the collection at hospitals located in the city of Fortaleza, Brazil, considering such aspects as frequency of service, hours of work and average mileage traveled by loadpackers per month.

## SE15 Dynamic Programming

### Contributed Session

**Chair:** Eugene A. Feinberg, SUNY, Harriman Sch. for Mgmt., Stony Brook, NY 11794-3775, efeinber@fac.har.synsb.edu

**1) Constrained Discounted Continuous Time Jump Markov Decision Processes, Eugene A. Feinberg, SUNY, Harriman Sch. for Mgmt., Stony Brook, NY 11794-3775, efeinber@fac.har.synsb.edu**

Optimization of continuous jump Markov decision processes can be reduced to optimization of discrete time Markov decision processes. In this new reduction scheme, piecewise-constant switching policies in continuous time models correspond to randomized policies in discrete time models.

**2) Stochastic Multiproduct Inventory Model with a Shelf Size Constraint, Dirk M. Beyer, Univ. of Toronto, Fac. of Mgmt., 105**

St. George St., Toronto, Ontario, M5S 3E6, Canada, beyer@fmgmt.mgmt.utoronto.ca, *Suresh P. Sethi, Sridhar Ramaswamy*

We study a periodic multiproduct inventory problem with stochastic demands. The total inventory of all products is restricted by a shelf size constraint. For the discounted cost and the average cost criteria, we prove the existence of optimal feedback policies and describe their structure.

**3) Optimal Dynamic Pricing of Perishable Products with Stochastic Demand & a Finite Set of Prices, Richard E. Chatwin, Applied Decision Analysis, Inc., 2710 Sand Hill Rd., Menlo Park, CA 94025, rchatwin@adainc.com**

We analyze dynamically pricing inventories of perishable products when demand is price sensitive and stochastic, and the firm can choose from a finite set of prices. Under the optimal pricing policy, the firm lowers prices as the end of the horizon approaches and raises prices as inventory falls.

**4) Determining Maintenance & Replacement Policies for a Three-State Deteriorating Process with Probabilistic Monitoring, Julie Simmons, Univ. of MI, Dept. of IOE, 1205 Beal Ave., Ann Arbor, MI 48109-2117, Stephen M. Pollock**

We investigate the problem of making maintenance or replacement decisions for deteriorating systems with probabilistic monitoring. Our goal is to characterize the structure of good (if not "optimal") policies to assist the decision maker in selecting maintenance and replacement actions over a finite or infinite horizon.

**5) Graph-Theoretic Models for Financial Dynamics, Alexander Christofides, Imperial Coll., Ctr. for Quant. Finance, Exhibition Rd., London, SW7 2BX, UK, n.christofides@ic.ac.uk, Gerry Salkin, Nicos Christofides**

We describe the main stochastic partial differential equation for financial price dynamics. A graph-theoretic model which represents these dynamics in discrete space is constructed using multidimensional DP for error control. Computational results are given for pricing exotic options with specified accuracy in imperfect financial markets.

## SE16 Japanese Manufacturing in North America

**Sponsor:** INFORMS Section on Technology Management

**Sponsored Session**

**Chair:** Jeffrey Liker, Univ. of MI, Dept. of IOE, Ann Arbor, MI 48109-2117, liker@umich.edu

**1) Patterns of Organizational Innovation Among Japanese Transplants in the US, Davis Jenkins, Great Cities Inst., 322 S Green St., Ste. 108, Chicago, IL 60607-3502, davis@uic.edu, Richard Florida**

Results are reported on the first survey of work practices of the population of Japanese transplants in the US plus US-owned suppliers to those plants. We look at the adoption of innovative approaches to work practices in these plants as compared to a general survey of manufacturing practices.

**2) The Transplantation of Japanese Management Techniques in the Electronics Industry, Martin Kenney, Univ. of CA, Dept. of HCD, Davis, CA 95616, mkenney@ucdavis.edu**

Most of our models of Japanese manufacturing are based on the auto industry. This presentation argues there are significant differences in the adoption of core methods such as JIT manufacturing when we look at the electronics industry.

**3) Recontextualization & Knowledge Transfer from Japanese to US Factories: The Case of Nippon Seiko Kooji, Mary Yoko Brannen, Univ. of MI, Sch. of Bus. Admin., Org. Behavior & HR Mgmt., Ann Arbor, MI 48109, myb@umich.edu, Jeffrey Liker, Mark Fruin**

This study investigates a case study of the transfer of NSK's ball bearing factory system to the US. Evidence of direct transfer is found for routine technical systems and recontextualization for more uncertain human resource practices.

**4) A Tale of Two Factories: The Best & Worst of Times in America, Mark Fruin, Univ. of MI, Sch. of Bus. Admin., Intl. Business, Ann Arbor, MI 48109, mfruin@umich.edu**

This study contrasts the experiences of 2 Toshiba factories in the US. One was very successful and the other a failure to the point of shutting down. The author identifies factors distinguishing the successful and unsuccessful cases.

## SE17 Operations Management V

### Contributed Session

**Chair:** Theodore D. Klastorin, Univ. of WA, Dept. of MS, Box 353200, Seattle, WA 98195-3200, tedk@u.washington.edu

**1) Supply Contract with Asymmetric Cost Information, Albert Y.**

Ha, Yale Univ., 135 Prospect St., New Haven, CT 06511-3729, albert.ha@yale.edu

We consider a simple supply chain for a short-life-cycle product with stochastic demand. We derive the optimal incentive-compatible contract that maximizes the supplier's profit when the manufacturer's cost is private information. Numerical examples show that a simple franchise contract performs reasonably well for the supplier.

2) **Production-Management-Trainer: Software for Teaching & Learning Operations Management**, *Horst Tempelmeier*, Univ. of Cologne, Sem. f. Produktion., Albertus-Magnus-Platz, Koeln, D-50923, Germany, tempelmeier@wiso.uni-koeln.de

PMT is an interactive program running under MS-Windows that enables its user to solve predefined as well as self-constructed example problems in the field of production, operations management and logistics. The PMT covers more than 50 types. The main features are presented and reports on practical experience given.

3) **On the Hazardous Material Stocking Problem**, *Theodore D. Klastorin*, Univ. of WA, Dept. of MS, Box 353200, Seattle, WA 98195-3200, tedk@u.washington.edu, *Gregory A. DeCroix*

We discuss the problem of stocking a hazardous material which may be spilled during transfer or leak during storage and show how this problem is analogous to previous research on variable yields and exogenous failures. Using an empirically derived cost function for material loss, we develop several models and describe their implications.

4) **No Title Supplied**, *Philip Huang*, VA Tech., 1007 Pamplin Hall, Blacksburg, VA 24061-0235, phuang@vt.edu

Suppliers have now played a critical role because they not only provide manufacturers with quality parts but also assist them in improving product design. How to select good suppliers has thus become an important management decision. We present a multi-criteria decision making model to select the right suppliers.

#### SE18 TUTORIAL: Selected Developments in Supply Chain Management

##### Invited Session

Chair: Evan L. Porteus, Stanford Univ., Stanford Bus. Sch., Stanford, CA 95305-5015

1) **TUTORIAL: Selected Developments in Supply Chain Management**, *Evan L. Porteus*, Stanford Univ., Stanford Bus. Sch., Stanford, CA 95305-5015

Supply chain management encompasses not only traditional operational management of multi-echelon production, inventory and distribution but includes the design of such systems, including coordinating mechanisms and technologies that facilitate flows between distinct people, locations and organizations that comprise these systems. The area is too broad to warrant a comprehensive tutorial...

#### SE20 Traffic Flow Theory

Sponsor: INFORMS Transportation Science Section  
Sponsored Session

Chair: Michael Cassidy, Univ. of CA, Civil & Env. Eng., Berkeley, CA 94720

1) **Bivariate Relations in Stationary Highway Traffic**, *Michael Cassidy*, Univ. of CA, Civil & Env. Eng., Berkeley, CA 94720

We demonstrate that unique bivariate relationships exist among traffic variables, such as flow and occupancy, when traffic conditions are approximately stationary. We have discovered through inspection of cumulative curves of vehicle arrival number and vehicle occupancy that sustained periods of nearly stationary conditions do arise in the traffic stream, even in the congested regime...

2) **A Cell Transmission-Based Assignment-Simulation Model for Integrated Freeway/Surface Street Systems**, *Athanasios Ziliaskopoulos*, Northwestern Univ., Dept. of Civil Eng., Evanston, IL 60208, *Sungjoon Lee*

This presentation enhances Daganzo's cell transmission model to simulate integrated freeway/surface street systems. Two main enhancements are proposed: the concept of adjustable size cells that improve the flexibility, accuracy and computational requirements of the model and a modeling approach to represent signalized intersections...

3) **Short-Term Dynamics of Freeway Traffic Variables**, *Seung-min Kang*, Univ. of CA, Civil & Eng. Eng., Irvine, CA 92697, *R. Jayakrishnan*

It is known that measured traffic variables, i.e., flow, occupancy and speed, do

not always behave according to the well-known 3-D curve relationship that the fundamental diagrams of traffic suggest. Rather, they often have dynamic variations over surface functions. We attempt to find stochastic patterns in the dynamic variation of traffic variables, based on short-period measurement data.

#### SE21 Airline Optimization

Cluster: Aviation Applications

Invited Session

Chair: Cynthia Barnhart, MIT, Ctr. for Transport. Studies, Rm. 1-229, Cambridge, MA 02139, cbarnhar@mit.edu

1) **The Through Flight Assignment Problem**, *Jennifer Reeb*, United Airlines, 1200 Algonquin Ave., Elk Grove Village, IL 60007, *Ahmad Jarrah*

The through flight assignment problem is concerned with matching same equipment arrival and departure flights to form 1-stop (through) flights at hub stations. The underlying model is an integer-flow network with side constraints that reflect various operational requirements. The model, examples and numerical results will be presented.

2) **Crew Pairing for a Regional Carrier**, *Guy Desautniers*, GERAD, 5255 Decelles, Montreal, Quebec, H3T 1V6, Canada, gerad@crt.umontreal.ca, *Jacques Desrosiers*, *A. Lasry*, *M. Solomon*

In the context of a regional carrier, it is not possible a priori to enumerate all the possible duties. We describe 2 types of networks used to generate the crew pairings. The impact on the networks representations of various rules and cost functions is also discussed.

3) **A Combined Daily/Exceptions Crew Planning Model**, *Pamela Vance*, Auburn Univ., Dept. of ISE, Auburn, AL 36849-5346, pvance@eng.auburn.edu, *Alper Atamturk*, *Ellis L. Johnson*, *George L. Nemhauser*, *Cynthia Barnhart*, *Eric Gelman*

We present a model that combines the daily and exceptions crew planning problems. This model explicitly decides which daily flights to add to the exceptions problem. The objective is to find a low-cost weekly solution without sacrificing too much of the daily pattern in the resulting crew pairings.

#### SE22 Supply Chain Inventory Management: Contracting & Coordination

Sponsor: INFORMS Section on Manufacturing & Service Operations Management

Sponsored Session

Chair: Charles J. Corbett, UCLA, Anderson Grad. Sch. of Mgmt., Box 951481, Los Angeles, CA 90005-1481, ccorbett@agsm.ucla.edu

1) **Manufacturing & Distribution Supply-Chain Coordination: Production & Pricing Strategies**, *Z. Kevin Weng*, Univ. of WI, Sch. of Business, 975 University Ave., Madison, WI 53706-0477

We study effects of coordination in a manufacturing and distribution system. It meets random demand sensitive to sales prices with the objective of maximizing expected profits of both the manufacturer and distributor. The coordination effect on a number of current managerial concerns is analyzed. Results yield insights into basic managerial issues for this type of manufacturing and distribution supply-chains.

2) **Issues in Supply Chain Management**, *Haresh B. Gurnani*, Hong Kong Univ. of Sci. & Tech., Dept of ISMT, Clear Water Bay, Kowloon, Hong Kong

We consider a 2-stage supply chain where a firm faces random demand for the finished product and the supplier offers random price promotions for a critical raw material. Optimal inventory/production decisions for the firm are determined in a multi-period setting. The motivation for the supplier to offer a promotion is also discussed.

3) **The Effect of Delivery Lean Time in a Single-Supplier/Multi-Buyer System**, *Dawn Barnes-Schuster*, Univ. of Chicago, Grad. Sch. of Bus., Chicago, IL 60637, dbarnes@iems.nwu.edu

We examine the effect of delivery lead times, between a supplier and buyers, on the operation of a buyer/supplier system. We consider a system composed of a supplier and buyers where it is assumed that the supplier faces a known production lead time. We determine optimal delivery lead times and derive conditions that determine the optimal location of the system safety stock...

4) **Consignment Stock & Supply Chain Incentive Structure**, *Charles J. Corbett*, UCLA, Anderson Grad. Sch. of Mgmt., Box 951481, Los Angeles, CA 90005-1481, ccorbett@agsm.ucla.edu

Consignment stock, in which a supplier pays for inventory held at a customer's site, can profoundly alter a supply chain incentive structure. Especially in the

presence of information asymmetries, consignment stock can sometimes alleviate and sometimes exacerbate coordination problems. Specifically, consignment stock may improve supply chain efficiency by inducing a supplier to reduce cycle times...

### SE23 Design & Control of Multi-Product Facilities with Setup Times

Cluster: Manufacturing & Service Management  
Invited Session

Chair: Saifallah Benjaafar, Univ. of MN, Dept. of Mech. Eng., Minneapolis, MN 55455, saif@maroon.tc.umn.edu

1) **A Conveyor Model for Production Control of Semiconductor Wafer Fabrication**, *Valerie Tardif*, Univ. of TX, Grad. Program in OR/IE, Dept. of Mech. Eng., Austin, TX 78712-1063, vtardif@mail.utexas.edu

We describe modifications to the model proposed by Hopp & Spearman for conveyor models of production lines. The modified system allows us to model a wafer fab as a system of conveyors. This model can then be used to generate releases so as to meet demands. Computational evidence suggests that it closely models reality.

2) **Dynamic Workload Allocation with Setup Times**, *Mohsen El Hafsi*, Univ. of CA, Sch. of Bus. Mgmt., Riverside, CA

We consider the dynamic allocation of a workload in a time-based competition context. The objective is to obtain an optimal allocation of the order at the different processing centers so as to minimize the average inventory, setup and operating costs as well as the cost of a delay in delivery time.

3) **Waiting Time Variance in Cyclic Multi-Product Systems with Setups**, *Mehdi Sheikhzadeh*, Univ. of MN, Dept. of Mech. Eng., Minneapolis, MN 55455, mehdi@me.umn.edu, *Saifallah Benjaafar*

We develop a general expression for the second moment of waiting time for cyclic multi-product systems operating under either an exhaustive or gated service policy. We show that the behavior of the first 2 moments can be very different. Specifically, we show that while the exhaustive policy always leads to a smaller expected waiting time, the same does not hold for waiting time variance.

### SE24 Decision Analysis V Contributed Session

Chair: Tim Zajic, Dept. of IE/OR, 422 Loma Vista, El Segundo, CA 90245, zajic@ieor.columbia.edu

1) **Optimal Dividend Payout Under Compound Poisson Income**, *Tim Zajic*, Dept. of IE/OR, 422 Loma Vista, El Segundo, CA 90245, zajic@ieor.columbia.edu

An individual receives income, modeled by a compound Poisson process and may pay out dividends until his savings become negative, whereupon a bankruptcy charge is paid and the process stops. We provide a dividend payment policy which maximizes the expected discounted dividend payout.

2) **Modeling Information Acquisition as a Stochastic Process**, *Paul S. Fischbeck*, Carnegie Mellon Univ., Dept. of Eng. & Public Policy, Pittsburgh, PA 15213-3890, pf12@andrew.cmu.edu, *Charles D. Linville*

How information is acquired over time affects optimal decision trajectories for sequential decision problems. By modeling the evolution of the information state as a stochastic process, it is possible, for example to characterize the expected value of an IS realistically and to create optimal sequential information acquisition strategies.

3) **A Rayleigh Distribution Model for Customer Choice**, *Vicki M. Bier*, Univ. of WI, Dept. of IE, 1513 University Ave., Madison, WI 53706-1578, bier@ie.engr.wisc.edu, *J. David Glycer*

We derive a closed-form expression for the probability that any of several independent (but non-identically distributed) Rayleigh variables will be the maximum. The motivating example is an application to assessing customer choice probabilities for different electricity pricing schemes, when the perceived benefits of the various options are independently distributed.

4) **Economic Analysis of a Large Engineering Contract**, *Chad Saitouu*, US Military Acad., D4 USCC, West Point, NY 10996, x85792d4@cadet2.usma.edu

I have been given the task of assisting MultiTech in the economic evaluation of the production of a new material handling system and to submit a bid for a contract with the military. There are 4 different alternatives combining the use of different companies to provide different requirements of the contract. I will take into account inflation, depreciation and taxes.

### SE25 PANEL: Myths, Heresies & Embarrassing Questions in OR Education

Sponsor: INFORMS Forum on Education  
Sponsored Session

Chair: Stephen M. Pollock, Univ. of MI, Dept. of IOE, Ann Arbor, MI 48109-2117, pollock@umich.edu

1) **PANEL: Myths, Heresies & Embarrassing Questions in OR Education**, *Andrew Vazsonyi*, Univ. of San Francisco, 102113.1352@compuserve.com, *Kannan Sethuraman*, Univ. of MI, *Stephen M. Pollock*, Univ. of MI, *Robert Phillips*, Decision Focus Inc.

The pedagogy of OR has evolved in an environment strongly influenced by career pressures (on students and faculty alike) and assumptions about effectiveness, scholarship and political realities. This has led to the creation of some powerful myths about the teaching of OR, and has engendered occasional heresies as well. The panel will discuss some of these...

### SE27 Statistical Methods for Increasing Simulation Efficiency

Sponsor: INFORMS College on Simulation  
Sponsored Session

Chair: Wheyming Tina Song, Ntl. Tsing Hua Univ., Dept. of IE, Hsinchu, Taiwan, ROC, song@nwu.edu

1) **T-Tests to Detect Transients in Simulated Time Series**, *David Goldman*, GA Inst. of Tech., Sch. of ISyE, Atlanta, GA 30332, sman@isye.gatech.edu, *Daniel H. Ockerman*, *Gamze Tokol*

We present a test for detecting transients in simulation output based on the familiar t-test. We also exploit the independence of this t-test and certain other initialization bias tests to construct "compound" initialization bias tests. We demonstrate and evaluate our tests using Monte Carlo simulation.

2) **Control Variates with Estimated Mean**, *Bruce W. Schmeiser*, Purdue Univ., Sch. of IE, 1287 Grissom Hall, W Lafayette, IN 47907-1287, schmeise@ecn.purdue.edu, *Michael R. Taaffe*

We study control variates in the situation when the control-variate means is unknown but is estimated, typically with a prior simulation experiment, with known precision. We consider the relationships among bias, induced correlation, relative MSE reduction, computing effort and generalized MSE, assuming the use of the MSE-optimal control weight, both with bias and without.

3) **Control Variates for Probability & Quantile Estimation**, *Barry L. Nelson*, Northwestern Univ., Dept. of IE/MS, 225 S Campus Dr., Evanston, IL 60208, nelsonb@nwu.edu

We present approximations to the optimal (variance minimizing) transformation of a given control variate for the purpose of estimating probabilities and quantiles, and show that it is no more difficult to implement than the standard linear control variate estimator. Project planning, queueing and inventory examples are used to illustrate the estimators.

4) **Correlated Control Variates for Metamodel Estimation**, *Wheyming Tina Song*, Ntl. Tsing Hua Univ., Dept. of IE, Hsinchu, Taiwan, ROC, song@nwu.edu, *Neng Hui Shih*

We develop a variance reduction technique that applies correlated control variates in a simulation experiment to estimate linear regression metamodels. A decision rule is proposed to determine whether the induced correlation of the control variates is positive or negative. Under specified conditions, the proposed technique is superior to a conventional variance reduction technique...

### SE28 Location Models I

Cluster: Location Analysis  
Invited Session

Chair: Oded Berman, Univ. of Toronto, Faculty of Mgmt., 105 St. George St., Toronto, Ontario, M5S 1E6, Canada, berman@fmgmt.mgmt.utoronto.ca

1) **Transforming Uncapacitated Profit Maximizing Location into Fixed Charge Problems**, *Mark S. Daskin*, Northwestern Univ., Dept. of IE/MS, Evanston, IL 60208-3109, daskin@iems.uwu.edu

We show how a profit maximization facility location problem can be transformed as an uncapacitated fixed charge problem when there are no capacities on the facility transformations. We also discuss computational results for sample problems.

2) **Dynamic Single Facility Location with Movement Restrictions**, *Lizhi Ma*, SUNY, Dept. of IE, Buffalo, NY 14260, lizhima@bunix.acsu.buffalo.edu, *Rajan Batta*

We focus on finding the optimal trajectory of a service unit as to minimize the average travel time to a call. Demand rates vary with time units and are restricted to travel at a maximum speed  $v$ .

**3) Brand Positioning Under Lexicographic Choice Rules, Joyendu Bhadury**, Univ. of New Brunswick, Fac. of Admin., PO Box 4400, Fredericton, NB, E3B 5A3, Canada, bhaduryj@fac.fadmin.unb.ca, **H. A. Eiselt**

We consider a 2-attribute (price, quality) brand positioning problem in competing brands. The customers are assumed to behave in accordance with a choice rule. Both Nash equilibrium and Stackelberg solutions are discussed.

**4) Location of Facilities on Biweighted Networks, Pitu B. Mirchandani**, Univ. of AZ, Dept. of SIE, Tucson, AZ 85721, pitu@tucson.sie.arizona.edu

A class of network location problems arise when one has to consider 2 weight links. In the application that motivated this research 1 weight represents and the second link work load. We provide a classification of location problems and discuss a few results for some of the problems.

## SE29 Inventory I

### Contributed Session

**Chair:** Emre Berk, Bilkent Univ., Fac. of Bus. Admin., Bilkent, Ankara, 06533, Turkey, eberk@bilkent.edu.tr

**1) A Modified (S-1,S) Inventory System with Arbitrary Demand Arrivals, Emre Berk**, Bilkent Univ., Fac. of Bus. Admin., Bilkent, Ankara, 06533, Turkey, eberk@bilkent.edu.tr

Consider an inventory system facing unit demands with arbitrary interarrival times. We propose a modified 1-for-1 ordering policy based on time elapsed since last demand arrival. We obtain operating characteristics of the system and provide bounds for optimization. Numerical results are also presented.

**2) A Continuous Review Inventory Model with a Time Discount, Ki Ling Cheung**, Hong Kong Univ. of Sci. & Tech., Clear Water Bay, Kowloon, Hong Kong, imcheung@usthk.ust.hk

We present a continuous review inventory model with a time discount. Whenever the supplier faces a likelihood of being out of stock, he may issue a discount to motivate customers to wait for product delivery. A new control policy is proposed and tested.

**3) A Repairable Item Inventory System with Demand Leadtime, Leonard Lu**, AT&T Labs., 101 Crawfords Corner Rd., Rm. 3K-324, Holmdel, NJ 07733, llu@qpc2.ho.att.com

Consider a repairable item inventory system where each order arrives with a due date. We examine the effect of such demand leadtime on the inventory policies and how this information can be used to improve the system performance. A solution method is also developed to find the policy parameter values.

**4) Optimal Batch Provisioning to Customers Subject to a Delay-Limit, Frank A. Van der Duyn Schouten**, Tilburg Univ., Fac. of Econ., PO Box 90153, Tilburg, 5000 LE, The Netherlands, f.a.vdrduynschouten@kub.nl, **Menachem Berg, Jorg Jansen**

We deal with batch provisioning and order aggregation with contractual obligation for the supplier to provide service within an agreed delay-limit. The main decision problem is to determine the moments at which a batch service (or aggregated delivery) should be executed. Several service provision policies are proposed and investigated.

**5) New Algorithms for Computing Optimal (s,S) Policies in a Stochastic Single Item/Location Inventory System, Youyi Feng**, Ntl. University of Singapore, Dept. of IS & Comp. Sci., Singapore, 119260, Singapore, **Baichun Xiao**

It has been acknowledged that a class of (s,S) policies is optimal to the single item/location inventory system. However, the computational inefficiency of finding a minimizer (s,S) among the existing algorithms restricts the application of (s,S) policies to the real-life problems. We use a novel approach to devise an algorithm to compute optimal (s,S)...

## SE30 Resources & Readiness

**Sponsor:** INFORMS Military Applications Society

### Sponsored Session

**Chair:** Anne J. Hale, Ctr. for Naval Analyses, 4401 Ford Ave., Alexandria, VA 22302, halea@cna.org

**1) Assessing Risk to Readiness, Anne J. Hale**, Ctr. for Naval Analyses, 4401 Ford Ave., Alexandria, VA 22302, halea@cna.org

Assessing the risk to unit readiness is important to the military planner in the era of declining budgets, force downsizing and process improvements. We provide

an example of how to assess risk for a weapon system given the variability of key logistics decision variables such as logistic response time.

**2) Force Deployment Planning & Execution: The Real Force Multiplier, Mark Geis**, 4401 Ford Ave., Alexandria, VA 22302, geism@cna.org

The US military's role as the world's premier crises response force depends entirely on its ability to plan for and execute short or no-notice force deployment operations. We explore the problems with force deployment planning and execution, their causes, implications and potential remedies.

**3) Aircraft Carrier Requirements for Consolidated Automated Support System, Larry Lynn**, 4401 Ford Ave., Alexandria, VA 22302, lynnl@cna.org

CASS diagnoses and repairs faulty naval avionics equipment. Using simulation modeling, we determined the most cost-effective mix of CASS stations to place on carriers. Our solution will allow the Navy to avoid more than \$150 million on life-cycle costs compared with their previous plans.

**4) Tools for Analyzing Navy Readiness, Laura Junor**, 4401 Ford Ave., Alexandria, VA 22302, junorl@cna.org

We present new techniques for tracking and predicting readiness. Our goal is to help readiness managers turn the overwhelming quantity of ship and aircraft readiness data into information about the current status of readiness and its drivers by applying indexing, benchmarking and regression methods.

## SE31 Simulation & Analysis in Support of Army XXI

**Sponsor:** INFORMS Military Applications Society

### Sponsored Session

**Chair:** Mark A. Burrough, US AMSAA, Aberdeen Proving Grd, MD 21005, burrough@arl.mil

**1) Simulation & Analysis in Support of Force XXI, Mark A. Burrough**, US AMSAA, Aberdeen Proving Grd, MD 21005, burrough@arl.mil

The Army is currently mounting a major campaign to modernize the fighting forces of the 21st century around advanced digital and ITs. We provide an overview of simulation and analysis currently being conducted to examine the wide range of issues related to this modernization effort.

**2) Task Force XXI Advanced Warfighting Experiment Analysis, Robert Bennett**, US Army TRADOC Analysis Ctr., WSMR, NM 88002-5502, bennettb@trac.wsmr.army.mil, **Richard Ast, Kevin Young**

TRAC-WSMR will present the modeling methodology being used to evaluate a digitized maneuver brigade. We describe the model-experiment-model technique and changes implemented into the Janus and CASTFOREM models. We conclude with an example application of the techniques used to evaluate EXFOR digitized training at Fort Hood.

## SE32 Network Design Aspects about ATM

**Sponsor:** INFORMS Technical Section on Telecommunications

### Sponsored Session

**Chair:** P. Harshavardhana, Bell Labs./Lucent, 101 Crawfords Corner Rd., Rm. 2L-338, Holmdel, NJ 07733, pharshavardhana@lucent.com

**1) Restorable Telecommunication Network Designs, Sri Nathan**, MCI, 2400 N Glenville Dr., MS 1201/107, Richardson, TX 75082, sri.nathan@mci.com

We provide a fundamental overview of restoration for a telecommunication network, highlighting its importance. We discuss pros and cons of providing restoration at various layers: namely optical, physical, system, logical and service layers. The main focus will be to show a methodology of designing SONET ring-based restoration platform suitable supported by service layer restoration such as ATM...

**2) Designing Survivable ATM Backbone Network in a Carrier Environment, Vikram Saksena**, AT&T Labs., 101 Crawfords Corner Rd., Rm. 1F-418, PO Box 3030, Holmdel, NJ 07733, vrs1@gsun.att.com, **Zbigniew Bogdanowicz**

ATM networks will allow us to transmit voice, data and video over the same transmission media. The cost of link topology will be a critical factor in these networks as the demand for the transmission bandwidth increases. A major quality-of-service objective will be network survivability. We describe a heuristic algorithm to design a cost-effective survivable ATM backbone network...

**3) Problems Related to Physical Ring Design in SONET Ring Networks, Richard T. Wong**, AT&T Labs., 101 Crawfords Corner Rd., Rm. 3K-321, PO Box 3030, Holmdel, NJ 07733, rtw@gpc2.att.

com, *Moshe Rosenwein*

Physical ring design involves bundling segments of routed demands to be transported via a single optical wavelength around a ring. We review issues related to physical ring design for SONEt networks and discuss a heuristic procedure for forming physical rings if the demand routing information has certain restrictions.

4) **An Optimization Tool for Designing Broadband ATM Networks**, *Subrahmanyam Dravida*, Bell Labs. - Lucent Technology, 101 Crawfords Corner Rd., Rm. 3M-337, PO Box 3030, Holmdel, NJ 07733, dravida@lucent.com, *P. Harshavardhana*

We present new techniques for designing broadband ATM networks. We have developed 2 fundamentally different techniques; 1 targeted for the full-fledged broadband environment where high bandwidth networks will be commonplace, the other intended for the transition scenario when broadband networks have to evolve from today's existing network...

### SE34 Choices in Optimization

Cluster: **Choice Engineering**

Invited Session

Chair: Ulrich Tushaus, Univ. der Bundeswehr Hamburg, Fachbereich Wirtschaft & Org., Hamburg, D-22039, Germany, ulrich.tushaus@unibw-hamburg.de

1) **Choice of Objectives & Their Social Consequences**, *Heiner E. Muller-Merbach*, Univ. Kaiserslautern, Am Lowentor 11, Darmstadt, 64287, Germany

Most OR models serve the purpose of finding the optimal solution for a problem. The solution depends upon the choice of the objective. If the model deals with people, they depend directly upon the objective. This puts social responsibility to the modeler. A survey of modeling objectives will be presented.

2) **Restructuring of Parcel Delivery Services**, *Paul Staehly*, Univ. St. Gallen, Inst. fur OR, Bodanstrasse 6, St. Gallen, 9000, Switzerland, paul.staehly@ifu.unisg.ch

Legal deregulation of the Swiss market for postal services forces the public PTT to restructure its parcel delivery. In this context, modeling and data gathering is analyzed for a 2-stage structure, especially the difficulties in modeling and determining adequately the costs of route deliveries for this strategic planning.

3) **Parametric Analysis of Fixed Costs in Facility Location**, *Andreas Klose*, Univ. St. Gallen, Inst. fur OR, Bodanstrasse 6, St. Gallen, 9000, Switzerland, andreas.klose@ifu.unisg.ch

The solution of a facility location problem does not only consist in optimal or nearly optimal solutions but also in a sensitivity analysis of the total cost curve. For discrete uncapacitated facility location problems, such a parametric analysis of the fixed costs can be done by means of Lagrangean relaxation.

4) **Modeling Choices: Impact From Practice**, *Ulrich Tushaus*, Univ. der Bundeswehr Hamburg, Fachbereich Wirtschaft & Org., Hamburg, D-22039, Germany, ulrich.tushaus@unibw-hamburg.de

One of the major decisions when applying OR is the choice of an adequate model. In practice, however, providing the model with the necessary data can be an equally difficult task. Some experience with different modeling choices concerning the problem and the data for a real-world problem is reported.

### SE36 PANEL: Promotion & Tenure - Everything You Wanted to Know But Were Afraid to Ask

Sponsored Session

Chair: Cynthia Barnhart, MIT, Ctr. for Transport. Studies, Rm. 1-229, Cambridge, MA 02139, cbarnhar@mit.edu

Co-Chair: Pamela Vance

1) **PANEL: Promotion & Tenure: Everything You Wanted to Know But Were Afraid to Ask**, *Cynthia Barnhart*, MIT, cbarnhar@mit.edu, *Pamela Vance*, Auburn Univ.

This session, sponsored by the INFORMS Women's Forum, will include presentations by department heads and other senior faculty describing the promotion and tenure process at various engineering and management schools. Their presentations will be followed by a Q&A period.

## Monday 08:00-09:30

### MA04 Public Policy Analysis in the Netherlands

Cluster: **Public Sector Applications**

Sponsor: **INFORMS Section on Public Programs & Processes**  
Sponsor/Invited Session

Chair: Warren E. Walker, Faculty RAND, c/o TU Delft, Landbergstraat 6, Delft, 2628 CE, The Netherlands, walker@rand.org

1) **A Decision Support System for Integrated Landscaping for the River Rhine**, *M. Kok*, HKV Consultants Lelystad, *W. Silva*

The landscape planning River Rhine DSS facilitates the exploration of options for the sustainable design and management of a river area. Its core is a 1-dimensional model for simulation of water movement and morphology. The DSS assesses the impacts of landscape planning strategies on all river functions.

2) **Regional Scenarios for Dynamic Traffic Management in the Netherlands**, *Erik J. Verroen*, TNO Ctr. Infrastruc. Transport. Reg. Dvlp., PO Box 6041, Delft, 2600 JA, The Netherlands, *Bart van Arum*

Dynamic traffic management is 1 way of controlling the negative impacts of the growth of car traffic. TNO-Inro was asked to organize several scenario-workshops and to estimate the effects of various dynamic traffic management strategies. We describe the project, its findings and the resulting policy recommendations.

3) **An Analysis of Infrastructure Options for the Dutch Civil Aviation System**, *Warren E. Walker*, Faculty RAND, c/o TU Delft, Landbergstraat 6, Delft, 2628 CE, The Netherlands, walker@rand.org, *Jonathan Cave*, *Kerry M. Malone*, *Adnan Rahman*, *Patricia Twaalfhoven*

The Dutch government is in the process of developing a new long-range civil aviation policy. One of its inputs is an analytical study that describes alternative contexts within which the Dutch civil aviation system may have to operate in the future and provides information on the uncertainties, choices to be made and performance of alternative configurations of airports in those contexts.

### MA05 Recent Developments in Linear Programming

Cluster: **Linear Programming**

Invited Session

Chair: Yahya Fathi, NC State Univ., Dept. of IE, PO Box 7906, Raleigh, NC 27695-7906, fathi@eos.ncsu.edu

1) **Unify Path Following Methods for Solving Convex Programming with Infinitely Many Linear Constraints**, *Ruey-Lin Sheu*, Ntl. Cheng-Kung Univ., Dept. of Math., Tainan, 70101, Taiwan, rsheu@mail.ncku.edu.tw, *Soon Yi Wu*

We present a path-following method to solve a smooth convex programming problem with infinitely many linear constraints. Lagrange duality and constraint qualification are derived to prevent duality gaps from being generated. A convergence proof for the primal problem in L1 norm and for the dual problem in weak topology is provided.

2) **Linear Programming via Unconstrained Convex Piecewise Linear Programming**, *Elmor L. Peterson*, NC State Univ., Dept. of Math. & OR, Raleigh, NC 27695, elpets@eos.ncsu.edu

A transformation of the class of all LP problems to a special class of unconstrained convex piecewise-LP problems will be described, as will some of its implications.

3) **A Measure of Effectiveness of Some LP Relaxations**, *Craig Tovey*, GA Inst. of Tech., Sch. of ISyE, Atlanta, GA 30332, ctovey@isye.gatech.edu

I propose measuring the effectiveness of LP formulations for certain IPs by the probability of integrality given random data, based on an idea of Savage's. This measure is interesting, though admittedly ambiguous, limited and unattractive in its computational complexity. I discuss its application to the matching problem.

4) **A Survey in Data Envelopment Analysis**, *Evelyn C. Brown*, Univ. of VA, 503 Plymouth Ave., Salisbury, NC 28144

This is a survey of recent literature in DEA, with application in assessing the technical efficiency of companies, agencies or other DMUs. An LP model and its dual are used in the application of DEA in real world problems. Possible methods for overcoming limitations are presented.

5) **LP Relaxation of an IP Model for the Tool Replacement Problem**, *Yahya Fathi*, NC State Univ., Dept. of IE, PO Box 7906, Raleigh, NC 27695-7906, fathi@eos.ncsu.edu, *Ali H. Awni*, *Henry L. W. Nuttle*

It is well known that in the context of the tool switching problem, the problem of determining an optimal tool replacement plan for a given sequence of jobs can be solved in polynomial time. We show that the LP relaxation of an IP model for this problem has an integer optimal solution, even though its constraint matrix is not TU.

**MA06 Heuristic Search for Operations Management**

Cluster: **Combinatorial Optimization**  
Invited Session

Chair: David L. Woodruff, Univ. of CA, Grad. Sch. of Mgmt., Davis, CA 95616, dlwoodruff@ucdavis.edu

1) **A Study on a Scheduling Problem for the Plastic Molding Department of an Audio Company**, *Carrie Ka Yuk Lin*, City Univ. of Hong Kong, Dept. of Applied Stats. & OR, 83 Tat Chee Ave., Kowloon Tong, Hong Kong, mslincky@cityu.edu.hk, *C. L. Wong, Y. C. Yeung*

We consider the scheduling problem for 2 major hi-fi models (involving 77 mold types) of an audio company with more than 10 types of (partially dedicated) molding machines. The objective is to minimize machine idle time. As the setup time for changing between mold types is significant and depends on machine, color and material of the related molds, this problem becomes NP-hard...

2) **Adaptive Memory Tabu Search for Set Covering Problems**, *Gary A. Kochenberger*, Univ. of CO, Campus Box 165, PO Box 173364, Denver, CO 80217-3364, gkochenberge@castle.cudenver.edu

Recent studies have demonstrated the effectiveness of applying TS procedures to combinatorial optimization problems. We describe the development and use of a critical-event memory TS approach to solve set covering problems. Computational experience with a variety of test problems is reported.

3) **Local Search in Planning for Sustainable Forest Harvesting**, *Arne Lokketangen*, Molde Coll., Britvegen 2, Molde, 6400, Norway, arne.lokketangen@himolde.no, *Geir Hasle, Gunnar Misund*

The planning of sustainable forest harvesting is an increasingly more complex task, balancing ecological, economical and recreational demands, resulting in models with both hard and soft constraints. We describe flexible memory-based local search and look at its special structures.

4) **The Progressive Hedging Algorithm in Lot-Sizing Models**, *David L. Woodruff*, Univ. of CA, Grad. Sch. of Mgmt., Davis, CA 95616, dlwoodruff@ucdavis.edu, *Kjetil Haugen, Arne Lokketangen, Asmund Olstad*

We consider the problem of lot-sizing for multiple products over multiple periods when there are set times, setup costs, holding costs and stochastic demand given in the form of discrete scenarios. Progressive hedging is described as the method of solving such problems. Computational experience to date is given.

**MA07 Frontiers of Optimization**

Cluster: **Nonlinear Programming**  
Invited Session

Chair: Claude Lemarechal, INRIA, BP 105, Le Chesnay, 78153, France, claude.lemarechal@inria.fr

1) **Nonsmooth Continuation Methods for Nonsmooth Equations**, *Stephen M. Robinson*, Univ. of WI, Dept. of IE, 1513 University Ave., Madison, WI 53706-1572, smr@cs.wisc.edu

We describe computational methods using nonsmooth continuation for the solution of variational inequalities and for other generalized equations involving polyhedral maximal monotone operators. Some of these are currently under development, whereas with others there is a fairly considerable amount of experience. Advantages and disadvantages will be discussed.

2) **Pseudomonotone Variational Inequality Problems: Existence of Solutions**, *Jean-Pierre Crouzeix*, Univ. de Clermont II, BP 206, Aubiere, 63174, France, crouzeix@ucfma.univ-bpclermont.fr

We give new necessary and sufficient conditions for existence in variational inequalities involving a pseudomonotone multi-valued mapping. They recover the classic conditions when searching a 0 or maximal monotone mapping. Applications are given to affine variational inequalities and linear complementarity.

3) **Separable Diagonalized Multiplier Method for Decomposing Nonlinear Programs**, *Philippe Mahey*, ISIMA, BP 125, Aubiere, 63173, France, mahey@flamengo.isima.fr, *Abdelouahad Hamdi*

We present a separable multiplier method which is specially tailored for the decomposition of structured optimization problems. Subproblems minimizations are substituted by single Newton steps preserving asymptotic quadratic local convergence under mild hypotheses.

4) **Partial Minimax Problems & Application to Chance-Constrained Problems**, *Jean-Christophe Culioli*, CAS-ENSM, 35 rue St. Honore, Fontainebleau, 77305, France, culioli@cas.ensmp.fr

We introduce a generalization of the minimax problem, called "partial minimax problem" which allows tolerances: one may not take the max on a proportion of the functions to get a better criterion. We give exact algorithms and heuristics, discuss connections with discretized chance-constrained programming and solve sample problems.

5) **A Study of the Duality Gap & Applications**, *Claude Lemarechal*, INRIA, BP 105, Le Chesnay, 78153, France, claude.lemarechal@inria.fr, *Arnaud Renaud*

Decomposable optimization problems are often efficiently solved with the help of dual algorithms. However, this approach is heuristic in the nonconvex case, as it introduces a duality gap. Via the definition of equivalent convex problems, we study the duality gap and apply our results to various dualization schemes.

**MA08 Applications of Integer Programming in Planning & Scheduling**

Cluster: **Integer Programming**  
Invited Session

Chair: Emmanuel Chajakis, Computer Command & Control Co., 2300 Chestnut St., Ste. 230, Philadelphia, PA 19103, chajakis@cccc.com

1) **Personnel Transportation Service System Design: Formulation & Solution Method**, *Fatma Gzara*, Bilkent Univ., Dept. of IE, Ankara, TR 06533, Turkey, gzara@bilkent.edu.tr, *Mustafa C. Pinar*

We study the planning of personnel transportation between work and residence. Decisions involved are stop location, their sequencing in bus routes and resident-to-stop assignment, to optimally trade-off transportation costs and employee satisfaction. The problem is harder than conventional vehicle routing. We present several formulations and their solution methods.

2) **A Local Search Heuristic for Unrelated Parallel Machine Scheduling with Efficient Neighborhood Search**, *Nanda Piersma*, Erasmus Univ., Econometric Inst., PO Box 1738, Rotterdam, 3000 DR, The Netherlands, piersma@few.eur.nl, *Wim van Dijk*

We study the problem of scheduling parallel unrelated machines to minimize makespan. We propose new local search algorithms that use machine efficiency for each job in the neighborhood search of a solution. We show that this method yields better solutions and shorter running times than more general local search heuristics.

3) **Cargo Routing through Hierarchical Network Decomposition**, *Dirk P. Guenther*, GA Inst. of Tech., Sch. of ISyE, Atlanta, GA 30332, dirk@isye.gatech.edu, *Ellis L. Johnson, John Vande Vate*

The size of today's airline network and response time restriction requires the use of special algorithms for air cargo routing. We present an algorithm that uses a hierarchical decomposition of the network. The algorithm computes a sequence of flights that is optimal wrt a multidimensional cost measure and the decomposition.

4) **MARLIN: Modeling Crude Oil Supply at Petroleum Refineries**, *Frederic H. Murphy*, Temple Univ., Sch. of Bus. & Mgmt., 323 Speakman Hall, Philadelphia, PA 19123, v5256e@vm.temple.edu, *Emmanuel Chajakis, Steve Welch, Scott W Andrews*

The main decisions involved in the upstream crude supply process at refineries are types, timing and sizes of crude load purchases and the mix of time vs. spot charters to accommodate production plans. We formulated the process as a profit maximization integer program. We discuss our experiences with the model.

**MA09 Project Scheduling**

Cluster: **Scheduling**  
Invited Session

Chair: Erwin Pesch, Univ. Bonn, Inst. Gessellschafts/Wirtschaft, Adenauerallee 24-42, Bonn, 53113, Germany, e.pesch@uni-bonn.de

1) **Solving the Simple Assembly Line Balancing Problem by an Adapted General Sequencing Algorithm**, *Arno Sprecher*, Christian Albrechts Univ. zu Kiel, Inst. fur Betriebswirtsch., Olshausenstrabe 40, Kiel, 24098, Germany

A general algorithm, good for dealing with a wide range of resource-constrained project scheduling problems, is adapted for solving the simple assembly line balancing problem. In spite of the general framework, the adaptation achieves the efficiency of the special purpose developments.

2) **Local Search Methods for Project Scheduling Under Partially Renewable Resource Constraints**, *Andreas Drexel*, Christian Albrechts Univ. zu Kiel, Inst. fur Betriebswirtsch.,

Olshausestr. 40, Kiel, D-24098, Germany, drexl@bwl.uni-kiel.de

We consider an extended project scheduling problem, based on partially renewable resources. The extension covers renewable and nonrenewable resources as special cases. Furthermore, it makes timetabling and shift scheduling amenable to project scheduling. Local search methods for solving this general model are presented.

**3) A Decision Support System for Scheduling the German Soccer League, Thomas Bartsch**, Christian Albrechts Univ. zu Kiel, Inst. für Betriebswirtschaft., Olshausenstr. 40, Kiel, D-24098, Germany, bartsch@bwl.uni-kiel.de

We have developed a user friendly computer system which supports efficient scheduling for the German soccer league. New objectives, e.g. attractiveness and fairness of the schedule, are taken into account. Our B&B algorithm generates schedules in a reasonable amount of time.

## MA10 Multi-Stage Stochastic Programming & Applications

Cluster: Stochastic Programming

Invited Session

Chair: Suvrajeet Sen, Univ. of AZ, Dept. of SIE, Tucson, AZ 85721, sen@sie.arizona.edu

**1) Optimal Power Generation Under Uncertainty via Stochastic Programming, Darinka Dentcheva**, Humboldt Univ. Berlin, Unter den Linden 6, Inst. of Math., Berlin, 10099, Germany, dary@mathematik.hu-berlin.de, **Werner Romisch**

We consider short-term cost-optimal generation of electric power under uncertain electricity demand. The generation system comprises thermal and pumped-storage hydro units. Two approaches to the problem are suggested via 2 different models which represent a multi-stage and a 2-stage stochastic program. Conceptual methods for solving the problems are sketched.

**2) Error Bounds in Stochastic Multistage Linear Programming: Numerical Results, Karl Frauendorfer**, Univ. of St. Gallen, Inst. of OR, Bodanstrasse 6, CH-9000 St. Gallen, St. Gallen, Switzerland, C. Marohn

The solvability of stochastic multistage programs suffer from the curse of dimensionality. The discrete time stochastic processes are approximated by barycentric scenario trees. In the convex case, error bounds may be evaluated at each node which helps to improve the accuracy with manageable effort. Numerical results will be presented for linear asset and liability problems.

**3) A Successive Refinement Algorithm for Multi-Stage Stochastic LPs, Suvrajeet Sen**, Univ. of AZ, Dept. of SIE, Tucson, AZ 85721, sen@sie.arizona.edu, **Janos Mayer, Peter Kall**

We consider multi-stage stochastic programs in which the right hand sides depend on continuous random variables. We devise a successive refinement algorithm in which continuous random variables are replaced by discrete approximations which are improved iteratively. Convergence of the method and some numerical examples will be presented.

## MA12 PANEL: Data Preparation for Neural Networks

Sponsor: INFORMS CSTS

Sponsored Session

Chair: Karla Yale, Yale Systems, Inc., 3931 Shoshonee Dr., Columbus, IN 47203, 103006.320@compuserve.com

**1) PANEL: Data Preparation for Neural Networks, Karla Yale**, Yale Systems, 103006.320@compuserve.com, **Russell Hill**, Virtual Genetic Systems

Data preparation is about 80% of any neural network. The panelists will cover the activities involved in data preparation for neural networks, GAs and agents, respectively. Then a comparison will be made of the similar steps in data preparation for each of the 3 branches of AI. Finally, the differences in the steps will be highlighted.

## MA13 Data Organization for OR-Based Decision Support Systems

Sponsor: INFORMS CSTS

Sponsored Session

Chair: Aniruddha S. Deshpande, United Airlines, Corporate R&D WHQKB, PO Box 66100, Chicago, IL 60666, adeshpande@ual.com

**1) Knowledge Discovery in Airline Origin & Destination Data, Alan Walker**, SABRE Decision Technologies, MD 7390 TSG, 1 E Kirkwood Blvd., Southlake, TX 76092, alanw@sdt.com

Airlines are collecting more and more data at an O-D level. Analysts can no

longer glean useful information from the database with simple queries. We present a number of techniques using classification, machine learning and visualization for finding human comprehensible knowledge in large O-D databases.

**2) Building a Data Warehouse of Airline Passenger Data, Gregory L. Campbell**, Decision Focus Inc., 650 Castro St., Ste. 300, Mountain View, CA 94041-2055, gregc@dfi.com

Airlines have huge amounts of passenger data useful for forecasting, examining trends and evaluating competitive actions. We describe some solutions to the rapid retrieval, grouping and aggregating of this data across its key dimensions: itinerary, booking, date, travel date, booking class and point of sale.

**3) System Architecture for Real-Time Data Availability, Ananda Rakshit**, United Airlines, 1200 E Algonquin Rd., Elk Grove Village, IL 60007, arakshit@ual.com

United Airlines has implemented OR-based decision tools to cope with traffic congestion, severe weather at hubs and aircraft/crew re-routing. A critical success factor for implementation of these tools is real-time data availability. We will highlight the architecture of the data system that feeds the decision tools.

## MA14 Logistics II

Contributed Session

Chair: Rob L. Snyder, Defense Fuel Supply Ctr., 8725 John J. Kingman Rd., DFSC-FL, Ste. 1950, Ft. Belvoir, VA 22060-6222, rsnyder@dfsc.dla.mil

**1) Evaluating Infrastructure When Demand is Uncertain, Rob L. Snyder**, Defense Fuel Supply Ctr., 8725 John J. Kingman Rd., DFSC-FL, Ste. 1950, Ft. Belvoir, VA 22060-6222, rsnyder@dfsc.dla.mil

The Defense Fuel Supply Center is constantly revalidating its infrastructure needs. Through simulation analysis, this study revealed that the costs of maintaining a nearby fuel terminal exceeded the costs of providing support from a more distant fuel terminal if the primary supplier failed to deliver.

**2) Network Planning for US Postal Service's Express Mail, Mei Zhang**, GA Inst. of Tech., 334481 GA Tech. Station, Atlanta, GA 30332-0205, mei@isye.gatech.edu, **H. D. Ratliff**

In an effort to improve the service level of US postal express mails, ground transportation networks need to be expanded while improving the utilization of vehicles. A network design model locates distribution centers where mail units are cross docked. The model minimizes the transportation costs while satisfying special time constraints.

**3) Optimal Quantity Policies for Shipment Consolidation Decisions, Sila Cetinkaya**, Univ. of Waterloo, Dept. of MS, Waterloo, Ontario, N2L 3G1, Canada, sila@watmims.uwaterloo.ca, **James H. Bookbinder**

We study a shipment consolidation problem where order arrivals are modeled as a Poisson process and, based on empirical evidence, order weights are assumed to follow an Erlang-2 process. Under these assumptions, optimal dispatch quantities are computed using renewal theory.

**4) Minimizing the Peak Load of Shared Storage Policies with Exact & Approximate Methods, Pierre Montulet**, Ecole Polytech., Dept. of Math & Indust., C.P. 6079, Succ. Centre-ville, Montreal, Quebec, H3C 3A7, Canada, pierrem@crt.umontreal.ca, **Andre Langevin, Diane Riopel**

The problem of minimizing the peak load in single-command cycle shared storage policies is studied. Exact and heuristic solutions are suggested. The exact solution is produced by column generation. The new heuristics assign units handled during busy days to close locations. With these, the peak load is drastically reduced.

## MA15 Applications in Scheduling & Distribution

Cluster: Network Flows

Invited Session

Chair: Janny Leung, City Univ. of Hong Kong, Dept. of MS, Tat Chee Ave., Kowloon, Hong Kong, arjanny@cityu.edu.hk

**1) The Application of Integer Programming in the Petrochemical Industry, Leslie-Ann Yarrow**, Chesapeake Decision Sciences, 200 South St., New Providence, NJ 07974, lay@chesapeake.com

Large petrochemical companies often use OR for planning and scheduling their plants. The planning process must allocate production between plants and offer a schedule for each plant that satisfies minimum campaign runs (batch sizes) and attempts to minimize setup and production costs. Two 0-1 integer-programming

formulations and solution results will be considered.

2) **Modeling & Solving the Capacitated Merge-in-Transit Problem**, *Bernard Gendron*, Univ. de Montreal, Dept. d'info. & OR, CP 6128, Succ. Centre-ville, Montreal, Quebec, H3C 3J7, Canada, gendron@iro.umontreal.ca, *Keely L. Croxton, Thomas L. Magnanti*

To better serve their customers' needs, several manufacturing firms are using merge centers as in-transit consolidation points. We present a large-scale MIP model for planning these operations and a Lagrangean-based solution method calibrated from an actual application. The dynamic multimode multicommodity model features merge center capacities and discontinuous cost functions.

3) **Efficient Trip Scheduling in a Shared-Ride Environment**, *Barbara J. Hoopes*, VA Tech., 7054 Haycock Rd., Falls Church, VA 22043, bhoopes@vt.edu

I will discuss the initial results of a study of a non-profit community transportation provider seeking to meet "alternative" transportation needs through a shared-ride system. The focus is on efficient trip-scheduling and vehicle-routing to increase productivity and control costs. Solutions must adhere to the unique constraints of the environment.

4) **Minimum Cost Flows in Gas Transmission Networks**, *E. Andrew Boyd*, TX A&M Univ., Dept. of IE, College Station, TX 77843-3131, boyd@marvin.tamu.edu, *Seongbae Kim*

The problem of minimizing the fuel used to deliver natural gas through a pipeline network is a large, nonlinear, mixed-integer program. An intelligent search algorithm is presented for solving this problem and computational results are presented for sample problems taken from industry.

#### MA16 Current Research Issues in Innovation Management

Sponsor: INFORMS Section on Technology Management

Sponsored Session

Chair: *Michael K. Badawy*, VA Polytech. Inst. & State Univ., Dept. of Mgmt., Pamplin Coll., 2990 Telestar Ct., Falls Church, VA 22042

1) **Blurred Lines: An Extended Theory of Role Ascription to Include Technological Agents**, *Terril L. Griffith*, Washington Univ., Sch. of Bus., One Brookings Dr., St. Louis, MO 63130-4899, griffith@wuolin.wustl.edu

When technological support such as GSSs are added to the organizational environment of groups, the sociotechnical system is made more complex. The conditions under which roles, e.g., task or socio-emotional, are ascribed to group members, facilitators and/or the technology are described and linked to group outcomes.

2) **Groupware, Workflow Automation & Organizational Learning**, *William M. Riggs*, GA Inst. of Tech., Dept. of Mgmt., Atlanta, GA 30332-0002, *Hagood Bellinger*

Groupware can both automate workflow and facilitate organizational learning. An empirical study of a groupware implementation finds evidence that users readily apply groupware to workflow automation. Conclusions are drawn about optimal management practice for such implementations. However, organizational learning via groupware is a longer term and more subtle process to manage.

3) **Designing a Technology Transfer Game Plan for the National Oceanic & Atmospheric Administration**, *David Gibson*, Univ. of TX, IC2 Inst., 2815 San Gabriel, Austin, TX 78705, davidg@icc.utexas.edu, *Earle N. Buckley*

We focus on evaluating the feasibility of using a technology business incubator to facilitate the spinning-out and spinning-in of technology to NOAA. Research focused on collecting survey and archival data on Charleston, SC in terms of the region's entrepreneurial infrastructure and emerging technology industries. Barriers and facilitators to the implementation of a CTI are discussed.

4) **Product Development Teams in Korea: Some Empirical Findings**, *Jingoo Lee*, KITECH, 371 36 Kasan-Dong, Kumchon Gu, Seoul, 153-023, Korea, leejj@intech.kitech.re.kr

We report on some findings of a study of product development teams in high-technology companies in Korea.

5) **Contemporary Innovation Management Fads: A Reevaluation & Call for Action**, *Michael K. Badawy*, VA Polytech. Inst. & State Univ., Dept. of Mgmt., Pamplin Coll., 2990 Telestar Ct., Falls Church, VA 22042

We will evaluate the contributions of some contemporary management techniques such as TQM and reengineering and propose an alternative framework for managing innovation.

#### MA17 Information Systems I

Contributed Session

Chair: *Robin H. Lovgren*, Univ. of Memphis, 104 Engineering, Memphis, TN 38152, ralovgren@cc.memphis.edu

1) **Neighborhood Delineation**, *Robin H. Lovgren*, Univ. of Memphis, 104 Engineering, Memphis, TN 38152, ralovgren@cc.memphis.edu

The primary task of the County Assessor is to provide reasonable and equitable property valuations. A GIS has been developed to delineate comparable clusters of homes. Optimization and statistical methods are employed to assure homogeneity and validate the results. Examples and special cases will be presented.

2) **Computer-Based Tourism Information System: Need of Turkey (R)**, *Birgul Egeli*, Bogazici Univ., MIS Dept., Bebek, Istanbul, 80815, Turkey, egeli@boun.edu.tr, *Meltem Ozturan*

Information in tourism industry and computer-based tourism information systems are pointed out in general. In the case of Turkey, current tourism information potential, available computer-based tourism information systems and the information needs are discussed. As a result, guidelines for establishing a nationwide computer-based information system for Turkey are proposed.

#### MA18 TUTORIAL: Nonlinear Programming

Invited Session

Chair: *Leon S. Lasdon*, Univ. of TX, MSIS Department, Coll. of Bus. Admin., Austin, TX 78712-1175

1) **TUTORIAL: Nonlinear Programming**, *Leon S. Lasdon*, Univ. of TX, MSIS Department, Coll. of Bus. Admin., Austin, TX 78712-1175

We survey recent advances in NLP software, modeling languages and applications. Software includes GRG and SQP solvers and recent advances in interior point and SLP algorithms. Both algebraic languages and spreadsheet solvers are discussed. In applications, we consider financial models and new work in the optimization of simulations.

#### MA19 Railroad Applications

Sponsor: INFORMS Railroad Applications SIG

Sponsored Session

Chair: *Scott B. Smith*, PTCG, Inc., 22 Third Ave., Burlington, MA 01803

1) **OR Applications: Getting the Users Onboard**, *John J. Gradek*, CP Rail, Windsor Station, Room 100, Montreal, Quebec, H3C 3E4, Canada

No abstract supplied.

2) **Locomotive Planning & Utilization**, *Gordon Trafton*, Illinois Central Railroad

No abstract supplied.

3) **An Overview of a Real-Time Decision Support System for Locomotive Management**, *Ajith B. Wijeratne*, Norfolk Southern Corp., 125 Spring St. SW, MS 110, Atlanta, GA 30303, *Arun G. Marar*

We describe the system architecture, user interfaces, locomotive assignment/repositioning models, forecasting models, data and data models used in the Norfolk Southern Thoroughbred Locomotive Management System currently being proto-typed. We also discuss the pros and cons of LQN methodology in the real-time decision support environment.

4) **A Real-Time Optimization System for Empty Car Distribution**, *Robert Muenz*, CSXX, *Noha Tohamy*, *Scott B. Smith*

CSX is implementing an optimization system for empty car distribution based on the MICROMAP model which has been used by truckload carriers. We discuss this implementation.

#### MA20 Computational Methods for Traffic Analysis & Management

Sponsor: INFORMS Transportation Science Section

Sponsored Session

Chair: *Srinivas Peeta*, Purdue Univ., Sch. of Civil Eng., W Lafayette, IN 47907-1284

1) **A Cooperative Approach to Distributed Network-Wide Traffic Congestion**, *Filippo Logi*, Univ. of CA, Civil & Env. Eng., Irvine, CA 92697, *Stephen G. Ritchie*

We introduce a multi-agent system architecture for distributed network-wide

traffic congestion management that provides the means for coordination and conflict-resolution based on a functionally accurate cooperative approach. The modules exchange information related to their interpretation of the network condition and the proposal of partial and incomplete strategies for an efficient management of congestion.

**2) Analysis of Distributed Computing Techniques for Dynamic Network Algorithms with On-Line ITS Operational Needs, Srinivas Peeta**, Purdue Univ., Sch. of Civil Eng., W Lafayette, IN 47907-1284, *Shu-Ching Chen*

Existing sequential processing solution techniques and/or single processor computational environments are inadequate for on-line operations, especially for methodologies that require the processing of network-wide time-dependent traffic-related data. We investigate RPC-based asynchronous distributed computing techniques in the context of dynamic network algorithms for on-line ITS applications...

**3) Simulation Results for Scheduling with Conflicts & Applications for Traffic Signal Control, Vitus Leung**, Univ. of CA, Dept. of Info. & Comp. Sci., Irvine, CA 92697, *Sandy Irani*

Scheduling of jobs that may be competing for mutually exclusive resources is considered. Conflicts between jobs are modeled with a "conflict graph," so that all concurrently running jobs must form an independent set in the graph. This model is natural and general enough to have applications in a variety of settings, including traffic intersection control. Simulation results algorithm will be given.

**MA21 What's Happening in Aviation OR: A Round Table Discussion**

**Cluster:** Aviation Applications  
**Invited Session**

**Chair:** Robert B. Rovinsky, Federal Aviation Admin., ASD-400, 800 Independence Ave. SW, Washington, DC 20591, *rrovinsky@mail.hq.faa.gov*

**1) What's Happening in Aviation Operations Research: A Round Table Discussion, Robert B. Rovinsky**, Federal Aviation Admin., ASD-400, 800 Independence Ave. SW, Washington, DC 20591, *rrovinsky@mail.hq.faa.gov*

This is an opportunity to discuss what is happening throughout the aviation OR world. Come prepared to speak about major problems, opportunities to apply OR as well as issues confronting you, your work group and the entire profession. The session will be relatively informal and will continue over lunch.

**MA22 Design of Manufacturing Systems**

**Sponsor:** INFORMS Section on Manufacturing & Service Operations Management  
**Sponsored Session**

**Chair:** Ilhyung Kim, Purdue Univ., Krannert Grad. Sch. of Mgmt., 1310 Krannert Bldg., W Lafayette, IN 47907-1310, *ikim@mgmt.purdue.edu*

**1) Requirements Planning for Multi-Product Systems with Component Substitutability, Anant Balakrishnan**, PA State Univ., Smeal Coll. of Bus. Admin., University Park, PA 16802-1913, *Joseph Geunes*

Designing product lines with substitutable components and subassemblies permits companies to reduce setup and inventory costs while offering a broad variety of products. We develop an efficient algorithm for multi-period production/procurement planning in make-to-order systems with substitution options. The model minimizes setup, production conversion and holding costs.

**2) A Comparison of Performance of U-Line & Straight-Line Layouts Under Stochastic Process Times, Suresh Chand**, Purdue Univ., Krannert Grad. Sch. of Mgmt., 1310 Krannert Bldg., W Lafayette, IN 47907-1310, *suresh@mgmt.purdue.edu*, *Ting Zheng*

We discuss the effect of process time variance on the performance of U-line layout and straight-line layout. We show cases when U-line layout is more productive than straight-line layout for low process time variance but less productive for high process time variance.

**3) Capacity Expansion of Flexible Manufacturing Plants, Ilhyung Kim**, Purdue Univ., Krannert Grad. Sch. of Mgmt., 1310 Krannert Bldg., W Lafayette, IN 47907-1310, *ikim@mgmt.purdue.edu*, *Hyung K. Koo*

Recently, financial option theory has been applied to various types of investment decision problems. We consider an issue of how we determine capacity expansion decisions for flexible manufacturing plants when future options are present.

**MA23 Recent Developments in Manufacturing Operations Scheduling**

**Cluster:** Manufacturing & Service Management  
**Invited Session**

**Chair:** Lei Lei, Rutgers Univ., Faculty of Mgmt., 180 University Ave., Newark, NJ 07102, *llel@andromeda.rutgers.edu*

**1) Optimal Allocation of Pallets in Small Flexible Manufacturing Systems, Arne Thesen**, Univ. of WI, Dept. of IE, 1513 University Ave., Madison, WI 53706, *thesen@engr.wisc.edu*

The production rate of a small FMC depends both on the order in which parts are produced on each machine and on the number and types of part-carrying pallets available. We study the problem of finding the optimal pallet mix and the corresponding scheduling policy for a given product mix.

**2) An Optimal Control Formulation for Multiclass Machine Scheduling Problems, Zhi-Long Chen**, Princeton Univ., Dept. of Civil Eng. & OR, Princeton, NJ 08544, *zhichen@princeton.edu*, *Warren B. Powell*

We give an optimal control formulation for a class of machine scheduling problems with multiple classes of jobs and stochastic parameters.

**3) Cyclic Scheduling of a Real-Time Telecommunications System, Tzyh-Jong Wang**, Bell Labs., 101 Crawford Corner Rd., Holmdel, NJ 07733, *tjwang@hohserve.lucent.com*

We solve the problem of cyclic scheduling of multi-class tasks on a real-time telecommunications system.

**4) Minimizing the Cost of a Transportation Schedule with Release & Due Date Constraints, Lei Lei**, Rutgers Univ., Faculty of Mgmt., 180 University Ave., Newark, NJ 07102, *llel@andromeda.rutgers.edu*, *Carla P. Gomes, Anna Oleska*

We introduce a local optimization approach to large-scale transportation problems with release and due date constraints on delivery operations. Applications in scheduling cargo aircraft are reported.

**5) How to Improve Business Operations via Data Visualization, Ke-Tsai Edward Chin**, AT&T, Mktg. Models/Sys/Analysis Grp., Murray Hill, NJ 07974, *kct@ulysses.att.com*

With the passing of new telecommunication laws and the competition becoming more intense than ever before, setting the "right" prices for telecommunication services becomes a matter of survival. Practical approaches to this issue are discussed.

**MA24 Strategic Decision Modeling**

**Sponsor:** INFORMS Decision Analysis Society  
**Sponsored Session**

**Chair:** Samuel E. Bodily, Univ. of VA, Darden Grad. Bus. Sch., PO Box 6550, Charlottesville, VA 22906-6550, *bodily@virginia.edu*

**1) Outside-In Strategic Modeling, James E. Matheson**, Strategic Decisions Group, 2440 Sand Hill Rd., Menlo Park, CA 94025-6900, *jmatheson@sdgnet.com*, *David Matheson*

Many DA models typically start with the business situation and then add incremental changes, implicitly assuming "business as usual," thus often missing consumer and industry trends and paradigm shifts. "Outside-in" modeling starts with assessments of technology and markets, and works inward to the implications for the business.

**2) Strategic Decision Modeling, Barry C. Smith**, SABRE Dec. Tech., 1 E Kirkwood Rd., MD 7390, Southlake, TX 76092

Many decision support models have been developed and used for the various aspects of airline planning. We review the development of an integrated approach to scheduling planning, pricing and yield management.

**3) The Role of Market Models in Strategic Product Decisions, Richard D. Smallwood**, Applied Decision Analysis, 2710 Sand Hill Rd., Menlo Park, CA 94025, *rsmallwd@adainc.com*

We first discuss the nature of strategic product decisions and the role that market models can play in estimating how future markets will respond to truly innovative product strategies. Specific problems such as changing market demographics, rising expectations and changing customers needs will be addressed. Possible solutions will be proposed in real examples.

**4) Linking Strategy & Decision Modeling, Samuel E. Bodily**, Univ. of VA, Darden Grad. Bus. Sch., PO Box 6550, Charlottesville, VA 22906-6550, *bodily@virginia.edu*

Concepts of strategy such as sustainable competitive advantage, value chain

analysis, competitor and industry analysis and portfolio of business, among others, are key to the success of businesses and managers. We discuss how the power of decision modeling can be combined with these concepts to bring additional insight and improved performance.

#### MA25 PANEL: Entrepreneurial OR Practice in a Changing Client Environment

Sponsor: INFORMS Forum on Education & Academic/Practice Interface Committee  
Sponsored Session

Chair: To be announced

#### MA26 Queuing Networks

Sponsor: INFORMS Applied Probability Section  
Sponsored Session

Chair: Jim Dai, GA Inst. of Tech., Sch. of ISyE, Atlanta, GA 30332-0205

##### 1) On the Global Stability Region of Two Station Queuing Networks with Probabilistic Routing, *John J. Hasenbein*, GA Inst. of Tech., Sch. of ISyE, Atlanta, GA 30332-0205, *Jim Dai*, *John Vande Vate*

We derive the global stability region for a 2-station queuing network with probabilistic routing. This region, given in terms of routing probabilities and average service and arrival rates, determines when a network has enough capacity to service incoming customers. We show that the conditions arise from the notions of virtual stations and push-starts...

##### 2) Diffusion Approximation of Make-to-Stock Assemble-to-Order Systems with Backorder & Partial Backorder, *Joseph Edward Nemeč*, MIT, OR Ctr., Rm. E40-419, Cambridge, MA 02139, *Vien Nguyen*

We consider a multi-commodity make-to-stock assemble-to-order system with a single flexible workstation and fixed initial basestock levels. Product orders arrive for possibly several components. We develop diffusion approximations for the workstation workload process and estimates for performance measures such as fill rates and inventory levels.

##### 3) Spatial Queuing Systems: Measure-Valued Markov Queuing Processes, *Xiatao Huang*, GA Inst. of Tech., Sch. of ISyE, Atlanta, GA 30332-0205, *Richard Serfozo*

A Jackson queuing network models the movement of customers among discrete stations. We introduce a generalization in which customers move in a general space, e.g., cellular phones or logistics movements in a region of the plane or customers in a discrete network that carry continuous marks (information) that determine their movements. We represent the system as a measure-valued Markov process...

##### 4) On the Monotone Global Stability Region of Fluid Networks, *Jim Dai*, GA Inst. of Tech., Sch. of ISyE, Atlanta, GA 30332-0205, *John J. Hasenbein*, *John Vande Vate*

We discuss global stability of fluid networks with more than 2 stations. We prove that the global stability region may not be monotone in terms of service time vector; the LP proposed by Bertimas, Gamarnik & Tsitsiklis (1995) may not characterize the global stability region or even the monotone global stability region; and the global stability region may not be the intersection of stability regions under all static buffer priority disciplines...

#### MA27 New Developments in Ranking & Selection Procedures for Simulation

Sponsor: INFORMS College on Simulation  
Sponsored Session

Chair: James R. Wilson, NC State Univ., Dept. of IE, Raleigh, NC 27695-7906, [jwilson@eis.ncsu.edu](mailto:jwilson@eis.ncsu.edu)

##### 1) Procedures for Selecting the Best System with Respect to a Standard or Default, *David Goldsman*, GA Inst. of Tech., Sch. of ISyE, Atlanta, GA 30332, [sman@isye.gatech.edu](mailto:sman@isye.gatech.edu), *Barry L. Nelson*

Suppose we are interested in comparing a number of competing systems with a given standard or with an existing default system. The goal is to choose the best of the competing systems only if that system is also superior to the standard or default. We study a number of selection and multiple comparisons procedures for the goal under various statistical assumptions on the underlying systems.

##### 2) Selection of the Best System in Steady-State Simulation, *Halim Damerdjii*, NC State Univ., Dept. of IE, Raleigh, NC 27695-7906, [damerdjii@eos.ncsu.edu](mailto:damerdjii@eos.ncsu.edu), *Peter W. Glynn*, *Marvin Nakayama*, *James R. Wilson*

There are a number of steady-state processes with unknown means. Using

simulation, we would like to select the process with the largest process mean and this with probability at least some prespecified threshold value. Under Bechofer's indifference-zone approach, we propose a Dudewicz-Dalal-type procedure based on the steady-state output analysis method of batch means...

##### 3) Multiple Comparisons with the Best in Steady-State Simulations Using Common Random Numbers, *Marvin Nakayama*, NJIT, Dept. of Comp. & Info. Sci., Newark, NJ 07102, [marvin@cis.njit.edu](mailto:marvin@cis.njit.edu)

We consider the problem of comparing the steady-state means of some small number of systems. In particular, we develop 2 different single-stage simulation procedures for multiple comparisons with the best using common random numbers. Our procedures are asymptotically valid when a functional central limit theorem holds.

#### MA28 Location Models II

Cluster: Location Analysis  
Invited Session

Chair: Zvi Drezner, CA State Univ., Grad. Sch. of Mgmt., Irvine, CA 92697, [zdrezner@fullerton.edu](mailto:zdrezner@fullerton.edu)

##### 1) Relocating Businesses to Revitalize Neighborhoods: A Competitive Location Framework, *Mamnoon Jamil*, Rutgers Univ., Sch. of Business, Camden, NJ 08102, *Alok Baveja*

Past research has shown that renewing the economy of inner-city crime-prone neighborhoods is a key component in a long-term framework for determining policy initiatives which would encourage businesses to locate their operations in such neighborhoods instead of other competing locations.

##### 2) Facility Location with Closest-Point Demands & Facilities, *Jack Brimberg*, Royal Military Coll. of Canada, Dept. of Eng. Mgmt., Kingston, Ontario, K7K 5L0, Canada, *George O. Wesolowsky*

We consider a new class of location problems where distances are between closest points of facilities and areas. Special cases, such as rectilinear distances and rectangular enclosing areas are solved.

##### 3) A Tabu Search Heuristic Approach for Location Problems, *Said Salhi*, Univ. of Birmingham, Man. Math Group, Edgbaston, B15 2TT, UK, [salhis@vms1.bham.ac.uk](mailto:salhis@vms1.bham.ac.uk)

Two elements in TS are investigated: use of a functional representation of the tabu size and a softer criterion to measure the aspiration level. These are more informative as they try to represent a given attribute at a given iteration. In the former, we use the change in the objective function; in the latter, we combine both the change and the tabu tenure of a given attribute at that iteration...

#### MA29 Inventory II

Contributed Session

Chair: S. Viswanathan, Nanyang Tech Univ., Nanyang Bus. Sch., 639798, Singapore, [asviswa@ntu.edu.sg](mailto:asviswa@ntu.edu.sg)

##### 1) An Algorithm for Determining the Optimal Q(s,S) Policy for Multi-Item Inventory Systems with Joint Setup Costs, *S. Viswanathan*, Nanyang Tech Univ., Nanyang Bus. Sch., 639798, Singapore, [asviswa@ntu.edu.sg](mailto:asviswa@ntu.edu.sg)

We propose a new class of policies for the multi-item inventory problem with stochastic demands and joint setup costs. An algorithm for determining the optimal Q(s,S) policy for the problem is presented. Computational results that demonstrate the superiority of the proposed class of policies are also presented.

##### 2) Enhanced (s,S) Policies for Single Product Periodic Review Systems, *Sanjay E. Ramaswamy*, IBM, TJ Watson Res. Ctr., PO Box 218, Rm. 01-225, Yorktown Heights, NY 10598, [ser@watson.ibm.com](mailto:ser@watson.ibm.com), *Amit Garg*

A study of single item single location inventory policies was conducted from the standpoint of convenient commercial implementation. Enhancements were made to existing implementations to increase accuracy of achieved service levels and/or reduce average inventory investments. Experiments comparing the enhancements with implementations currently available in the market were also conducted...

##### 3) Inventory Control for Low Demand Items, *Martin L. Puterman*, Univ. of British Columbia, Fac. of Commerce, 2053 Main Mall, Vancouver, BC, V6T 1Z2, Canada, [marty@markov.commerce.ubc.ca](mailto:marty@markov.commerce.ubc.ca), *Tchavdar Dangalchev*, *Kaan Katirciogulu*

We describe our approach to developing an inventory management system for low demand items for ESCO Industries, a manufacturer of hardware for the forestry, mining and construction industry. We discuss features of the application which lead us to use a combined simulation optimization approach instead of a continuous review stochastic model.

##### 4) Exact Analysis of Continuous Review (R,Q)-Policies in 2-

**Echelon Inventory Systems with Compound Poisson Demand, Sven Axsater**, Lund Univ., Dept. of IE, Lund, S-221 00, Sweden, sven.axsater@ie.lth.se

We consider a 2-level inventory system with 1 central warehouse and N retailers. All installations apply different continuous review installation stock (R,Q)-policies. The retailers face independent compound Poisson demand processes. Transportation times are constant. We present a method for exact evaluation of control policies that provides the complete probability distributions of the retailer inventory levels.

### MA30 Picatinny Arsenal & West Point Joint Relationship I

Sponsor: INFORMS Military Applications Society

Sponsored Session

Chair: Julie C. Chu, Armament Research Development Eng. Ctr., Picatinny Arsenal, NJ 07806-5000, Chair

Co-Chair: John A. Marin

1) **Picatinny Arsenal & West Point Joint Relationship: One - Designing Solutions for the Army of the 21st Century, Julie C. Chu**, Armament Research Development Eng. Ctr., Picatinny Arsenal, NJ 07806-5000, Chair, **James E. Armstrong, Jr.**

We present lessons on how to develop and maintain a productive partnership between industry and academia. The Systems Engineering Department at the US Military Academy, West Point, has built an important relationship with a real-world client in the industry we serve, the Army. The client is the Advanced Systems Concepts Office, US Army Armament Research, Development and Engineering Command, Picatinny Arsenal, New Jersey...

2) **Designing an Intelligent Ammunition Supply Area, Alan Santucci**, AMSTA-AR-AL, B455, Picatinny Arsenal, N-07806-5000, asantu@pica.army.mil

Ensuring combat forces are supplied with ammunition in a timely and efficient manner is a critical problem similar to distribution problems in industry. Current operations concerning ammunition supply areas are manpower intensive; however, as the Army downsizes, reduction in ammunition personnel may be as high as 50%. We address alternative systems to ensure throughput from an ammunition supply area meets the needs of clients (combat units)...

3) **Contingency Force Ammunition Supply Operations, Alan Santucci**, AMSTA-AR-AL, B455, Picatinny Arsenal, N-07806-5000, asantu@pica.army.mil

The implementation of US policy objectives requires the Army to be able to enter into contingency operations in areas that cannot be supported by a port with a large logistics operations. In such cases, the Army must resupply ammunition of inserted forces from an offshore location. We examine alternative instream resupply systems to include a sea-based ammunition supply system...

### MA31 Future of Army Training Analysis

Sponsor: INFORMS Military Applications Society

Sponsored Session

Chair: Ron Cooper, USA TRAC, ATRC-WG, WSMR, NM 88002-5502, cooperr@trac.wsmr.army.mil

1) **Distance Learning, Embedded Training & Army Training Challenges, Ed George**, USA TRAC, ATRC-WG, WSMR, NM 88002-5502, george@trac.wsmr.army.mil

As the Army is structuring for the future, it must also find new ways to train and sustain the force capabilities. This challenge is complicated by tightening budgets, changing missions and increasingly sophisticated digitized equipment. Distance learning and some related technologies can be powerful tools for addressing these unique training challenges faced by the US Army...

2) **The Training Implications of Digitization for the Army of the 21st Century, Charles R. Hughes**, USA TRAC, ATRC-WG, WSMR, NM 88002-5502, hughesc@trac.wsmr.army.mil

We discuss the training insights and lessons learned from the recent Task Force XXI Advanced Warfighting Experiment. During this AWE, a 3-phased training effectiveness analysis was conducted to determine the experimental force baseline proficiency, new digital equipment training and implementation of the new digital equipment in the field. Results and general insights from the analysis will be presented.

3) **JANUS Linkage to Applique, Stanley C. Ritter**, Advanced Technologies, Inc., TRADOC Analysis Ctr., WSMR, NM 88002-5502

Applique is a digital command and control system consisting of PC class computers and software using modern GUIs. Applique systems link individual operational elements throughout a brigade structure using tactical Internet communications architecture. The procedures, systems and network for

implementing the Janus link to Applique are described. The architecture of the battalion CPX and the relationship to the Janus/Aplique environment are explained.

### MA32 Global Network Design Issues

Sponsor: INFORMS Technical Section on Telecommunications

Sponsored Session

Chair: A. Kashper, AT&T, 101 Crawfords Corner Rd., Rm. 2J-407, Holmdel, NJ 07733, arik@attmail.com

1) **On Optimizing Access Networks & Hub Selection for Regions Consisting of Many Countries, G. Anadalingam**, Univ. of PA, Dept. of Systems Eng., Philadelphia, PA 19104, anand@systems.seas.upenn.edu, **Margaret Tan**

Southeast Asia contains a number of small countries, each implementing telecommunications networks within its own boundaries. Each country would have its own international gateways, for reasons of nationalism and control of information flows. We use optimization models to examine cooperative networks and estimate the costs and benefits of sharing hubs.

2) **A Multi-Commodity Flow Approach to Global Facility Planning, Lawrence D. Fossett**, AT&T Labs., 101 Crawfords Corner Rd., Rm. 2B-431, PO Box 3030, Holmdel, NJ 07733, l.fossett@att.com, **Dah Nain Lee, Lucia I. Resende, Mauricio G. C. Resende**

Worldwide liberalization of telecommunication markets is changing the international telecommunications environment from its bilateral model of operation to an integrated, global network environment. We describe a methodology for analyzing global capacity requirements which includes a multi-commodity flow LP model. Traditionally, a commodity is defined as a unique point-to-point traffic...

3) **Optimization Techniques for Operation Planning of Mobile Communication Networks, Takeshi Mizuike**, Kokusai Denshin Denwa Co., Ltd., KDD R&D Labs., 2-1-15 Ohara Kamifukuoka-shi, Saitama, 356, Japan, **Satoshi Konishi, Yoji Kishi, Yu Watanabe**

Efficient and flexible operations planning is required for mobile communication networks mainly due to limited frequency resources. Combinatorial optimization, graph theory and mathematical programming are useful techniques. Recent application of such techniques to frequency channel assignment and call through-put analysis is introduced for terrestrial cellular and mobile satellite networks.

4) **Multilateral Network Design Using Uncertainty, A. Kashper**, AT&T, 101 Crawfords Corner Rd., Rm. 2J-407, Holmdel, NJ 07733, arik@attmail.com

We review telecommunications network design problems for international networks. We discuss the mathematical model incorporating demand uncertainty and show how to use stochastic DP approaches to derive an optimal multi-period network design policy and investigate the trade-off between purchasing direct capacity or paying transit carriers for routing calls via 3rd countries...

### MA33 OR Applications I

Contributed Session

Chair: Thomas W. Knowles, IL Inst. of Tech., Stuart Sch. of Bus., 565 West Adams St., Chicago, IL 60661, knowles@stuart.iit.edu

1) **Forecasting Natural Gas Demand Using Statistical Networks, Thomas W. Knowles**, IL Inst. of Tech., Stuart Sch. of Bus., 565 West Adams St., Chicago, IL 60661, knowles@stuart.iit.edu

Forecasts of demand for natural gas are important for tactical decisions of gas purchase amounts. Statistical networks are an alternative to traditional regression-derived models. We describe the application of statistical networks, the resulting models and compare the performance of the models to regression for a particular demand region.

2) **SisGRAFO: An MVI System for Graph Optimization, Marcos Jose Negreiros**, Unv. Estadual do Ceara, R. Pereira Valente, 350 apto. 200, Fortaleza CE, 60160-250, Brazil, **Nelson Maculan, Francisco Negreiros Gomes**

We show a VIM system for graph optimization that supports such problems as constrained K-spanning trees, Steiner trees, shortest paths, network flows, transportation problems, location, TSP and constrained TSP, VRP on nodes and/or arcs and assignment problems, i.e., matching, CCP, LSA. They are explored by some related state-of-the-art network algorithms...

3) **Development of a Flexible CIM Software Using Distributed Object Technology, Chang-Ouk Kim**, Korea Univ., Dept. of IE, Sungbuk-gu, Seoul, 136-075, Korea, sungskim@kucncx.korea.ac.kr,

**Sung-Schick Kim**

For most hierarchical CIM enterprises, we develop a production integration framework which can identify most common production objects of each layer and a distributed object-oriented CIM software which can flexibly integrate the distributed production objects using an event-driven workflow method.

**4) Applications of Intelligent Agents in Information Systems, Cindy L. Corritore**, Creighton Univ., Coll. of Bus. Admin., Omaha, NE 68178, cindy@creighton.edu, **Betty L. Hickman, Daniel Peak**

With the proliferation of electronically available data, there is growing interest in methods that facilitate incorporation of such data into business processes. One approach involves the use of intelligent autonomous software assistants, or agents. We will discuss applications of agents in ISs, including those dealing with decision support.

**MA34 Derivatives Risk Management**

**Cluster: Choice Engineering  
Invited Session**

**Chair: Les Clewlow**, Warwick Univ., Warwick Bus. Sch., Coventry, CV4 7AL, UK, forclc@wbs.warwick.ac.uk

**1) Customizing Risk Management Securities via Asset Liability Management Systems, John M. Mulvey**, Princeton Univ., Dept. of Civil Eng. & OR, Princeton, NJ 08544, mulvey@macbeth.princeton.edu

Asset and liability management systems identify scenarios that cause difficulties for long-term institutional investors. The wealth path can be reshaped by purchasing customized derivatives with payoffs conditional on several economic conditions, such as the trend in interest rates and inflation. An example is presented for a large international insurance company.

**2) Robust Quasi-Static Hedges for Exotic Options, Les Clewlow**, Warwick Univ., Warwick Bus. Sch., Coventry, CV4 7AL, UK, forclc@wbs.warwick.ac.uk, **Ana Pascoa, Silio Ararico**

We develop a multi-period, multi-objective goal programming approach to hedging financial options positions. In contrast to conventional approaches, we are able to obtain robust dynamic hedges which embody the multiple objectives of realistic and accurate modeling of the market and realistic constraints on the edge transactions.

**Monday 10:00-11:00****MW35 Welcoming Session**

**Welcoming Session**

**Chair: Fred Raafat**, San Diego State Univ., Coll. of Bus. Admin., Info. & Dec. Systems Dept., San Diego, CA 92182-0127, fred.raafat@sdsu.edu

**Monday 11:00-12:00****MP35 Plenary: Principles of Inference - In Theory & In Practice**

**Plenary Session**

**Chair: Harry Markowitz**, Harry Markowitz Co., 1010 Turquoise St., Ste. 245, San Diego, CA 92109

**1) PLENARY: Principles of Inference - In Theory & In Practice, Harry Markowitz**, Harry Markowitz Co., 1010 Turquoise St., Ste. 245, San Diego, CA 92109

Decision making should be Bayesian, but classic (R.A. Fisher, Neyman-Pearson) inference can be highly misleading for Bayesians, as can the use of diffuse priors. Recommended procedures are illustrated using an important financial application. In particular, we consider how to bound Bayesian shifts in belief for compound hypotheses.

**Monday 13:00-14:30****MB04 Evaluating Benefits of Government Aviation Technology Programs**

**Cluster: Public Sector Applications**

**Sponsor: INFORMS Section on Public Programs & Processes**

**Sponsor/Invited Session**

**Chair: Jesse P. Johnson**, Logistics Mgmt. Inst., 2000 Corporate Ridge, Rm. 2026, McLean, VA 22102, jjohnson@mail.lmi.org

**1) A Runway & Airport Capacity Model for Evaluating**

**Terminal Area Aviation, David Lee**, Logistics Mgmt. Inst., 2000 Corporate Ridge, McLean, VA 22102, dlee@lmi.org, **Gerald W. Shapiro**

To assess proposals for improving airport capacity, we determine runway capacities as Pareto frontiers in the arrival/departure rate plane, from weather-dependent statistics of several aircraft performance and ATC procedures measures. Airport capacities as functions of weather and demand follow from matching capacities of assigned runway configurations to demand.

**2) Translating Improvements in Aircraft Technology into Economic Benefits, Earl Wingrove**, Logistics Mgmt. Inst., 2000 Corporate Ridge, McLean, VA 22102, ewingrove@lmi.org, **Peter Kostiuk, Robin Sickles, David Good**

To assist US industry with future technological challenges, NASA must identify research areas with the greatest potential for improving the air transportation system. To link the economics of flight with the technology of flight, NASA is building an Aviation System Analysis Capability, ASAC. ASAC utilizes a parametrically-based model linking airline operations and investments in aircraft with aircraft characteristics.

**3) An Aircraft/Air Traffic Management Functional Analysis, Mel Etheridge**, Logistics Mgmt. Inst., 2000 Corporate Ridge, McLean, VA 22102, metheridge@lmi.org, **Peter Kostiuk**

We describe an interactive discrete-event simulation model which quantifies communications and task load demands placed on flight crew, controllers and dispatchers under different air traffic management concepts and technologies. The model replicates an ARTCC's operations over 3 hours using actual flight data, identifying possible bottlenecks and areas requiring further research.

**4) Aviation System Analysis Capability, Earl Wingrove**, Logistics Mgmt. Inst., 2000 Corporate Ridge, McLean, VA 22102, ewingrove@lmi.org, **Peter Kostiuk, James Villani, Eileen Roberts**

ASAC aims to provide decision makers with the ability to estimate the impact of advanced technologies on the air transportation industry. Using a systems perspective, ASAC incorporates models that analyze the technical and economic effects of aircraft improvements, changes in air traffic management, noise and other aviation system components.

**MB05 Linear Programming: Strong Polynomiality & Related Issues**

**Cluster: Linear Programming**

**Invited Session**

**Chair: Santosh N. Kabadi**, Univ. of New Brunswick, Fac. of Admin., PO Box 4400, Fredericton, NB, E3B 5A3, Canada, kabadi@unb.ca

**1) Equivalence of Exact & E-Approximation Separation & Optimization Problems in Fixed Dimension, Santosh N. Kabadi**, Univ. of New Brunswick, Fac. of Admin., PO Box 4400, Fredericton, NB, E3B 5A3, Canada, kabadi@unb.ca

We summarize recent results on equivalence (in strong polynomiality sense) of exact and approximation linear separation and linear optimization problems on a convex set in fixed dimension.

**2) New Polynomial-Time Cycle-Cancelling Algorithms for Minimum Cost Flows, James B. Orlin**, MIT, Rm. E53-357, Sloan Sch. of Mgmt., Cambridge, MA 02139, jorlin@mit.edu, **P. T. Sockalingam, Ravi Ahuja**

We describe a new cycle-canceling algorithm that solves the minimum cost flow problem in  $O(m \log(nU)(m + n \log n))$  time. Our algorithm is a scaling algorithm and proceeds by augmenting flows along cycles with sufficiently large residual capacity. We also describe a strongly-polynomial variant of this algorithm that runs in  $O(m(m + n \log n) \min(\log(nU), m \log n))$  time.

**3) Algorithms for the Equal Flow Problem, Ravi Ahuja**, Rutgers Univ., Dept. of MSIS, Sch. of Bus., PO Box 5062, New Brunswick, NJ 08903-5062, ahuja@rutcor.rutgers.edu, **James B. Orlin, Paola Zuddas, G. Sechi**

The equal flow problem is a generalization of the minimum cost flow problem in which a specified set of arcs are restricted to have equal (or proportionate) flow. This problem arose in the modeling of water resource management problem in the region of Sardinia, Italy. We describe several algorithms for the equal flow problem including 2 polynomial-time algorithms.

**4) Strong Dual Feasible Trees & Polynomial Dual Simplex Algorithms for Network Flow Problems, Ronald Armstrong**, Rutgers Univ., RUTCOR, PO Box 5062, New Brunswick, NJ 08903-5062, **Zhiying Jin**

Fundamental properties of strong dual feasible trees will be presented which directly yield strongly polynomial algorithms for several network flow

problems. Excess scaling methods will be outlined which provide strongly polynomial algorithms for several problems including the minimum cost flow problem and a polynomial algorithm for the generalized maximum flow problem.

### MB06 Integer Programming, Theory & Applications

Cluster: Combinatorial Optimization

Invited Session

Chair: Gabor Pataki, Columbia Univ., Sch. of Eng., 330 Mudd, New York, NY 10027, gp1h@andrew.cmu.edu

1) **Convex Programming for Disjunctive Programs**, *Joao Soares*, Columbia Univ., Grad. Sch. of Bus., 417 Uris Hall, New York, NY 10027, jls55@columbia.edu, *Sebastian Ceria*

Given a finite number of convex sets, whose algebraic representation is known, we study the problem of optimizing a convex function over the convex hull of the union of these sets. This problem has applications in linear and nonlinear integer programming.

2) **CORC: The Computational Optimization Research Center at Columbia University**, *Gabor Pataki*, Columbia Univ., Sch. of Eng., 330 Mudd, New York, NY 10027, gp1h@andrew.cmu.edu, *David Bayer*, *Daniel Bienstock*, *Sebastian Ceria*, *Donald Goldfarb*, *Eva K. Lee*

We describe our latest research in integer programming that is carried out at the CORC Center at Columbia University. The Center is a joint venture between Columbia, Cornell University and IBM.

3) **A Class of Hard Integer Programs & the Group Relaxation**, *Gerard P. Cornuejols*, Carnegie Mellon Univ., GSIA, Pittsburgh, PA 15213-3890, *Milind Dawande*

We consider a special class of integer programs. We show that the problems in this class are extremely hard and LP-based B&B/B&C methods and show that using the discrete group relaxation is an efficient way to solve these problems.

### MB07 Interior Point Column Generation Algorithms for Convex Programming

Cluster: Nonlinear Programming

Invited Session

Chair: Zhi-Quan Luo, McMaster Univ., Dept. of Elec. & Comp. Eng., Communication Res. Lab., Hamilton, Ontario, L8S 4K1, Canada, luoqz@mcmail.cis.mcmaster.ca

1) **Solving Mixed Integer Nonlinear Programming Problems Using an Interior Point Method**, *John E. Mitchell*, RPI, Dept. of Math. Sci., Troy, NY 12180, mitchj@rpi.edu, *Eva K. Lee*

We discuss a parallel implementation of an interior B&C method for solving mixed integer nonlinear programming problems. We consider warm starting the method at the nodes of the tree and also within the nodes of the tree. Computational results are presented.

2) **Nonlinear Programming with Constraints Given by an Oracle**, *Jean-Louis Goffin*, McGill Univ., Fac. of Mgmt., 1001 Sherbrooke St. W, Montreal, Quebec, H3A 1G5, Canada, goffin@management.mcgill.ca, *Faranak Sharifi Mokhtarian*

The nonlinear analytic center cutting plane method can be applied to the solution of problems with a smooth nonlinear objective and constraints given by a separation oracle. Complexity results will be given.

3) **Cutting Surfaces & Analytic Center: A Polynomial Algorithm for the Convex Feasibility Problem Defined by Self-Concordant Inequalities**, *Zhi-Quan Luo*, McMaster Univ., Dept. of Elec. & Comp. Eng., Communication Res. Lab., Hamilton, Ontario, L8S 4K1, Canada, luoqz@mcmail.cis.mcmaster.ca, *Jie Sun*

Consider a nonempty convex set defined by a finite number of convex differentiable inequalities admitting a self-concordant logarithmic barrier. We study the analytic center-based column generation algorithm using "convex cuts" for finding a feasible point in this set. Our method has a polynomial worst case complexity on the total number of cuts to be used.

### MB08 Applications of Discrete Optimization in Operations Management

Cluster: Integer Programming

Invited Session

Chair: Dilip Chhajed, Univ. of IL, Dept. of Bus. Admin., 350 Commerce W, 1206 S 6th St., Champaign, IL 61820, chhajed@uiuc.edu

Co-Chair: Timothy J. Lowe

1) **Hoist Scheduling of a Circuit Board Production Line**, *Janny Leung*, City Univ. of Hong Kong, Dept. of MS, Tat Chee Ave., Kowloon, Hong Kong, arjanny@cityu.edu.hk

In a circuit-board production line, there are no inventory buffers between processing stages and upper and lower bounds on processing times. Hoist-scheduling is the problem of determining the sequence and time of the inter-stage moves. We discuss the difficulties of scheduling multiple hoists and present some models and heuristic approaches.

2) **Feeder Network Optimization With & Without Holdovers**, *Chryssi Malandraki*, UPS, 2311 York Rd., Timonium, MD 21093, chm@roadnet.ups.com

In UPS operations, packages go through various transshipment points where they are sorted and directed to the next point in their route. Various constraints have to be satisfied when determining the route of a package or type of equipment used for transporting it. We consider the problem of determining optimal cost trailer-combination types that have enough capacity to transport the given volume of packages.

3) **Finding Schedules in a Mixed-Model Production System with Significant Setups**, *Renato E. de Matta*, Univ. of IA, Coll. of Bus. Admin., Iowa City, IA 52242, *Rodney Traub*

We address the problem of determining production schedules at a pair of serial work centers in a mixed-model production system. The supplying work center incurs a significant total setup time when it produces to a level schedule. We minimize total earliness subject to constraints on product due dates. Computational results are presented.

4) **Edge-Partitioning a K-Tree into Two Smaller Trees**, *Dilip Chhajed*, Univ. of IL, Dept. of Bus. Admin., 350 Commerce W, 1206 S 6th St., Champaign, IL 61820, chhajed@uiuc.edu

The problem of edge coloring a partial k-tree into 2 partial p- and q- trees with  $p, q < k$  is considered. An algorithm is provided to construct such a coloring with  $p+q = k$ . The usefulness of this result in a Lagrangian decomposition framework to solve certain combinatorial optimization problems is discussed.

### MB09 Single Machine Scheduling

Cluster: Scheduling

Invited Session

Chair: Joanna Jozefowska, Poznan Univ. of Tech., Inst. of Comp. Sci., ul. Piotrowo 3A, Poznan, 60-695, Poland, jjozef@poznlv.put.poznan.pl

1) **Single Machine Scheduling with Deadlines & Similar or Opposite Ordering of Release & Due Dates**, *Valery Gordon*, Inst. of Eng. Cybernetics, Academy of Sci. of Belarus, 6 Surganov Str., Minsk, 22001, Belarus, gordon@newman.basnet.minsk.by, *Elena Potapneva*, *Frank Werner*

The single machine scheduling problem to minimize the weighted number of late jobs is considered. The due dates for some jobs are in fact deadlines: these jobs are to be completed on time. The problem is shown to be polynomially solvable for some special relations of processing times and weights.

2) **Batching to Minimize Job Flow Times on One Machine**, *Erwin Pesch*, Univ. Bonn, Inst. Gesellschafts/Wirtschaft, Adenauerallee 24-42, Bonn, 53113, Germany, e.pesch@uni-bonn.de

Consider the problem of manufacturing different parts from different types on 1 machine in batches requiring setups. The objective is to minimize the sum of the item flow times. For a fixed type number, the problem can be solved polynomially. Efficient heuristics are presented for large numbers of types.

3) **Scheduling Around the Shortest Job**, *Joanna Jozefowska*, Poznan Univ. of Tech., Inst. of Comp. Sci., ul. Piotrowo 3A, Poznan, 60-695, Poland, jjozef@poznlv.put.poznan.pl, *Wieslaw Kubiak*

The results concerning the computational complexity of problems of scheduling around the shortest job with various types of penalty functions are presented. Polynomial type algorithms are given for concave penalty functions. The worst case behavior for the alternating algorithm and a class of penalty functions are estimated.

4) **Greedy Randomized Methods for a General Approach to Manpower Scheduling**, *Frank Salewski*, Christian Albrecht Univ. du Kiel, Wilhelm Seeling Platz 1, Inst fur BWL, Kiel, D-24118, Germany, salewski@bwl.uni-kiel.de

A new approach to manpower scheduling is introduced which is general enough to cover most of the aspects relevant within areas separately dealt with so far.

The model is closely related to resource-constrained project scheduling. Furthermore, regret-based biased random sampling methods tailored to the problem structure are presented.

### MB10 Stochastic Programs with Network Structure

Cluster: Stochastic Programming

Invited Session

Chair: Raymond K. Cheung, Hong Kong Univ. of Sci. & Tech., Dept. of IE & Eng. Mgmt., Clear Water Bay, Kowloon, Hong Kong, rcheung@usthk.ust.hk

#### 1) Subproblem Structure in Dynamic Network Flow Problems with Uncertain Arc Capacities, Gregory Glockner, GA Inst. of Tech., Sch. of ISyE, Atlanta, GA 30332-0205, George L. Nemhauser

We consider the structure of subproblems that arise in dynamic network flow problems. By relaxing the capacity constraints, the resulting subproblem has structure similar to a shortest path problem. We discuss this structure and how the resulting subproblems can be solved in time  $O(K^2E)$  where  $K$  is the number of scenarios.

#### 2) Financial Product Development with Stochastic Programs, David D. Bai, Princeton Univ., Dept. of Civil Eng. & OR, Princeton, NJ 08544, John M. Mulvey

We model the process of financial product development as a stochastic program. The proportion of the elementary assets and the transaction dynamics are so determined that the resulting product has the desired risk profile. The model considers numerous uncertain factors and is solved with a special decomposition algorithm.

#### 3) Stochastic Approximation Methods for a Network-Wide Distribution Problem, Anton J. Kleywegt, GA Inst. of Tech., Sch. of ISyE, Atlanta, GA 30332-0205, Jason D. Papastavrou

We consider the operations of a less-than-truckload carrier that manages a network of terminals and a fleet of vehicles. The carrier has to make regular decisions regarding acceptance of loads and dispatching of vehicles in a dynamically changing stochastic environment. Computing optimal policies is feasible only for small systems; for larger systems, we study a number of approximation methods and compare their performance.

#### 4) Approximation Techniques for Stochastic Dynamic Networks, Raymond K. Cheung, Hong Kong Univ. of Sci. & Tech., Dept. of IE & Eng. Mgmt., Clear Water Bay, Kowloon, Hong Kong, rcheung@usthk.ust.hk

Dynamic networks offer special structures that allow us to develop approximation solution techniques. We consider several approximation techniques for dynamic networks with random arc capacities, those with random supplies and those with nonlinear, random arc costs.

#### 5) Multistage Stochastic Linear Programming Model for Planning Circuit-Switched Telecommunications Networks with Rapidly Varying Demand, Grant Cameron, Univ. of AZ, Dept. of SIE, Tucson, AZ 85721, cameron@sie.arizona.edu

We model and solve 2 related problems in circuit-switched networks: determining network link capacities and routing network traffic. The model incorporates demand distributions that change rapidly with respect to the average call holding time. We obtain an approximate solution by a decomposition algorithm which computes costs for the network states.

### MB12 OR in Telecommunications I: Design & Management Problems

Sponsor: INFORMS CSTS

Sponsored Session

Chair: Djangir Babayev, US WEST Advanced Tech., 4001 Discovery Dr., Ste. 280, Boulder, CO 80303, dbabayev@advtech.uswest.com

#### 1) Optimizing PCS Backhaul Networks: Should Wireless Network Engineers Care?, Tony Cox, Cornerstone Consulting, 999 18th St., Denver Place S Tower Ste. 3220, Denver, CO 80202, tonycox@cnrstn.com

Many telecommunications network design engineers doubt that OR optimization methods can produce significantly better designs than experienced human experts on real-world problems. We describe a case study in which expert engineers learned to design significantly better networks (more than 10% less costly) by analyzing the design produced by a GA.

#### 2) Solving Real-World Field Technician Scheduling Problems, Jiyang Xu, US WEST Advanced Tech., 4001 Discovery Dr., Boulder, CO 80303, jiyang@advtech.uswest.com

A field technician scheduling problem is to assign a set of jobs, at different locations with time windows, to technicians with different job skills. This is a generalization of the VRP with time windows since technician skills need to match job types. We present several heuristic procedures, including a greedy heuristic, a local search algorithm and a greedy randomized adaptive search procedure...

#### 3) Some Relative Performance Efficiency Evaluation Problems & Models in a Telecommunication Company, Djangir Babayev, US WEST Advanced Tech., 4001 Discovery Dr., Ste. 280, Boulder, CO 80303, dbabayev@advtech.uswest.com, George Bell, Richard L. Hewitt, Manuel Laguna, Scott Parrish

We consider relative performance efficiency evaluation in a telecommunication company. A new model of DEA is presented, the dominance model. The model is based on Pareto optimality analysis, uses the same input-output data as traditional DEA models and does not use LP methodology. Computational complexity of the dominance model is  $O()$ , i.e., significantly lower than models using LP methods.

### MB13 Geographic Information Systems

Sponsor: INFORMS CSTS

Sponsored Session

Chair: Michael Racer, Univ. of Memphis, Dept. of Ind. & Systems Eng., Memphis, TN 38152, racerm@cc.memphis.edu

#### 1) Spatial Data Analysis at Fedex, Gokhan Usanmaz, Federal Express Corp., OR & Spatial Applications, Memphis, TN 38132, Joe D. Hinson, Gail S. Hines

We consider a real-life VRP in Federal Express in Paris. Rapid generation of several initial solutions and a subsequent merge procedure that combines the best parts of these tours seems to offer the most promise for delivery window and network constraints. This solution is improved by local post-optimization.

#### 2) Assessing Work Teams Using Group Support Systems Services, R. Michael Godfrey, CA State Univ., 1250 Bellflower Blvd., IS Dept., Long Beach, CA 90840, mgodfrey@csulb.edu

GSS technical services provide new opportunities for work teams to efficiently assess contextual and operational variables having strong influences on team outcomes. Improved measurements of key factors contributing to work team effectiveness help generate ideas and incentives needed for dynamic organizational designs.

#### 3) No Title Supplied

No abstract supplied.

#### 4) A Nested Sampling Methodology for Quality Control of Spatial Data, Miguel Gonzalez, Univ. of Memphis, 104 Engineering, Memphis, TN 38152, magonzalez@cc.memphis.edu, Michael Racer, Mohammad M. Amini

Data quality management is a concept of great importance in any IS. In the case of GIS, this importance is enhanced as the viability of the system and is very dependent on information quality. We present some innovative spatial data quality measures.

### MB14 Logistics III

Contributed Session

Chair: Ronald Scott Tibben-Lembke, Univ. of NV, Dept. of Managerial Sci., MS 028, Reno, NV 89557

#### 1) Current Trends in Reverse Logistics, Ronald Scott Tibben-Lembke, Univ. of NV, Dept. of Managerial Sci., MS 028, Reno, NV 89557, Dale Rogers

RLs are now recognized by many firms as an important part of their business. In some cases, RL competencies have become an important strategic weapon. We will describe the results of a research project which is a comprehensive examination of current RL trends and practices.

#### 2) Vendor Managed Replenishments: Analytical Characterization of Strategic Benefits, Y. Aviv, Columbia Univ., Grad. Sch. of Bus., 116th & Broadway, New York, NY 10027, Avi Federgruen

We present analytical models to characterize and measure the benefits associated with vendor management replenishments in general supply chains as opposed to traditional coordination mechanisms where suppliers respond passively to orders placed by downstream facilities (retailers). We investigate the relative impact of various system parameters and supply chain characteristics.

#### 3) Coordinating Production & Logistics, Jan Dethloff, Universitaet Hamburg, Inst. f. Logistik u Transport, Von-Melle-Park

5, Hamburg, 20146, Germany, dethloff@rrz.uni-hamburg.de

Production and logistic chains consisting of multiple plants for the various stages of production linked by logistic systems are reviewed. New approaches to optimize the production planning and transportation planning in such supply chains are presented, taking into account the interdependence of both fields of decision.

**4) Route Design & Inventory Control as an Integrated System, Katherine Pryor**, 2175 Lakeview Dr., # 103, Ypsilanti, MI 48198, kpryor@engin.umich.edu, **Chelsea C. White, III**

In a manufacturing environment, the supplier/assembly chain is divided into components to facilitate their analysis. As a result, the system they comprise is less efficient. Our goal is to examine whether modeling 2 of the components, route design and inventory control, together yields a more efficient/less costly system.

## MB15 Networks & Cuts

Cluster: Network Flows

Invited Session

Chair: David Hartvigsen, Univ. of Notre Dame, Coll. of Bus. Admin., PO Box 399, Notre Dame, IN 46556-0399, david.hartvigsen.1@nd.edu

**1) The K-Median Problem on a Tree, Rakesh Vohra**, OH State Univ., Fisher Coll. of Bus., Haggerty Hall, 1775 College Rd, Columbus, OH 43210, vohra.1@osu.edu, **Marc E. Posner, Sven de Vries**

While the K-median problem on a tree is known to be polynomially solvable, no exact LP characterization is known. We report on some facets and valid inequalities for the problem as well as complete polyhedral descriptions for some special cases.

**2) Minimal Connected Enclosures on an Embedded Planar Graph, J. Scott Provan**, Univ. of NC, Dept. of OR, CB 3180, Smith Bldg., Chapel Hill, NC 27599-3180, scott.provan@unc.edu, **Christos Alexopoulos, H. D. Ratliff, Bryan R. Stutzman**

Polynomial algorithms are given for finding a shortest walk, cycle or trail enclosing an obstacle or set of obstacles in a plane graph with non-negative edge weights. These algorithms can be applied to construct minimum weight 2-connected sets spanning a set of points lying on the boundary of a plane graph.

**3) Compact Representation of Cuts, David Hartvigsen**, Univ. of Notre Dame, Coll. of Bus. Admin., PO Box 399, Notre Dame, IN 46556-0399, david.hartvigsen.1@nd.edu

The well-known cut equivalent tree (Gomory & Hu) is a compact representation of the min cuts in an undirected graph. We generalize this notion to the multiterminal cut problem and other problems. This work extends the related work of Hassin.

**4) Polynomial Min/Max Relaxed Cycle & Cut Cancelling Minimum-Cost Flow Algorithms, Maiko Shigeno**, Tokyo Inst. of Technology, Dept. of Math. & Comp. Sci., Tokyo, 152, Japan, maiko@is.titech.ac.jp, **Satoru Iwata, S. Thomas McCormick**

Our new cycle-canceling algorithms for minimum cost flow cancel a most negative node-disjoint family of cycles and our cut-canceling algorithms cancel a most positive cut, wrt a scale-relaxed optimality parameter. Our efficient implementation of these algorithms matches the fastest bounds for canceling algorithms.

## MB16 Technology Intensive Alliances

Sponsor: INFORMS Section on Technology Management

Sponsored Session

Chair: George F. Farris, Rutgers Univ., Grad. Sch. of Mgmt., 180 University Ave., Newark, NJ 07102-1895, gfarris@gsmack.rutgers.edu

**1) Formal & Informal Networks: Mechanisms for Interorganizational Learning in the Semiconductor Industry, Lori Rosenkopf**, Univ. of PA, 2000 SH-DH, Wharton Sch., Philadelphia, PA 19104-6370, rosenkopf@wharton.upenn.edu, **Paul Almeida**

Both formal and informal mechanisms enable learning via interorganizational networks. Using patent citations to indicate instances of interorganizational learning, we explore how and when the type of interfirm ties (including alliances, mobility of inventors, geographic closeness and technological similarity) facilitate the acquisition of knowledge embedded in semiconductor patents.

**2) Information & Technology Sharing in an International Joint Venture, Eric Rebentisch**, MIT, 77 Massachusetts Ave., Rm. 33-

407, Cambridge, MA 02139, erebenti@mit.edu

Information and knowledge transfer in an international joint venture were studied, with the specific forms of knowledge and technology shared correlated with the methods used in the transfers. Important insights into the level of effort required to transfer knowledge and the types of knowledge that are readily transferred were gained.

**3) European Technology Alliances, Christopher L. Tucci**, NYU, Stern Sch. of Bus., Tisch Hall, 40 W 4th St., New York, NY 10012-1118, tucci@alumni.stanford.org

We report on a survey of 489 European technology alliances. The relation between the initial structure (interpartner characteristics) and final outcomes is examined. The main results are that initial conditions, especially market overlap between partners, as well as process management are important in strategic and technical goal attainment.

**4) Changing Technological Focus in Biotechnology Alliances, Varghese George**, Rutgers Univ., 81 New St., Rm. 308, Newark, NJ 07102, vgeorge@andromeda.rutgers.edu, **George F. Farris**

We examine how the technological focus of interfirm alliances shifts over time in the biotechnology and selected pharmaceutical sectors. Analyses are based on alliances from a recent 5-year period. We further investigate the reasons for such shifts in the technologies that mediate the alliances and implications for the participating firms.

## MB17 Information Systems II

Contributed Session

Chair: Paulo Goes, Univ. of CT, 368 Fairfield Rd., Storrs, CT 06269-2041, goes@uconnvm.uconn.edu

**1) Methods for Database Security, Paulo Goes**, Univ. of CT, 368 Fairfield Rd., Storrs, CT 06269-2041, goes@uconnvm.uconn.edu, **Ram Gopal, Robert S. Garfinkel**

We address the problem of answering queries to a database without divulging confidential information. Methods are devised for answering an unlimited number of queries having a variety of structures. The answers consist of a point and an interval which is guaranteed to contain the correct answer. Computational results are presented.

**2) A Multiperiod Resource Allocation Model for Data Quality Enhancement, Rema Padman**, Carnegie Mellon Univ., Heinz Sch. of Policy & Mgmt., Pittsburgh, PA 15213, rpadman+@andrew.cmu.edu, **Giri Kumar Tayi**

As organizations begin to use data strategically, effective allocation of resources to enhance the level of data quality becomes critical. We develop a multiperiod resource allocation model which explicitly considers multiple data sets with varying error rates and differing impacts of those errors while meeting data integrity and resource utilization targets for each period.

**3) A Self-Adaptive Paretoan Approach to Information Technology Investment, P. Pete Chong**, Gonzaga Univ., E 502 Boone, AD Box 9, Spokane, WA 99258, chong@gonzaga.edu, **Ye-Sho Chen, Kenneth R. Walsh**

Rapid changes in IT have made information systems investment decisions more dynamic and difficult. We use Herbert Simon's model for describing Pareto distribution to predict changes in parameters in a multi-criteria decision-making model to improve manager's understanding of the dynamic implications of the alternatives.

**4) The Application & Maintenance of Non-Consistent Database Views, David D. Chao**, San Francisco State Univ., Coll. of Bus., 1600 Holloway Ave., San Francisco, CA 94132, dchao@sfsu.edu, **Robert C. Nickerson**

Database views typically are maintained to be consistent with the database at a specific time. There are applications, however, where users may prefer or require views which are not consistent with the database. This research examines the various kinds of non-consistent views and investigates their application and maintenance.

**5) A Framework for MS/OR Model Base Design, Hugo Yoshizaki**, Univ. of Sao Paulo, Dept. of Production Eng., CP 61548, Sao Paulo SP, 05424-970, Brazil, hugo@usp.br

A 2-level framework is presented to help MS/OR model-based planning and design. First, each decision is localized inside a topological meta-model of the decision structure to help consistency analysis. Then, basic requirements for clustering and defining decision-aiding models are derived. An example of a logistic system is presented.

## MB18 TUTORIAL: Applied Conjugate Duality

Invited Session

**Chair:** Thomas Jefferson, Sultan Qaboos Univ., Coll. of Commerce & Econ., Sultanate of Oman, Oman

**1) TUTORIAL: Applied Conjugate Duality, Thomas Jefferson,** Sultan Qaboos Univ., Coll. of Commerce & Econ., Sultanate of Oman, Oman

This tutorial is intended for people interested in applying conjugate duality to gain insight into OR applications. Conjugate duality has its roots in mathematics; however, it has been found to be valuable in understanding problems which can be modeled as convex programs. Initial applications were engineering-oriented as nonlinear engineering models are quite common...

**MB19 Operations Research Applications in Passenger Rail**

**Sponsor:** INFORMS Railroad Applications SIG

**Sponsored Session**

**Chair:** Chip Kraft, Amtrak, 400N Capitol St. NW, 7th Fl., Washington, DC 20001, chipkraft@aol.com

**1) Washington Union Terminal Simulation, Karl W. Ginther,** Amtrak, Philadelphia, PA

A simulation model measures capacity, utilization and throughput for critical areas in the station, storage yards and maintenance facilities for a 15-20 year planning horizon, including the impact of new, high speed trainsets. The model is used both for engineering design and financial justification of required capital expenditures.

**2) Simulation of Northeast Corridor Operations, Thomas W. Morgan,** Amtrak, Philadelphia, PA

Amtrak uses a powerful and flexible simulation language to model the mixed use operations on the NEC. This presentation will focus on the benefits of this approach and its applicability outside the NEC. The presentation will also focus on the scheduling system being used for NEC operations.

**3) Strategic & Tactical Support Tools for Passenger Rail Scheduling, Nejib Ben-Kheder,** SABRE Decision Tech., PO Box 619616, Ft. Worth, TX 75261, nejib@sdt.com

A comprehensive tool set, including demand forecasting, capacity allocation train routing, yield management and pricing, helps plan SNCF train schedules based on long term forecasts, then fine tunes them as the day of departure approaches. The tools cover the lifetime of a schedule, consistently seeking to maximize railroad profitability.

**4) Revenue Management on the Tracks, Bellur N. Srikar,** Amtrak, 60 Massachusetts Ave., NE, Washington, DC 20002

Amtrak's yield management system analyzes historical and current passenger demand by fare class to generate a plan that authorizes the most profitable mix of fares and OD pairs to be sold. The yield management application has allowed Amtrak to increase revenues in spite of stiff competition from highly discounted airfares.

**MB20 Dynamic Traffic Assignment I (Network Algorithms)**

**Sponsor:** INFORMS Transportation Science Section

**Sponsored Session**

**Chair:** Athanasios Ziliaskopoulos, Northwestern Univ., Dept. of Civil Eng., Evanston, IL 60208

**1) Path Processing in a Rolling Horizon Dynamic Traffic Assignment Model, Anthony Chen,** Univ. of CA, Dept. of Civil & Env. Eng., Irvine, CA 92697, **R. Jayakrishnan**

To make DTA operational for real-time implementation, a rolling horizon scheme is used which assumes that the time-dependent O-D demand is available as the DTA assigns traffic in a rolling basis. The DTA problem is formulated as a 2-level optimization program with an embedded traffic model simulating traffic dynamics. Storing and updating paths in a dynamic rolling horizon traffic assignment framework are discussed.

**2) How Less can be More on Networks with Spillovers: Implications for Dynamic Traffic Assignment, Carlos F. Daganzo,** Univ. of CA, Dept. of Civil & Env. Eng., Berkeley, CA 94720

By increasing the capacity of a link in a traffic network, the overall capacity of the system can be reduced and the network may become oversaturated. Two scenarios are used to illustrate the fact that a simple network consisting of 2 links in parallel is susceptible to a "diversion effect" and a closed-loop network without a route choice is susceptible to a "gridlock effect..."

**3) An A Priori Optimization Strategy for the Off-Line Stochastic Dynamic Traffic Assignment Problem, Srinivas Peeta,** Purdue Univ., Sch. of Civil Eng., W Lafayette, IN 47907-1284, **Chao Zhou**

We formulate the a priori stochastic DTA problem and propose a Monte Carlo-based solution algorithm to obtain the a priori solution. This algorithm

consists of a deterministic DTA solution methodology, an O-D demand generator given historical time-dependent O-D distributions for the planning horizon and a procedure for computing the a priori solution...

**4) A Stochastic Linear Programming Model for the Single Destination System Optimum Dynamic Traffic Assignment Problem, Athanasios Ziliaskopoulos,** Northwestern Univ., Dept. of Civil Eng., Evanston, IL 60208

No abstract supplied.

**MB21 Aircraft & Passenger Choice**

**Cluster:** Aviation Applications

**Invited Session**

**Chair:** Craig A. Hopperstad, Boeing Commercial Airplane Group, PO Box 3707, MS 75-14, Seattle, WA 98124-7207, craig.a.hopperstad@boeing.com

**1) Passenger Decision Modeling at Boeing, Craig A. Hopperstad,** Boeing Commercial Airplane Group, PO Box 3707, MS 75-14, Seattle, WA 98124-7207, craig.a.hopperstad@boeing.com

For the past 30 years, Boeing has attempted to model the effect of aircraft on passenger choice. A brief history and a summary description of the current Boeing model is provided.

**2) Elements of Airline Image, Ken Fox,** Boeing Commercial Airplane Group, Box 3707, MS 64-20, Seattle, WA 98124, kenneth.fox@pss.boeing.com

The products and services offered by airlines have been broadly grouped into 5 categories: availability and reliability, marketing programs, service, in-flight cabin environment and types of airplanes flown. Shown here is the relative influence of each category on the airline's overall image.

**3) The Effect of Aircraft Interiors on Passenger Choice, Klaus Brauer,** Boeing Commercial Airplane Group, Box 3707, MS 75-14, Seattle, WA 98124

The effect of airplane interiors on passenger preference has until recently been poorly understood. Even such measures as seat width have provided only poor correlations to passenger preference measures. We review the identification of the key factors which together explain the majority of variation in passenger preference for airplanes.

**MB22 Modeling Retailer Strategies & Optimal Consumer Response**

**Sponsor:** INFORMS Section on Manufacturing & Service Operations Management

**Sponsored Session**

**Chair:** David R. Bell, UCLA, Anderson Sch., Los Angeles, CA 90095-1481, dbell@anderson.ucla.edu

**1) A Generalization of Choice, Incidence & Quantity Response, V. Padmanabhan,** Stanford Univ., Grad. Sch. of Bus., Stanford, CA 94305-5015, fpaddy@crow.n.stanford.edu, **David R. Bell, Jeongwen Chiang**

Using an extension of Chiang's model (1991), we estimate brand choice, purchase incidence and purchase quantity elasticities for multiple product categories. We show how variance in the observed choice/incidence/quantity elasticity ratio can be systematically explained by brand and category characteristics. Implications for retailer promotional strategies are discussed.

**2) Exploiting the Installed Base Using Cross-Merchandising & Category Destination Programs, Xavier Dreze,** Univ. of Southern California, Sch. of Bus., Los Angeles, CA 90089, xdm@sbaxdm.usc.edu, **Stephen J. Hoch**

Previous research, e.g., Dickson & Sawyer (1990), has shown that consumers have very little price knowledge. We address this issue by investigating whether priming and price recognition can act as a substitute for price knowledge. The implications for price-based competition are discussed.

**3) On the Role of the Sale Sign, Duncan I. Simester,** Univ. of Chicago, Grad. Sch. of Bus., 1101 E 58th St., Chicago, IL 60637, fdsimest@gsbvxb.uchicago.edu

Retailers use sales signs to convey information about price discounts. Consumers' interpretation of the magnitude and availability of future prices are influenced by this current period information. We develop an equilibrium price-signaling model which characterizes optimal use of sales signs.

**4) Rational Shopping Behavior & the Option Value of Variable Pricing, David R. Bell,** UCLA, Anderson Sch., Los Angeles, CA 90095-1481, dbell@anderson.ucla.edu, **Teck H. Ho, Christopher S.**

**Tang**

We present a model of rationality shopping behavior under price uncertainty. We show that as price variability increases, consumers take more shopping trips, buy smaller quantities per trip and spend less per trip. These model implications are tested on multicategory scanner panel data. Implications for retail pricing and EDLP-HILO competition are discussed.

**MB23 Manufacturing Technology Management: Models & Applications**

Cluster: Manufacturing & Service Management  
Invited Session

Chair: John J. Liu, Univ. of WI, Sch. of Bus., Milwaukee, WI 53201, [jjl@csd.uwm.edu](mailto:jjl@csd.uwm.edu)

1) **Optimal Timing of Design Liaison in a Concurrent Engineering Project with Uncertain Completion Time**, *Susan H. Xu*, PA State Univ., Dept. of MSIS, Coll. of Bus., University Park, PA 16802, [shx@psuvm.psu.edu](mailto:shx@psuvm.psu.edu)

When manufacturing activities are carried out under concurrent engineering projects, design liaison meetings are often adopted as a primary vehicle to establish necessary communications among relevant functional groups such as R&D, marketing and manufacturing. Since the time to complete the project is usually uncertain, the timing of the design liaison becomes nontrivially important...

2) **On the Dynamics of Manufacturing Technology Diffusion**, *John J. Liu*, Univ. of WI, Sch. of Bus., Milwaukee, WI 53201, [jjl@csd.uwm.edu](mailto:jjl@csd.uwm.edu)

We study the dynamics of manufacturing technology diffusion after the R&D phase. The technology diffusion over the associated PLC is characterized by a dynamic diffusion equation which incorporates both time- and volume-based diffusion effects. A deterministic OTD model is developed to determine technology management policies so that the total profit over the PLC is maximized...

3) **Project Scheduling of Multipurpose Resources to Minimize Cost**, *George Vairaktarakis*, Marquette Univ., Coll. of Bus. Admin., Milwaukee, WI 53201-1881, [vairaktarakis@vms.csd.mu.edu](mailto:vairaktarakis@vms.csd.mu.edu)

Project management is a critical tool for world-class agile producers. We minimize a linear combination of activity completion times. The project network is assumed to be a tree and project activities are executed on processors with different flexibility characteristics. We discuss the effect of processor flexibility into scheduling complexity.

4) **Dynamic Regulation of Technological Quality Diffusion Under Exogenous Disturbance**, *Seong-Hyun Nam*, Univ. of WI, Sch. of Bus., Milwaukee, WI 53201

TQD refers to interrelation between production process quality and customer perceived product quality, the former non-observable, the latter observable to customers. Investments in process quality may not be justifiably reflected in the perceived product quality. We consider an on-line quality regulation system...

**MB24 Interpretations of Probability**

Sponsor: INFORMS Decision Analysis Society  
Sponsored Session

Chair: Ralph F. Miles, Jr., Univ. of Southern CA, Inst. Safety & Systems Mgmt., 3608 Canon Blvd., Altadena, CA 92001, [rmiles@mizar.usc.edu](mailto:rmiles@mizar.usc.edu)

1) **From Classic to Subjective Interpretations of Probability**, *Ralph F. Miles, Jr.*, Univ. of Southern CA, Inst. Safety & Systems Mgmt., 3608 Canon Blvd., Altadena, CA 92001, [rmiles@mizar.usc.edu](mailto:rmiles@mizar.usc.edu)

We will discuss the classic (Bernoulli 1713, Laplace 1820), a priori (Keynes 1921, Carnap 1950), relative frequency (von Mises 1928, Reichenbach 1949) and subjective (Ramsey 1926, de Finette 1937, Savage 1954) interpretations of probability and their applicability to DA.

2) **Against Calibration**, *A. Hajek*, CA Inst. of Tech., Dept. Humanities & Social Sci., Mail 228-77, Pasadena, CA 91125, [ahajek@hss.caltech.edu](mailto:ahajek@hss.caltech.edu)

The main desideratum of a belief is that it be true; but what is the corresponding desideratum of a degree of belief? Van Fraassen, Joyce and others argue that it is that the degree of belief be well calibrated; roughly, that it agrees with the appropriate relative frequency. I argue against this claim.

3) **Quantum Probability & Its Potential Application to Decision Analysis**, *Robert F. Bordley*, GM Corp. R&D Ctr., R&D Portfolio Planning, 30500 Mound Rd., Warren, MI 48090-9055,

[rbordley@cmsa.gmr.com](mailto:rbordley@cmsa.gmr.com)

Quantum mechanics have been extremely successful at describing systems at the atomic level. The state "q" of a quantum mechanical system is given by a wave function  $\Psi(q)$ , where the probability that the system is in state "q" is  $P(q) = \Psi(q) * \Psi(q)$ . We discuss the prospects that quantum probability concepts can contribute to DA.

**4) PANEL: Interpretations of Probability**

A panel of distinguished theorists will discuss the preceding 3 presentations on the interpretations of probability.

**MB25 Case Studies & Projects in Operations Research**

Sponsor: INFORMS Forum on Education  
Sponsored Session

Chair: B. Curtis Eaves, Stanford Univ., Dept. of OR, Stanford, CA 94305, [bceaves@soe.stanford.edu](mailto:bceaves@soe.stanford.edu)

1) **Developing a Seamless Corporate Alliance**, *B. Curtis Eaves*, Stanford Univ., Dept. of OR, Stanford, CA 94305, [bceaves@soe.stanford.edu](mailto:bceaves@soe.stanford.edu)

For several years the OR department at Stanford has conducted a required sequence of corporate sponsor project courses for MS students. Recently, the hurdle of charging sponsors \$2000 apiece to support project course assistants has been surmounted. The next step is to combine the corporate affiliates program with the program for project courses.

2) **Managing a Case Studies Class**, *Karl Schmedders*, Stanford Univ., Dept. of EES & OR, Hoover Inst., Stanford, CA 94305-4023, [karl@or.stanford.edu](mailto:karl@or.stanford.edu)

MS students in our department are required to take a case studies class in preparation for working on corporate sponsor projects. There are several goals to be accomplished in such a course, and achieving all of them in 1 quarter can be difficult.

3) **Long-Term Field Projects: Keeping Sponsors Interested**, *Matt Carlyle*, Stanford Univ., Dept. of EES & OR (4023), Stanford, CA 94305-4023, [mcarlyle@leland.stanford.edu](mailto:mcarlyle@leland.stanford.edu)

Getting productive feedback from a project sponsor is critical to the success of the work. Open, effective communication on the part of the team or researcher is the key to keeping sponsors interested and active in the process. We present a mechanism for the interchange of information and indicate how it performed on a project for a large underground mining company.

**MB26 Performance & Control of Multiclass Queueing Networks**

Sponsor: INFORMS Applied Probability Section  
Sponsored Session

Chair: Dimitris Bertsimas, MIT, Rm. E53-359, Cambridge, MA 02139

1) **Multiclass Queueing Networks in Heavy Traffic**, *Ruth J. Williams*, Univ. of CA, Dept. of Math., 9500 Gilman Dr., La Jolla, CA 92093-0112

Heavy traffic limit theorems for queueing networks have been proved for single class queueing networks and for some multiclass networks. However, there is no heavy traffic limit theorem for multiclass networks in general. Recent progress on this problem will be reported.

2) **BIGSTEP Control of a Processing Network with Two Servers Working in Parallel**, *J. Michael Harrison*, Stanford Univ., Grad. Sch. of Bus., Stanford, CA 94305-5015, [fharrison@gsb-lira.stanford.edu](mailto:fharrison@gsb-lira.stanford.edu)

We examine a simple queueing system with 2 servers, 2 job classes and an alternate routing capability. A discrete-review control policy is shown to be asymptotically optimal in the heavy traffic limit and asymptotic cost performance is shown to be the same as with a single pooled resource.

3) **Optimal Control of Multiclass Queueing Networks with Changeover Times**, *Dimitris Bertsimas*, MIT, Rm. E53-359, Cambridge, MA 02139, *Jose Nino-Mora*

We address the performance optimization problem in a multiple-station multiclass queueing network with changeover times by means of the achievable region approach. Constraints (including linear, positive semidefinite and convex) bounding this region are developed by formulating equilibrium relations satisfied by the system, as well as policies arising from the formulations.

4) **An Algorithm for Optimal Draining of Fluid Reentrant Lines**, *Gideon Weiss*, MIT, Sloan Sch. of Mgmt., Rm. E53-361, Cambridge, MA 02139, [gweiss@mit.edu](mailto:gweiss@mit.edu)

Recent work reveals close relations between multiclass queueing networks and

their fluid models, in questions of stability and optimal control. Optimal control of a fluid reentrant line is formulated as a separated continuous LP. We present a recursive (DP) primal dual algorithm to solve it.

### MB27 Mathematical Models for Input & Output Processes & File Management Monte Carlo Simulation

Sponsor: INFORMS College on Simulation

Sponsored Session

Chair: W. David Kelton, Univ. of Cincinnati, Dept. of QAOM, PO Box 210130, Cincinnati, OH 45221-0116, david.kelton@uc.edu

#### 1) Standardized Time Series & Generalized Semi-Markov Processes, Peter J. Haas, IBM Almaden Res. Ctr., 7139 Wooded Lake Dr., San Jose, CA 95120

The usual model for the underlying process of a discrete-event stochastic system is the GSMP. We provide conditions on the building blocks of a finite state GSMP under which point estimates and confidence intervals for time-average limits can be obtained using methods based on standardized time series.

#### 2) Performance Analysis of the Simulation Calendar, Halim Damerdjii, NC State Univ., Dept. of IE, Raleigh, NC 27695-7906, damerdji@eos.ncsu.edu, Peter W. Glynn

The linked-list and indexed-list data structures are investigated. Two stochastic models, interaction hold and Jackson network, are considered. We present results on the number of key comparisons to find a new record's insertion point. This can be useful when deciding whether to scan a doubly-linked list from its head or tail, or when deciding the number of middle pointers in an indexed list.

#### 3) Simulation Input Distributions & Variance Reduction from a Bayesian Viewpoint, Stephen E. Chick, Univ. of MI, Ind. & Op. Eng., 1205 Beal Ave., Ann Arbor, MI 48170, sechick@engin.umich.edu

A Bayesian framework is proposed which connects the subjectivist and frequentist techniques used in practice and resolves known problems with each. Results include an algorithm for sampling distributions and parameters for DEFS replications and variance reduction techniques when there is uncertainty as to which input distribution is best.

#### 4) Retrospective Approximation Algorithms for Generation of Multivariate Random Vectors, Huiifen Chen, Da-Yeh Inst. of Tech., Dept. of IE, 112 Shan-Jeau Rd., Dah-Tsuen, Chang-Hwa, 51505, Taiwan, huiifen@aries.dyt.edu.tw, Chung-Gong Jeng

We consider the generation of n-dimensional random vectors with specified marginal distributions and correlation matrix. The general 3-step approach requires solving  $n(n-1)/2$  1-dimensional equations to obtain the given correlations. We solve these equations simultaneously by RA algorithms. Numerical results show that RA algorithms perform efficiently for various distributions.

### MB28 Location Models III

Cluster: Location Analysis

Invited Session

Chair: Jack Brimberg, Royal Military Coll. of Canada, Dept. of Eng. Mgmt., Kingston, Ontario, K7K 5L0, Canada

#### 1) Variants of the Punt Return Problem, Jack Brimberg, Royal Military Coll. of Canada, Dept. of Eng. Mgmt., Kingston, Ontario, K7K 5L0, Canada, W. Hurley, R. Johnson

The punt returner location problem in football seeks to locate stationary punt returners in order to maximize the number of punts which will be caught. We report on some extensions of the basic model, such as whether it is worthwhile to have one or more returners in motion just before the ball is kicked.

#### 2) A Statistical Comparison of Three Goodness-of-Fit Criteria Used to Evaluate the Accuracy of Distance Predicting Functions, Halit Uster, McMaster Univ., Sch. of Bus., MGD-219, 1280 Main St. W, Hamilton, Ontario, L8S 4M4, Canada, usterh@mcmaster.ca, Robert F. Love

Distance predicting functions may be used in a variety of applications for estimating travel distances between points. To evaluate the accuracy of distance predicting functions, goodness-of-fit criteria are employed. Absolute deviations, squared deviations and normalized absolute deviations are the 3 criteria most often employed for modeling distances...

#### 3) Insights into Planar & Spherical Minimax Location, Zvi Drezner, CA State Univ., Grad. Sch. of Mgmt., Irvine, CA 92697, zdrezner@fullerton.edu

We develop alternative formulations for the 1-center location problem on the plane and on the sphere. These formulations employ the correlation matrix

between the demand points and resemble many statistical formulations. They give interesting insights into the structure of these problems. Algorithms based on these new formulas are not expected to be more efficient than existing methods.

#### 4) Location Models for Different Market Situations, Kathrin Fischer, Univ. Hamburg, Von-Melle Park 5, Hamburg, D-20146, Germany, kfischer@rrz.uni-hamburg.de

Classic models for location planning, not taking into account competitive forces, and equilibrium models covering the situation of different suppliers competing for spatially distributed demand are reviewed and compared. The relationship between different approaches is examined and a unified classification scheme for the models is presented.

### MB29 Inventory III

Contributed Session

Chair: Gregory A. DeCroix, Univ. of WA, Sch. of Bus. Admin., Box 353200, Seattle, WA 98195-3200, decroix@u.washington.edu

#### 1) Inventory Management Under Stochastic Demand & Supply Disruptions, Gregory A. DeCroix, Univ. of WA, Sch. of Bus. Admin., Box 353200, Seattle, WA 98195-3200, decroix@u.washington.edu, Tony Arreola-Risa

We explore a stochastic-demand inventory system that faces random supply disruptions. Under a modified (s,S) policy, we determine the optimal values of the policy parameters. We analyze the system's response to changes in the frequency and duration of supply disruptions and to changes in demand and cost levels.

#### 2) Delays in Multi-Echelon Inventory Systems, Jonas Andersson, Lund University, Dept. of IE, PO Box 118, Lund, S-22100, Sweden, jonas.andersson@ie.lth.se

We consider a 2-level inventory system with 1 warehouse and several different retailers. Transportation times are constant. We assume compound Poisson demand at the retailers. All facilities apply continuous review (R,Q)-policies. We derive exact probability measures for the delivery delays facing the retailers.

#### 3) Demand Estimation in Lost Sales Inventory Systems, Xiaomei Ding, Univ. of British Columbia, Fac. of Comm., 2053 Main Mall, Vancouver, BC, V6T 1Z2, Canada, ding@markov.commerce.ubc.ca, Martin L. Puterman

We develop methods to estimate the parameters of a discrete demand distribution in lost sales inventory systems. Demands are modeled by a 0-inflated Poisson distribution. Maximum likelihood estimates and dynamic Bayesian updates of the demand distribution are obtained. These methods are illustrated through simulation and are applied to the newsvendor and (s,S) inventory systems.

#### 4) Decomposition of a Multi-Echelon Inventory System, Johan Marklund, Lund Univ., Dept. of IE, PO Box 118, Lund, S-22100, Sweden, johan.marklund@ie.lth.se, Jonas Andersson

We consider a distribution system with 1 warehouse and a number of non-identical retailers. We analyze a coordination procedure based on a simple approximation, where retailers replace their stochastic leadtimes with correct averages. The procedure allows us to find near optimal solutions when each installation applies single-level inventory control techniques.

### MB30 Redstone Arsenal/Huntsville Military Operations Research Society

Sponsor: INFORMS Military Applications Society

Sponsored Session

Chair: Bruce W. Fowler, US Army Missile Command, Adv. Systems Concepts Office, Missile R&D Eng. Ctr., Redstone Arsenal, AL 35898-5242

#### 1) Early Entry Force Deployability, John P. Ballenger, Raytheon Electronic Systems, Huntsville, AL

We address deployability issues faced by early entry forces in a forced entry scenario. Studies and analyses of early entry forces sometime begin with light forces already on the ground and avoid deployability issues. Given limited fast sea transport and air transport, early entry forces are faced with trade-offs regarding transport weight and effective, initial combat power...

#### 2) What Value ATR?, Gerald M. Evans, Advanced Systems Concepts Office, Missile R&D and Eng. Ctr., Redstone Arsenal, NJ 35898-5242, Bruce W. Fowler

Modern systems analytical techniques offer some promise of providing insight into the question of the value of ATR in operational environment. We apply these techniques to sketch insights into 3 areas: difficulty of simulating ATR

performance in the environment of virtual simulation; time lines of the acquisition (search and detection) and engagement combat processes to provide comparison between convention and ATR-augmented systems...

**3) Revisiting History, Bruce W. Fowler, US Army Missile Command, Adv. Systems Concepts Office, Missile R&D Eng. Ctr., Redstone Arsenal, AL 35898-5242**

Most battles are not set pieces but previous analyses have considered them to be so. We review previous historical analyses of attrition order and repeat the analysis, incorporating engagement reinforcements in the formalism.

### MB31 Operations Research in Theater Medical Modeling

Sponsor: INFORMS Military Applications Society

Sponsored Session

Chair: William M. Pugh, Naval Health Research Ctr., 271 Catalina Blvd., Bldg. 33IT, Rm. 200, San Diego, CA 92152, pugh@nhrc.navy.mil

**1) Generation of Casualty Rates from a Combat Simulation, Jamis K. Pugh, NCCOST, RDT&E Division, Code 784, 49940 Laffing Rd., Rm. 432, San Diego, CA 92152-6167, pugh@nose.mil**

Although combat simulations can be used to estimate casualties, medical planners have developed casualty rates independent of these simulations. A preliminary evaluation of the potential of using casualty rates generated by the Marine Air-Ground Tactical Warfare Simulation to drive medical resource allocation models will be discussed.

**2) Modeling Medical Supply Operations, Michael R. Galarneau, Naval Health Research Ctr., 271 Catalina Blvd., Bldg. 331B, San Diego, CA 92152, galarneau@nhrc.navy.mil, Kevin J. Mahoney, Paula J. Konoske**

The Naval Health Research Center is developing a model for predicting the medical supply requirements of forward medical treatment facilities. In the model, treatment tasks and medical supply items are linked so that customized supply streams can be projected for each of 350 injuries/diseases known to occur in theater.

**3) Forecasting Medical Casualties, Christopher Blood, Naval Health Research Ctr., 271 Catalina Blvd., Bldg. 332, San Diego, CA 92152, blood@nhrc.navy.mil**

A medical casualty forecasting system has recently been developed to provide medical planners with estimates of the average daily rates of medical admissions that may be sustained in a given scenario, indicate the maximum daily patient loads that may be incurred and for which planning is necessary and enhance understanding of the statistical properties of injury and illness rates for use in future modeling efforts.

**4) Ability Performance Modeling, Ross Vickers, Jr., Naval Training Ctr., PO Box 85122, San Diego, CA 92186, vickers@nhrc.navy.mil**

Simple ability-performance models yield good first approximations to predict performance on many Navy physical tasks. These models are being combined with known effects of fatigue and environmental exposures to produce dynamic models of performance in operational setting. Primary applications are expected to be in selection, training and wargaming.

### MB32 Design & Routing for Telecommunication Networks

Sponsor: INFORMS Technical Section on Telecommunications

Sponsored Session

Chair: Larry J. LeBlanc, Vanderbilt Univ., Owen Grad. Sch. of Mgmt., 401 21st Ave. S, Nashville, TN 37203-9865, leblancl@ctrvax.vanderbilt.edu

**1) Routing on SONET Ring Networks, B. Doshi, AT&T Bell Labs./Lucent Technologies, 101 Crawford Corner Rd., Holmdel, NJ 07733, btd@lucent.com, Subrahmanyam Dravida, P. Harshavardhana, R. Nagarajan, P. Johri**

We consider the problem of routing demands on SONET rings to minimize network cost. A family of heuristic algorithms is presented for this problem. These algorithms include path selection and routing of inter-ring demands as well as load balancing on single rings. Numerical studies are presented to highlight the algorithms and the routing issues.

**2) A Comparison of Simulated Annealing & Genetic Algorithms for WAN Topology/Design/Routing, Larry J. LeBlanc, Vanderbilt Univ., Owen Grad. Sch. of Mgmt., 401 21st Ave. S, Nashville, TN 37203-9865, leblancl@ctrvax.vanderbilt.edu, June S. Park, Byung H. Lim, Russell Reddick**

We compare the computational performance of a SA algorithm and a GA for large WAN topology/design/routing problems. Different strategies for annealing,

mutation, immigration, population size and selection for crossover are described and computational results reported.

**3) Frame Relay Network Design, Zbigniew Bogdanowicz, AT&T Labs., 101 Crawford Corner Rd., Rm. 1F-418, PO Box 3030, Holmdel, NJ 07733, zrb@gsun.att.com, Eric Rosenberg**

Frame relay networks have many design constraints, including upper bounds on the bandwidth and number of circuits per facility, the number of facilities incident to a node and the requirement that the network must survive a fiber cut. We describe a minimum-cost network design heuristic that satisfies these constraints.

**4) An ATM Routing for Telecommunication Networks, Steve Y. Chiu, US WEST Advanced Tech., 4001 Discovery Dr., Boulder, CO 80303, schiu@advtech.uswest.com, Jeifeng Xu, Fred W. Glover**

We consider the problem of optimizing an ATM data network by efficiently routing PVC demands and installing link capacities. The problem is formulated as a bi-level integer programming problem where the subproblem defines the performance constraints for each link. Computational results are reported for applying an effective TS algorithm.

### MB33 OR Applications II

Contributed Session

Chair: Julia Pet-Edwards, Univ. of Central FL, Dept. of IE & Mgmt. Systems, Orlando, FL 32816-2450, edwards@iems.engr.ucf.edu

**1) Structured Approaches to Developing Hierarchies in the Analytic Hierarchy Process, Dennis J. Frankos, Univ. of Central FL, Dept. of IE & Mgmt. Systems, Orlando, FL 32816, edwards@iems.engr.ucf.edu, Julia Pet-Edwards, Robert L. Armacost, Jamshid C. Hosseini**

Constructing hierarchies or networks is an important step in the AHP. Differing decision maker perspectives result in variations of linkages and groupings among hierarchy elements. Interpretive structural modeling and cluster analysis techniques are used to model these variations. Examples demonstrate these techniques.

**2) Measuring the Economic Impacts of Telecommuting, Jin-Ru Yen, Ntl. Taiwan Ocean Univ., Dept. Shipping & Mgmt. Trans., 2 Peining Rd., Keelung, 202, Taiwan, jryen@ntou66.ntou.edu.tw**

Our research proposes a framework to estimate economic impacts from telecommuting. Key components in the framework such as the prediction of telecommuting occasions and the estimation of economic savings are discussed. An empirical study is conducted based on the proposed framework and data obtained in the Taipei.

**3) Vulnerability Assessment of Hierarchies & Markets (R), George N. Kenyon, TX Tech. Univ., PO Box 42101, MS 2101, Lubbock, TX 79409-2101, kenyon@ttu.edu, Alexander Talalayevsky**

Competitive pressures are forcing companies to adopt flatter and more efficient coordination structures. With these flatter structures, there is the associated benefit of reduced coordination costs and improved coordination efficiency. But, there is also an increased risk of single point failures that could leave the firm unable to effectively compete in the marketplace...

**4) Military Installation Management, Zachary D. D'Angelo, US Military Acad., PO Box 0559, West Point, NY 10997, x73885g2@usmal.usma.edu**

Military installations form the basis of the US Army's ability to project force around the world. Improving and managing these installations is a complex problem and presents many challenging requirements. The undergraduate Engineering Management majors at USMA have studied and analyzed this problem. We present the results of their analysis.

### MB34 Controlling Continuous Decision Spaces: New Statistical Methods in Quality Control

Cluster: Choice Engineering

Invited Session

Chair: Wilfried Seidel, Univ. der Bundeswehr Hamburg, Fachbereich Wirtschafts & Org., Hamburg, 22039, Germany, w\_jever@unibw-hamburg.de

**1) Time Series & Forecasting: Applications in Statistical Quality Control, B. Mike Adams, Univ. of AL, Dept. of MS & Stats., Box 870226, Tuscaloosa, AL 35487-0226, badams@alston.cba.ua.edu**

Recent developments in monitoring processes which produce inherently autocorrelated observations are discussed. Specifically, the use of forecasting tools to distinguish typical process drift from atypical process shifts are examined. Problems associated with forecast-based monitoring schemes and

possible solutions are delineated.

2) **Economic Acceptance Sampling for the Average Square Deviation from Target per Item**, *Rainer Gob*, Univ. Wurzburg, Inst. fur Math. & Stats., Sanderring 2, Wurzburg, 97070, Germany, goeb@mathematik.uni-wuerzburg.de

Standard statistical lot inspection schemes consider mainly 2 measures of lot quality: lot proportion nonconforming and lot mean. However, another important lot quality measure of broad application is the average square deviation from a target value per item in the lot. We develop economic acceptance sampling plans for this measure of lot quality.

3) **Robust Inspection Strategies in the Presence of Continuously Improved Quality**, *Wilfried Seidel*, Univ. der Bundeswehr Hamburg, Fachbereich Wirtschafts & Org., Hamburg, 22039, Germany, w\_jever@unibw-hamburg.de

In a modern quality program, optimal adjustment of inspection strategies to the production process is essential. To achieve this goal, a robust soft modeling approach is proposed. It uses partial prior information which can be gained from past data very easily.

4) **A Linear Programming Approach for Calculating Robust Inspection Strategies Based on Quality History**, *Roger Fandom*, Univ. der Bundeswehr Hamburg, Inst. fur Stats. & Quant. Econ, Hamburg, 22039, Germany, roger.noubiap@unibw-hamburg.de, *Wilfried Seidel*

The proposed strategies are based on partial prior information. A crucial step is the calculation of the maximum risk compatible with the available information; this can be done by LP. Unimodality properties allow us to construct efficient algorithms for minimizing the maximum risk.

## Monday 14:45-16:15

### MC04 What Can We Learn About Public Policy from Volunteer Organizations?

Cluster: **Public Sector Applications**

Sponsor: **INFORMS Section on Public Programs & Processes**

Sponsor/Invited Session

Chair: **Douglas Samuelson**, 8711 Chippendale Ct., Annandale, VA 22003-3807, dsamuel@seas.gwu.edu

1) **Cost-Benefit Analysis of the Role of Government: The WORMSC Model**, *Douglas Samuelson*, 8711 Chippendale Ct., Annandale, VA 22003-3807, dsamuel@seas.gwu.edu

Volunteer organizations which employ professional management companies face many of the same issues as society as a whole, e.g., does the company (government) stifle initiative, seek to make work for itself regardless of benefit, waste money and build bureaucracy? Recent experience of the Washington OR/MS Council, WORMSC, provides an interesting model.

2) **The Case of INFORMS**, *Randall S. Robinson*, INFORMS, 901 Elkridge Landing Rd., Ste. 400, Linthicum, MD 21090-2909, 76270.3250@compuserve.com

Volunteer organizations in many respects follow approaches now widely advocated for organizations of all kinds. I will review a number of organizational dimensions which I believe critically affect the success of INFORMS and indicate where INFORMS tried to place itself in each dimension. Then I will speculate where I might position government.

### MC05 New Directions in Algebraic Modeling Languages

Cluster: **Linear Programming**

Invited Session

Chair: **Robert Fourer**, Northwestern Univ., Dept. of IE/MS, 2225 N Campus Dr., Evanston, IL 60208-3119, rer@iems.nwu.edu

1) **Enhanced Communications Between Modeling Language Systems & Solvers**, *David M. Gay*, Bell Labs., 600 Mountain Ave., Murray Hill, NJ 07974-0636, dmg@research.bell-labs.com

We describe several extensions to the AMPL language and solver interface. Detecting partially separable structure and computing second derivatives permits better support of nonlinear solvers. A new framework for defining qualifiers (dot suffixes) permits each solver to associate a greater variety of status, priority and solution information with model components.

2) **Embedding a Modeling Language System in Specialized Application Software**, *Sanjay Saigal*, Compass Modeling Solutions, Inc., 1005 Terminal Way, Ste. 100, Reno, NV 89502, saigal@modeling.com

Modeling languages are great prototyping tools, but how do they help modelers build applications that can be turned over to users? We describe several possibilities with emphasis on the design of a procedural interface that lets a run-time version of an algebraic model be "hidden" inside a custom-built user interface.

3) **New Modeling Language Features for Combinatorial Optimization via Logic Programming**, *Robert Fourer*, Northwestern Univ., Dept. of IE/MS, 2225 N Campus Dr., Evanston, IL 60208-3119, rer@iems.nwu.edu

Algebraic modeling languages have not proved especially helpful for working with combinatorial optimization problems other than IPs. We describe a series of extensions that permit combinatorial problems to be formulated naturally and to be addressed directly by new solvers that have their roots in the principles of logic programming.

### MC06 Heuristic Approaches to Routing & Scheduling Problems

Cluster: **Combinatorial Optimization**

Invited Session

Chair: **J. Wesley Barnes**, Univ. of TX, Grad. Program in OR, Dept. of Mech. Eng., Austin, TX 78712, wbarnes@mail.utexas.edu

1) **Production Scheduling & Inventory Control in the Presence of Sequence-Dependent Setup Times**, *Manuel Laguna*, US WEST Advanced Tech., 4001 Discovery Dr., Boulder, CO 80303

We report the development of a heuristic procedure to address a realistic production and inventory control problem in the presence of sequence-dependent setup times. The formulation of the problem also includes inventory holding costs, minimum and maximum inventory levels per product and regular and overtime capacity limits.

2) **A New Heuristic for the Capacitated Arc Routing Problem**, *Gilbert Laporte*, CRT, Univ. of Montreal, Montreal, Quebec, H3C 3J7, Canada, *Alain Hertz*, *Michel Mittaz*

We develop a TS heuristic for the capacitated arc routing problem on a directed graph. Results on benchmark problems indicate that the proposed method consistently outperforms existing heuristics and often produces an optimal solution.

3) **STEEPNET: A Tabu Search-Based Specialization of the Steepest Edge Method for Solving Network Flow Problems**, *Hamid R. Nemat*, GA State Univ., Dept. of Dec. Sci., Coll. of Bus. Admin., Atlanta, GA 30303, hnemat@gsu.edu, *Jay E. Aronson*

We describe the STEEPNET method for solving network flow problems. STEEPNET starts by solving a RNP. TS is used to intelligently increase the dimensionality of this RNP. A specialization of the steepest-edge algorithm is used to assign a tabu status to arcs that can potentially be added to the RNP, which is then re-solved. Numerical tests on a set of benchmark problems are presented.

4) **A Reactive Search Heuristic for Precedence Constrained Vehicle Routing Problems with Time Windows**, *William Nanry*, Univ. of TX, Grad. Program in OR, Austin, TX 78712, bnanry@mail.utexas.edu, *J. Wesley Barnes*

We present a new reactive search approach to precedence constrained VRPs with time windows. Special cases of this class of problems are the pickup-and-delivery problem and the dial-a-ride problem.

### MC07 Generalized Convexity/Monotonicity

Cluster: **Nonlinear Programming**

Invited Session

Chair: **Siegfried Schaible**, Univ. of CA, Grad. Sch. of Mgmt., Riverside, CA 92521, schaible@ucr1.ucr.edu

1) **On Duality for Finite Sums of Ratios**, *Carlton H. Scott*, Univ. of CA, Grad. Sch. of Mgmt., 350 GSM, Irvine, CA 92717, chscott@uci.edu, *Thomas Jefferson*

A sum of ratios of functions is generally nonconvex. Here, we derive duality results for a special case where the sum is convex and for the general nonconvex case. Concepts from conjugate function theory and geometric programming are used.

2) **Equilibrium Problems Under Generalized Monotonicity**, *Siegfried Schaible*, Univ. of CA, Grad. Sch. of Mgmt., Riverside, CA 92521, schaible@ucr1.ucr.edu, *Monica Bianchi*, *Nicolas Hadjisavvas*

A Blum/Oettli-type equilibrium problem unifies several classic models, e.g., optimization problems, variational inequality problems, saddlepoint problems.

Existence and uniqueness results are derived relaxing the rigid monotonicity assumption in the original work to generalizations of monotonicity. Both the scalar- and vector-case are studied.

**3) On Conjugations for Functions with Values in Extensions of Ordered Groups, Juan Enrique Martinez-Legaz, Univ. Autonoma of Barcelona, Dept. d'Economia/ Hist. Econ., Bellaterra, 08193, Spain, iemartinez@volcano.uab.es, Ivan Singer**

We extend results on DC duality theory and subdifferentials to the framework of generalized conjugations for functions with values in the canonical enlargement of a complete ordered group. We give applications to conjugations and subdifferentials for functions with values in the extended non-negative real line.

**4) On the Closure & Connectedness of the Efficient Set for Strictly Quasiconvex Vector Minimization, Erjiang Sun, Univ. of FL, Dept. of Dec. & Info. Sci., Gainesville, FL 32611, sune@chizp.cba.ufl.edu**

Concepts for vector-valued functions to be quasiconvex and strictly quasiconvex are defined by using the convexity and lower semicontinuity of the level set of this function. It is proved that the efficient solution set is closed and connected for the vector minimization problem with a strictly quasiconvex objective function.

### MC08 Industrial Applications of Integer Programming

Cluster: **Integer Programming**  
Invited Session

Chair: Arthur L. Fenaroli, 15 Rockefeller Ln., Rhinebeck, NY 12572, artf@vnet.ibm.com

**1) Nurse Scheduling with Generalized Programming, Brigitte Jaumard, Ecole Polytech. & GERAD, Dept. of Math. & IE, CP 6079, Succ. Centre-ville, Montreal, Quebec, H3C 3A7, Canada, brigitte@crt.umontreal.ca, Frederic Semet, Tsevi Vovor**

We present a 0-1 column generation model with a resource constrained shortest path auxiliary problem for the automation of the nurse scheduling process. We will discuss the case of the Montreal Royal Victoria Hospital.

**2) Using Integer Programming in Production Applications, Randy Mastromonaco, IBM P514, 522 South Rd., Poughkeepsie, NY 12601, randy@thebeast.pok.ibm.com**

The uncertainty of the solution time for IPs prevents their wide spread use in production applications. We discuss several techniques that were used in production applications to control the IP solution time.

**3) A Short Term Planning System for a Forest Company, Rafael Epstein, Univ. of Chile, Dept. of IE, PO Box 2777, Santiago, Chile, Andres F. Weintraub, Jaime Gabarro, Enrique Nieto, Pedro Sapunar**

A short term planning system for optimizing the operations of a forest company is presented. The system is based on an LP with a column generation procedure to consider the huge number of feasible cutting patterns. The subproblem resembles a nonlinear knapsack problem.

**4) Optimizing Vessel Schedules for Tanker "Lightering", Emmanuel Chajakis, Computer Command & Control Co., 2300 Chestnut St., Ste. 230, Philadelphia, PA 19103, chajakis@cccc.com, Frederic H. Murphy, Steve Welch**

Tankers delivering crude oil to certain refineries need to be partially unloaded, i.e., "lightered," before reaching the dock. An operator of lightering vessels tries to optimally trade-off fleet costs and tanker demurrage. We solved the problems as an IP and implemented heuristics. Results are most valuable during tanker congestion.

### MC09 Scheduling of Manufacturing Systems

Cluster: **Scheduling**  
Invited Session

Chair: Panos Kouvelis, Washington Univ., Olin Sch. of Bus., One Bookings Dr., St. Louis, MO 63130-4899, kouvelis@wuolin.wustl.edu

**1) Machine Scheduling with Multiple Jobs on One Processor Pattern, Chung-Lun Li, Washington Univ., Olin Sch. of Bus., 1 Brookings Dr., St. Louis, MO 63130, lichung@olin.wustl.edu, X. Q. Cai, Chung-Yee Lee**

We consider a new scheduling problem with a "multiple-job-on-1-processor" pattern, where several jobs can be processed by a single processor simultaneously, provided that the total size of the jobs does not exceed the capacity of the processor at any time. We consider the problems to minimize the makespan of the schedule. The well known first-fit decreasing heuristic is

generalized and its worst-case behavior studied.

**2) Solving Stochastic Scheduling Problems with Lagrangian Methods, John R. Birge, Univ. of MI, Dept. of IOE, 1205 Beal Ave., Ann Arbor, MI 48109-2117**

When demands, processing times and resource availabilities are all random, finding an optimal schedule becomes a complex stochastic optimization problem. Lagrangian methods applied to a corresponding deterministic problem are often effective but produce duality gaps. For the stochastic problem, we show that duality gap actually vanishes as the number of samples in a discrete approximation is increased...

**3) Cyclic Scheduling in Synchronous Assembly Lines, Selcuk Karabatli, Koc Univ., Gradu. Sch. of Bus., Istinye, Istanbul, 80860, Turkey, Panos Kouvelis**

We address cyclic scheduling issues in synchronous assembly line environments, i.e., no job can move from 1 workstation to the next if a workstation is busy anywhere on the line. We formulate the problem, discuss its complexity and present an implicit enumeration algorithm. We further provide interesting managerial insights for improving the performance of such lines...

### MC10 Simulation-Based Optimization

Cluster: **Stochastic Programming**  
Invited Session

Chair: Alexander Shapiro, GA Inst. of Tech., Sch. of ISyE, Atlanta, GA 30332, ashapiro@isye.gatech.edu

**1) Accelerating the Convergence of Random Search Methods for Discrete Stochastic Optimization, Sigrun Andradottir, GA Inst. of Tech., Sch. of ISyE, Atlanta, GA 30332-0205**

We present several different ways of using the data generated by a random search method to estimate the solution of a discrete stochastic optimization problem. Both theoretical and numerical results will be used to compare the various approaches.

**2) Efficiency Improvement for Cell-Loss Rate Estimation in ATM-Type Queuing Networks, Pierre L'Ecuyer, Univ. de Montreal, DIRO, CP 6128, Succ. Centre-ville, Montreal, Quebec, H3C 3J7, Canada, Yanick Champoux**

Small cell-loss rates are estimated in an ATM switch modeled as a queuing network with finite buffers. Importance sampling improves the simulation efficiency by large factors in certain types of large-scale realistic models.

**3) A Stochastic Branch & Bound Method, Andrzej Ruszczyński, Univ. of WI, Dept. of IE, 1513 University Ave., Madison, WI 53706, rusz@ie.engr.wisc.edu, Vladimir I. Norkin, Georg Pflug**

We present a new method for solving stochastic integer or global optimization problems. At each step, a partition of the feasible set is considered and for each subset stochastic estimates of lower and upper bounds are generated. The method is convergent with probability one. An application to water quality management illustrates the theory.

**4) Large Finding Optimal Material Release Times by Simulation-Based Optimization, Alexander Shapiro, GA Inst. of Tech., Sch. of ISyE, Atlanta, GA 30332, ashapiro@isye.gatech.edu, T. Homem de Mello**

We study the problem of finding optimal release times of jobs in a single-type production environment, by using simulation-based techniques for stochastic programming. An existing model is discussed and reinterpreted in terms of longest-path problems in graph theory which allows for the derivation of sensitivity results. An algorithm is presented and some numerical experiments reported.

### MC12 OR in Telecommunications II: Business, Capital & Budget Allocation Problems

Sponsor: **INFORMS CSTS**  
Sponsored Session

Chair: Djangir Babayev, US WEST Advanced Tech., 4001 Discovery Dr., Ste. 280, Boulder, CO 80303, dbabayev@advtech.uswest.com

**1) An Integrated Business Simulation Model for Personal Communications Services Companies, Tony Cox, Cornerstone Consulting, 999 18th St., Denver Place S Tower Ste. 3220, Denver, CO 80202, tonycox@cnrstn.com, Warren Kuehner, Kerrie Paige, Jennifer Parker**

We describe a wireless business simulation model for PCS companies that predicts the probable impacts on market share and future cash flows of changes in product offerings, pricing, network infrastructure and coverage, customer care and business operations. The model simulates customer behaviors,

competition and resulting cash flows.

2) **OR Analysis of Capital Allocation Problems in the Telecommunications Industry**, *Paul Thompson*, US WEST Advanced Tech., 4001 Discovery Dr., Boulder, CO 80303, pthomps@advtech.uswest.com

An important problem in the telecommunications industry arises from the need to allocate capital to proposed expansion projects. We present several mathematical models of this problem and discuss our success in applying this analysis within a complex tactical planning environment.

3) **An Approach to the High Level Budget Allocation in a Telecommunication Company**, *Scott Parrish*, US West Advanced Tech., 4001 Discovery Dr., Boulder, CO 80303, parrish@advtech.uswest.com, *Djangir Babayev*, *George Bell*

The operation of the major basic telephone network is considered as the interconnected operations of functional units, e.g., capacity provisioning, service assurance, service delivery, local network operations, etc. Nonlinear models of each constituent operation, based on queueing theory, have been used to formulate a budget allocation model...

### MC13 Intelligent Systems for Spacecraft Operations I

Sponsor: INFORMS CSTS

Sponsored Session

Chair: *Barin N. Nag*, Towson State Univ., Dept. of Mgmt., Towson, MD 21204, nag-b@toe.towson.edu

1) **An Agent-Based Approach to Automated Mission Operations**, *Walter Truskowski*, NASA Goddard Sp Flight Ctr., Automation Tech. Sect., Code 522.2, Greenbelt, MD 20771, walter.truskowski@gsfc.nasa.gov, *Jide Odubiyi*

The application of multi-agent system concepts in the development and operation of automated ground and space systems for near-Earth unmanned scientific missions will be discussed. Research issues, technical challenges and various operations scenarios will be presented. The current status of a prototype test bed for agent-based mission operations will be discussed.

2) **Automated Scheduling for the DATA-CHASER Shuttle Payload Operations**, *Steve Chien*, Jet Propulsion Lab., MS 525-3660, 4800 Oak Grove Dr., Pasadena, CA 91109-8099, steve.chien@jpl.nasa.gov, *G. Rabideau*, *P. Stone*, *J. Willis*, *C. Eggemeyer*, *T. Mann*

We describe the DCAPS iterative repair scheduling system which automatically generates executable science and engineering plans and schedules from high level goals. The DATA-CHASER shuttle payload is scheduled for flight in 1997 and DCAPS significantly reduces the effort and turnaround time in schedule generation and modification.

3) **On Board Planning for New Millennium Deep Space I Autonomy**, *Nicola Muscetola*, NASA Ames Research Ctr., Moffet Field, CA 94035, mus@ptolemy.arc.nasa.gov, *Ben Smith*, *Steve Chien*, *Chuck Fry*, *Sunil Mohan*, *G. Rabideau*, *David Yan*

The DS1 mission, which flies in 1998, will use an on-board planner that reduces high level mission goals into tasks that are then carried out by a task executive. The planner uses heuristic refinement search and constraint propagation (for time and other task parameters) to generate its plans.

4) **Intelligent Automation of Spacecraft Orbit Determination**, *Barin N. Nag*, Towson State Univ., Dept. of Mgmt., Towson, MD 21204, nag-b@toe.towson.edu, *David Weidow*

Determination of spacecraft orbit position and ephemeris (arc of orbit) from tracking ground stations and data relay satellites is a complex process involving the intelligent recovery of partial and/or incorrect data, combined with atmospheric effects. We discuss schema and heuristics for intelligent data analysis in automation without intelligent operators.

### MC14 Issues in Logistics

Sponsor: INFORMS Section on Logistics

Sponsored Session

Chair: *Ashok Srinivasan*, Duke Univ., Fuqua Sch. of Bus., Box 90120, Durham, NC 27708, ashok@mail.duke.edu

1) **The Value of Information in a Supply Chain**, *Ravi Anupindi*, Northwestern Univ., Kellogg Grad. Sch. of Mgmt., MEDS Dept., Evanston, IL 60208, r-anupindi@nwu.edu, *K. Ananad*, *Yehuda Bassok*

We study the value of information in a supply chain and the bullwhip effect. More specifically, we consider a supply chain with 1 supplier and N retailers. We show, in a finite and infinite horizon setting, the effects of different information structures on the bullwhip effect and on the performance of

different players.

2) **Multiple Issue Negotiation in Supply Contracting**, *Dajun Zeng*, Carnegie Mellon Univ., Robotics Inst./GSIA, 5000 Forbes Ave., Pittsburgh, PA 15213, zeng+@cs.cmu.edu, *Arthur Hsu*, *Katia P. Sycara*

We extend the game-theoretic framework to address complex practical issues from supply contracting which involves multi-issue, multi-criteria negotiation. We report experimental results on the effect of asymmetrical information and learning via Bayesian updating.

3) **A Planning Model for Logistics Systems: Algorithms & Illustrations**, *Ashok Srinivasan*, Duke Univ., Fuqua Sch. of Bus., Box 90120, Durham, NC 27708, ashok@mail.duke.edu, *Uday Venkatadri*

We present a nonlinear optimization model for logistics systems planning that captures bottleneck congestion effects for major resources such as plants, processes, transportation links, suppliers and distribution centers. Several illustrative scenarios are examined. Computational experience with LP-based algorithms is presented.

### MC15 Linear Cost Network Flow Algorithms

Cluster: Network Flows

Invited Session

Chair: *Michael Florian*, Univ. of Montreal, Dept. d'IRO & CRT, PO Box 6128, Succ. Centre-Vill, Montreal, Quebec, H3X 2X8, Canada, mike@crt.umontreal.ca

1) **Auction & Relaxation Algorithms for Linear Network Flow Problems**, *Dimitri P. Bertsekas*, MIT, Dept. Elect. Eng./Comp. Sci., Cambridge, MA 02139

We discuss a new and very fast-in-practice algorithm for the max-flow problem. It consists of a sequence of augmentations along paths constructed by an auction-like algorithm. We then show how this algorithm can be used as a preprocessor to solve efficiently difficult minimum cost flow problems using the relaxation method.

2) **Dimension-Expanding Network Optimization Algorithms**, *Jay E. Aronson*, Univ. of GA, Terry Coll. of Bus., Dept. of Mgmt., Athens, GA 30602-6256, jaronson@nedley.mgmt.uga.edu

We describe 3 relatively new, dimension-expanding approaches to solving the pure network flow problem: the pivot & probe network flow algorithm, PAPNET, Kang & Aronson, the TS network flow algorithm, TABUNET, Nemati & Aronson and the forward network simplex algorithm, FORNET, Higbie & Aronson.

3) **An Efficient Implementation of the Network Simplex Method**, *Michael Florian*, Univ. of Montreal, Dept. d'IRO & CRT, PO Box 6128, Succ. Centre-Vill, Montreal, Quebec, H3X 2X8, Canada, mike@crt.umontreal.ca, *Denis Lebeuf*

We present a new code which implements the network simplex method based on a new adaptive heuristic method for pivot choice. The pivot choice is modified dynamically during the execution of the algorithm. This new code was tested on a variety of problems. The comparative results obtained show that is among the most efficient implementations of this algorithm.

### MC16 Organizational Capabilities for Innovation

Sponsor: INFORMS Section on Technology Management

Sponsored Session

Chair: *Deborah Dougherty*, McGill Univ., Fac. of Mgmt., 1001 Sherbrooke St. W, Montreal, Quebec, H3A 1G5, Canada, doughert@management.mcgill.ca

1) **Process Innovation: A Grammatical View of Capabilities & Constraints**, *Brian T. Pentland*, MI State Univ., East Lansing, MI 48824-1032

Grammatical models provide a way of dividing organizational processes into constituent parts that are enabled and constrained by structural features of the organization as well as technology, coordination and culture. We use the grammatical perspective to analyze capabilities and constraints on process innovation.

2) **Formalization as Learning in Process Reengineering**, *Bryan Borys*, Univ. of Southern CA, Sch. of Public Adm., Los Angeles, CA 90089-0041, bborys@praetor.usc.edu

While bureaucratization is often viewed as a barrier to organizational learning, it may facilitate learning by serving as an organizational technology. Participant-observation of process reengineering shows how formalization of tacit and informal behaviors encourages organizational members to examine the properties of those behaviors and provides a medium for organizational

learning.

3) **Learning & Change in Two Nuclear Power Plants**, *Elaine K. Yakura*, MI State Univ., SLIR/436 S Kedzie Hall, E Lansing, MI 48824, elaine.yakura@ssc.msu.edu

High-reliability organizations are, ironically, structured so that it is sometimes difficult to learn from mistakes. "Anti-change" mindsets may be appropriate in risky contexts but can also hinder learning. We will present data from 2 nuclear power plants to illustrate how these mindsets can both help and hinder change.

4) **Building Capacities for Product Innovation**, *Deborah Dougherty*, McGill Univ., Fac. of Mgmt., 1001 Sherbrooke St. W, Montreal, Quebec, H3A 1G5, Canada, doughert@management.mcgill.ca

We analyze the differences between non-innovative, incrementally innovative and comprehensively innovative organizations in a variety of industries. Fundamentally different capacities for arranging knowledge, organizing tasks, building work identities and controlling work characterize the differences. We discuss how to build new capacities from old ones.

## MC17 Information Systems III

### Contributed Session

Chair: Hsing K. Cheng, Coll. of William & Mary, Sch. of Bus. Admin., Williamsburg, VA 23187-8795, hxchen@dogwood.tyler.wm.edu

1) **Structural Insights of Software Pricing Diffusion Models**, *Hsing K. Cheng*, Coll. of William & Mary, Sch. of Bus. Admin., Williamsburg, VA 23187-8795, hxchen@dogwood.tyler.wm.edu, *Julian Keilson, Yu-Ming Wang*

Using probability notation, we analyze software pricing models based on Bass product diffusion models. Closed forms of various probability functions associated with the product diffusion models are derived, providing structural insights into empirical results reported in the marketing literature.

2) **Warranty, Maintenance & Upgrade Decisions Under Risk**, *Izzet Sahin*, Univ. of WI, Sch. of Bus. Admin., Milwaukee, WI 53201, *Fatemeh Mariam Zahedi*

An MDP model is proposed for the determination of optimal warranty, maintenance and upgrade decisions for software and ISs. The main elements of the model, its solution and some of its applications are discussed.

3) **Is Business Process Reengineering for Small Business?**, *Francois Bergeron*, Univ. Laval, Fac. des. Sci. de l'Admin., Ste. Foy, Quebec, G1K 7P4, Canada, francois.bergeron@fsa.ulaval.ca

A survey on BPR was done in 134 Canadian enterprises, including 28 SMEs and 106 large enterprises. Although the BPR projects found in SMEs were implemented under organizational, technical and methodological conditions that were far from ideal, these enterprises seemed to draw significant advantages from their projects.

## MC18 TUTORIAL: Geometric Programming

### Invited Session

Chair: Kenneth O. Kortanek, Univ. of IA, Dept. of MS, Coll. of Bus. Admin., Iowa City, IA 52242

1) **TUTORIAL: Geometric Programming**, *Kenneth O. Kortanek*, Univ. of IA, Dept. of MS, Coll. of Bus. Admin., Iowa City, IA 52242

GP as a next level of extension of LP owes its origins to the arithmetic-geometric mean inequality. During the last 35 years, manifest applications have occurred in many fields, including engineering design, reliability, operations (project management and lot sizing), economics and marketing, statistical inference, entropy and telecommunications...

## MC19 Train Scheduling Algorithms

Sponsor: INFORMS Railroad Applications SIG

### Sponsored Session

Chair: Bruce G. Schinelli, TTX Co., 101 N Wacker Dr., Chicago, IL 60606, bgschinelli@ttxco.com

1) **Current & Future Directions in Computer Support for Freight Train Scheduling**, *Carl D. Van Dyke*, Multimodal Applied Systems, Inc., 347 Elizabeth Ave., Ste. 105, Somerset, NJ 08873-1101

Freight train scheduling is a complex process that must take many factors into account, including physical route, traffic carried, connections, crew and locomotive requirements and line capacity. Schedules must be robust enough to survive the occurrence of extras, annulments, consolidations and schedule

deviations. No computer system currently supports all of these issues...

2) **Predicting On-Time Performance in Scheduled Railroad Operations: An Example of Application to Train Scheduling**, *Susan F. Hollowell*, USAir, 3501 N 17th St., Arlington, VA 22207, *Patrick T. Harker*

In previous work, the authors developed an analytical line delay model and validated the model as a predictive tool. We present the results of extensive empirical tests on the use of the model as a prescriptive tool for the generation of train schedules.

3) **On the Necessity of Realistic Benchmark Data for Integrated Planning & Operations Systems**, *Frank Boyle*, Union Switch & Signal Inc., 1000 Technology Dr., Pittsburgh, PA 15219, *Joe Profeta*

The availability of realistic data for benchmarking software that integrates and optimizes railroad operations could significantly improve the effectiveness of such products as well as provide for objective measurement of their worth. We suggest that a data set specification be developed by the railroads and be accepted by vendors as a benchmark.

## MC20 PANEL: Dynamic Traffic Assignment II - Development of Real-Time Systems & Control

Sponsor: INFORMS Transportation Science Section

### Sponsored Session

Chair: Shaw-Pin Miaou, Oak Ridge Ntl. Lab., Oak Ridge, TN 37831

1) **PANEL: Development of Real-Time DTA Systems Under the FHWA - Initiative Control & Methodological Issues**, *Henry Lieu*, FHWA, *Shaw-Pin Miaou*, Oak Ridge Ntl. Lab.

ITSs are currently being developed and deployed to exploit computer and electronic communication technologies to improve the efficiency, productivity and safety of existing transportation facilities. The success of important ITS subsystems such as ATIS and ATMS depend on the availability and dissemination of timely and accurate estimates of prevailing and emerging conditions...

2) **PANEL: Dynamic Traffic Assignment II**, *Henry Lieu*, FHWA, *Ajay K. Rathi*, Oak Ridge Ntl. Lab., *Shaw-Pin Miaou*, Oak Ridge Ntl. Lab., *Mike Summers*, Oak Ridge Ntl. Lab., *Rabi Mishalani*, MIT, *Moshe E. Ben-Akiva*, MIT, *Haris Koutsopoulos*, Carnegie Mellon Univ., *Hani S. Mahmassani*, Univ. of TX, *Yaser Hawas*, Univ. of TX

No abstract supplied.

## MC21 Air Cargo Yield Management

Cluster: Aviation Applications

### Invited Session

Chair: Robert Phillips, Decision Focus Inc., 650 Castro St., Ste. 300, Mountain View, CA 94041-2055, bobp@dfi.com

1) **An Introduction to Air Cargo Yield Management**, *Robert Phillips*, Decision Focus Inc., 650 Castro St., Ste. 300, Mountain View, CA 94041-2055, bobp@dfi.com

Air cargo yield management consists of managing the commitments made to customers, i.e., pricing, contracting and bookings, based on maximizing profitability in the face of uncertain demand. It has a number of features that distinguish it from passenger airline yield management. We review the state-of-the-art of air cargo yield management.

2) **Application of System Profit Management at KLM**, *Ted Sapountzis*, Decision Focus, Inc., 650 Castro St., Ste. 300, Mountain View, CA 94024, *Dirk Genike*

SPM is the application of interactive revenue and cost management techniques in the freight transportation industry. The authors will present the concepts of SPM and the integration of these concepts in KLM cargos strategy, business approach, process and systems.

3) **Yield Management at British Airways World Cargo**, *Peter Wiener*, ICO Global Communications, 1 Queen Caroline St., Hammersmith, W6 9BN, UK

No abstract supplied.

4) **Routing in Support of Yield Management**, *Ganesh Vaideeswaran*, Decision Focus, Inc., 650 Castro St., Ste. 300, Mountain View, CA 94041, ganes@dfi.com

No abstract supplied.

## MC22 Operations Strategy in Information Centered Industries

**Sponsor:** INFORMS Section on Manufacturing & Service Operations Management

**Sponsored Session**

**Chair:** Uday S. Karmarkar, UCLA, Anderson Sch. of Mgmt., 110 Westwood Plaza, Los Angeles, CA 90095-1481, uday.karmarkar@anderson.ucla.edu

1) **Analysis & Improvement of Information-Intensive Services, Uday M. Apte**, SMU, Cox Sch. of Bus., Dallas, TX 75275-0333, uapte@mail.cox.smu.edu

We propose a set of criteria and methodology for understanding and characterizing information-intensive services. Adopting a process management perspective, we also present a framework of analysis and improvement of such services. Finally, the proposed concepts are illustrated with examples drawn from financial and/or other services.

2) **To Outsource or Not to Outsource: That is the Question, Frances X. Frei**, Univ. of Rochester, Simon Sch. of Bus., 3-345 Simon Hall, Rochester, NY 14267, **Ravi Kalakota**

We present a business model that guides financial services through the make or buy decision for remote banking products. The critical question addressed for both online banking as well as call-center banking is where to draw the boundaries in terms of what should be done in-house, where alliances would be most advantageous and when outsourcing makes the most sense.

3) **Service Design & Competition in Business Information Services, T. C. A. Bashyam**, Montgomery & Associates, 100 Wilshire Blvd., Ste. 400, Santa Monica, CA 90401

Business information services, such as Reuters and Mead Data Central, provide information to professional subscribers. We examine 2 competing technologies for delivering business information: a package service which uses physical media such as CD-ROMs and an online service. They differ in the amount of content delivered and available pricing mechanisms...

4) **Gateway Competition in Information-Based Services, David Choi**, UCLA, Anderson Sch. of Mgmt., 110 Westwood Plaza, Box 961481, Los Angeles, CA 90095-1481, dchoi@anderson.ucla.edu, **Uday S. Karmarkar**

In certain services, there can be more than 1 way to reach a customer, to sell the service. Capturing the customer and becoming the gatekeeper for the service leads to a strong position in the service chain. Changing service technologies and channels are leading to increased competition for this role. We analyze gateway competition in retail (consumer) banking.

## MC23 Production Scheduling & Due Date Management

**Cluster:** Manufacturing & Service Management

**Invited Session**

**Chair:** Jeffrey W. Herrmann, Univ. of MD, Dept. of Mech. Eng., College Park, MD 20742, jwh2@eng.umd.edu

1) **A Procedure for Scheduling & Diagnostic in Finite-Capacity, Multi-Product, Multi-Stage Production Environments, Valerie Tardif**, Univ. of TX, Grad. Program in OR/IE, Dept. of Mech. Eng., Austin, TX 78712-1063, vtardif@mail.utexas.edu, **Mark L. Spearman**

Planning releases and prioritizing work must be done with the often conflicting goals of meeting due dates and minimizing inventory. However, in finite-capacity production environments, it is often impossible to meet all due dates without overtime of some due data renegotiation. We propose a procedure which evaluates the feasibility of proposed plans...

2) **Integrating Due-Date Assignment, Order Release & Priority Scheduling in Complex Production Environments, Steve Lawrence**, Univ. of CO, Coll. of Bus. & Admin., CB 419, Boulder, CO 80303-0419, stephen.lawrence@colorado.edu

No abstract supplied.

3) **Demand Management Policies & Their Impact on Firm's Performance, Prabhu K. Aggarwal**, Coll. of William & Mary, Bus. Sch., Williamsburg, VA 23185, pkagga@dogwood.tyler.wm.edu, **Kevin B. Hendricks**

We model a firm's long-term profitability as a function of its demand management policies using both stochastic modeling and simulation. Our research indicates that significant improvements are possible using easy-to-implement policies that selectively accept/reject orders.

4) **Due-Date Determination in the Stochastic Single Machine Problem with Earliness & Tardiness Penalties, Hossein M.**

**Soroush**, Kuwait Univ., Coll. of Sci., Dept. Stats./OR, PO Box 5969, Safat, 13060, Kuwait, hsoroush@kuc01.kuniv.edu.kw

We study the problem of due-date determination and sequencing of stochastic jobs on a single machine where job earliness and tardiness penalties are distinct. The objective is to determine the optimal sequence and optimal due-dates which jointly minimize the expected total earliness and tardiness penalties. A case where processing times are normally distributed is fully explored.

## MC24 Communicating About Probability & Uncertainty

**Sponsor:** INFORMS Decision Analysis Society

**Sponsored Session**

**Chair:** Patrick S. Noonan, Emory Univ., Goizueta Bus. Sch., Dec. & Info. Analysis, Atlanta, GA 30322, patrick\_noonan@bus.emory.edu

1) **Patterns of Preferences for Numerical & Verbal Probabilities, David Budescu**, Univ. of IL, Dept. of Psychology, 603 E Daniel St., Champaign, IL 61820, dbudescu@s.psych.uiuc.edu, **Michael Olson**

We examined preferences for numerical and verbal models of expressing uncertainty. Both models were used to communicate uncertainty regarding precise and vague events between 2 partners. Preference for mode was moderated by the direction of communication and nature of the events. Mode of expression affected the efficacy of subsequent decisions.

2) **Are We on the Same Wavelength? Measures of "Concord" for Verbal Probabilities, Patrick S. Noonan**, Emory Univ., Goizueta Bus. Sch., Dec. & Info. Analysis, Atlanta, GA 30322, patrick\_noonan@bus.emory.edu

Choice of a particular verbal expression of uncertainty can be modeled as a complex interactive decision. We use survey and experimental data to investigate the role of a desire for concord - mutual agreement about the nature of an uncertainty - between the person selecting the phrase and its intended audience.

3) **Evaluating Diagnostic Systems: A Level Playing Field, Ward Edwards**, Wise Decisions, Inc., 11466 Laurelcrest Rd., Studio City, CA 91604, wedwards@mizar.usc.edu

Diagnostic systems observe data and make inferences. Categorical systems output a best guess; probabilistic systems output a probability distribution over diagnoses. Categorical systems are compared by counting correct diagnoses. Probabilistic systems are compared using strictly proper scoring rules. We trivially extend the latter tool to permit fair comparisons between categorical and probabilistic systems.

## MC25 The Use of Projects to Teach OR/MS

**Sponsor:** INFORMS Forum on Education

**Sponsored Session**

**Chair:** Ellen S. Jordan, Tiffin Univ., 155 Miami St., Tiffin, OH 44883, ejordan@cgate.tiffin.edu

1) **Running a Global Projects Course, Laura Rock Kopczak**, Stanford Univ., IE/EM Dept., Terman 351, Stanford, CA 94305-4024, kopczak@leland.stanford.edu

We will describe a global projects course run last year in the IE/EM Department at Stanford. Groups of students from Stanford, Eindhoven, or Hong Kong Universities work together on a global business problem.

2) **Comparing Project-Based Teaching with Traditional Methods, Arif Rana**, Lahore Univ. of MS, Opp. Sector U, LCCHS, Lahore Cantt., 54792, Pakistan

Two sections of a first-year MBA course will be taught in the fall of 1996. One will be project-based, while the other will be taught from a traditional standpoint. Student evaluation and teacher perspective will be given.

3) **What I Learned From a Project-Based Course, Kenichi Futamura**, AT&T, 101 Crawfords Corner Rd., Rm. 3K-312, Holmdel, NJ 07733-3030, futamura@qpc2.att.com

A practitioner's view of the benefits of learning in a project-based course will be presented.

4) **A Term Project in a Required Undergraduate Management Science Course, Thomas A. Grossman**, Univ. of Calgary, 2500 University Dr. NW, Fac. of Mgmt., Calgary, Alberta, T2N 1N4, Canada, grossman@mgmt.ucalgary.ca

We recently introduced a term project in our 3rd-year B.Comm. MS course. Student groups develop a project with local business, carry out a complete analysis and present the results. We share what we have learned about our students, our teaching and the "content" of the MS course.

**MC26 Stochastic Dynamic Programming**

Sponsor: INFORMS Applied Probability Section  
Sponsored Session

Chair: Arthur F. Veinott, Jr., Stanford Univ., Dept. Eng. Econ. Systems & OR, Stanford, CA 94305

1) **Temporal Differences-Based Policy Iteration & Applications in Neuro-Dynamic Programming**, *Dimitri P. Bertsekas*, MIT, Dept. Elect. Eng./Comp. Sci., Cambridge, MA 02139, *Sergey Ioffe*

We consider a new policy iteration method for DP problems based on the notion of temporal differences. The method is primarily geared to large and complex problems where the use of approximations is essential. We develop the theory of the method with and without approximation and use it to train a tetris-playing program.

2) **Pricing Derivative Securities in Incomplete Markets: An  $\epsilon$ -arbitrage Approach**, *Dimitris Bertsimas*, MIT, Rm. E53-359, Cambridge, MA 02139, *L. Kogan, A. Lo*

We propose a general dynamic control method to price derivative securities in incomplete markets. Rather than replicating the payoff of the derivative security exactly by dynamically trading, we replicate the payoff approximately. We apply our methods to models with transaction costs, models with stochastic volatility, jump diffusions and path dependent derivative securities.

3) **Maximizing Population Growth**, *Arthur F. Veinott, Jr.*, Stanford Univ., Dept. Eng. Econ. Systems & OR, Stanford, CA 94305, *Uriel G. Rothblum*

Consider maximizing the long-run population growth of Markov population decision chains, e.g., wealth, throughput. There exists nonnegative  $(g, d)$  such that the expected population size in period  $N$  is bounded above by  $O(N^{d-1}g^N)$  for every policy and is attained by a stationary policy. Characterizations and computations are discussed.

**MC27 Modeling & Simulation in Business Process Reengineering**

Sponsor: INFORMS College on Simulation  
Sponsored Session

Chair: John M. Charnes, Univ. of KS, Sch. of Bus., 345M Summerfield Hall, Lawrence, KS 66045-2003, john.charnes@ukans.edu

1) **Simulation Models Use as a Management Decision Tool Within the Restaurant Industry**, *Beth Kulick Carpenter*, Automation Assoc. Inc., System Design Analysis, 512 Via de la Valle, Ste. 209, Solana Beach, CA 92075, bkulick@aaisim.cts.com

A simulation model is presented that assists restaurant managers in determining appropriate staffing levels and assignments to support customer service time targets. The model is driven by actual point-of-sale data such that alternate markets and day segments may be quickly analyzed.

2) **Business Process Modeling with SIMPROCESS**, *Maya Binur*, CACI Products Co., 3333 N Torrey Pines Ct., La Jolla, CA 92037, maya@caciasl.com

An application is presented to demonstrate use of SIMPROCESS which integrates process diagramming, event-driven hierarchical simulation and ABC in a single, object-oriented environment. SIMPROCESS is designed to reduce the time and money required to develop new products, service customers and fulfill demand.

3) **Model-Based Enterprise as a Methodology for Continuous Organizational Learning & Enterprise Process Improvement**, *Thomas Caporello*, AZ State Univ., CIM Res. Ctr., Coll. of Eng., Goldwater Bldg., Rm. 534, Tempe, AZ 85287, caporello@asu.edu, *Dan L. Shunk*

MBE methodology is utilized by combining industry clockspeed, modeling and simulation and rapid change implementation to leverage the knowledge gained from a process of multiple product development processes with continual reviews in a manufacturing company. MBE provides a structure for organizations to learn and improve continually.

**MC28 Location Analysis**

Cluster: Location Analysis  
Invited Session

Chair: H. A. Eiselt, Univ. of New Brunswick, Fac. of Admin., PO Box 4400, Fredericton, NB, E3B 5A3, Canada, haeiselt@unb.ca

1) **Finding Nash Equilibrium on a Cactus**, *Joyendu Bhadury*, Univ. of New Brunswick, Fac. of Admin., PO Box 4400, Fredericton, NB, E3B 5A3, Canada, bhaduryj@fac.fadmin.unb.ca,

**H. A. Eiselt**

We consider the problem of finding Nash equilibrium on a special kind of graph, namely, cactus. Previous work is first reviewed. Some new ideas on how to compute them efficiently are also discussed.

2) **Customer Choice Models**, *H. A. Eiselt*, Univ. of New Brunswick, Fac. of Admin., PO Box 4400, Fredericton, NB, E3B 5A3, Canada, haeiselt@unb.ca, *Gilbert Laporte*

So far, most authors dealing with multi-facility location models have assumed that customers patronize the cheapest facility. While this behavior appears natural, most consumers do not behave that way. We investigate a number of individual utility functions and their performance regarding a number of reasonable axioms.

3) **Flow Intercepting Spatial Allocation Models**, *Oded Berman*, Univ. of Toronto, Faculty of Mgmt., 105 St. George St., Toronto, Ontario, M5S 1E6, Canada, berman@fmgmt.mgmt.utoronto.ca, *Dmitry Krass*

We extend the popular spatial interaction model for locating competitive facilities to include customer demand originating from both paths and nodes of a network. Such extension is particularly applicable to facilities relying on bypassing customer traffic, e.g., gas stations, convenience stores. An optimization model for locating a set of new facilities is developed; exact and approximate solution algorithms will be discussed.

4) **Location of Retail Facilities Under Conditions of Uncertainty**, *Tammy Drezner*, CA State Univ., Dept. of Mktg., Fullerton, CA 92834, *Zvi Drezner*

Models for the optimal location of retail facilities are premised on current market considerations. We incorporate future market conditions into the model for the location of a retail facility. Future market conditions are analyzed as a set of several possible scenarios. We analyze the problem of finding the best location for a new facility...

**MC29 Designing Contracts in Supply Chain Systems**

Cluster: Inventory Management  
Invited Session

Chair: Steven Nahmias, Santa Clara Univ., Dec. & Info. Sci. Dept., Santa Clara, CA 95053

1) **Capacity Choice & Allocation: Strategic Behavior & Supply Chain Performance**, *Gerard Cachon*, Duke Univ., Fuqua Sch. of Bus., Box 90120, Durham, NC 27708-0120, *Martin Lariviere*

We consider a supply chain in which a single supplier sells to several downstream customers. The supplier has limited capacity and customers are privately informed of their optimal stocking levels. If customer orders exceed available capacity, the supplier allocates capacity using a publicly known allocation mechanism. We investigate how the retailers behave in this environment...

2) **Designing Contracts with Multiple Suppliers of Retail Fashion Merchandise**, *Narendra Agrawal*, Santa Clara Univ., DIS Dept., Leavey Sch. of Bus., Santa Clara, CA 95053, nagrawal@mailier.scu.edu, *Stephen A. Smith, Andy Tsay*

A set of manufacturers supply the retailer's portfolio of merchandise, which changes with time. The suppliers differ in their lead times, unit costs, capacity and storage limitations. We develop a model for optimizing the retailer's commitments to suppliers using an approximation for demand uncertainty.

3) **Inventory Pooling with Claims**, *Eitan Zemel*, Northwestern Univ., Kellogg Grad. Sch. of Mgmt., Evanston, IL 60208, *Yehuda Bassok, Ravi Anupindi*

We consider a distribution system consisting of  $N$  retailers. Each retailer  $i$  decides on stock level  $Y_i$  and faces random demand  $D_i$ . Upon realization of demands, each retailer may have excess demand and some may have excess inventory. We present different allocation rules of inventory, profits and revenues. We examine the effects of these rules on the total inventory and profit.

4) **Optimal & Approximate Adjustment Policies for a Fixed Delivery Contract**, *Kamran Moynadeh*, Univ. of WA, Sch. of Business, Seattle, WA 98195-3200, *Steven Nahmias*

We consider a contract in which  $Q$  units are to be delivered every  $T$  time units. We assume  $Q$  is less than demand in a period and allow for the opportunity for the buyer to adjust the delivery quantity upwards for a premium. Demand is random. We consider a continuous review infinite horizon setting and show that optimal adjustment policies are extremely complex...

### MC30 Recent Operations Research Projects at the US Military Academy

Sponsor: INFORMS Military Applications Society  
Sponsored Session

Chair: Michael L. McGinnis, US Military Acad., OR Ctr., West Point, NY 10996, fm0768@exmail.usma.edu

Co-Chair: Robert G. Phelan, Jr.

1) **Scheduling Support for the US Army's Close Combat Tactical Trainer System**, *Michael L. McGinnis*, US Military Acad., OR Ctr., West Point, NY 10996, fm0768@exmail.usma.edu, *Robert G. Phelan, Jr.*

The US Army is developing a new training facility, CCTT, where armored units will train in a virtual environment on a digitized battlefield. Major planning tasks involve selecting and scheduling training scenarios and resources. Simultaneous scenarios requiring varying levels of simulators, workstations, operators and semi-automated (computerized) forces complicate scheduling...

2) **Systems Reengineering of the Army's Tactical Staffs Using Computer Simulation**, *Robert G. Phelan, Jr.*, US Military Acad., OR Ctr., West Point, NY 10996, fr0161@exmail.usma.edu, *Michael L. McGinnis*

FORCE XXI is integrating computer, information and communications technologies throughout the force. These are having a profound impact on command and control processes, especially at division and below. We present a computer simulation model under development for the ADO to help evaluate alternatives for reengineering Army staffs at division and below for information operations.

3) **A New Approach to Forecasting Military Officer Personnel**, *Michael L. McGinnis*, US Military Acad., OR Ctr., West Point, NY 10996, fm0768@exmail.usma.edu

Currently, military officer strength is aged from 1 year to the next using a single set of transition rates. These reflect the cumulative attriting effects of personnel management policies as well as social and economic factors on an office year group. We extend the military office transition rate forecasting model by using 3 separate transition rates. Results from a practical application are presented.

### MC31 Future Main Battle Tank Simulation

Sponsor: INFORMS Military Applications Society  
Sponsored Session

Chair: Stan Gray, TRADOC Analysis Ctr., ATRC-WAB, WSMR, NM 88002-5502, grays@trac.wsmr.army.mil

1) **Tank Extended Range Munition Study**, *Saul Solis*, TRADOC Analysis Ctr., ATRC-WAB, WSMR, NM 88002

US Army TRADOC Analysis Center, MSMR, assisted the Army Research Laboratory in evaluating a tank extended range munition, TERM, concept. Seven TERM candidates were examined in 2 CASTFOREM high-technology threat scenarios. Munition capabilities included direct fire and/or beyond visual range engagements at extended ranges. Results show significant payoffs for FMBT lethality and survivability.

2) **Future Tank Technologies in Support of US Army Science Board**, *Alvin Crowder*, TRADOC Analysis Ctr., ATRC-WAB, WSMR, NM 88002

US Army TRADOC Analysis Center, MSMR, assisted the US Army Science Board in its tank modernization study. Current and future alternatives were modeled in CASTFOREM with derivatives including survivability, low observability, increased lethality and improved target acquisition. Metrics studied included total kills, total losses and personnel losses. Best combinations were modeled during the 3-phased study.

### MC32 Network Design & Engineering of Emerging Telecommunication Systems

Sponsor: INFORMS Technical Section on Telecommunications  
Sponsored Session

Chair: Youngho Lee, US WEST Advanced Tech., 4001 Discovery Dr., Ste. 280, Applied Research, Boulder, CO 80303, yhlee@advtech.uswest.com

1) **Topological Design of Local Access Network with Service Survivability**, *Moon-Gil Yoon*, Hankuk Aviation Univ., 200-1 hwajun-dong, Koyang-shi Kyunggi-d, Seoul, Korea, *Hu-gon Kim*

We deal with a design issue of survivable LAN telecommunication networks. To prevent the possibility of severe service loss in the event of a single link failure, there exist 2 link disjoint paths between central office and user node. To construct a cost-effective network, we consider hubs representing subscriber loop carrier systems. We develop a mathematical model and heuristics to solve

it efficiently.

2) **A Forward Link Power Control Algorithm for Cellular CDMA Systems: A Mathematical Programming Approach**, *Seong-Lyun Kim*, Electronics & Telecomm. Research Inst., System Eng. Sec., Mobile Telecomm. Div., Taejon, 305-350, Korea, *Geon Cho*

We propose a new algorithm for the FLPC in IS-95 based cellular CDMA systems. We formulate FLPC as an optimization problem and design an algorithm, i.e., FLPC algorithm, for the formulation. Computational experiments on the proposed algorithm indicate practical applicability of our algorithm to real systems.

### MC33 Optimization Techniques I

Contributed Session

Chair: Arne S. Drud, ARKI Consulting & Develop. A/S, Bagsvaerdvej 246A, Bagsvaerd, 2880, Denmark, adrud@arki.dk

1) **A General Pre-Processor for GAMS Models**, *Arne S. Drud*, ARKI Consulting & Develop. A/S, Bagsvaerdvej 246A, Bagsvaerd, 2880, Denmark, adrud@arki.dk

We describe a general purpose pre- and post-processor for GAMS models, independent of and usable with most GAMS solvers. The pre-processor removes variables, aggregates or disaggregates constraints based on user options, adds domain bounds for nonlinear models, checks scaling, etc. We report experiments with various GAMS solvers.

2) **Modeling & Experimentation for Multiple Response Optimization**, *Daniel R. Rand*, Univ. of MN, 805 28th St. NW, Rochester, MN 55901, rand0030@maroon.tc.umn.edu, *Kevin J. Dooley*

An algorithm for multiple response optimization will be described that satisfies 2 objectives: to formulate an aggregate response function when individual responses have already been modeled as functions of control variables and to expand response surface search techniques to pursue a collective optimum (for multiple responses) with efficient experimentation.

3) **MProbe: Estimating the "Shape" of Nonlinear Functions**, *John W. Chinneck*, Carleton Univ., Systems & Comp. Eng., 1125 Colonel by Dr., Ottawa, Ontario, K1S 5B6, Canada, chinneck@sce.carleton.ca

The "shape" of nonlinear functions is crucial in NLP: are they convex or concave or almost so or both? MProbe provides an estimate of shape in a specified region. A function that is analytically nonlinear may be simpler, e.g., linear, in the region of interest.

4) **A Deterministic Method for the Global Optimization of Heat Exchanger Networks**, *Juan M. Zamora*, Carnegie Mellon Univ., Dept. of Chem. Eng., Pittsburgh, PA 15213-3890, jz29@andrew.cmu.edu, *Ignacio E. Grossmann*

A rigorous global optimization method is presented for the synthesis of heat exchanger networks with no stream splitting. We propose convex relaxations of the heat transfer equation and use linear convex envelopes for concave costs. These are used within a B&B search that involves MINLP subproblems with contaction steps.

### Monday 16:30-18:00

#### MD04 How Good are Medical Records as a Basis for Cost Decisions

Cluster: Public Sector Applications

Sponsor: INFORMS Section on Public Programs & Processes

Sponsor/Invited Session

Chair: Douglas Samuelson, 8711 Chippendale Ct., Annandale, VA 22003-3807, dsamuel@seas.gwu.edu

#### MD05 Linear Programming in Approximation & Algorithms I

Cluster: Linear Programming

Invited Session

Chair: Vasant A. Ubhaya, ND State Univ., Dept. of Comp. Sci. & OR, 258 IACC Bldg., Fargo, ND 58105, ubhaya@plains.nodak.edu

1) **A Best Approximation Approach to Linear Programming**, *Frank Deutsch*, PA State Univ., Dept. of Math., 417 McAllister Bldg., University Park, PA 16802, deutsch@math.psu.edu

Mangasarian (1984) showed that finding the minimal norm solution to the LP

problem, maximize  $cx$  s.t.  $Ax \leq b$  and  $x \geq 0$ , reduces to computing the best approximation to a sufficiently large multiple of  $c$  from the feasible set of the LP. We will discuss the practicality of solving the LP this way.

2) **Consistency of Moment Systems**, *Adrian Lewis*, Univ. of Waterloo, Dept. of Combinatorics & Opt., Waterloo, Ontario, N2L 3G1, Canada, [aslewis@orion.uwaterloo.ca](mailto:aslewis@orion.uwaterloo.ca)

I present a computable criterion for deciding when a given Euclidean vector lies in the interior or boundary of the convex cone generated by a given compact set. Such questions underlie moment problem solvability and stability. The criterion involves minimizing a smooth, unconstrained, finite-dimensional, convex function.

3) **Constrained Interpolation & Approximation from a Convex Subset of Hilbert Space**, *Joseph D. Ward*, TX A&M Univ., Dept. of Math., College Station, TX 77843, [jward@math.tamu.edu](mailto:jward@math.tamu.edu)

Let  $H$  be a Hilbert space and  $C$  its closed convex subset. Let  $K$  be the intersection of  $C$  with a finite number of given half spaces. We show that the best approximation to a  $x$  in  $H$  from  $K$  is identical to that some  $y$  in  $H$  from  $C$ .

## MD06 A Heuristic Approach for Berth Planning

Cluster: **Combinatorial Optimization**

Invited Session

Chair: Buyang Cao, ESRI Inc., 380 New York St., Redlands, CA 92373, [bcao@esri.com](mailto:bcao@esri.com)

1) **A Heuristic Approach for Berth Planning**, *Stefan Voss*, Tech. Univ. Braunschweig, Abteilung Allg. BWL, Abt.-Jerusalem-Strasse 7, Braunschweig, D-38106, Germany, [stefan.voss@tu-bs.de](mailto:stefan.voss@tu-bs.de)

Optimizing the operations on a container terminal berth planning is considered. The overall objective is to guarantee a fast dispatching of ships. A heuristic approach, including TS, is proposed. The algorithm was tested on real-world data as well as on randomly generated instances.

2) **A Tabu Search Heuristic Procedure for Solving the Transportation Problem with Exclusionary Side Constraints**, *Minghe Sun*, Univ. of TX, Div. of Mgmt. & Mktg., Coll. of Bus., San Antonio, TX 78249-0634, [msun@lonestar.utsa.edu](mailto:msun@lonestar.utsa.edu)

A new TS heuristic solution procedure for the transportation problem with exclusionary side constraints is developed. The simplex method on a graph is employed to lead the search from one trial solution to an adjacent trial solution. Reported computational results show that the procedure outperforms an existing heuristic procedure.

3) **Neighborhood Routing & Scheduling Problems with Vehicle/Site Dependencies**, *John Sniezek*, Univ. of MD, Coll. of Bus. & Mgmt., College Park, MD 20742, *Lawrence Bodin*, *Michael Ball*

Sanitation routing and scheduling problems have special considerations not ordinarily encountered in more traditional street routing and scheduling problems. These issues are described and procedures that we have developed for overcoming these issues are explored.

4) **GIS & Combinatorial Optimization: Their Applications in the Telecommunications Industry**, *Buyang Cao*, ESRI Inc., 380 New York St., Redlands, CA 92373, [bcao@esri.com](mailto:bcao@esri.com), *Charles MacLeod*

We present a system incorporating the techniques of GIS and combinatorial optimization, regarding the problem of designing an optimal layout of a telephone cable network meeting certain constraints imposed by the business logic. An algorithm based on ejection chain techniques to find reasonable cable layout is presented. An implementation within ArcView/ArcInfo client/server environment is discussed.

## MD07 Numerical Optimization

Cluster: **Nonlinear Programming**

Invited Session

Chair: Jean-Pierre Dussault, Univ. de Sherbrooke, Dept. de Math. et d'Info., Sherbrooke, Quebec, J1K 2R1, Canada, [jean-pierre.dussault@dmi.usherb.ca](mailto:jean-pierre.dussault@dmi.usherb.ca)

1) **A Polynomial Interior-Exterior Algorithm for Linear & Quadratic Programming**, *Abdelhamid Benchakroun*, Univ. de Sherbrooke, Dept. de Math. et d'Info., Sherbrooke, Quebec, J1K 2R1, Canada, [benchakr@dmi.usherb.ca](mailto:benchakr@dmi.usherb.ca), *Khalid Elyassini*

We describe a polynomial interior-exterior algorithm for convex quadratic programming problems. The algorithm is based on path following ideas and uses the mixed interior-exterior penalty function. Each iteration updates a penalty parameter and finds an approximate solution of the Karush-Kuhn-Tucker system of equations which characterizes a solution of the mixed interior-exterior penalty function...

2) **Generalized SNQP Methods**, *Gningue Youssou*, Laurentian Univ., Dept. of Math. and Comp. Sci., Sudbury, Ontario, Canada, [youssou@ramsey.cs.laurentian.ca](mailto:youssou@ramsey.cs.laurentian.ca)

We propose a generalization of the SNQP method to nonsmooth optimization problems. The objective might be formulated as a sum of different composite nonsmooth functions. For some of this class, the SNQP cannot be applied. For others, such as the well known L1 problem, the sum can be transformed in a unique composite nonsmooth function and consequently, the SNQP method can be applied...

3) **Capacity & Flow Assignment Problem in Telecommunications Networks via Generalized Benders Decomposition**, *Abdelhamid Benchakroun*, Univ. de Sherbrooke, Dept. de Math. et d'Info., Sherbrooke, Quebec, J1K 2R1, Canada, [benchakr@dmi.usherb.ca](mailto:benchakr@dmi.usherb.ca), *F. Boyer*, *Philippe Mahey*

The CFA problem addresses the difficult problem to jointly optimize dimensioning and routing on a communication network. We propose a mixed integer nonlinear model which is well-adapted to the design of packet-switched networks with grade of service constraints. Each link in the original topology is modeled with multiple arcs associated with each capacity level to ensure the separability of the mixed formulation...

4) **Asymptotic Properties of Augmented Lagrangian Algorithms**, *Jean-Pierre Dussault*, Univ. de Sherbrooke, Dept. de Math. et d'Info., Sherbrooke, Quebec, J1K 2R1, Canada, [jean-pierre.dussault@dmi.usherb.ca](mailto:jean-pierre.dussault@dmi.usherb.ca)

Variants of the augmented Lagrangian algorithm are considered. The dual variables may be updated or not, and the penalty parameter may be kept as large as possible or may be driven to 0. We analyze the convergence rates of the various strategies and provide numerical illustrations of the results.

## MD08 Computational Mixed Integer Programming

Cluster: **Integer Programming**

Invited Session

Chair: Eva K. Lee, Columbia Univ., Sch. of Eng., Dept. of IE/OR, New York, NY 10027, [evakylee@icy.ieor.columbia.edu](mailto:evakylee@icy.ieor.columbia.edu)

1) **A Branch & Cut Solver for Treatment Plan Optimization for Radiation Therapy**, *Eva K. Lee*, Columbia Univ., Sch. of Eng., Dept. of IE/OR, New York, NY 10027, [evakylee@icy.ieor.columbia.edu](mailto:evakylee@icy.ieor.columbia.edu)

This problem concerns a particular type of radiation therapy which involves the placement of radioactive sources inside/near a tumor site. We present MIP models for this problem. Computational strategies involving cutting planes, heuristics and special branching will be described. Numerical results based on real patient data will be presented.

2) **A Branch & Cut Algorithm for Capacitated Network Design Problems**, *Oktay Gunluk*, Cornell Univ., Sch. of OR/IE, Ithaca, NY 14853-3801, [oktay@cs.cornell.edu](mailto:oktay@cs.cornell.edu)

We present a B&C algorithm to solve a MIP formulation of the capacity expansion problem. We present new strong inequalities for the problem and propose a new branching rule. We also report on our computational experience with a parallel implementation of the algorithm.

3) **Decomposing Matrices by Cutting Planes**, *Alexander Martin*, Konrad-Zuse-Zentrum Berlin, Heilbronner Str 10, Berlin, D-10711, Germany, [martin@zib.de](mailto:martin@zib.de)

Given a 0-1 matrix  $A$  and a number of block  $B$  of size  $K$ , assign as many rows as possible to the blocks such that there is no column that has a non-0 entry in 2 rows that are assigned to different blocks. We develop a B&C algorithm and report on our computational experiences.

4) **Computational Results with Cutting Planes on Mixed 0-1 Convex Nonlinear Programs**, *Robert A. Stubbs*, Northwestern Univ., Apt. 102, Naperville, IL 60563-0105, *Sanjay Mehrotra*

Over the past decade, great strides have been made in solving large-scale mixed 0-1 LPs, largely due to advances in cutting plane techniques. However, little progress has been made in solving mixed 0-1 NLPs. We describe a procedure for generating "lift & project" cuts for convex MINLPs.

## MD09 Production Scheduling & Capacity Reservation Systems

Cluster: **Scheduling**

Invited Session

Chair: Michael Pinedo, NYU, Stern Sch. of Business, New York, NY 10012, [mpinedo@rd.stern.nyu.edu](mailto:mpinedo@rd.stern.nyu.edu)

1) **Optimization Methods for the Flexible Flow Shop Total**

**Weighted Tardiness Problem, Michael Pinedo**, NYU, Stern Sch. of Business, New York, NY 10012, mpinedo@rd.stern.nyu.edu, *Ya Yang*

We present 2 algorithms to minimize the total weighted tardiness in flexible flow shop. One is a B&B method and the other is a stage-based decomposition heuristic.

**2) A Production Capacity Reservation & Scheduling Problem, Vipul Agrawal**, NYU, Stern Sch. of Bus., 40 W 4th St., New York, NY 10012, vagrawal@stern.nyu.edu, *Michael Pinedo, Sridhar Seshadri*

We study the problem of reserving capacity in a manufacturing facility over a fixed time horizon. The available capacity is represented by a number of time slots within the horizon. Customers make bids for these slots. Customers may have different values for the capacity for different time slots and their value assessment may also change over time...

**3) Asymptotically Optimal Scheduling Control of a Dual Resource Constrained Manufacturing System, Cathy Xia**, Stanford Univ., Dept. of OR, Terman 473, Stanford, CA 94305, xia@leland.stanford.edu, *J. George Shanthikumar*

We consider a multi-center manufacturing system that produces multiple product types. The number of machines in each of the machine centers and the number of operators available for the system are limited. We are interested in developing a scheduling and operator allocation policy that will minimize the inventory carrying cost...

**MD12 Performance of Communications Systems**

Sponsor: INFORMS CSTS

Sponsored Session

Chair: Sidney L. Hantler, IBM, TJ Watson Res. Ctr., PO Box 704, Yorktown Heights, NY 10598, hantler@watson.ibm.com

**1) Policing & Traffic Shaping at the UNI: A Sticky Buffer in Tandem with a Spacer, Alan Konheim**, Univ. of CA, Santa Barbara, CA 93106, konheim@cs.ucsb.edu

An ATM connection is a contract between the user and network. A user provides traffic descriptors and quality of service parameters in a connection-request. The network evaluates its residual resources, making a connection if they are sufficient to provide the requested grade of service. A flow control scheme regulates the actual rate at which ATM-cells are delivered to the network...

**2) Binary Logarithmic Access Method: What Does it take to Fix Ethernet?, Mart L. Molle**, Univ. of California, Riverside, CA, mart@cs.ucr.edu

The BLAM is an enhanced version of CSMA/CD that interoperates with existing Ethernet nodes, while providing substantial performance improvements under moderate to high load conditions. We describe its performance benefits and explain what has been done to add it to the IEEE 802.3 standard.

**3) Webstones: How Will the World Evaluate WWW Servers?, Michael K. Molloy**, Hewlett-Packard Labs., Ft. Collins, CO 80525, molloy@hpfcdm.fc.hp.com

Just as SPEC adopted the LADDIS benchmark as SFS 1.0 to rank various network file system servers, a new benchmark for ranking various WWW servers will be released in 1997. We provide a brief overview of Web services and describe the specifics of the benchmark and how it creates its synthetic load. Several issues about the synthetic nature of the benchmark will be discussed.

**4) Matrix Geometric Algorithmic Solutions for M/G/1 Type Markov Chains, Nail Akar**, Univ. of MO, Comp. Sci. Telecommunications, Kansas City, MO 64110, akar@cstp.umkc.edu, *Khosrow Sohraby*

We propose new algorithms for studying the stationary behavior of M/G/1 type Markov chains with rational probability generating matrices. Many models arising in analysis of telecommunication networks fall into this class. We show that the solution of the Markov chain has a modified matrix geometric form.

**5) A Model of Multilink Transmission Groups with Priority in Communication Networks, Sidney L. Hantler**, IBM, TJ Watson Res. Ctr., PO Box 704, Yorktown Heights, NY 10598, hantler@watson.ibm.com, *B. A. Taylor, H. R. Gail*

We model a multilink communication channel with priority structure as a Markov chain whose 1-step transitions depend only on the server states and difference in queue lengths, such that only the number of customers of the highest class in the queue can decrease in a single step. We present a technique for computing the equilibrium probabilities and waiting times for customers.

**MD13 Intelligent Systems for Spacecraft Operations II**

Sponsor: INFORMS CSTS

Sponsored Session

Chair: Barin N. Nag, Towson State Univ., Dept. of Mgmt., Towson, MD 21204, nag-b@toe.towson.edu

**1) Automated Resource Allocation & Scheduling for a Network of Deep Space Communications Antennae, Steve Chien**, Jet Propulsion Lab., MS 525-3660, 4800 Oak Grove Dr., Pasadena, CA 91109-8099, steve.chien@jpl.nasa.gov, *Raymond Lam*

The demand-based automated scheduling system, DANS, is an automated scheduling system developed at the Jet Propulsion Laboratory to schedule deep space network antennae resources. DANS uses priority driven, best-first, constraint-based local search and iterative optimization techniques to perform priority-based scheduling of antennae and subsystem resources to fulfill spacecraft communication requests.

**2) The Failure Detection & Correction System for the LANDSAT-7, Steven S. Scott**, NASA Goddard Sp Flight Ctr., Code 430, Greenbelt, MD 20771, ssscott@sssindy1.gsfc.nasa.gov, *Jeffrey Rapp, Peter Spidalieri, James Andary, Arthur Obenschain*

To meet LANDSAT-7's 72-hour autonomous operations requirement for maintaining satellite health and safety without an independent hardware controller, a systematic approach has been developed to identify and secure the integrity of all critical satellite health and safety functions. A layered response hierarchy to safing the satellite is described.

**3) A Natural Language Processing Agent Based on Pattern Matching, Paul Chi**, Bowie State Univ., Dept. of Comp. Sci., Bowie, MD 20715, pchi@cs.bowiestate.edu, *Leena P. Nathan, Nagi Wakim, Sadanand Srivastava, Ping Chung*

We describe an intelligent interface software called user system interface agent, USIA. A natural language processing agent based on pattern matching has been developed as part of the USIA system. USIA consists of a group of cooperating agents which are responsible for assisting users in generating spacecraft reports.

**4) Automation of Scheduling Orbit Determination Programs, David Weidow**, NASA Goddard Sp Flight Ctr., Flight Dynamics Div., Software Eng. Branch Code 5522, Greenbelt, MD 20771, dweidow@pop500.gsfc.nasa.gov, *Paul Chi, Manjit Bhatia, Barin N. Nag*

At present, outputs of the orbit determination programs are manually reviewed and checked by flight dynamics personnel. We present a plan to automate this process. Specifically, we outline the design of a rule-based expert system written in CLIPS. The main idea is to capture the expertise of human operators into the rules of the knowledge base. The preliminary results of a prototype system will be presented.

**MD14 Management of Supply Chains**

Sponsor: INFORMS Section on Logistics

Sponsored Session

Chair: Shitao Yang, Univ. of NC, Kenan-Flagler Bus. Sch., Chapel Hill, NC 27599-3490, uyst@email.unc.edu

**1) Integrating Operations Management with Cost Accounting, Tianbing Qian**, Univ. of IA, Dept. of MS, Iowa City, IA 52246, tqian@dollar.biz.uiowa.edu, *Philip C. Jones, Ramji Balakrishnan*

Traditionally, OM and CA are 2 distinct communities with little communication. The reality is that OM needs cost estimates from CA and CA's output depends on the operational policy determined by OM. We study the behavior of such interaction and a number of analytical results and managerial observations are presented.

**2) A Multi-Agent Framework for Supply Chain Management, Dan Zhu**, Univ. of IA, Dept. of MS, Coll. of Bus. Admin., Iowa City, IA 52242, dan-zhu@uiowa.edu

Agents communications and coordinations play important roles in supply chain management. We review the literature and discuss relevant issues, then propose our design framework and present some preliminary results.

**3) A New Cluster of Multi-Echelon Inventory Control Systems, Shitao Yang**, Univ. of NC, Kenan-Flagler Bus. Sch., Chapel Hill, NC 27599-3490, uyst@email.unc.edu

We design a new cluster of multi-echelon inventory control systems that are highly sensitive to the projected customer demand, such as DRP, while as robust as echelon-based ROP systems to the bullwhip effect. Empirical evidence as well as analytical results are provided to demonstrate their simplicity and superior performances.

**MD15 Multicommodity Flows**

Cluster: Network Flows

Invited Session

Chair: Mauricio G. C. Resende, AT&T Labs., 600-700 Mountain Ave., 2D-152, PO Box 636, Murray Hill, NJ 07974-0636, mgcr@research.att.com

1) **Theoretical & Practical Aspects of Computing Multicommodity Network Flows**, *M. D. Grigoriadis*, Rutgers Univ., Dept. of Comp. Sci., New Brunswick, NJ 08903, grigoria@cs.rutgers.edu

Recently developed fast approximation schemes and related complexity results for block-structured optimization, multicommodity network flows and certain communication network routing problems are reviewed. These methods are compared to other structured optimization approaches which can also be practical in solving such large-scale problems.

2) **Simplex & Interior Point Specialized Algorithms for Solving Non-Oriented Multicommodity Flow Problems**, *A. Lissier*, CNET ISSY, Issy les Mx, F-92131, France, abdel.lissier@issy.cnet.fr, *P. Chardaire*

Multicommodity network flows arise in a variety of contexts typical among which is the dimensioning telecommunication networks. We present various approaches based on specialization of the simplex algorithm and interior point methods to solve non-oriented multicommodity flow problems. Algorithms are tested with data from the France Telecom Paris district transmission network...

3) **An Efficient Implementation of an Interior Point Method for Multicommodity Network Flows**, *L. F. Portugal*, Univ. of Coimbra, Coimbra, Portugal, luispt@dragao.it.uc.pt, *Mauricio G. C. Resende*, *G. Veiga*

We present an efficient implementation of the truncated primal-infeasible dual-feasible interior point algorithm for LP to solve large instances of multicommodity network flow problems. The implementation uses a preconditioned conjugate gradient algorithm to determine an approximate search direction. We describe the preconditioners and show how the code performs on large test problems.

**MD16 Distinguished Speaker: New Frontiers in Entrepreneurship Research**

Sponsor: INFORMS Section on Technology Management

Sponsored Session

Chair: Jeffrey Liker, Univ. of MI, Dept. of IOE, Ann Arbor, MI 48109-2117, liker@umich.edu

1) **A 15-Year Program of "Cutting Edge" Entrepreneurship Research**, *Charles W. Hofer*, Univ. of GA, Dept. of Mgmt., Terry Coll. of Bus., Athens, GA 30602-6256

Dr. Hofer and 2 former students will describe a research program on entrepreneurship which has produced 14 Ph.D. dissertations. The 7 dissertations Dr. Hofer has personally supervised have won 7 dissertation awards, including 2 from INFORMS. This presentation will focus on how to create and maintain quality, innovation and relevance over an extended period of time.

2) **The Influence of Strategy & Industry Structure on New Venture Success**, *Scott W. Kunkel*, Univ. of San Diego, Sch. of Bus., 5998 Alcalá Park, San Diego, CA 92110

We examine the determinants of new venture success using a database of more than 150 initial public offering statements. We seek to explain why some new ventures failed and others succeeded.

3) **Assessing Entrepreneurial Competence: A Study of Venture Capitalists' Decision Making**, *Carolyn J. Fausnaugh*, FL Inst. of Tech., Sch. of Bus., 150 W University Blvd., Melbourne, FL 32901

What do venture capitalists look for in entrepreneurs and their ventures? How do they decide who to fund and who not to fund? This research combines qualitative and quantitative analysis of in-depth (2-4 hour) interviews with several venture capitalists. It greatly enriches our understanding of the venture capitalists' decision-making processes...

**MD17 Information Systems IV**

Contributed Session

Chair: Donald Ballou, Univ. of Albany, Dept. of MSIS, BA 310, Albany, NY 12222, dpb67@cnsibm.albany.edu

1) **Establishing Priorities for Data Quality Enhancement in Data Poor Environments**, *Donald Ballou*, Univ. of Albany, Dept. of MSIS, BA 310, Albany, NY 12222, dpb67@cnsibm.albany.edu, *Giri Kumar Tayi*

Information systems are analyzed to identify strategies for improving overall quality of multiple, specified outputs. A potentially very large number of raw data items are pruned so as to form a network suitable for analysis. The work is in the context of environments characterized by insufficient availability of data.

2) **A Self-Adaptive World Wide Web Proxy Caching Strategy Based on Dynamic Access Patterns**, *Edward F. Watson*, LA State Univ., 3190 CEBA Bldg., Baton Rouge, LA 70803, ewatson@unix1.sncc.lsu.edu, *Ye-Sho Chen*, *Ying Shi*

We develop a cache management strategy based on sound theory and principles from the information sciences that can be utilized on-line, in real-time. Our approach is to study current cache algorithms and utilize empirical data to develop efficient and effective self-adaptive cache management strategies to handle anticipated Web growth.

3) **A Comparative Analysis of OR/MS Models and IS Implementation**, *Dolphy M. Abraham*, Loyola Marymount Univ., 7900 Loyola Blvd., H-213, Los Angeles, CA 90045-8385, dabraham@lmumail.lmu.edu, *Linda Leon*

OR/MS models historically have had limited success with implementation but they are changing to better suit end-user needs. IS has gone through a similar transition. With changes in the management of technology, the acceptance and use of IS has improved. Research on IS implementation provides useful lessons for OR/MS developers.

**MD18 TUTORIAL: Operations Strategy in Service Management**

Invited Session

Chair: Uday S. Karmarkar, UCLA, Anderson Sch. of Mgmt., 110 Westwood Plaza, Los Angeles, CA 90095-1481, uday.karmarkar@anderson.ucla.edu

1) **TUTORIAL: Operations Strategy in Service Management**, *Uday S. Karmarkar*, UCLA, Anderson Sch. of Mgmt., 110 Westwood Plaza, Los Angeles, CA 90095-1481, uday.karmarkar@anderson.ucla.edu

Just as with service operations, the special characteristics of services require novel approaches to the analysis of service competition. The absence of a tangible product means that traditional quantity-based models of demand and supply, or of value and cost do not apply very well. Furthermore, the lack of a portable product naturally affects the structure of service chains...

**MD19 Optimization I**

Contributed Session

Chair: Giacomo Patrizi, Univ. "La Sapienza", Dept. of Stats., Piazza Aldo Moro 5, Rome, 00185, Italy, patrizi@cam07a.sta.uniroma1.it

1) **Linear Complementarity Formulations of Combinatorial Problems**, *Giacomo Patrizi*, Univ. "La Sapienza", Dept. of Stats., Piazza Aldo Moro 5, Rome, 00185, Italy, patrizi@cam07a.sta.uniroma1.it

Common combinatorial problems are solved as linear complementarity problems and computational results are given for standard benchmark problems. It will be shown that this method in continuous space more than holds its own among the more usual procedures.

2) **Knapsack Loading with Stability & Accessibility Constraints**, *Ronald P. Pelot*, Tech. Univ. of Nova Scotia, Dept. of IE, PO Box 1000, Halifax, Nova Scotia, B3J 2X4, Canada, pelotrp@tuns.ca, *Janos D. Pinter*

As part of a biomechanical model of personal load carriage, an optimal kit placement program has been developed. Given a set of non-uniform objects with known mass, volume and accessibility requirements, pack them in the rucksack so that a desirable center of mass and tight packaging is achieved.

3) **Lagrangian Relaxation for Flow Shop Scheduling**, *George G. Polak*, Wright State Univ., Dept. of MSIS, Rike 271, Dayton, OH 45435, gpolak@desire.wright.edu

Lagrangian relaxation decomposes flow shop scheduling into unlinked 1-machine sequencing problems without due dates. These subproblems are amenable to the greedy algorithm and moreover, do not have the integrality property. Thus, the Lagrangian lower bound can be stronger than the LP bound.

**MD20 PANEL: Dynamic Traffic Assignment III - Development of Real-Time Systems, Software Issues & Guidance Schemes**

**Sponsor:** INFORMS Transportation Science Section  
**Sponsored Session**

**Chair:** Shaw-Pin Miaou, Oak Ridge Ntl. Lab., Oak Ridge, TN 37831

**1) PANEL: Development of Real-Time DTA Systems Under the FHWA Initiative - Software Issues & Guidance Schemes, Henry Lieu, FHWA, Shaw-Pin Miaou, Oak Ridge Ntl. Lab.**

ITSs are currently being developed and deployed to exploit computer and electronic communication technologies to improve the efficiency, productivity and safety of existing transportation facilities. The success of important ITS subsystems such as ATIS and ATMS depend on the availability and dissemination of timely and accurate estimates of prevailing and emerging traffic conditions...

**2) PANEL: Dynamic Traffic Assignment III, Henry Lieu, FHWA, Ajay K. Rathi, Oak Ridge Ntl. Lab., Shaw-Pin Miaou, Oak Ridge Ntl. Lab., Mike Summers, Oak Ridge Ntl. Lab., Rabi Mishalani, MIT, Moshe E. Ben-Akiva, MIT, Haris Koutsopoulos, Carnegie Mellon Univ., Hani S. Mahmassani, Univ. of TX, Yaser Hawas, Univ. of TX**

No abstract supplied.

**MD21 Aviation Modeling & Simulation**

**Cluster:** Aviation Applications  
**Invited Session**

**Chair:** Michael White, MITRE Corp., 1820 Dolly Madison Blvd., MS W-281, McLean, VA 22102-3481, mwhite@mitre.org.com

**1) Fast-Time NAS Analysis with the Detailed Policy Assessment Tool, Fred Wieland, MITRE Corp., 1820 Dolly Madison Blvd., MS W-281, McLean, VA 22102-3481**

Fast-time simulations of the NAS are useful for policy analysis and as decision support tools. We shall present a fast-time parallel simulation of queueing delays in the NAS, and discuss its uses both as an analytical device and as a real-time decision tool.

**2) Macro Modeling of the National Airspace System, Michael White, MITRE Corp., 1820 Dolly Madison Blvd., MS W-281, McLean, VA 22102-3481, mwhite@mitre.org.com**

We describe a prototype macro model of the NAS and features included to mitigate the approximations inherent in macro modeling. The prototype is compared to a conventional detailed model and conclusions are drawn concerning the merits of macro modeling as applied to analyses of the NAS.

**3) The SIMMOD Model, Alan Miller, CACI, 1100 N Glebe Rd., Arlington, VA 22201**

SIMMOD, developed for the FAA using CACI's SIMSCRIPT II.5 simulation programming language, is a comprehensive planning tool for airport designers and managers, air traffic planners and airline operations analysts. This software system aids in the study and evaluation of enroute air traffic, terminal area air traffic and airport and airline ground operations...

**4) The RAMS Model, Brian Wood, CACI, 1100 N Glebe Rd., Arlington, VA 22201**

To increase simulation capacity, quality and flexibility, the Eurocontrol Experimental Centre has developed a new state-of-the-art model known as RAMS. CACI's MODSIM II object-oriented simulation language was selected as the standard for the RAMS development. RAMS enables planners to assess controller workload and traffic behavior using very accurate flight-profile calculations...

**MD22 Manufacturing I**  
**Contributed Session**

**Chair:** Chaiho Kim, Santa Clara Univ., Leavey Sch. of Bus., Santa Clara, CA 95053, ckim@scu.edu

**1) Materials Requirement Planning for Semiconductor Manufacturing, Chaiho Kim, Santa Clara Univ., Leavey Sch. of Bus., Santa Clara, CA 95053, ckim@scu.edu, Mikes Sisos**

We will examine some of the problems in developing computerized materials requirement planning systems for semiconductor manufacturing. We will also show a prototype system we developed with spreadsheets using Visual Basic for applications and one that we developed with relational databases using Visual Basic.

**2) Optimal Buffer Allocations in Cyclic Mixed-Model Assembly Lines, Leonora Fuxman, St. John's Univ., Mgmt. Dept., 800 Utopia Pkway, Jamaica, NY 11439, ydlfngt@sjmusic.stjohns.edu**

We provide new insights into properties of optimal buffer allocations in cyclic asynchronous mixed-model assembly lines with deterministic processing times. Buffer allocations that guarantee the maximum throughput rate on the assembly line with minimum number of buffers are characterized and an efficient algorithm is developed to find such configurations.

**3) Simulation Optimization for the (s,S) Inventory Policy, Talal Alkhamis, Kuwait Univ., Dept. of Stats. & OR, PO Box 5969, Safat, 13060, Kuwait, Mohammed Al Wakeel**

We present an optimization algorithm using simulation for the (s,S) inventory policy. Computational results and comparison studies with other algorithms will be presented.

**4) Effect of External & Internal Learning Rate Differences on Manufacturing Improvement (R), Bowon Kim, KAIST, 207-43 Cheongryangri Dongdaemo, Seoul, 130-012, South Korea, bwkim@cais.kaist.ac.kr**

For effective operations, manufacturing firms face dynamic decision making, e.g., how much external technology in different development stages to bring into the internal production system. Employing an optimal control model incorporating learning rate differences in external and internal technological innovation, we derive analytical answers and economic implications.

**MD23 Production Scheduling Models**

**Cluster:** Manufacturing & Service Management  
**Invited Session**

**Chair:** Chung-Lun Li, Washington Univ., Olin Sch. of Bus., 1 Brookings Dr., St. Louis, MO 63130, lichung@olin.wustl.edu

**1) Machine Scheduling in Liquid Crystal Display Manufacturing, Chung-Yee Lee, TX A&M Univ., Dept. of IE, College Station, TX 77845, cylee@acs.tamu.edu, Shu-Ming Ng, Tin Ming Chung**

We discuss the job scheduling problem of the polyimide process in liquid crystal display manufacturing. The setup time between jobs depends on job families and space diameter and could vary dramatically for different sequencing of jobs. Our purpose is to sequence jobs to minimize the total completion time.

**2) Analysis of Algorithms for Master-Slave Systems, George Vairaktarakis, Marquette Univ., Coll. of Bus. Admin., Milwaukee, WI 53201-1881, vairaktaraki@vms.csd.mu.edu**

Master-slave systems find applications in many industrial settings. Each job consists of a preprocessing, a slave and a postprocessing task that must be processed in this order. We study 3 different order specifications for the tasks. The objective is to minimize makespan. Error analysis and computational experiments accompany our results.

**3) An Efficient Heuristic for the Single Machine Early/Tardy Scheduling Problem, Arie Harel, Univ. of Toronto, Fac. of Mgmt., 105 St. George St., Toronto, Ontario, M5S 3E6, Canada, Hilary Cheng**

Sequencing jobs with different due dates and heterogeneous earliness and tardiness costs is computationally prohibitive for large numbers of jobs. We present a new heuristic method for such problems that takes an amount of time that depends only linearly in the number of jobs.

**4) Hybrid Flowshops with Multipurpose Machines, Panos Kouvelis, Washington Univ., Olin Sch. of Bus., One Bookings Dr., St. Louis, MO 63130-4899, kouvelis@wuolin.wustl.edu, George Vairaktarakis**

We address scheduling problems for a 2-stage HFS with significant processing flexibility across stages. We present a pseudopolynomial dynamic programming algorithm to generate a schedule that minimizes makespan for the single machine per stage case. We discuss heuristics for the HFS with several machines at each stage.

**MD24 Decision Analysis Research: What Industry Needs from Academia & Vice Versa**

**Sponsor:** INFORMS Decision Analysis Society  
**Sponsored Session**

**Chair:** David G. Lowell, Strategic Decisions Group, 2440 Sand Hill Rd., Menlo Park, CA 94025-6900, dlowell@sdgnet.com

**1) Educational Needs for Decision Consultants, Carl S. Spetzler,**

Strategic Decisions Group, 2440 Sand Hill Rd., Menlo Park, CA 94025-6900, cspetzler@sdgnet.com

Decision consultants require both technical and "people" capabilities: technical competencies to treat problems that are difficult because of uncertainty, dynamics, interrelated factors, complex value structures and a myriad of alternatives; and people competencies to resolve conflicts, operate in high-performance teams and deal with organizational complexities...

**2) Creating Adaptive Decision Architectures for Knowledge-Intensive Enterprises, Vin Moley**, Strategic Decisions Group, 2440 Sand Hill Rd., Menlo Park, CA 94025, vmoley@sdgnet.com

The information appliance industry exists in a rapidly changing world. Companies must adapt quickly to unexpected opportunities and threats. Decision science can add significant value by providing norms for collaborative decision making and rigorous decision architecture. This presentation addresses the technical and psychosocial aspects of adaptive decision making.

**3) Decision Analysis Research Needs Coming from Real Applications, Peter A. Morris**, Applied Decision Analysis Inc., 2710 Sandhill Rd., Menlo Park, CA 94025-7020, pmorris@adainc.com

This presentation will compare analytical needs of modern DA projects with the set of methodologies currently in place and suggest a set of high-potential research topics that would fill the gaps.

**4) Decision Analysis: What Academia Needs from Industry, Robert L. Winkler**, Duke Univ., Fuqua Sch. of Bus., Durham, NC 27708-0120, rwinkler@mail.duke.edu

Closer ties with DA consulting firms and groups in specific companies could benefit both teaching and research in academia and in turn should provide some value for industry as well. Some suggestions will be given along these lines with the hope of simulating further ideas.

#### MD25 PANEL: Using Projects to Teach Modeling

Sponsor: INFORMS Forum on Education

Sponsored Session

Chair: Ellen S. Jordan, Tiffin Univ., 155 Miami St., Tiffin, OH 44883, ejordan@ccgate.tiffin.edu

**1) PANEL: Using Projects to Teach Modeling, Olivia M. Carducci**, Lafayette Coll., **Ellen S. Jordan**, Tiffin Univ., **B. Curtis Eaves**, Stanford Univ., **Arthur T. Benjamin**, Mudd Coll., **Thomas R. Willemain**, RPI

Panelists will briefly summarize their experience in the benefits and problems of project-based instructions. The majority of the session will rely on audience questions.

#### MD26 Optimal Design & Control of Queues

Sponsor: INFORMS Applied Probability Section

Sponsored Session

Chair: Shaler Stidham, Jr., Univ. of NC, Dept. of OR, CB 3180, Smith Bldg., Chapel Hill, NC 27599-3180, sandy@or.unc.edu

**1) Switch Scheduling to Achieve Maximal Throughput, Rhonda L. Righter**, Santa Clara Univ., Dept. of Dec. & Info. Sci., Santa Clara, CA 95053, rrighter@scuacc.scu.edu, **Eitan Altman**, **Zhen Liu**

Achieving high throughput in input-queued switches has been found to be difficult, especially when traffic is nonuniform. For general stationary ergodic nonuniform arrival processes, we show that 100% throughput can be achieved using a new algorithm that is easy to implement and simpler than previously proposed algorithms.

**2) Inventory Control When Demand is Varying & Dependent on an External Process, Srinivas Rajagopal**, Univ. of PA, Dept. of Systems Eng., SEAS, Philadelphia, PA 19104-6315, srini@systems.seas.upenn.edu

We examine the issue of optimal inventory control when the per-period demand is driven by an environment process not under our control. Examples of such models abound in practice. We show that the structure of the optimal policy can be characterized for very general models using SMDP.

**3) Successive Overrelaxation Flow-Control Algorithms for Multiclass Networks, Christopher M. Rump**, SUNY, Dept. of IE, Buffalo, NY 14260-2050, crump@acsu.buffalo.edu

We study the convergence of relaxed equilibrium-seeking algorithms employed by multiclass users of a shared link in a telecommunication network. In this setting, we compare the asymptotic behavior of the red-black algorithm to earlier results obtained for sequential (Gauss-Seidel) and asynchronous (Jacobi) implementations.

**4) Some Issues in Input Pricing for Queues with Applications to Telecommunications, Shaler Stidham, Jr.**, Univ. of NC, Dept. of OR, CB 3180, Smith Bldg., Chapel Hill, NC 27599-3180, sandy@or.unc.edu

We consider the stability of the equilibrium input prices and arrival rates to a queue under an iterative algorithm corresponding to periodic adaptive customer response to congestion, assuming that entering customers make payments that determine their priority in the queue. Applications to pricing in communication networks are given.

#### MD27 Simulation Success Stories

Sponsor: INFORMS College on Simulation

Sponsored Session

Chair: David Goldsman, GA Inst. of Tech., Sch. of ISyE, Atlanta, GA 30332, sman@isyte.gatech.edu

Co-Chair: Keebom Kang

**1) Communicating Complex Ideas, Doug Shannon**, TRW, One Sp Park, R9/1831, Redondo Beach, CA 90278, doug\_shannon@qmail4.nba.trw.com

The commercial, graphic simulator Extend models distributed data processing, data communication, satellite orbits and manpower planning. This simulation uses audio, animation and hierarchical graphics to model a complex architecture and communicate understanding. The manpower simulation models the space environment which drives it. The entire program is visible from the main page...

**2) Beneficial Outcomes from Actual Simulation Studies, Beth Kulick Carpenter**, Automation Assoc. Inc., System Design Analysis, 512 Via de la Valle, Ste. 209, Solana Beach, CA 92075, bkulick@aaisim.cts.com

Simulation studies are often performed to assist with a critical question or decision that must be made within an organization. Three case studies are presented that illustrate uses of simulation: capital investment verification, operations troubleshooting and management planning.

**3) Finding the Optimal Stocking Level for Video New Releases, Arthur J. Swersey**, Yale Sch. of Mgmt., 135 Prospect St., New Haven, CT 06511-3729, **Albert Y. Ha**

A video store must decide how many total copies of new releases to maintain in inventory. We view the problem as a queuing system and use simulation to find the optimal stocking level. Our solution is insensitive to key model assumptions and leads to several important insights.

#### MD28 Health Applications I

Contributed Session

Chair: Eric Wolstenholme, Leeds Metropolitan Univ. Bus. Sch., Bronte Hall, Beckett Park Campus, Leeds, LS6 3QS, UK, eric@cognitus.co.uk

**1) The Development of System Dynamics Simulation as a Pharmacoeconomic Tool, Eric Wolstenholme**, Leeds Metropolitan Univ. Bus. Sch., Bronte Hall, Beckett Park Campus, Leeds, LS6 3QS, UK, eric@cognitus.co.uk, **Karie Clifford**

We describe the application of system dynamics simulation to the pharmacoeconomic evaluation of new anaesthetics within hospital environments. Such new products bring enhanced clinical safety and the model provides a flight simulator to test the financial effects of translating this confidence into changes in hospital clinical and management practices.

**2) Product Innovation & Diversification in the Pharmaceutical Industry, Laura B. Cardinal**, Duke Univ., Fuqua Sch. of Bus., Box 90120, Durham, NC 27706, cardinal@mail.duke.edu, **Donald E. Hatfield**

Agency problems appear to negate potential benefits of technology transfer in a diversified setting. The pharmaceutical industry offers the opportunity to take a closer look. Firms range from a pure pharmaceutical firm to a healthcare concern with a pharmaceutical division to a fully diversified firm with a pharmaceutical division. We look at innovative outputs of pharmaceutical firms across these settings.

**3) Managing Change in the Health Care Services Sector Beyond the Year 2000, L.L. Jayaraman**, Montclair State Univ., PA 433, Upper Montclair, NJ 07043, jayaraman@saturn.montclair.edu

Health care services in the US are undergoing philosophical, technological, strategic and operations transformations. A framework is developed and presented for evaluating these transformations and responding to them from a management perspective.

**MD29 Policy Issues in Manufacturing****Cluster: Inventory Management****Invited Session****Chair:** Rachel Q. Zhang, Univ. of MI, Dept. of IOE, Ann Arbor, MI 48109-2117, rzhang@engin.umich.edu

1) **Bite I of the Whole Enchilada**, *Matthew J. Sobel*, SUNY, Harriman Sch. Mgmt. & Policy, Stony Brook, NY 11794-3775, msobel@fac.har.sunysb.edu

We present a dynamic model which integrates a firm's decisions in manufacturing, distribution, marketing and finance. The objective is to maximize the expected present value of the time stream of dividends. In important cases, the appropriate interactions among different kinds of decisions, i.e., operations, marketing and finance, can be made explicit.

2) **Managing Manufacturing System Assets & Subcontracting Policies**, *James R. Bradley*, Cornell Univ., 552 Malott Hall, Johnson Grad. Sch. of Mgmt., Ithaca, NY 14853-4201, jrb28@cornell.edu, *Peter W. Glynn, J. Michael Harrison, Hau L. Lee*

This research analyzes the interaction between capacity, inventory and subcontracting policies. The effect of a firm's strategy on the optimal inventory and subcontracting policies, the firm's performance and managers' decision making rationale is demonstrated.

3) **Assembly Systems with Constant Processing Times & Stochastic Demands**, *Weiming Zhang*, Columbia Univ., New York, NY 10027, *Paul H. Zipkin*

We consider an assembly system with constant processing times and stochastic demands. We develop a superior variant of the classic base-stock policy by exploiting bottlenecks. Also, we show that certain stages hold very little stock. Finally, we show how to evaluate such policies, assuming Poisson demand.

4) **Optimal Lead Time Policies**, *Rachel Q. Zhang*, Univ. of MI, Dept. of IOE, Ann Arbor, MI 48109-2117, rzhang@engin.umich.edu, *Mark L. Spearman*

We examine 2 due-date setting problems first studied by Wein: Problem I - minimizing the average due-date lead time subject to a constraint on the fraction of tardy jobs and Problem II - average job tardiness. We show that Problem I leads to unethical practice and Problem II is equivalent to a widely used policy.

**MD30 The Impact of Information Technology on the Education & Practice of Military OR I****Sponsor: INFORMS Military Applications Society**  
**Sponsored Session****Chair:** James E. Armstrong, Jr., US Military Acad., Dept. of Systems Eng., Mahan Hall, Rm. 419, West Point, NY 10996-1779, fj8305@exmail.usma.edu**Co-Chair:** James F. Sullivan

1) **Emerging Information Age Trends in Operations Research Education & Practice**, *James F. Sullivan*, US Military Acad., Dept. of Systems Eng., Mahan Hall, Rm. 419, West Point, NY 10996-1779, fj8305@exmail.usma.edu, *James E. Armstrong, Jr.*

The rapid and accelerating pace of advances in IT is changing the way our society lives and works. The education and practice of OR is being changed now by these same forces and even more change is likely into the first quarter of the 21st century. Key questions to ask is what are the needs of the educators and practitioners of OR in the next century likely to be? And what will IT be able to deliver to meet those needs?...

2) **Developing Lifelong Learning Skills in a Technological Classroom**, *James F. Sullivan*, US Military Acad., Dept. of Systems Eng., Mahan Hall, Rm. 419, West Point, NY 10996-1779, fj8305@exmail.usma.edu, *Jeff Joles*

Within the next decade, the undergraduate educational experience will be transformed as students bring inexpensive personal digital assistants and portable PCs into classrooms connected to the Internet. Rather than passively receiving a lecture, students will ask questions about information obtained outside of class and work in small teams on exercises or projects during class...

**MD31 JOP&E Modeling & Documentation****Sponsor: INFORMS Military Applications Society**  
**Sponsored Session****Chair:** Thomas R. Gullledge, George Mason Univ., Inst. of Public Policy, Fairfax, VA 22030-4444, gullledge@gmu.edu

1) **JOP&E**, *Thomas R. Gullledge*, George Mason Univ., Inst. of Public Policy, Fairfax, VA 22030-4444, gullledge@gmu.edu

We provide an introduction to the concepts of enterprise integration, cross-functional process integration and the alignment of information systems to support organizational processes. The presentation also includes a brief introduction to the JOP&E process and lays the foundation for the JOP&E model presented in this session.

2) **Integrated Enterprise Modeling**, *Murat Tarimcilar*, George Mason Univ., Inst. of Public Policy, 10640 Page Ave., Ste. 400, Fairfax, VA 22030-4444, tarim@erols.com

This presentation provides an introduction to the architecture of integrated systems, ARIS, methodology. It includes a presentation of the organizational, functional, data and control views. The presentation describes the modeling methodology used to document the JOP&E process.

3) **Integrated JOP&E Modeling**, *Rainer Sommer*, George Mason Univ., Inst. of Public Policy, 10640 Page Ave., Ste. 400, Fairfax, VA 22030-4444, rsommer@gmu.edu

This presentation describes the JOP&E process and the JOP&E model. It gives a description of the JOP&E reengineering that was completed for the Joint Staff.

**MD32 Wireless Communication****Sponsor: INFORMS Technical Section on Telecommunications**  
**Sponsored Session****Chair:** Suresh Sridhar, Naval Postgrad. Sch., Code SM-SR, Dept. Syst. Mgmt., 555 Dyer Rd., Bldg. 330, Monterey, CA 93943, sridhar@nps.navy.mil

1) **Capacity of Multifunctional Wireless Telecommunication Switches**, *Amit Mukhopadhyay*, Ericsson, Inc., 7760 McCallum Blvd., # 19201, Dallas, TX 75252, exuamit@exu.ericsson.se

With the advent of wireless technology, the number of different types of switches, i.e., MSCs, HLRs, etc., has grown dramatically and there is a trend in the industry to combine some logical nodes into one entity. We address the issues of expressing capacity of such switches on an operating hyperplane.

2) **Paging & Tandem Queues with Reneging**, *Christopher Rose*, Rutgers Univ., Elec. & Comp. Eng., WINLAB, PO Box 909, Piscataway, NJ 08855-0909, crose@ece.rutgers.edu, *C. Saraydar*

Call setup requests can be blocked in a mobile communication system owing to paging delay which results in caller reneging and channel unavailability. We find the minimum paging rate required to meet a loss probability criterion for different arrival rates, paging area sizes, impatience thresholds and available voice channels.

3) **Challenges in Developing Wireless Data Services for the Mass Market**, *Danh T. Lai*, Pacific Bell Mobile Services, 4420 Rosewood Dr., Bldg. 2, 3rd Fl., Pleasanton, CA 94588, dlai@pacbell.mobile.com

The challenges in developing mobile data services for the mass market fall into several categories: enabling device(s); application(s); affordability (price elasticity); value and enabling infrastructure. We attempt to address some of the above challenges.

4) **Network Management in a Mobile Computing & Communications System**, *H. Michael Chung*, CA State Univ., Dept. of Info. Systems, Coll. of Bus. Admin., Long Beach, CA 90840-8506, hmchung@csulb.edu

We review the evolution of wireless computing and communication systems and analyze the network management issues focusing on technological transition, interconnectivity and systems integration in a local customer market.

**MD33 Optimization Techniques II****Contributed Session****Chair:** Dinesh A. Mirchandani, Univ. of KY, DSIS, Sch. of Mgmt., Gatton Coll. of Bus. & Econ., Lexington, KY 40506-0034, dinesh0@convex.uky.edu

1) **A Hybrid, Synergistic Procedure for the Traveling Salesman Problem**, *Dinesh A. Mirchandani*, Univ. of KY, DSIS, Sch. of Mgmt., Gatton Coll. of Bus. & Econ., Lexington, KY 40506-0034, dinesh0@convex.uky.edu, *Ramakrishnan Pakath, Kenneth J. Sims*

We propose a hybrid, synergistic heuristic for solving the TSP that exploits the elastic neural network, SA, GA and TS methods. We compare its performance with procedures such as the Clarke-Wright, GENIUS and iterated Lin-Kernighan strategies and also the methods we hybridize when used in isolation.

2) **Nested Partitions Method for Global Optimization**, *Leyuan Shi*, Univ. of WI, Dept. of IE, 1513 University Ave., Madison, WI 53706-1572, leyuan@ie.engr.wisc.edu, *Siggi Olafsson*

We propose a randomized global optimization methodology. The new method, the NP method, uses partitions and random sampling techniques to create a Markov chain which has been proved to have global optima as its absorbing states. The NP method is also highly matched to emerging passively parallel processing capabilities.

3) **Tabu Search When Noise is Present: An Illustration in the Context of Cause & Effect Analysis**, *Daniel Costa*, Univ. of Calgary, Fac. of Mgmt., 2500 Univ. Dr. NW, Calgary, Alberta, T2N 1N4, Canada, [dcosta@mgmt.ucalgary.ca](mailto:dcosta@mgmt.ucalgary.ca), *Edward A. Silver*

We wish to find the true cause of an undesirable effect. The time to investigate each potential cause is a random variable. The problem is to sequence the potential causes so as to maximize the chance of finding the true cause before a specified time horizon. TS, including sampling and statistical tests, is examined.

#### MD34 PANEL: NSF Research Opportunities

Cluster: NSF Research Opportunities

Invited Session

Chair: L. Robin Keller, Univ. of CA, Grad. Sch. of Mgmt., 401 GSM, Irvine, CA 92697-3125, [lrkeller@uci.edu](mailto:lrkeller@uci.edu)

Co-Chair: Donald Gross

1) **PANEL: NSF Research Opportunities**, *Jon Leland*, Ntl. Science Foundation, [jleland@nsf.gov](mailto:jleland@nsf.gov), *Georgia-Ann Klutke*, Ntl. Science Foundation

NSF programs that have traditionally supported research in OR and MS are the OR and Production Systems Program, ORPS, in the division of design, manufacturing and industrial innovation in the Engineering Directorate and the Decision, Risk and MS Program, DRMS, in the division of social, behavioral and economic research in the Social, Behavioral and Economic Sciences Directorate...

### Tuesday 08:00-09:30

#### TA02 Teaching Optimization Modeling on the Web: The MPL On-Line Tutorial

Sponsor: INFORMS CSTS

Sponsored Session

Chair: Bjarni Kristjansson, Maximal Software Inc., 2111 Wilson Blvd., Ste. 700, Arlington, VA 22201, [bjarnik@site.gmu.edu](mailto:bjarnik@site.gmu.edu)

1) **Teaching Optimization Modeling on the Web: The MPL On-Line Tutorial**, *Bjarni Kristjansson*, Maximal Software Inc., 2111 Wilson Blvd., Ste. 700, Arlington, VA 22201, [bjarnik@site.gmu.edu](mailto:bjarnik@site.gmu.edu)

Maximal Software has developed an on-line tutorial on the Web specifically designed for teaching optimization modeling the way it is currently being applied in the corporate world. This is a complete course, with all the supporting tools including a model library, exercises and case models and a downloadable student version of both MPL and CPLEX.

#### TA04 Decision & Risk in the Public Sector

Cluster: Public Sector Applications

Sponsor: INFORMS Section on Public Programs & Processes

Invited/Sponsor Session

Chair: Robin Dillon, Stanford Univ., Dept. of IE, Stanford, CA 94305, [dillon@leland.stanford.edu](mailto:dillon@leland.stanford.edu)

1) **Six Levels of Treatment of Uncertainty in Risk Analysis**, *M. Elisabeth Pate-Cornell*, Stanford Univ., Dept. of IE/EM, Stanford, CA 94305, [mep@leland.stanford.edu](mailto:mep@leland.stanford.edu)

Full treatment of all epistemic and aleatory uncertainties in probabilistic risk analysis can be complex and costly. Some decisions require such an analysis; others don't. I show how different levels of uncertainty analysis (including plausible upper bounds and probabilistic risk analysis) correspond to different decision frameworks.

2) **Integrating Expert Judgments on Seismic & Volcanic Risk**, *Peter A. Morris*, Applied Decision Analysis Inc., 2710 Sandhill Rd., Menlo Park, CA 94025-7020, [pmorris@adainc.com](mailto:pmorris@adainc.com)

We describe an expert-aggregation process developed for DOE, NRC and EPRI by a group of decision and risk analysts and earth scientists. The process is based on state-of-the-art mathematical and behavioral methods for combining expert probabilities. We will describe its application in 2 high-level risk-analysis projects.

3) **Value of Information Analysis for Managing Nuclear Wastes**, *Thomas Eppel*, Decision Insights, Inc., 4590 MacArthur Blvd., Ste.

500, Newport Beach, CA 92660, *Detlof Von Winterfeldt*

Several information collection strategies were analyzed to support the disposal of nuclear tank wastes at DoE's Hanford site. The model concentrates on tanks that potentially contain transuranic waste and was fully parametrized to allow extensive sensitivity and value-of-information analyses. Implications for individual tanks and groups of tanks are discussed.

4) **Cost Risk Analysis for the Department of Energy**, *Robin Dillon*, Stanford Univ., Dept. of IE, Stanford, CA 94305, [dillon@leland.stanford.edu](mailto:dillon@leland.stanford.edu)

Several approaches exist for incorporating uncertainty in a cost estimate. This presentation describes a process which uses estimates prepared for a contingency analysis, along with expert elicitation to develop an accuracy probability distribution of a project's cost. This approach was used for the DoE's tritium supply study.

#### TA05 Linear Programming in Approximation & Algorithms II

Cluster: Linear Programming

Invited Session

Chair: Vasant A. Ubhaya, ND State Univ., Dept. of Comp. Sci. & OR, 258 IACC Bldg., Fargo, ND 58105, [ubhaya@plains.nodak.edu](mailto:ubhaya@plains.nodak.edu)

1) **Lipschitz Stability of Least Norm Solutions of Linear Programming Problems**, *Martina Finzel*, Mathematical Inst., Bismarckstr. 1 1/2, Erlangen, 91054, Germany, [finzel@mi.uni-erlangen.de](mailto:finzel@mi.uni-erlangen.de), *Wu Li*

The least norm solution of an LP problem can be considered as a regularized solution of the original problem. We establish the Lipschitz stability of the least norm solution of an LP problem with respect to data perturbations and discuss some related issues.

2) **Constrained Curve & Surface Fitting in Financial Modeling**, *Philip W. Smith*, Windward Technologies, Inc., 12039 Mulholland, Meadows, TX 77477, [pwsmith@aol.com](mailto:pwsmith@aol.com)

We discuss the fitting of financial curves and surfaces. Various constraints and objective functions are proposed to attempt to accurately model a variety of circumstances. The efficacy of fitted models will be assessed and we also evaluate the underlying numerical computation.

3) **Dykstra's Algorithm & Fenchel Duality for Convex Minimization in Hilbert Space**, *John J. Swettis*, Old Dominion Univ., Dept. of Math. & Stats., Norfolk, VA 23529, [swettis@mathpc.math.odu.edu](mailto:swettis@mathpc.math.odu.edu), *Frank Deutsch*, *Wu Li*

We study a special dual form of convex minimization problems in a Hilbert space, which is formally derived from Fenchel duality and is useful for Dykstra's algorithm. We relate certain duality results with the so-called CHIP property and propose an extension of Dykstra's algorithm to strongly convex minimization problems.

4) **Discrete Approximation Problems**, *Vasant A. Ubhaya*, ND State Univ., Dept. of Comp. Sci. & OR, 258 IACC Bldg., Fargo, ND 58105, [ubhaya@plains.nodak.edu](mailto:ubhaya@plains.nodak.edu)

We consider approximation by classes of functions which are isotone, convex and quasi-convex on  $n$  points of the real line. We use various distance functions. We develop efficient polynomial algorithms and discuss their computational complexity. We introduce an additional integer constraint on the approximating functions in some of the problems.

#### TA06 CO Formulation & Meta-Heuristics in VLSI Layout

Cluster: Combinatorial Optimization

Invited Session

Chair: Andrew B. Kahng, UCLA, Comp. Sci. Dept., 3713 Boelter Hall, Los Angeles, CA 90095-1596, [abk@cs.ucla.edu](mailto:abk@cs.ucla.edu)

1) **A Multilevel Genetic Approach to VLSI Circuit Partitioning with Applications to Circuit Placement**, *Charles J. Alpert*, IBM Austin Research Lab., 1140 Burnet Rd., MS 9460, Austin, TX 78758, [alpert@austin.ibm.com](mailto:alpert@austin.ibm.com), *Dennis J.-H. Huang*, *Andrew B. Kahng*

We present a hybrid multilevel-genetic circuit partitioning heuristic for partitioning of large circuit netlists; experiments show that our technique achieves very strong results with respect to solution quality/runtime tradeoffs. We also formulate the VLSI timing-driven placement problem for standard-cell and gate-array design styles...

2) **Genetic-Based Placement Algorithms for Standard- & Macro-Cell Styles of VLSI Layouts**, *Pinaki Mazumder*, Univ. of MI, Dept.

Elect. Eng./Comp. Sci., Ann Arbor, MI 48105, mazum@eecs.umich.edu

We discuss the implementation of GAs for standard-cell (alternating rows of logic cells of uniform heights and routing channels) and macro-cell (rectilinear cells with arbitrary positions and orientations) styles of VLSI layouts. Intrinsic parallelism of the GA leads to a distributed implementation with near-linear speedup...

**3) Interconnect Optimization in CAD for VLSI, John Lillis,** Univ. of CA, Dept. of EECS, Berkeley, CA 94720, jlillis@eecs.berkeley.edu, **Chung-Kuan Cheng**

We discuss recent developments in interconnect optimization in the physical design of VLSI circuits. We review recent technological trends which have made previously negligible effects of interconnect critical in the performance of VLSI systems and discuss delay models and problem formulations and give an overview of algorithmic techniques for tackling problems based largely on multi-dimensional dynamic programming.

**4) PERT Algorithms with Two-Sided Bounds: Applications to Circuit Optimization with Short Path & Long Path Constraints, Chung-Kuan Cheng,** Univ. of CA, Dept. of CSE, La Jolla, CA 92093-0114, kuan@cs.uscd.edu

We devise new network flow algorithms with conditional arc capacities to optimize the PERT problem with bounds on both shortest and longest paths. The method is used to optimize the timing of VLSI circuit with 2-sided bounds on path delays.

#### TA07 Discrete Time Queueing

Cluster: Discrete Time Queueing  
Invited Session

Chair: Alan Krinik, CA State Polytech. Univ., 3801 W Temple Ave., Pomona, CA 91768, ackrinik@csupomona.edu

**1) Infinite Block-Structured Transition Matrices & Their Properties, Yiqiang Q. Zhao,** Univ. of Winnipeg, Dept. of Math. & Stats., Winnipeg, Manitoba, R3B 2E9, Canada, **Wei Li, W. John Braun**

We study Markov chains with infinite state block-structured, especially with block-repeating, transition matrices and various associated measures. Necessary and/or sufficient conditions are obtained for a Markov chain to be ergodic, recurrent or transient in terms of these measures.

**2) A Combinatorial Queueing Model Related to the Ballot Problem, Shahar Boneh,** Metro. State Coll. of Denver, Dept. of Math., Denver, CO 80217-3362, boneh@mscd.edu, **Vassilis G. Papanicolaou**

We consider a queue in which customers need to receive change for a purchase. We use lattice graph methods to derive the probability distribution for the number of times change is not available. We will also show asymptotic results and applications.

**3) The Combinatorics of Birth-Death Processes & Application to Queues, S. G. Mohanty,** McMaster Univ., Dept. of Math. & Stats., Hamilton, Ontario, L8S 4K1, Canada, **W. Bohm, Alan Krinik**

We first show that the transient solution of a birth-death process obtained through uniformization is formally equivalent to the one obtained through discretization. Then we derive transition functions by applying a combinatorial technique. It provides solutions to queueing systems, such as M/M/c models and those with balking and reneging.

**4) Transient Probabilities of M/M/2-Like Queueing Systems, Alan Krinik,** CA State Polytech. Univ., 3801 W Temple Ave., Pomona, CA 91768, ackrinik@csupomona.edu, **Lilly Chen, Mitra Mosallaie**

Transient probabilities of M/M/2-like birth-death processes are calculated using the randomization/combinatorial approach. A sensitivity analysis of transient probabilities as effected by changes in specific birth-death rates is presented. Generalizations to M/M/n-like processes are indicated. Our method is free of transform theory and Bessel function representations.

#### TA08 Integer Programming I

Contributed Session

Chair: Ann E. Bixby, Northwestern Univ., 2225 N Campus Dr., Evanston, IL 60201, abixby@fido.iems.nwu.edu

**1) A Facet Generation Procedure with Application to Assembly Design Problems, Radu Gadidov,** TX A&M Univ., Dept. of IE, College Station, TX 77843-3131, rcg5078@tam2000.tamu.edu, **Wilbert E. Wilhelm**

We present a B&C implementation of the FGP. Besides the cuts generated by

FGP, a new class of cuts is discussed. A set of assembly design problems is used to provide insights into the computational characteristics of the procedure.

**2) Parametric & Sensitivity Analysis in Combinatorial Optimization: A Survey, Barbaros C. Tansel,** Bilkent Univ., Dept. of IE, Bilkent, Ankara, 06533, Turkey, barbaros@bilkent.edu.tr, **Muhittin Hakan Demir, Fatma Sibel Salman**

We review algorithmic and theoretical aspects of parametric and sensitivity analysis in combinatorial optimization and point out directions for future research.

**3) Rostering Using Integer Programming & Nested Column Generation, Andrew J. Mason,** Univ. of Auckland, Dept. of Eng. Sci., Private Bag 92019, Auckland, New Zealand, a.mason@auckland.ac.nz

Providing efficient service requires careful rostering of staff. We document a new integer programming column generation approach to a rostering problem. A careful problem formulation utilizing an a priori construction of a 2-tiered column generator allows solution times of under 10 minutes on a PC for an 86-nurse example.

**4) The Generate & Cut Approach for the Capacitated Vehicle Routing Problem, Ann E. Bixby,** Northwestern Univ., 2225 N Campus Dr., Evanston, IL 60201, abixby@fido.iems.nwu.edu, **Collette R. Coullard, David Simchi-Levi**

We look at the capacitated VRP and present a set partitioning-based algorithm for its optimal solution. Our approach combines a cutting plane algorithm with a column generation strategy.

**5) 400 Point Rectilinear Steiner Minimal Trees, David M. Warme,** 4633 Guinea Rd., Annandale, VA 22003, warme@s3i.com

An improved version of the Salowe-Warme algorithm for rectilinear Steiner minimal trees is presented. Using an IP/LP formulation, this method has obtained optimal solutions to problems with up to 400 terminals. The method has also yielded optimal solutions to 1000 point Euclidean problem instances.

#### TA09 Scheduling I

Contributed Session

Chair: Michael H. Veatch, Gordon Coll., Dept. of Math., Wenham, MA 01984, veatch@gordonc.edu

**1) Optimal Manufacturing Flow Controllers: Zero-Inventory Policies & Control Switching Sets, Michael H. Veatch,** Gordon Coll., Dept. of Math., Wenham, MA 01984, veatch@gordonc.edu

A continuous flow control model of a single workstation with multiple failure modes and part types is considered. Conditions are found under which unreliability does not affect the optimal policy and no inventory is held, analogous to the single part type result of Bielecki & Kumar. The optimal policy is characterized using switching sets.

**2) Combined Production & Maintenance Scheduling for a Multiple-Product, Multiple-Stage Production System, Thomas W. Sloan,** Golden Gate Univ., 536 Mission St., San Francisco, CA 94105-2968, tsloan@ggu.edu

Results obtained for a single-stage system are extended to a multiple-stage system. We demonstrate that substantial gains can be made by using information about equipment condition when making production scheduling decisions. Simple policies are derived which meet production requirements and result in fewer repairs than heuristic rules currently in practice.

**3) Scheduling Jobs that are Subject to Deterministic Due Dates & Have Deteriorating Expected Rewards, Yat-Wah Wan,** Hong Kong Univ. of Sci. & Tech., Dept. of IE/EM, Clear Water Bay, Hong Kong, ieywan@usthk.ust.hk, **Takashi Ishikida**

A single server processes jobs that can yield rewards but expires on predetermined dates. Expected immediate rewards from each job are deteriorating. The instance is formulated as a multi-armed bandit problem and an index-based scheduling policy is shown to maximize the expected total reward.

**4) Bayesian Approach to Scheduling of Manpower on a Single Machine, Jeriad M. Zoghby,** Univ. of TX, OR/IE Dept., Dept. of Mech. Eng., Austin, TX 78712, jmz@mail.utexas.edu, **Elnira Popova**

A model is created to predict production levels to improve the scheduling of manpower. Production comes from a machine which is running 24 hours a day. Predictions are made through Bayesian analysis of worker data on current and past production. Predictions will later be used to set up parameters in a simulation model.

**TA10 Supply Chain Management**Cluster: **Supply Chain**

Invited Session

Chair: David Simchi-Levi, Northwestern Univ., Dept. of IE/MS, ML5B 2225 N Campus Dr., Evanston, IL 60208-3119, levi@iems.nwu.edu

1) **The Computerized Beer Game: Teaching the Value of Integrated Supply Chain Management**, *Philip Kaminsky*, Northwestern Univ., Dept. of IE/MS, 2225 N Campus Dr., Evanston, IL 60208, *David Simchi-Levi*

For years, instructors have used the traditional Beer Game to teach important concepts in supply chain management. Several important supply chain management concepts cannot be clearly illustrated this way. We were thus motivated to develop a new, computerized version, helpful in explaining these ideas. We describe some shortcomings of the traditional game and present our computerized version.

2) **Quantifying the Bullwhip Effect in a Simple Supply Chain: The Impact of Forecasting & Lead Times**, *Zvi Drezner*, CA State Univ., Grad. Sch. of Mgmt., Irvine, CA 92697, zdrezner@fullerton.edu, *Jennifer K. Ryan*, *David Simchi-Levi*

An important observation in supply chain management, the bullwhip effect, suggest that demand variability increases as one moves up a supply chain. We quantify this effect for simple, 2-stage supply chains consisting of a single retailer and a single manufacturer.

3) **The Impact of Exponential Smoothing Forecasts on the Bullwhip Effect**, *Fank Chen*, Northwestern Univ., Dept. of IE/MS, 2225 N Campus Dr., Evanston, IL 60208, *Jennifer K. Ryan*, *David Simchi-Levi*

We analyze the impact of exponential smoothing forecasts on variability in orders for simple, 2-stage supply chains consisting of a single retailer and a single manufacturer. We contrast these results with the increase in variability due to the use of a moving average technique.

4) **Supply-Chain Management: Integrating Inventory & Transportation**, *Lap Mui Ann Chan*, Philips Laboratories, 345 Scarborough Rd., Briarcliff Manor, NY 10510, *Ana Muriel*, *David Simchi-Levi*

We analyze the problem faced by companies using LTL carriers for the distribution of products across their supply chain. The timing and routing of shipments need to be coordinated to minimize total system costs including inventory, routing and shortage costs by taking advantage of economies of scale offered by the carriers. We model this problem using a set-partitioning approach...

**TA11 Restaurant Systems**Cluster: **Tourism**

Invited Session

Chair: Jackie Hueter, Taco Bell Corp., 17901 Von Karman, Irvine, CA 92714, jhueter@tacobell.com

1) **New Product Introductions in Multi-Unit Restaurant Systems**, *Jackie Hueter*, Taco Bell Corp., 17901 Von Karman, Irvine, CA 92714, jhueter@tacobell.com, *Christine Johnstone*

We review techniques used for successful new food product introductions on a nationwide scale. Topics discussed will include dynamics between major operating profit ad cost drivers, tools used to estimate those drivers, techniques for quantifying tradeoffs, testing and validation approaches, decision framework and implementation planning.

2) **Review of Quantitative Techniques Applied in the Foodservice Sector to Cause Fundamental Change**, *Mark Godward*, Strategic Restaurant Engineering

We review various quantitative techniques that have been leveraged to optimize operations in multiunit foodservice chains. The focus is on how several quantitative techniques are combined to generate results that have strategic implications because they cause or institutionalize fundamental change. The approach applied impacts the design of facilities and equipment, management complement, labor management systems, etc...

3) **Simulation Applications in Restaurants**, *Ali S. Kiran*, Kiran & Associates, 1350 Rosecrans St., Ste. C, San Diego, CA 92106-2633, kiran@powergrid.electrictiti.com, *Dan O'Neil*

Simulation models addressing various critical issues in restaurant management will be presented. The models, developed using service model simulation software, and their assumptions and performance in real world problems will be provided. The issues addressed include capacity and layout problems for front and back room operations, operator requirement analysis and scheduling.

**TA12 Computational Services in Information Networks**Sponsor: **INFORMS CSTS**

Sponsored Session

Chair: Rudolf Mueller, Humboldt Univ. zu Berlin, Inst. fuer Wirtschaftinfo., Spandauer Str. 1, Berlin, 10178, Germany, rmueller@wiwi.hu-berlin.de

1) **The Network-Enabled Optimization System: Optimization Services on the Internet**, *Joseph Czyzyk*, Argonne Ntl. Lab., Math. & Comp. Sci. Division, Argonne, IL 60439-4844, czyzyk@mcsl.anl.gov

The NEOS project seeks to make optimization methods accessible by using the server, an on-line problem-solving environment, the guide, a Web-accessible book of methods, software and interactive examples and the library, a collection of optimization software. Our presentation will highlight each element.

2) **Value Added Services for Combinatorial Optimization**, *Peter Becker*, Univ. Tuebingen, Inst. fuer Informatik, Sand 13, Tuebingen, D-72076, Germany, becker@informatik.uni-tuebingen.de, *Rudolf Mueller*

Distributed computational services for combinatorial optimization can benefit from 2 types of services. First, identify problem instances as members of a subclass of a general problem class. Second, combine services which compute lower and upper bounds for hard problems. We outline such value adding services in the system MatSe.

3) **Accessing & Publishing Scientific Software with the MMM System**, *Rudolf Mueller*, Humboldt Univ. zu Berlin, Inst. fuer Wirtschaftinfo., Spandauer Str. 1, Berlin, 10178, Germany, rmueller@wiwi.hu-berlin.de, *Peter Schmidt*

A big share of scientific software is implemented in dedicated languages, e.g., Matlab, Mathematica, Gauss. We present the system MMM that supports researchers who publish such software modules in the Internet. Remote execution services and data conversion services enable cross-language use of published modules, for example, in Matlab scripts.

**TA13 Reports from the Front: Case Studies in Real-World OR Consulting I**Sponsor: **INFORMS CSTS**

Sponsored Session

Chair: Sanjay Saigal, Compass Modeling Solutions, Inc., 1005 Terminal Way, Ste. 100, Reno, NV 89502, saigal@modeling.com

1) **Implementing Large-Scale OR Models in the Airline Industry**, *Roy Marsten*, Cutting Edge Optimization, 3446 Habersham Rd., Atlanta, GA 30305, ceoinc@delphi.com, *Radhika Subramanian*, *Luana Gibbons*

We present reflections on our experience during the past 5 years applying OR models for Delta Air Lines. The models include fleet assignment, crew scheduling, maintenance planning and route development. Special attention will be given to the increasing realism of the models made possible by today's computational power.

2) **Natural Gas Scheduling at El Paso Natural Gas**, *Steve Hoyle*, Logicon RDA, 105 E Vermijo, Ste. 450, Colorado Springs, CO 80903, shoyle@logicon.com

Scheduling the transportation of 3-4 billion cubic feet of gas used to take EPNG staff 4-8 hours every day. We describe the design, implementation and deployment of an automated LP model that has cut the scheduling time to 20 minutes and simultaneously increased throughput 1-3%.

3) **What OR/MS Has to Offer the Call Center Industry**, *Vijay Mehrotra*, Onward Inc., 888 Villa St., Ste. 210, Mountain View, CA 94041, vijay@onward-net.com

Call centers are large complex systems that are rich with OR/MS problems. I present our success as consultants within call centers, focusing on forecasting and scheduling methods that we have employed as well as the "people side" of turning these projects into successes.

4) **Solving Large-Scale LP Problems from the Real World**, *Xing Tong*, Chesapeake Decision Science Inc., 2105 S Bascom Ave., Ste. 370, Campbell, CA 95008, xit@chesapeake.com

Some large-scale LP problems from real-world applications are very difficult to solve, even with the help of today's modern computing technology. We focus on some issues addressed and approaches taken during the implementation of such a large-scale model.

**TA14 Environmental Decision & Risk Analysis**

Sponsor: INFORMS Section on Environment

Sponsored Session

Chair: Gregory S. Parnell, VA Commonwealth Univ., Dept. Math. Sci., Oliver Hall, 1015 W Main St., PO Box 842014, Richmond, VA 23284-2014, gparnell@vcu.edu  
gsparnell@aol.com

1) **Dense Non-Aqueous Phase Liquid Decision & Risk Analysis, Mamadou Diallo**, VA Commonwealth Univ., Dept. of Math. Sci., Oliver Hall, 1015 W Main St., Richmond, VA 23284-2014, gparnell@vcu.edu, **Gregory S. Parnell**

The DoE office of Environmental Management is concerned with the cleanup of DNAPLs. We perform a pilot decision and risk analysis to evaluate alternative remediation technologies to clean a DNAPL site at Paducah, Kentucky. The most sensitive assumptions are identified.

2) **A Prototype Dense Non-Aqueous Phase Liquid Decision Model, Anthony Papatyi**, AFIT, Dept. of Op. Sci., 2950 P St., Bldg. 640, WPAFB, OH 45433-7765, apapathi@afit.af.mil, **Richard F. Deckro, Jack Kloeber**

A number of competing technologies are being developed by the DoE for DNAPL characterization, treatment, containment and monitoring processes, specifically for the WAG6 site, C-400, Paducah, Kentucky. We have developed the VCU pilot risk analysis into a prototype DA model.

3) **A Modified Decision Support System for Remediation Technology Selection Strategies, Brian J. Grellk**, AFIT, Dept. of Op. Sci., 2950 P St., Bldg. 640, WPAFB, OH 45433-7765, bgrellk@afit.af.mil, **Jack A. Jackson, Jr., Richard F. Deckro**

The DoE Office of Environmental Management is responsible for cleaning up subsurface contaminants. We perform a pilot decision and risk analysis evaluating possible remediation technology strategies at the Idaho National Laboratory Pit 9 site. Each strategy is ranked based on a scoring system accounting for life cycle costs, time and risks.

4) **Cost & Development Risk Guidance for DoE Environmental Technology Developers, Gregory S. Parnell**, VA Commonwealth Univ., Dept. Math. Sci., Oliver Hall, 1015 W Main St., PO Box 842014, Richmond, VA 23284-2014, gparnell@vcu.edu  
gsparnell@aol.com

The DoE Office of Environmental Management has developed the technology investment decision model to manage the development of environmental technologies. Seven stages of technology maturation are identified from basic research through implementation. The model provides a stage-to-gate process to support senior decision-makers.

**TA15 Stochastic Networks**

Cluster: Network Flows

Invited Session

Chair: Warren B. Powell, Princeton Univ., Dept. of Civil Eng. & OR, Princeton, NJ 08544

1) **Solving Hard Combinatorial Problems by Neuro-Dynamic Programming, Dimitri P. Bertsekas**, MIT, Dept. Elect. Eng./Comp. Sci., Cambridge, MA 02139

We discuss 2 general frameworks for solving approximately difficult combinatorial problems using the neuro-dynamic programming methodology. In the first, one systematically learns how to combine several heuristic algorithms by experience with related problems. In the second, one learns how to search the solution space using any of a number of local search methods.

2) **A Dynamic Network Model for Air Traffic Flow Management, Gregory Glockner**, GA Inst. of Tech., Sch. of ISyE, Atlanta, GA 30332-0205, **George L. Nemhauser**

Air traffic delays occur when demand exceeds available capacity. In day-to-day operations, delays can be reduced by modifying flight plans. We propose a dynamic network flow model that used random arc capacities to reflect uncertain airport capacities. Based on our simulation, this can reduce annual delay costs by \$330 million.

3) **An Adaptive, Nonlinear Control Algorithm for Dynamic Resource Allocation Problems, Greg Godfrey**, Princeton Univ., CASTLE Lab., Dept. of Civil Eng. & OR, Princeton, NJ 08544, **Warren B. Powell**

We describe an adaptive nonlinear approximation method for solving certain classes of dynamic programs that arise in resource allocation problems. The logic successively approximates the expected value function with a piecewise linear, concave function. The approximation guarantees integer solutions for the subproblems and is computationally very fast...

**TA16 Product Variety by Design**

Sponsor: INFORMS Section on Technology Management

Sponsored Session

Chair: Viswanathan Krishnan, Univ. of TX, Dept. of Mgmt., Austin, TX 78712, krishnan@mail.utexas.edu

1) **The Role of Product Architecture in Product Family Design, Viswanathan Krishnan**, Univ. of TX, Dept. of Mgmt., Austin, TX 78712, krishnan@mail.utexas.edu, **Rahul Singh, Devanath Tirupati**

We study the effect of product architecture on the composition of a product family. A firm is faced with the trade-off of investing pre-development time in a modular architecture which, however, offers economies in the development of variants. The product family decision problem is formulated and solved optimally.

2) **Information: The Hidden Cost of Product Variety, Mustafa V. Uzumeri**, Auburn Univ., Sch. of Bus., Dept. of Mgmt., Auburn University, AL 36849-5358, uzumeri@business.auburn.edu

As product variety drives manufacturing tasks to change at faster rates, more workers are forced onto the steep part of some learning curve. To cope, designers will have to become far more efficient at communicating product information.

3) **An Application of Designing Products & Processes for Supply Chain Management, Amit Garg**, IBM, TJ Watson Res. Ctr., PO Box 218, Yorktown Heights, NY 10598, agarg@watson.ibm.com

We describe an application of designing products and processes for supply chain management at a large electronics products manufacturer. The objective was to reduce the costs of complexity resulting from a proliferation of products and processes in the manufacturer's supply chain for which we developed a modeling and analysis tool.

4) **Architecture, Variety & Product Performance, Karl Ulrich**, Univ. of PA, The Wharton Sch., 1317 SH-DH, Philadelphia, PA 19104, **David Ellison**

A trend in industrial practice appears to be towards increased organizational and product modularity, in part to enhance the ability of the firm to offer high variety. In a study of the portable computing industry, we examine the impact of this approach on product performance.

**TA17 Electric Power Markets**

Sponsor: INFORMS Section on ENRE

Sponsored Session

Chair: James Bushnell, Univ. of CA, Energy Institute, 2539 Channing Way, Berkeley, CA 94720, jimb@cimsim.berkeley.edu

1) **An Integrated Framework for Energy Market Offers, Glenn R. Drayton-Bright**, Univ. of Canterbury, Dept. of Mgmt., Private Bag 4800, Christchurch, New Zealand, g.drayton@mang.canterbury.ac.nz, **E. Grant Read**

Provision of reserves is a significant cost in electricity markets. We present an LP framework for jointly optimizing energy/reserve dispatch/pricing in such a market, allowing all reserve providers to communicate limits and efficiency effects arising from the joint provision of energy and reserve.

2) **A Multi-Round Load-Slice Auction for Electric Power, Wedad Elmaghraby**, Univ. of CA, IEOR Dept., Berkeley, CA 94720, wood@cimsim.ieor.berkeley.edu, **Shmuel S. Oren**

We describe a new approach to electricity auctions in a power pool. The load curve is "filled up" from the bottom up through sequential load slice bidding. In this scheme, generation is self-committed, thus eliminating the need for bidders to specify dispatch constraints. We analyze the equilibrium properties of time-slice and load-slice auctions.

3) **The Competitive Effects of Transmission Capacity in a Deregulated Electricity Market, James Bushnell**, Univ. of CA, Energy Institute, 2539 Channing Way, Berkeley, CA 94720, jimb@cimsim.berkeley.edu, **Severin Borenstein, Steven Stoft**

In an unregulated electricity market, the degree to which generators compete will be largely determined by the transmission capacity between their locations. We study the impact of transmission capacity on competition among generators. Our results indicate that small investments in transmission may yield large payoffs in terms of increased competition.

**TA18 TUTORIAL: Service Operations Management - An Agenda for Normative & Empirical Analysis**

Invited Session

**Chair:** Patrick T. Harker, Univ. of PA, OPIM Dept., 1300 SH-DH, Wharton Sch., 3620 Locust Walk, Philadelphia, PA 19104-6315, harker@eniac.seas.upenn.edu

**1) TUTORIAL: Service Operations Management - An Agenda for Normative & Empirical Analysis, Patrick T. Harker, Univ. of PA, OPIM Dept., 1300 SH-DH, Wharton Sch., 3620 Locust Walk, Philadelphia, PA 19104-6315, harker@eniac.seas.upenn.edu**

The service sector is not only the largest segment of all developed economies, but also consumes more than 85% of IT investment every year. As such, this segment provides tremendous opportunities for academic research and the application of OR/MS methodologies. This tutorial will review the state-of-the-art in the analysis of service operations in general..

#### TA19 Optimization II Contributed Session

**Chair:** Zhongxian Wang, Montclair State Univ., 234 McCosh Rd., Upper Montclair, NJ 07043, wangj@saturn.montclair.edu

**1) The Sensitivity Analysis of Goal Point Approaches, Zhongxian Wang, Montclair State Univ., 234 McCosh Rd., Upper Montclair, NJ 07043, wangj@saturn.montclair.edu, Arun Kumar, Qiyang Chen**

We investigate the sensitivity of goal point approaches with respect to the choice of a given goal point. Three different distance equations will be tested to determine the minimum distance between the goal points and the feasible region. The results will be examined by comparing the lengths of the distance vectors for different orders of an equation.

**2) Cyclic Scheduling of Production & Maintenance in Continuous Multiproduct Plants, Vipul Jain, Carnegie Mellon Univ., Dept. of Chem. Eng., Pittsburgh, PA 15213, vjain@andrew.cmu.edu, Ignacio E. Grossmann**

Mixed integer models are presented for the scheduling of processes in which the performance of equipment decreases with time. Aside from selecting sequencing and assignments, key decisions include the times for equipment shut down for maintenance and the number of production cycles for each product. An application to ethylene plants is presented.

**3) Optimal & Heuristic Procedures for the U-Line Assembly Line Balancing Problems, Wen-Chyuan Chiang, Univ. of Tulsa, Coll. of Bus., 600 S College Ave., Tulsa, OK 74104-3189, qm\_wc@centum.utulsa.edu, Panos Kouvelis**

We present a B&B procedure and a fast heuristic procedure to solve the U-line assembly line balancing problems. Computational results will be reported.

**4) Dual Response Surface Optimization: Sensitivity of Design Parameters, Kwang-Jae Kim, PA State Univ., Dept. of Indust. & Mfg. Eng., 207 Hammond Bldg., University Park, PA 16802, kjkie@engr.psu.edu, Dennis K. J. Lin**

Dual response system has proven to be a powerful tool in modern quality engineering when both location and dispersion effects are under concern. A formal optimization modeling approach to the dual response problem is proposed. The sensitivity of the design parameters to input changes is investigated.

#### TA20 Freeway Traffic Congestion Dynamics

**Sponsor:** INFORMS Transportation Science Section  
**Sponsored Session**

**Chair:** R. Jayakrishnan, Univ. of CA, Civil & Env. Eng., Irvine, CA 92697

**1) The Interplay Between Recurrent & Non-Recurrent Congestion, David Anderson, Univ. of CA, Dept. of Economics, Irvine, CA 92697**

We model interplay between average traffic volumes and non-recurrent congestion. Average traffic volumes effect the likelihood of traffic accidents (non-recurrent congestion). Traffic accidents also effect average traffic volumes by influencing drivers' departure-time choices. The model can be used to determine the benefits of providing information to reduce non-recurrent congestion.

**2) Experimental Studies on the Dynamic Features of Freeway Traffic, John R. Windover, Univ. of CA, Civil & Env. Eng., Inst. of Transport. Studies, Berkeley, CA 94720**

We describe detailed observations of backward-moving disturbances in dense freeway traffic. Reproducible features of disturbances associated with vehicle accelerations and those associated with vehicle decelerations are presented with speculation on driver behavior that underlies these features. These features are

shown by visual inspection of modified curves of measured cumulative vehicle arrival number vs. time...

**3) Stochastic Lane-Changing Modeling & Its Application to ATMS, Jih-Biing Sheu, Univ. of CA, Civil & Env. Eng., Irvine, CA 92697, Stephen G. Ritchie**

A stochastic system modeling approach is proposed for real-time prediction of vehicular lane-changing probabilities. Vehicular lane-changing behavior is modeled with a discrete-time nonlinear stochastic system and predicted using a recursive estimation algorithm developed for estimating lane-changing probabilities and other state variables of the system...

**4) Time-Dependent OD Flow Estimation in a Freeway Under ATIS Environment in an Incident Induced Congestion Situation, Debashish Bhattacharjee, Purdue Univ., Dept. of Civil Eng., W Lafayette, IN 47907, James Krogmeier, Kumares C. Sinha**

We present a real-time freeway O-D demand prediction algorithm from traffic counts using adaptive Kalman filtering techniques where the effect of information on users' route switching behavior under a non-recurrent congested traffic condition has been explicitly addressed using a dynamic aggregate route diversion model. Changes in drivers' perceptions have been captured...

#### TA21 Transportation III Contributed Session

**Chair:** Jin-Yuan Wang, Ntl. Chiao Tung Univ., Dept. of Transport., 1001 University Rd., Hsinchu, 300, Taiwan, jinyuan@tem.nctu.edu.tw

**1) Flight Schedule Modifications in the Case of the Perturbation, Goran Stojkovic, GERAD & Ecole Polytech., 3000 Cote-Ste.-Catherine, Montreal, Quebec, H3T 2A7, Canada, gerad@crt.umontreal.ca, Francois Soumis**

An airline prepares an aircraft rotation plan in advance but when perturbations occur, this plan becomes infeasible. We propose an optimization model to delay some flights in such a way as to become compatible with the planned aircraft rotations. This could be formulated as an LP where the number of constraints is large. The dual of this formulation is a minimum cost flow problem...

**2) A Framework for Locating Highway Incident Response Vehicles in Urban Areas, Raktim Pal, Purdue Univ., 1284 Civil Engineering Bldg., W Lafayette, IN 47907, pal@ecn.purdue.edu, Kumares C. Sinha**

Congestion caused by highway incidents is a major concern for road users in urban areas. To minimize the adverse effect of incidents, appropriate response strategies are required which would clear incidents as quickly as possible. An important component of these strategies is the appropriate deployment of incident response vehicles. A framework is proposed to find optimal locations of incident response vehicles in an urban area...

**3) On a Shortest Path Problem with Time Windows & Linear Waiting Costs, Daniel Villeneuve, Ecole Polytech. & GERAD, 3000 Cote-Ste-Catherine, Montreal, Quebec, H3T 2A7, Canada, danielv@crt.umontreal.ca, Guy Desaulniers**

We consider a shortest path problem with time windows and linear costs for waiting before visiting a node. Such a problem may arise when a decomposition approach is used to solve the multi-depot vehicle scheduling problem with time windows. We show that this problem is equivalent to a shortest path problem with 2 types of resource variables. Numerical results are presented.

**4) A Real Time Bus Dispatching & Rescheduling System, Jin-Yuan Wang, Ntl. Chiao Tung Univ., Dept. of Transport., 1001 University Rd., Hsinchu, 300, Taiwan, jinyuan@tem.nctu.edu.tw, Fang-Chyi Liou**

A real-time bus dispatching and rescheduling system, which integrates CIS and GPS, is developed for Hsinchu City, Taiwan. With this system, users are able to know the exact position of each bus. When traffic jams occur, appropriate action could be taken to provide better service for the public.

#### TA22 Managing Global Operations

**Cluster:** Global Manufacturing Practice  
**Invited Session**

**Chair:** Amiya Chakravarty, Tulane Univ., Freeman Sch. of Bus., New Orleans, LA 70118-5669

**1) Production Entry Strategies, Ann Gray, Harvard Univ., Sch. of Bus., Boston, MA 02163**

When a company builds a new plant, it must decide how much capacity to install, which products to produce and what process technology to use. When this plant is a company's first plant in a developing market, these decisions impact not only how that plant will perform, but how well the company is

positioned to expand in that market. These decisions must then be made as part of an entry strategy...

## 2) Risk Sharing Foreign Supply Contracts in the Presence of Exchange Rate Fluctuations

We consider a single-product multiperiod purchasing model where the purchase price depends on the exchange rate of a foreign currency. The purchase price is defined in such a way that the firm will share the risk with the supplier. Optimal purchasing strategies and valuation of the supply contract will be discussed.

## 3) Product Variety, Capacity & Pricing Decision in a Global Manufacturing Environment, *Amiya Chakravarty*, Tulane Univ., Freeman Sch. of Bus., New Orleans, LA 70118-5669

Trade-offs in global manufacturing decisions essentially involve markets, resource costs, investments and trade-barriers. We develop an investment model that helps determine optimal quantities to be manufactured and exported from various countries, optimal prices and investments in different countries and optimal "loading" of investment overheads to products. We discuss interesting managerial insights arising from the model.

## TA23 The Role of Flexibility in Managing Uncertainty: Manufacturing & Service

Cluster: Manufacturing & Service Management  
Invited Session

Chair: Shanling Li, McGill Univ., Fac. of Mgmt., 1001 Sherbrooke St. W, Montreal, Quebec, H3A 1G5, Canada, li@management.mcgill.ca

### 1) The Plant Location & Flexible Technology Acquisition Problem, *Vedat Verter*, McGill Univ., 1001 Sherbrooke St. W, Fac. of Mgmt., Montreal, Quebec, H3A 1G5, Canada, verter@management.mcgill.ca

We discuss simultaneous optimization of the location and technology content of a firm's manufacturing facilities, where FMSs are considered among the technology alternatives. This problem is usually encountered by the managers of global firms who have to incorporate the interdependencies between configurational decisions in their strategy planning process.

### 2) The Impact of Facility Flexibility on Marketing Competitiveness, *Alysse Rosewater*, GA Inst. of Tech., DuPree Sch. of Mgmt., Atlanta, GA 30332-0520, alysse.rosewater@mgt.gatech.edu, *Cheryl Gaimon*

Facility flexibility allows rapid changeover for successive product generations of high volume products with short life cycles. A model is developed that evaluates the tradeoffs of technology investment and marketing benefits. Further development of the model includes the effect of competition and/or the impact of investment in R&D.

### 3) Evaluating Investments in Machines with Different Degrees of Flexibility, *Sampath Rajagopalan*, Univ. of Southern CA, Sch. of Business, Los Angeles, CA 90089-1421, srajagopalan@sba.usc.edu, *Steven Yu*

We present a model for deciding which machines to purchase, given a set of machines with different degrees of flexibility. Investment, production and lead time related costs are used in evaluating the set of machines. We discuss the application of the approach using data from a concrete cutting tool manufacturer.

### 4) Capacity Expansion & Technology Choice with Dynamic, Uncertain Demands: A Scenario-Based Stochastic Programming Approach

We examine long-term capacity and technology decisions in a stochastic dynamic environment. We formulate the general problem as a large-scale stochastic programming model and develop solution procedures. Variants of the model for specific industrial settings are examined in detail. Finally, we present computational results to illustrate applications for deriving managerial insights.

## TA24 Applications of Decision Analysis in Industry I

Sponsor: INFORMS Decision Analysis Society  
Sponsored Session

Chair: Robert K. Perdue, Westinghouse Electric Corp., Sci. & Tech. Ctr., 1310 Beulah Rd., Pittsburgh, PA 15235-5098, perdue.r.k@wec.com

### 1) Applications of Decision Analysis at Eastman Kodak, *Robert C. Kwit*, Eastman Kodak Co., Strategy Planning & Analysis, 343 State St., Rochester, NY 14650-0309

We discuss techniques to deal with situations encountered during nearly 10 years of applications experience. This includes sensitivity analysis for problems with many alternatives and uncertainties and a quick method for approximating

the utility of multiple criteria.

### 2) Decision Analysis at the ALCOA Technical Center, *Paul R. Bruggink*, Alcoa Tech. Ctr., Strategy & Venture Analysis, 10 Technical Dr., Alcoa Center, PA 15069-0001

The 12-year history of the application of DA techniques to evaluate R&D projects and portfolios of projects is described. The processes used for assessing the probability of technical success and value given success are illustrated. Guidelines for effective use of DA are also presented.

### 3) Applications of Decision Analysis at PPG Glass Technology Center, *Mukesh Rustagi*, PPG Industries, Inc., Tech. Services Glass Group, Guys Run Rd. PO Box 11210, Pittsburgh, PA 05238-0472

A decision-and-risk, DRA, was done to assist in the decision making for development and commercialization of a new automotive glass product. The DRA process was used to select the technology during development, to make the capital investment decision to commercialize and finally, to select a manufacturing location.

### 4) Decision Analysis Support for Power Generation Initiatives, *William F. Trappen*, Westinghouse Electric Corp., 4400 Alafaya Trail, Orlando, FL 32826-2399

We describe several applications of DA to support electric power generation business strategies, including analyses of options to improve existing operating units, contractual warranty exposure associated with risk-sharing initiatives and a study in which deregulation of the electric power market is modeled as an uncertainty.

## TA25 Undergraduate Education

Sponsor: INFORMS Forum on Education  
Sponsored Session

Chair: James K. Lowe, USAF Acad., 2354 Fairchild Dr., Ste. 6H79F Academy, CO 80840, lowejk.dfm@usafa.af.mil

### 1) BSc Program Develop: Tradeoffs & Resolution, *Arif Rana*, Lahore Univ. of MS, Opp. Sector U, LCCHS, Lahore Cantt., 54792, Pakistan

Our university recently started a Bsc program with concentrations in Economics and Computer Science. We have gone through an extensive exercise of the aims and objectives of the program with satisfactory results. Another concentration in operations is in development.

### 2) Sensible Rules for Remembering Duals: The SOB Method, *Arthur T. Benjamin*, Mudd Coll., Math. Dept., Claremont, CA 91711

No abstract supplied.

### 3) Facts & Fables of OR Instruction, *Andrew Vazsonyi*, Univ. of San Francisco, McLaren Sch. of Bus., 156 Oak Is Dr., Santa Rosa, CA 95409, 102113.1352@compuserve.com

A recent video entitled, "Is Management Science Dead?" accurately poses the question, but fails to support the negatory reply. Several fables will be presented and challenged in the pursuit of relevancy within the OR classroom.

### 4) Survey Results: Undergraduate OR Evaluation, *Andrew P. Armacost*, USAF Acad., 2354 Fairchild Dr., Ste. 6H79, USAF Academy, CO 80840, armacostap.dfm@usafa.af.mil

Every graduate of the USAFA OR program since 1987 was asked to complete a survey evaluating the value of their undergraduate experience. In addition, surveys were distributed to the supervisors of our graduates. Speaking, writing and problem solving skills were queried in addition to the traditional "tools of OR" preparation.

### 5) OR Curriculum: Value-Based Curriculum Development, *James K. Lowe*, USAF Acad., 2354 Fairchild Dr., Ste. 6H79, USAF Academy, CO 80840, lowejk.dfm@usafa.af.mil

The OR curriculum underwent a thorough review based upon underlying values developed by an interdisciplinary working group. Values led to program goals and outcomes. Faculty "defined" outcomes relative to their courses and mapped courses to program outcomes, resulting in surprises, challenges and improvement.

## TA26 Heavy Tails and/or Long Range Dependence

Sponsor: INFORMS Applied Probability Section  
Sponsored Session

Chair: Sidney I. Resnick, Cornell Univ., School of OR/IE, Rhodes Hall, Ithaca, NY 14853

### 1) Self-Similar Network Traffic & the World Wide Web, *Mark Crovella*, Boston Univ., Comp. Sci. Dept., 111 Cummington St.,

Boston, MA 02215

Detection of self-similarity in wide- and local-area computer network traffic has serious implications for the performance modeling and evaluation of computer networks and network protocols. Mechanisms that give rise to self-similar network traffic are illustrated by empirical measurements of the WWW. The observed self-similarity originates in heavy-tailed distributions of Web document sizes.

**2) Estimation for ARMA Processes with Stable Noise, Richard A. Davis,** CO State Univ., Dept. of Stats., Ft. Collins, CO 80523

Two estimation procedures, maximum likelihood and least absolute deviation, for the parameters of an ARMA(p,q) process when the innovations belong to the domain of attraction of a non-normal stable distribution, will be discussed. The performance and behavior of these estimators will also be described.

**3) Heavy-Tailed Modeling in Insurance, T. Mikosch,** Univ. of Groningen, PO Box 800, Groningen, 9700 AV, The Netherlands

Modeling extremal events is a preoccupation in the insurance/reinsurance business. We consider standard models of insurance mathematics, i.e., time series, sum processes, stochastic differential equations, etc., and discuss which input distributions cause heavy-tailed output. Various probabilistic techniques are discussed to handle the occurrence of large values in these models.

**4) Heavy Tails & Long-Range Dependence in Queuing Models, Gennady Samorodnitsky,** Cornell Univ., Sch. of OR/IE, Rhodes Hall, Ithaca, NY 14853, **David C. Heath, Sidney I. Resnick**

Heavy tails and long-range dependence are interlinked in the queueing context in many ways. We discuss the behavior of queues under long memory and some implications of long memory on the design of queueing systems.

## TA27 Stochastic Processes

### Contributed Session

**Chair:** Wolfgang Brueggemann, Univ. of Hamburg, Inst. for Logistic/Transport., Von-Melle-Park 5, Hamburg, 20146, Germany, na.brueggemann@na-net.ornl.gov

**1) The Threshold Bootstrap for Time Series Analysis, Daesu Park,** RPI, DSES, 110 8th St., Troy, NY 12180-3590, parkd2@rpi.edu, **Thomas R. Willemain**

We present a resampling method for time series, TB. The TB resamples random-sized chunks defined by level crossings of a stationary process. We present empirical performance comparisons with the moving blocks and stationary bootstraps. We also discuss the practical issue of choice of chunk size.

**2) MDP-Based Large-Scale Network Admission & Routing, Christopher W. Zobel,** Univ. of VA, 154-4 Georgetown Rd., Charlottesville, VA 22901, czobel@virginia.edu, **William T. Scherer**

We investigate approaches to solving very large-scale network routing and admission problems, using a MDP formulation and focusing on simulation/optimization techniques, together with aggregation of network states. A brief literature review helps to motivate the application of these approaches to both telecommunications and traffic networks.

**3) Time- vs. Frequency-Domain Standard Error Estimates for Linear Trends, Wolfgang Brueggemann,** Univ. of Hamburg, Inst. for Logistic/Transport., Von-Melle-Park 5, Hamburg, 20146, Germany, na.brueggemann@na-net.ornl.gov, **Benjamin D. Santer**

Evaluating the significance of a linear trend in a single observed realization requires estimates of the variability of the underlying stochastic process, and hence, of the standard error of the trend. Issues of trend significance arise in a number of applications, e.g., climate change, capital markets, etc. Time- and frequency-domain estimators for the standard error have been used frequently...

## TA28 Using Information Technology in Managed Care

**Cluster:** Health Care Technology, Policy & Applications

**Invited Session**

**Chair:** Douglas R. Wholey, Carnegie Mellon Univ., Dept. of Social & Dec. Sci., Pittsburgh, PA 15213, wholey+@andrew.cmu.edu

**1) Prescription Drug Use Review Programs: Medicaid, Managed Care & Outcomes Measures, Alan Lyles,** John Hopkins Univ., Sch. Hygiene & Public Health, 615 N Wolfe St., Baltimore, MD 21205-2179, ayles@phnet.sph.jhu.edu, **Ilene Zuckerman**

DUR identifies and corrects preventable drug therapy misuse. Current state waivers moving medical assistance patients into managed care plans increase the timeliness of valid and effective criteria for drug use profiling and interdicting potential hazardous exposures (prosecutive DUR) as well as profiling patterns of prescribing (retrospective DUR).

**2) Physician Profiling in Group Practices, Christopher P. Tompkins,** Brandeis Univ., Inst. for Health Policy, Heller Grad. Sch., Waltham, MA 02254-9110, tompkins1@binah.cc.brandeis.edu, **Sarita Bhalotra**

Profiling is a technique that multispecialty group practices can use to improve quality and efficiency. Groups can examine physician performance by calculating ratios of medical inputs to patient or population outputs. We analyze group claims data and suggest how physician profiling can help organizations balance clinical and economic considerations.

**3) New Clinical Uses of Computerized Health Administration Data, David Knutson,** Inst. for Research & Education, Health Systems Studies, 3800 Park Nicollet Blvd., Minneapolis, MN

Mr. Knutson will describe new clinical uses of computerized health care data designed for patient enrollment, billing and budgeting. These include clinical epidemiological assessment of populations and episode of care specific process and assessment of conformance with clinical guidelines for external accountability and of practice variation for clinical process improvement.

**4) The Current State of Information Systems in Health Maintenance Organizations, Douglas R. Wholey,** Carnegie Mellon Univ., Dept. of Social & Dec. Sci., Pittsburgh, PA 15213, wholey+@andrew.cmu.edu, **Rema Padman, Richard Hamer, Shawn Schwartz, Randi Stillman**

We present the results of a national survey on IT and development in health maintenance organizations. We describe functions supported, new technology utilization, costs and staffing, physician and purchaser support systems and data captured and maintained. Multivariate analyses show the effect of HMO characteristics on IT use.

## TA29 Coordination Issues in Inventory & Assembly Systems

**Cluster:** Inventory Management

**Invited Session**

**Chair:** Candace Arai Yano, Univ. of CA, Dept. of IE/OR, Berkeley, CA 94706, yano@ieor.berkeley.edu

**1) Management of Worksharing Systems, John O. McClain,** Cornell Univ., Johnson Grad. Sch. of Mgmt., Malott Hall, Ithaca, NY 14853-4201, jom@cornell.edu, **L. Joseph Thomas, Kenneth L. Schultz**

Worksharing occurs when machines are not uniquely assigned to workers. In 1 version, operators move downstream until encountering another worker. We present design rules for practical situations, including unequal work content across machines, varying process times and unequal workers. Rules are introduced to control workflow under various realistic conditions.

**2) Effective Heuristics for Multi-Product Shipment Models, Milind Dawande,** Carnegie Mellon Univ., Grad. Sch. of Ind. Admin., Pittsburgh, PA 15213, **Srinagesh Gavirneni, Sridhar R. Tayur**

We consider shipment models where multiple customers ask for sets of products. The first shipment must be at least a minimum fraction of the total demand and second shipment (if any) cannot be too small and cannot be further split. We present both optimal procedures and heuristics.

**3) Coordinating Procurement of Assembly Components with Random Leadtimes, Candace Arai Yano,** Univ. of CA, Dept. of IE/OR, Berkeley, CA 94706, yano@ieor.berkeley.edu, **Panupol Lerssiriruriya, Jeannette Song**

Contract assemblers must procure many different components to satisfy forecasted orders and many of these components have random leadtimes. Using insights from simple versions of this problem and from simulation results, we develop and test several implementable heuristic procedures for specifying how much to order and when.

## TA30 PANEL: The Utility of Modeling & Simulation in Operational Effectiveness Analysis

**Sponsor:** INFORMS Military Applications Society

**Sponsored Session**

**Chair:** Roy Reynolds, TRADOC Analysis Ctr., WSMR, NM 88002-5502, reynoldr@trac.wsmr.army.mil

**1) PANEL: The Utility of Modeling & Simulation in Operational Effectiveness Analyses, Roy Reynolds,** TRADOC Analysis Ctr., reynoldr@trac.wsmr.army.mil, **Gabriel Rouquie, Jr., US Army Combat Analysis Group, Cyrus Staniec,** Simulation & Analysis Ctr.

Why use modeling and simulation in operational effectiveness analyses? Our

panel will address this question from 3 perspectives: DoD, Commander-in-Chief and Army. The DoD uses modeling and simulation to examine unified and joint operational issues. At the theater level, the warfighting Commander-in-Chiefs use modeling and simulation to evaluate different courses-of-action...

### TA31 Oak Ridge Military OR

Sponsor: INFORMS Military Applications Society  
Sponsored Session

Chair: Dean S. Hartley, Oak Ridge Ntl. Labs., 1099 Commerce Park, Oak Ridge, TN 37830-8627, dhx@ornl.gov

#### 1) Environmental Security Access & Exchange Information System (ESAXIS), Robert Abercrombie, Oak Ridge Ntl. Lab., 1099 Commerce Park, Oak Ridge, TN 37830, abe@ornl.gov

ESAXIS is an internet-based information system that establishes a single addressable integrated system which accesses and analyzes disparate information available on the internet or in proprietary databases, through the use of intelligent search engines, employing fuzzy logic and pattern matching algorithms.

#### 2) Requirements for Operations Other Than War Analytic Tools, Dean S. Hartley, Oak Ridge Ntl. Labs., 1099 Commerce Park, Oak Ridge, TN 37830-8627, dhx@ornl.gov

Recently, the Unified and Specified Commands developed a set of requirements for the analytic tools that are needed to support OOTW. These 22 requirements will be discussed. It is hoped that the community will work on producing the required tools.

### TA32 Business, Engineering & Modeling in Telecommunication Systems

Sponsor: INFORMS Technical Section on Telecommunications  
Sponsored Session

Chair: Youngho Lee, US WEST Advanced Tech., 4001 Discovery Dr., Ste. 280, Applied Research, Boulder, CO 80303, yhlee@advtech.uswest.com

#### 1) Optimization Modeling Therapy for Large, Disorganized Companies, Tony Cox, Cornerstone Consulting, 999 18th St., Denver Place S Tower Ste. 3220, Denver, CO 80202, tonycox@cnrstn.com

Profit and growth in large telecommunications companies can be limited by poor coordination among divisions. Breakdowns in information (how do my division's actions affect corporate profit?), incentives and coordination impair decision making. We describe how business simulation and optimization modeling can help restore essential information flows and improve team performance.

#### 2) Solving a Dynamic Routing Communications Network Design Problem Using Tabu Search, Jiefeng Xu, Univ. of CO, Sch. of Bus., CB 419, Boulder, CO 80309-0419, jiefeng.xu@colorado.edu, Steve Y. Chiu, Fred W. Glover

Optimizing trunk capacity in a dynamic routing network is an important and challenging telecommunication problem. Traffic can be routed over a 1-link direct path or over a 2-link alternate path. Routing plans can be changed dynamically as the traffic changes. We solve this problem by an effective tabu method.

#### 3) Separability of Forecasting & Decision Models in Decision Support Systems, Paul Thompson, US WEST Advanced Tech., 4001 Discovery Dr., Boulder, CO 80303, pthomps@advtech.uswest.com, Jason Rupe

Management DSSs commonly contain forecasting and decision functions. Using concepts from optimal control theory, we develop conditions under which these component functions are separable, i.e., where changes to the forecasting model are equivalent to corresponding changes to the decision model in terms of the output structure. These provide valuable insight into optimal design criteria for component models of DSSs.

#### 4) Robust Optimization & Strategy Development, N. R. Natraj, US WEST Advanced Tech., 4001 Discovery Dr., Boulder, CO 80303, Manuel Laguna

We present a model based on robust optimization that can be used to analyze the impacts of strategic decisions on resource allocation in uncertain environments. This model can be used to make optimal resource allocation decisions through optimal choice of strategies to implement. We discuss some approaches to solving the model and present computational results.

### TA34 PANEL: Organizational Information Systems - Strategic Directions & Implications

Cluster: Management Information Systems  
Invited Session

Chair: Theo Addo, San Diego State Univ., IDS Dept., San Diego, CA 92182-8234, theo.addo@sdsu.edu

#### 1) PANEL: Organizational Information Systems - Strategic Directions & Implications, Sanford Ehrlich, Lawrence Rhyne

No abstract supplied.

### Tuesday 10:00-11:30

#### TB01 Keynote: Marketplace Issues - Health Care in the 21st Century

Keynote Session

Chair: James Hudak, Andersen Consulting, 100 William St., Wellesley, MA 02181

#### 1) KEYNOTE: Marketplace Issues - Health Care in the 21st Century, James Hudak, Andersen Consulting, 100 William St., Wellesley, MA 02181

This presentation will explore market positioning strategies that are emerging in the health care industry and will discuss how plans can overcome the barriers to establishing a competitive position in a changing and evolving health care marketplace.

#### TB04 Emergency Service & Facility Location

Cluster: Public Sector Applications

Sponsor: INFORMS Section on Public Programs & Processes

Invited/Sponsor Session

Chair: Marvin B. Mandell, UMBC, Policy Sci. Grad. Program, 1000 Hilltop Circle, Baltimore, MD 20250, mandell@umbc.edu

#### 1) Neural Network Prediction of EMS Call Demand, Michael W. Hubble, Western Carolina Univ., Dept. of Health Sci., Emergency Medical Care Program, Cullowhee, NC 28723, mhubble@wcvax1.wcu.edu

Standard regression techniques dominate much of the previous work in forecasting demand for EMS services. Neural networks represent an alternative to standard regression forecasting methods. Preliminary results are provided from a neural network model used to predict the temporal and spatial variation of call demand in an urban EMS system.

#### 2) Who's in Control? Reconciling 911 with Community Policing, Gerard Murphy, Baltimore County Police Dept., Office of the Chief, 700 E Joppa Rd., Towson, MD 21286

Cellular phones, non-emergency calls and increasing workload threaten to overwhelm police 911. This overworked system jeopardizes public safety and hinders the crime prevention and problem analysis efforts of officers. A suburban police department looks for ways to manage 911 before it cripples community policing. Can OR help?

#### 3) EMS Priority Dispatch & Optimal Facility Location, Marvin B. Mandell, UMBC, Policy Sci. Grad. Program, 1000 Hilltop Circle, Baltimore, MD 20250, mandell@umbc.edu

EMS priority dispatch systems are intended to spare ALS personnel from less serious calls for service, thereby increasing their availability for critical incidents. We examine how priority dispatching influences the optimal location of emergency units along with the tradeoffs associated with different combinations of ALS and BLS units.

#### TB05 Multiobjective Linear Programming

Cluster: Linear Programming

Invited Session

Chair: Jerald P. Dauer, Univ. of TN, Dept. of Math., Chattanooga, TN 37403-2598, jdauer@utcvn.utc.edu

Co-Chair: Yi-Hsin Liu

#### 1) Generating the Efficient Outcome Set in Multiple Objective Linear Programs: The Bicriteria Case, Harold P. Benson, Univ. of FL, Dept. of Dec. & IS, 351 BUS Bldg., Box 117169, Gainesville, FL 32611-7169, cyeonwc@nervm.nerdc.ufl.edu

An algorithm called OUTSET is presented that generates the efficient outcome set of a multiple objective LP with 2 objective functions. Unlike standard algorithms, OUTSET does not attempt to generate the efficient decision set. As

a result, OUTSET is suitable for very large problems.

**2) Multiple Objective Solution for Tetris, Michael M. Kostreva,** Clemson Univ., Dept. of Math. Sci., Martin Hall, Clemson, SC 29634-1907, flstgla@clemson.edu, **Rebecca Hartman**

The electronic game Tetris is among the most popular games in history, with more than 40 million copies sold. Multiple objective dynamic programming shows how to obtain a Pareto optimal strategy within a discrete optimal control formulation. Four objective functions derived from players' experience are scalarized for practical implementation.

**3) Experimental Evaluation of Methods for Deriving Ratio Priorities, Eng Ung Choo,** Simon Fraser Univ., Fac. of Bus. Admin., Burnaby, BC, V5A 1S6, Canada, **Bertram Schoner, William C. Wedley**

Numerous methods have been proposed for deriving priority vectors from pairwise comparison matrices based on different underlying assumptions. We compare the effectiveness of these methods by evaluating their results from computer simulated data matrices. Three criteria are used to rank the accuracy of the resulting priority vectors.

**4) An Augmented Lagrangian Scalarization for Multiple Objective Programming, Matthew L. Tenhuisen,** Univ. of NC, Math. Sci. Dept., 601 S College Rd., Wilmington, NC 28403-3297, tenhuis@cms.uncwil.edu, **Margaret M. Wiecek**

The MOP is related to its epsilon-constraint single objective counterpart for which an augmented Lagrangian is developed. The resulting scalarization generates approachable points that are identified as locally and/or globally efficient solutions of the MOP.

**5) Optimization Over the Efficiency Set via Bilevel Linear Program, Yi-Hsin Liu,** Univ. of NE, Dept. of Math. & Comp. Sci., 60th & Dodge Sts., Omaha, NE 68182-0243, liu@cwis.unomaha.edu, **Jerald P. Dauer**

Selecting an optimal solution of a certain function over an efficient solution set of a MOLP is formulated as a bilevel LP. We discuss and develop a solution algorithm.

## TB06 Solution of Combinatorial Problems

**Cluster: Combinatorial Optimization**  
**Invited Session**

**Chair: Monique Guignard,** Univ. of PA, Wharton Sch., 1300 SH-DH, 3620 Locust Walk, Philadelphia, PA 19104-6366, guignard@dantzig.wharton.upenn.edu

**1) Theoretical Limitations to the Dual Procedure for Calculating Lower Bounds on the Quadratic Assignment Problem, Peter M. Hahn,** 1416 Park Rd., Elverson, PA 19520, 73114.3141@compuserve.com, **Siddharth Mahajan, A. Ornatsky**

The dual procedure for QAPs provides efficient bounding for a B&B solution. Here, the QAP is iteratively reformulated in a series of equivalent QAPs, producing increasing lower bounds. We present the theoretical limit to these lower bounds and compare this to bounds for several test instances. The relationship of bounds to iterations is investigated.

**2) Quadratic Assignment Problems in Real World Applications, Gyana R. Parija,** IBM OSL, 522 South Rd., Poughkeepsie, NY 12601-5400, **Robert H. Clark**

QAPs arise in real world applications such as keyboard design, airport gate planning, hospital layout, machine location and the ordering of interrelated data on magnetic tapes. We present computational results of using OSL in IBM's RS/6000 and SP2 platforms to solve a set of QAPs.

**3) On the Use of Lagrangean Relaxation & Penalties within Branch & Bound, Monique Guignard,** Univ. of PA, Wharton Sch., 1300 SH-DH, 3620 Locust Walk, Philadelphia, PA 19104-6366, guignard@dantzig.wharton.upenn.edu, **Xiaopei Wang, Siwhan Kim**

We study the use and efficiency of Lagrangean relaxation and Lagrangean penalties within B&B, using either a specialized code or BAOBAB, a B&B shell in C++ (Chevalier, University of Louvain). BAOBAB uses relaxation for bounding and lets the user define branching rules. We discuss applications and present computational results.

**4) Logical Processing: Extensions, Old & New, Kurt Spielberg,** IBM, 100 N 22nd St., Unit 134, Philadelphia, PA 19103, kurtspie@vnet.ibm.com, **Monique Guignard**

In A we recommend for difficult (M)IP models (logical degree large): user introspection plus semi-automatic generation and processing of (0,1) inequalities in response to variable settings. B discusses striking computational improvements from double contraction and setting BB priorities, using A. C

deals with probing in "constraint tightening" of L. Escudero.

## TB07 Statistical Inference in Queueing Models

**Cluster: Estimation & Approximation in Queueing Systems**  
**Invited Session**

**Chair: Sudha Jain,** Univ. of Toronto, Dept. of Stats., Toronto, Ontario, M5S 1A1, Canada, jainsu@utstat.utoronto.ca

**1) Statistical Estimation of Tail Probabilities in Queueing Networks, Marcelo Torres,** Stanford Univ., Dept. of OR, Stanford, CA 94305-4022, marcelo@stochastic.stanford.edu, **Peter W. Glynn**

Connection-oriented communication networks are populated by connections whose stochastic behavior is unknown a priori. Some proposed congestion management schemes base decisions on the observed behavior of traffic sources. Our presentation focuses on various statistical estimators that arise in trying to predict loss (or equivalently, tail) probabilities at switches in such networks.

**2) Sensitivity of Output Performance Measures to Input Distributions in Queueing Modeling, Donald Gross,** George Mason Univ., Dept. of OR & Eng., Sch. of IT & Eng., Fairfax, VA 22030-4444, dgross1@gmu.edu, **Man Juttijudata**

For a G/G/1 queue, selecting standard 2-parameter distributions for arrival and service processes, wherein the first 2 moments are fit from data, can often lead to wide discrepancies in output performance measures. In many cases, 5 moments must be captured for adequate results.

**3) Recent Developments in Priority Queues with General Arrival Streams or in Tandem, David Stanford,** Univ. of Western Ontario, Dept. of Stat. & Actuarial Sci, London, Ontario, N6A 5B7, Canada, stanford@stats.uwo.ca

We review exact results for priority queues with at least one general arrival stream. A commonly used method for calculating average delay is shown to be inexact when higher priority arrivals are non-Poisson. QBD results for Poisson-arrival priority queues in tandem are presented.

**4) Estimation in Stochastically Ordered Queues, Sudha Jain,** Univ. of Toronto, Dept. of Stats., Toronto, Ontario, M5S 1A1, Canada, jainsu@utstat.utoronto.ca

The principle of stochastic ordering is applied to compare performance measures, such as waiting times of 2 queueing systems. Monte Carlo simulation is employed to study the behavior of such systems. The practical utility of stochastic comparisons is discussed under both moderate and heavy traffic conditions.

## TB08 Integer Programming II

**Contributed Session**

**Chair: Behrokh Khoshnevis,** Univ. of Southern CA, Los Angeles, CA 90089-0193, khoshnev@atlas.usc.edu

**1) A Mixed-Integer Linear Programming Formulation for the Integration of Process Planning & Scheduling Problem, Wei Tan,** TYECIN Systems, Inc., 4 Main St., Los Altos, CA 94022, weitan@tyecin.com, **Behrokh Khoshnevis**

We describe an MILP formulation for solving the minimum makespan problem of integrated process planning and scheduling. Our approach models the choice of alternate process plans, sequencing of features to be processed on the same machine and sequencing of features on the same part as a single formulation. Computational testing shows our approach yields better results than other approaches in a reasonable solution time.

**2) A New Approach to Solve the Combined Location-Routing Problem, Lenin Kailasammani,** Case Western Reserve Univ., 2749 Euclid Heights Blvd. #1, Cleveland Heights, OH 44106, mlk001@enr.latech.edu

A hierarchical structure with location as the main problem and routing as a subordinate problem is considered. Interestingly, capacity of depots and maximum fleet size at each depot are included in the proposed location-routing method. An SA algorithm is used to improve the solution further.

**3) Understanding the Structure of Quadratic Assignment Problems, Bharat K. Kaku,** Univ. of MD, Coll. of Bus. & Mgmt., College Park, MD 20742-7215, bkaku@bmgmtmail.umd.edu

We investigate the structure of the QAP and develop a classification scheme for these problems using criteria and measures that would be meaningful to practitioners.

**4) An Integer Programming Formulation of the U-Line Balancing Problem, Vinayak V. Deshpande,** Univ. of PA, Wharton Sch., 1300 SH-DH, 3620 Locust Walk, Philadelphia, PA 19104,

deshpa52@wharton.upenn.edu, **Kumar Rajaram, Monique Guignard**

We develop an IP-based formulation of the U-line balancing problem and develop a solution procedure based on Lagrangean relaxation. Two intuitive heuristics are proposed to improve the solution. Computational results indicate that this method provides an efficient basis to solve several practical large-sized problems to optimality.

#### TB09 Scheduling II Contributed Session

**Chair:** Craig W. Schmidt, Carnegie Mellon Univ., Dept. of Chem. Eng., Pittsburgh, PA 15213, cs76@andrew.cmu.edu

1) **Scheduling R&D Tasks with Uncertain Durations to Maximize Expected Value**, **Craig W. Schmidt**, Carnegie Mellon Univ., Dept. of Chem. Eng., Pittsburgh, PA 15213, cs76@andrew.cmu.edu, **Arthur Hsu, Ignacio E. Grossmann**

We consider heuristic techniques to schedule tasks to maximize the expected value of R&D projects where task failure may lead to project termination. We completely model uncertain task durations to obtain the overall project duration distribution. We report computational results on an actual agricultural chemical new product development process.

2) **A Computer Scheduling Simulation of a University Registration Priority Process**, **Gordon D. Johnson**, CA State Univ., Dept. of MS, Northridge, CA 91330-8245, gordon.johnson@csun.edu, **Catherine A. Romack**

A simulation of student progress towards the Bachelor's degree in Business will compare the number of semesters needed to complete the upper division Business core under the existing priority vs. proposed alternatives. The criterion is the average number of semesters to complete the upper division core.

3) **Conference Scheduling**, **Susan Lash**, IL State Univ., 308 Harper Ct., Normal, IL 61761, sslash@rs6000.cmp.ilstu.edu

We present a method for conference scheduling. Several parallel sessions are offered and the objective is to schedule the presentations so that each participant can attend as many of their preferences as possible.

4) **A Sequential Knapsack Heuristic for Course Scheduling**, **Nathan Y. Chan**, Decision Focus Inc., 650 Castro St., Ste. 300, Mountain View, CA 94041, nathan@dfi.com, **Kenneth J. Wapman**

A heuristic algorithm is presented for generating a multi-week schedule of courses at multiple-classroom facilities. The algorithm involves a myopic sequence of knapsack problems and incorporates various technical, business and financial constraints. A summary of an actual effort for a major software firm is presented.

#### TB10 Supply Chains: Improving Customer Service Through Postponement

**Cluster:** Supply Chain  
Invited Session

**Chair:** Michael J. Magazine, Univ. of Cincinnati, Dept. of QAOM, PO Box 210130, Cincinnati, OH 45221-0130, mike.magazine@uc.edu

1) **Contracting to Minimize the Cost of Customer Service Under Demand Uncertainty**, **Karen Donohue**, Univ. of PA, The Wharton School, Philadelphia, PA 19104-6366, donohuek@opim.wharton.upenn.edu

We examine a problem of moral hazard that arises when demand forecast accuracy is influenced by both marketing research efforts and manufacturing leadtime reduction efforts. Borrowing from Juran, we divide the cost of supporting high customer service in this environment into 4 categories and examine how cost allocation among categories is influenced by the contracting scheme used.

2) **Is Postponement Always Beneficial?**, **Amit Garg**, IBM, TJ Watson Res. Ctr., PO Box 218, Yorktown Heights, NY 10598, agarg@watson.ibm.com, **Nitin Nayak, Rangarajan Jayaraman**

We present results of an analysis of worldwide supply chain of IBM's Storage Systems Division. Our study examined various postponement alternatives in order to reduce inventories and cycles times and found that postponement may not always be the most cost-effective solution. We also identify some key drivers of benefits accruing from postponement.

3) **Managing the Design of Assembly Sequences for Delayed Product Differentiation**, **Jayashankar M. Swaminathan**, Univ. of CA, Haas Sch. of Bus., Berkeley, CA 94720, **Sridhar R. Tayur**

An important and challenging issue while designing a product line deals with determining an efficient and consistent final assembly sequence for products. In

recent years, increase in product variety has influenced manufacturers to delay differentiation of products, complicating the above problem further. We provide an integrated model to analyze generation of efficient assembly sequences...

4) **Factors Affecting the Packaging Postponement Decision**, **Greg Graman**, Univ. of Cincinnati, Dept. of QAOM, PO Box 210130, Cincinnati, OH 45221, **W. David Kelton, Michael J. Magazine**

A given houseware product is packaged in several carton configurations. Packaging prior to demand realization may result in high inventories and/or low service levels. Identification of products which benefit from packaging postponement requires examination of inventory costs, service level, product volume and value and demand variability and correlation.

#### TB11 Tourism Research I

**Cluster:** Tourism  
Invited Session

**Chair:** Abraham Pizam, Univ. of Central FL, Dept. of Hospitality Mgmt., PO Box 161400, Orlando, FL 32816-1400, abraham.pizam@bus.ucf.edu

1) **Tourism Planning: Traditions & Developments**, **Michael Hall**, Univ. of Canberra, Faculty of Communication, PO Box 1, Belconnen, ACT 2616, Australia, cmjh@comserver.canberra.edu.au

We provide an overview of the various traditions of tourism planning and their development. We argue that tourism planning has developed from primarily within a regional and urban planning framework and has had little relationship until recently with developments in public administration and business planning fields. We conclude that such a situation has resulted in an inadequate conceptualization of tourism product and planning approaches.

2) **Behavioral Research in Tourism Marketing: Conceptual & Methodological Challenges**, **Brent Ritchie**, Univ. of Calgary, Faculty of Mgmt., Scofield Hall, Calgary, Alberta, T2N 1N4, Canada, britchie@mgmt.ucalgary.ca

We focus on the particular challenges which researchers face in adapting and extending traditional behavioral research methods to the field of tourism marketing. We summarize the most important conceptual paradigms adopted in tourism and identify topic areas where conceptual foundations remain weak. We then examine particular methodological difficulties faced by tourism marketing researchers...

#### TB12 Advances in Computational Methods for Reasoning Under Uncertainty

**Sponsor:** INFORMS CSTS  
Sponsored Session

**Chair:** Eric Horvitz, Microsoft Research, Decision Theory Group, Redmond, WA 98052-6399, horvitz@microsoft.com

1) **Abstraction & Approximation Techniques for Fully Observable Markov Decision Processes**, **Craig Boutilier**, Univ. of British Columbia, Dept. of Comp. Sci., Vancouver, BC, V6T 1Z4, Canada, cebly@cs.ubc.ca

We describe recent methods for abstraction and approximation in the solution of FOMDPs that exploit compact problem representations of system dynamics and reward functions, e.g., Bayesian networks. Using these representations to discover the (degree of) relevance of various system features, we present 3 techniques that solve MDPs without explicit state-space expansion.

2) **Real-Time Evaluation of Influence Diagrams**, **Bruce D'Ambrosio**, OR State Univ., Dept. of Comp. Sci., Corvallis, OR 97331, dambrosi@research.cs.orst.edu

Real-time decision algorithms are a class of incremental resource-bounded (Horvitz, 89) or anytime (Dean, 93) algorithms for evaluating influence diagrams. We present a test domain for real-time decision algorithms and the results of experiments with several real-time decision algorithms in this domain. Results demonstrate high performance for 2 algorithms...

3) **Efficient Alternatives to Monte Carlo Simulation for Propagation of Uncertainty**, **Max Henrion**, The Decision Laboratory, 4984 El Camino Real # 105, Los Altos, CA 94022-1433, henrion@lumina.com, **Sky Coyote, Rich Sonnenblick**

Quasi-random sampling methods have been proposed as more efficient than Monte Carlo and Latin hypercube sampling for uncertainty analysis in large probabilistic models. We present experimental results showing that little-known quasi-random methods can provide significant advantages in efficiency for important classes of model.

4) **Learning Bayesian Networks: State of the Art & Challenges**,

**Moises Goldszmidt**, SRI Intl., Ravenswood Ave., Menlo Park, CA 94025, moises@erg.sri.com

I will overview the state-of-the-art in methods for the automatic induction of Bayesian networks from data, put these methods in perspective with respect to statistical pattern recognition and describe applications and challenges driving the research. These applications include data mining, multimedia databases, classification, human-computer interaction and intelligent agents.

**5) Embedded Automated Decision Making in the Personal Computing Environment**, *Eric Horvitz*, Microsoft Research, Decision Theory Group, Redmond, WA 98052-6399, horvitz@microsoft.com

I will describe advances in the application of probability and utility for embedded decision making in the personal computing milieu and detail how probabilistic and decision-theoretic inference can be harnessed to enhance the value of computing applications. I will address applications of embedded inference for addressing problems with human-computer interaction and for controlling computation.

### **TB13 Reports from the Front: Case Studies in Real-World OR Consulting II**

**Sponsor:** INFORMS CSTS

**Sponsored Session**

**Chair:** Sanjay Saigal, Compass Modeling Solutions, Inc., 1005 Terminal Way, Ste. 100, Reno, NV 89502, saigal@modeling.com

**1) OR Models & the "Management Information Value Chain"**, *Robert Phillips*, Decision Focus Inc., 650 Castro St., Ste. 300, Mountain View, CA 94041-2055, bobp@dfi.com

An OR model can be thought of as a single link in a MIVC that converts raw data into decisions. The success of the model depends on the strength of all the links. Implications for successful implementation are discussed.

**2) Challenges in the Implementation of OR Models in Industry**, *Adriana Deiner*, AddVal Technology, Inc., 1021 S Wolfe Rd., Ste. 265, Sunnyvale, CA 94086, adriana@addval.com

We focus on data collection and modeling issues in implementing commercial OR models. We explore topics such as how data gathering and cleansing efforts relate to model implementation time, ease of use vs. model sophistication as a success predicate and incorporating knowledge of client sophistication in the design process.

**3) Critical Success Factors in Implementing Math Programming Models**, *J. B. Moore*, Univ. of Waterloo, Dept. of MS, Waterloo, Ontario, N2L 3G1, Canada, jbmoores@mansi.watstar.uwaterloo.ca

Two design activities contribute measurably to the success or failure of implementing non-trivial decision support models - the quality of the user interface and the database design. We provide advice and examples based on the author's experience in designing and implementing a significant number of successful PC-based mathematical-programming DSS.

**4) Operations Research in Practice**, *Charles J. McCallum, Jr.*, AT&T Labs., 101 Crawfords Corner Rd., HO 3L-323, Holmdel, NJ 07733-3030, cjmc@mailnet.ho.att.com

OR has a rich history at AT&T, visible from at least the 1950s. This period has seen change both in the field of OR and at AT&T, resulting in some interesting stories as OR theory has been put into practice. Some lessons learned are illustrated through real-life examples.

### **TB14 Solid Waste Management Decision Support**

**Sponsor:** INFORMS Section on Environment

**Sponsored Session**

**Chair:** William Brent Nixon, AFIT/ENV, Dept. of Eng. & Environ. Mgmt., 2950 P St., Bldg. 640, WPAFB, OH 45433-7765, bnixon@afit.af.mil

**1) A Decision Support Model for MSW Management**, *Jack Kloeber*, Dept. of the Air Force, AFIT/ENS, 2950 P St., Bldg. 640, WPAFB, OH 45433, jkloeber@afit.af.mil, *John F. Muratore*

A model was developed to assist municipal solid waste managers in selection of a strategy to maximize compliance with the EPA hierarchy for waste management while minimizing social and financial costs. The model considers marginal costs and benefits of reduction, composting, recycling, incinerating and landfilling of the waste stream.

**2) Decision Analytic Model of MSW Recycling Strategies**, *Greg A. Williams*, AFIT/ENV, 2950 P St., WPAFB, OH 45433, gwilliam@afit.af.mil, *Jack Kloeber*

A model was developed which considers 4 methods of recycling solid wastes for residential and operational areas of Air Force installations. Probabilistic participation rates and market prices allow analysis under uncertainty. Financial and waste diversion results are shown for each strategy, allowing selection of preferred strategy.

**3) Determining the Social Value in MSW Management Decisions**, *Camille M. Still*, AFIT/ENV, 2950 P St., WPAFB, OH 45433, cstll@afit.af.mil, *Jack Kloeber*

Environmental managers use technological means to design solid waste management systems. However, programs that reduce waste require behavioral changes that depend on participants' attitudes and motivations. Convenience, environmental consciousness and recreation value can and should be considered when environmental managers determine solid waste strategies.

**4) A Decision Support Model to Select Optimal MSW Management Policy**, *Johnathon L. Dulin*, AFIT/ENS, 2950 P St., WPAFB, OH 45433, jdulin@afit.af.mil, *Jack Kloeber*

We use DA to select a waste management policy which maximizes environmental value and diversion from landfills and minimizes cost at Air Force installations. It makes decisions regarding waste streams and levels to reduce, compost, recycle and incinerate, considering the uncertain values of the decision maker.

### **TB15 Network Optimization**

**Cluster:** Network Flows

**Invited Session**

**Chair:** James B. Orlin, MIT, Rm. E53-357, Sloan Sch. of Mgmt., Cambridge, MA 02139, jorlin@mit.edu

**1) Min Cuts Without Max Flow**, *Te Chiang Hu*, Univ. of CA, Comp. Sci. Dept., La Jolla, CA 92093, hu@cs.ucsd.edu, *M. T. Shing*

We review papers which obtain minimum cuts without first obtaining maximum flows. We also discuss more recent results.

**2) Solving Inverse Optimization Problems in Polynomial Time**, *Ravi Ahuja*, Rutgers Univ., Dept. of MSIS, Sch. of Bus., PO Box 5062, New Brunswick, NJ 08903-5062, ahuja@rutcor.rutgers.edu, *James B. Orlin*

Given a non-optimal solution  $x^*$  for an optimization problem, the "inverse" optimization problem is to perturb the cost data by a minimum amount so that  $x^*$  is optimal for the perturbed problem. We consider inverse optimization problems for a large number of network and combinatorial optimization problems.

**3) Finding K-Route Flows Efficiently**, *Charu Aggarwal*, IBM, TJ Watson Res. Ctr., PO Box 704, Yorktown Heights, NY 10598, charu@watson.ibm.com, *James B. Orlin*

An elementary K-route flow in a network  $G=(N,A)$  is a 0-1 flow of exactly K units from the source node  $s$  to the sink node  $t$ . A K-route flow is any flow that may be expressed as a non-negative sum of elementary K-route flows. We give elegant and surprisingly efficient algorithms for finding maximal K-route flows.

### **TB16 Technology Commercialization for Superior Performance**

**Sponsor:** INFORMS Section on Technology Management

**Sponsored Session**

**Chair:** R. Ray Gehani, Rochester Inst. of Tech., 108 Lomb Memorial Dr., Rochester, NY 14623, rrgbbu@rit.edu

**1) Effectively Managing Global Product Development Teams**, *Edward F. McDonough, III*, Northeastern Univ., Coll. of Bus. Admin., Boston, MA 02115, *Kenneth B. Kahn*, *Abbie Griffin*

We look at the managerial actions that project leaders take to promote communication in GNPTs. Managing global new product projects effectively requires the use of multiple types of communication mechanisms. But our understanding of these communication mechanisms, their impact and their capabilities is very limited...

**2) The Impact of Innovation Sources & Types on Organizational Performance**, *Shanthi Gopalakrishnan*, Fairleigh Dickinson Univ., Teaneck, NJ 07666

To create value from innovations, executives need to make 2 interrelated decisions. The first, to select the right type of innovations, radical vs. incremental, congruent with a firm's context. The second is to decide whether firms should rely on internal or external sources for innovations. Using data from 101 commercial banks, we examine the impact of innovation types on organizational performance...

**3) The Role of Complimentary Competencies in Technology**

**Commercialization, R. Ray Gehani**, Rochester Inst. of Tech., 108 Lomb Memorial Dr., Rochester, NY 14623, rrgbbu@rit.edu

We discuss the significant role of various complimentary competencies in the commercialization of technology. Their impact will be discussed with respect to generation of superior performance for a technology-driven firm. Influence of some external environmental variables will be included to introduce the contingency effect in the resource-based view of strategy.

**TB17 Market Trading, Bidding & Settlement Models for Electric Power**

**Sponsor:** INFORMS Section on ENRE  
**Sponsored Session**

**Chair:** Hung po Chao, Electric Power Research Inst., Hillview Ave., PO Box 10412, Palo Alto, CA 94303, hchao@eprinet.epri.com

1) **An Institutional Design for an Electricity Contract Market with Central Dispatch, Hung po Chao**, Electric Power Research Inst., Hillview Ave., PO Box 10412, Palo Alto, CA 94303, hchao@eprinet.epri.com, **Stephen C. Peck**

We present an incentive compatible institutional design that fully explores the economic efficiency of an electric contract market via a power exchange while fostering real-time dispatch efficiency and reliability via a system operator.

2) **Games & Strategies in the Evolving Electric Power Market, Paul R. Kleindorfer**, Univ. of PA, Wharton School, Philadelphia, PA 19104-6366, **Dongjun Wu**

We present an overview of strategic games used for understanding effective company and regulatory strategies for various market participants under alternative scenarios on pricing and institutional structures for the ISO, contract and spot markets in electric power. We discuss recent experience with these "gaming" approaches and associated research challenges.

3) **Coordinated Multilateral Trades for Power, Pravin Varaiya**, Univ. of CA, Elec. Eng. & Comp. Sci., Berkeley, CA 94720, varaiya@ees.berkeley.edu, **Felix Wu**

A minimal independent system operator, ISO, is described and compared with the maximal ISO proposed by the California Public Utility Commission.

**TB18 TUTORIAL: Bucket Brigades - An Example of Self-Organizing Logistic Systems**

**Invited Session**

**Chair:** John J. Bartholdi, III, GA Inst. of Tech., Sch. of ISyE, Atlanta, GA 30332, john.bartholdi@isye.gatech.edu

1) **TUTORIAL: Bucket Brigades - An Example of Self-Organizing Logistics Systems, John J. Bartholdi, III**, GA Inst. of Tech., Sch. of ISyE, Atlanta, GA 30332, john.bartholdi@isye.gatech.edu

Social insects operate logistics systems that are highly effective even without blueprint or management. Instead, global coordination emerges spontaneously through the multiple interactions of many simple components. In a similar way, when workers on a flow line are organized into "bucket brigades," they can function as a self-organizing system that spontaneously achieves its own optimum configuration...

**TB19 Optimization III**  
**Contributed Session**

**Chair:** Dietmar Kunde, Naval Postgrad. Sch., OR Dept., Monterey, CA 93943, dmkunde@nps.navy.mil

1) **Interval Flow Networks: Enhancement & Applications, Aruna Apte**, SMU, Dept. of Comp. Sci. & Eng., Dallas, TX 75275-0122, aapte@seas.smu.edu, **Richard S. Barr**

The interval flow network model is a disjunctive programming problem in which the flow on some or all of the arcs is restricted to be either within a specified range or 0. We present some enhancements of this model and of applications and new solution approaches for this important class of networks.

2) **Optimization of Form Assembly for the Armed Services Vocational Aptitude Battery, Dietmar Kunde**, Naval Postgrad. Sch., OR Dept., Monterey, CA 93943, dmkunde@nps.navy.mil, **Robert F. Dell, Isif A. Krass, Gary Thomasson**

The Armed Services Vocational Aptitude battery test is given to about 900,000 applicants each year. Creating this test consists of assigning questions from a question pool to multiple forms. We describe a MILP developed to create forms and how its solution has helped to develop better forms.

**TB20 Traffic Control Techniques for Urban Networks**

**Sponsor:** INFORMS Transportation Science Section

**Sponsored Session**

**Chair:** K. Larry Head, Univ. of AZ, SIE Dept., Tucson, AZ 85721

1) **Estimation & Prediction in a Real-Time Traffic Adaptive Signal Control Logic: The RHODES Prototype, K. Larry Head**, Univ. of AZ, SIE Dept., Tucson, AZ 85721, **Pitu B. Mirchandani, Steve Shelby**

The estimation and prediction of several important traffic parameters, including queue size, saturation flow rate, turning percentages and future arrivals in a real-time setting are discussed. Accurate estimation is essential for effective real-time control. We discuss these issues within the framework of the RHODES real-time control prototype.

2) **Signal Control & Route Guidance in a Congested Traffic Network Under Time-Varying Demands: A Formulation & Solution Algorithm, Akmal Abdel-Fatah**, Univ. of TX, Dept. of Civil Eng., Austin, TX 78712, **Hani S. Mahmassani**

We consider the problem of a central controller seeking to jointly set signals and route tripmakers to optimize system performance. A mathematical formulation of the problem is given and a heuristic algorithm that relies on a simulation-based time-dependent assignment procedure is presented. Numerical examples are discussed.

3) **A Network-Coordinated Signal Control Formulation with Explicit Platoon Movement Constraints, Wann-Ming Wey**, Univ. of CA, Civil & Env. Eng., Irvine, CA 92697, **R. Jayakrishnan**

We present a network-coordinated formulation for the traffic signal optimization problem. The link traffic flows are modeled based on platoon dispersion, captured through a set of arcs in a linear network flow program. A special purpose network simplex algorithm developed to handle the fixed fraction flow split problem is discussed. Some computational results are also provided.

4) **A Multi-Objective Control Framework for Integrated Freeway-Surface Street Control, Douglas M. Gettman**, Univ. of AZ, SIE Dept., Bldg. 20, Rm. 111, Tucson, AZ 85721, **K. Larry Head, Pitu B. Mirchandani**

Existing freeway control systems limit access to maximize vehicle throughput. When vehicles are denied access, they cause increased congestion at the interchange. Some interchanges are better suited than others to manage the congestion. We present a framework that considers the multiobjective problem of maximizing freeway throughput and minimizing interchange congestion.

**TB21 Transportation IV**  
**Contributed Session**

**Chair:** A. Futer, Sci. App. Intl. Corp., 3 Cambridge Ctr., Cambridge, MA 02142, futer@volpe5.dot.gov

1) **Measurements of Air Traffic Management Software Performance, A. Futer**, Sci. App. Intl. Corp., 3 Cambridge Ctr., Cambridge, MA 02142, futer@volpe5.dot.gov, **L. Epstein, M. Kenny**

The FAA is sponsoring the development of the enhanced traffic management system, ETMS, to provide mechanisms for resolving air traffic congestion problems. Analysis of ETMS performance was conducted based on a number of metrics. The analysis indicated problem areas and suggested solutions. Based on this analysis, ETMS performance is being substantially improved.

2) **Optimal Airline Seat Allocation with Overbooking, Wen Zhao**, Univ. of PA, 1300 SH-DH, 3620 Locust Walk, Philadelphia, PA 19104, zhao75@opim.wharton.upenn.edu, **Yu-Sheng Zheng**

We characterize the optimal booking policy for flights with multiple classes and possible no-shows. We show that the nested class policy, which reserves a fixed number  $k(m)$  of seats for the highest  $m$  classes, may not be optimal when no-shows are allowed.

3) **The Airline Passenger Mix Problem with Recapture, Timothy S. Kniker**, MIT, OR Center, 77 Mass Ave., Rm. E40-130, Cambridge, MA 02139, knish@mit.edu, **Cynthia Barnhart, Ahmad Jarrah**

We present an LP formulation of the assignment of passengers to flight legs in an airline network. Our model incorporates the effects of spill and recapture. It is quickly solved using a column generation approach where many of the constraints can be relaxed.

4) **Multimodal Load Planning for Time Definite Cargo Carriers, Cheng-Chang Lin**, Ntl. Cheng Kung Univ., Dept. of Transport MS, 1 University Rd., Tainan, Taiwan ROC, cclin@mail.ncku.edu.tw

Time definite air cargo carriers provide air express services for customer's

urgent cargoes. Multimodal load planning for carriers is to determine cargo routes and an integrated air and ground vehicle fleet to minimize the total operating cost. We will present a mathematical model, an algorithm and some computational results.

## TB22 Issues in Global Operations Management

Cluster: Global Manufacturing Practice

Invited Session

Chair: Vikas Sinha, Univ. of TX, Sch. of Mgmt., Richardson, TX 75083-0688

1) **Sourcing Strategies to Exploit Regional Capabilities, Sriram Dasu**, Univ. of Southern CA, Sch. of Bus. Admin., Los Angeles, CA 90089-1421, [sdasu@sba.usc.edu](mailto:sdasu@sba.usc.edu)

Multinationals have the opportunity to allocate different tasks in the value chain to different regions. We explore the links between product development, role of different plants and global sourcing.

2) **Manufacturing & Marketing Strategies in International Competition, George C. Hadjinicola**, Univ. of Cyprus, Dept. of Public & Bus. Admin., kallipoleos 75, Nicosia, CY1678, Cyprus, [bageorge@atlas.pba.ucy.ac.cy](mailto:bageorge@atlas.pba.ucy.ac.cy)

We examine manufacturing issues such as factory location, cost of setting up a facility, inventory, economics of scale, product design and postponement in conjunction with marketing issues such as product positioning and pricing, as well as international elements such as transportation costs and exchange rate. These factors are combined with the structure of an international enterprise to see the impact on its profitability.

3) **Global Sourcing Strategies Under Exchange Rate Uncertainty, Vikas Sinha**, Univ. of TX, Sch. of Mgmt., Richardson, TX 75083-0688, [Panos Kouvelis](mailto:Panos Kouvelis)

A firm needs to source a product from various sources, or vendors, some of whom are located in foreign countries. The firm has to choose vendors and decide on sourced quantity from each vendor. The supplier choice and sourced quantities can be adjusted dynamically at the expense of switchover costs in response to fluctuating exchange rates. We present interesting, and seemingly counterintuitive, results on the effects of the variance...

## TB23 FMS Planning & Scheduling Problems

Cluster: Flexible Manufacturing Systems

Invited Session

Chair: Kathryn E. Stecke, Univ. of MI, Sch. of Bus. Admin., 701 Tappan St., Ann Arbor, MI 48109-1234, [kstecke@umich.edu](mailto:kstecke@umich.edu)

1) **Multicriterion Decision Support for the Past Type Selection & Loading Problems of FMSs, Beate Bossert**, Univ. of Hohenheim 510A, Inst. für Betriebswirtschaft., Stuttgart, 70593, Germany, [bossert@uni-hohenheim.de](mailto:bossert@uni-hohenheim.de)

Due to changing priorities in the production planning of FMSs, it seems to be useful to involve the decision maker in the planning process. Therefore, an interactive heuristic approach for a discrete vector optimization problem with 5 objectives for the part type selection and the loading problems is proposed.

2) **Scheduling Methods for FMSs Under Tooling Constraints, Susumu Fujii**, Kobe Univ., Dept. of Comp. & Syst. Eng., Kobe, 657, Japan, [fujii@seg.kobe-u.ac.jp](mailto:fujii@seg.kobe-u.ac.jp), **Hiroshi Morita, Hirotada Matsumoto**

We propose a scheduling method for autonomous manufacturing systems under tooling constraints. Jobs and tools assigned to machining centers in the load plan are to be scheduled, maintaining the load balance of a prescribed plan. A satisfactory schedule is autonomously obtained by reassigning jobs and tools from the plan.

3) **A Bi-Criteria Multi-Purpose Machine Openshop Scheduling Problem, Shintarou Mohri**, Osaka Univ., Dept. of Appl. Physics, Fac. of Eng., Suita Osaka, 565, Japan, [sin@ap.eng.osaka-u.ac.jp](mailto:sin@ap.eng.osaka-u.ac.jp), **Hiroaki Ishii, Teruo Masuda**

An MPM can process different types of operations and it becomes a main processing tool in FMSs. We consider the openshop case of an MPM scheduling problem with bicriteria objectives of Cmax and Lmax and show a procedure to find nondominated schedules by an LP formulation.

4) **Minimizing Makespan in a Flow Shop with Parallel Machines, Sanjeev Sinha**, i2 Tech., 909 E Las Colinas Blvd., Irving, TX 75039, [sanjeev\\_sinha@i2.com](mailto:sanjeev_sinha@i2.com), **Narayan Raman**

We study a 2-stage flow shop with identical parallel machines at each stage. The problem is modeled as a mathematical program. Lower bounding and fast, efficient heuristics solution procedures are developed. The performance of the lower bound and the heuristic procedures is established through an extensive

computational study.

## TB24 Applications of Decision Analysis in Industry II

Sponsor: INFORMS Decision Analysis Society

Sponsored Session

Chair: Prakash Shrivastava, GM Technical Ctr., Eng. Ctr., MC 480-111-N26, 30200 Mound Rd., Warren, MI 48090-9010, [lnustc1.lz1nyj@gmeds.com](mailto:lnustc1.lz1nyj@gmeds.com)

1) **Decision Analytic Optimization Models for Nuclear Testing, Inspection & Maintenance, William J. McAllister**, Westinghouse Electric Corp., Sci. & Tech. Ctr., 1310 Beulah Rd., Pittsburgh, PA 15235-5098

This presentation discusses a DA framework for the development of optimal testing, inspection and maintenance of nuclear power plant components which integrate technical, regulatory and economic issues. Example plant applications are also discussed.

2) **R&D Portfolio Planning Using Decision Analysis, Robert F. Bordley**, GM Corp. R&D Ctr., R&D Portfolio Planning, 30500 Mound Rd., Warren, MI 48090-9055, [rbordley@cmsa.gmr.com](mailto:rbordley@cmsa.gmr.com)

DA has been used in planning R&D portfolios in a wide variety of major companies. This approach makes intensive use of decision hierarchies, influence diagrams, strategy tables and decision analytic interviews. This presentation reviews this literature, presents GM experience and closes with practical comments on DA approaches to R&D.

3) **Global Plant Location: An Integrated Decision Support-Based Approach, Srinivasan Rajagopalan**, RPI, Dept. of DSES, CII 5015, 110 8th St., Troy, NY 12180, [Prakash Shrivastava](mailto:Prakash Shrivastava)

We describe an approach to the global manufacturing plant location problem. Methods currently available are purely quantitative cost-based techniques. This presentation tackles the problem using a "softer" approach that considers both quantitative and qualitative factors. Different decision-making tools such as LP and decision trees are presented.

## TB25 PANEL: OR/MS in Business School Education I - Has the Bubble Burst?

Sponsor: INFORMS Forum on Education

Sponsored Session

Chair: Thomas L. Magnanti, MIT, OR Ctr., Rm. E40-147, Cambridge, MA 02139-4307, [magnanti@mit.edu](mailto:magnanti@mit.edu)

1) **PANEL: OR/MS in Business School Education I - Has the Bubble Burst?, William P. Pierskalla**, UCLA, **Robert S. Sullivan**, Univ. of TX, **Douglas D. Tuggle**, American Univ., **Thomas R. Willemain**, RPI

Although OR/MS has always been a mainstay of modern business school education, the changing climate of business schools has raised questions about the profession's relevance and positioning as part of a business school curriculum. Are the glory years behind us? Need we change, and if so, how? Panelists will report on the findings of an INFORMS Task Force on OR/MS in business schools...

## TB26 Descriptors for Point Processes

Sponsor: INFORMS Applied Probability Section

Sponsored Session

Chair: Marcel F. Neuts, Univ. of AZ, Dept. of Systems & IE, Tucson, AZ 85721

1) **Challenges in Spatial/Temporal Stochastic Modeling, V. Ramaswami**, BELLCORE, 331 Newman Springs Rd., Rm. NVC 2X-151, Red Bank, NJ 07701-7020

New developments in telecommunications in wireless and mobile communications are in need of good performance analysis tools and methods that incorporate both the spatial and temporal nature of demands and capacities. The success of modeling will also depend strongly on the identification of key measurements and on their appropriate use. We discuss key challenges in these areas and report on WIP.

2) **Point Process Measures: What Do They Tell Us?, Bo Friis Nielsen**, Technical Univ. of Denmark, Inst. of Math. Modeling, Bldg. 321, Lyngby, DK-2800, Denmark, [bfni@imm.dtu.dk](mailto:bfni@imm.dtu.dk)

To illustrate how different measures relate to queuing behavior, we compare LAN traces to sample paths of MAPs. We consider the IDC, the IDI, the SQSD, the R/S static and some properties of the marginal interarrival time distribution. We measure the corresponding queuing behavior by tail probabilities and moments of the queue length and of the fundamental period...

3) **Exploring the Behavior of Data Streams by Random**

**Transformations, Marcel F. Neuts**, Univ. of AZ, Dept. of Systems & IE, Tucson, AZ 85721

Many operations in communications engineering, such as the leaky bucket and other traffic shaping schemes, are essentially random transformations of point processes. By examining well-chosen random transformations, we can bring out qualitative features of point processes and develop mathematical tools for their quantification, i.e., decomposition of a point process into component processes by a multinomial switch...

### TB27 Strategy I

#### Contributed Session

**Chair:** Denis Lacoste, Toulouse Business Sch., 5 rue Brossolette, Toulouse, 31400, France, d.lacoste@esc-toulouse.fr

1) **Toward a Causal Model of Strategic Risk, Denis Lacoste**, Toulouse Business Sch., 5 rue Brossolette, Toulouse, 31400, France, d.lacoste@esc-toulouse.fr

We highlight the different causal variables of strategic risk, their links and the means firms can use to reduce the final risk. The proposed model allows us to point up the trade-off between different kinds of risks and between risk and return. The model is finally used to explain Bowman's paradox.

2) **Coalition Analysis in the Group Decision Support System GMCR II, Marc Kilgour**, Wilfrid Laurier Univ., Dept. of Math., Waterloo, Ontario, Canada N2L 3C5, mkilgour@mach1.wlu.ca, Xiaoyong Peng, Liping Fang

A coalition consists of 2 or more decision makers in a strategic conflict who can act jointly to benefit every coalition member. The GDSS GMCR II, implementing the graph model for conflict analysis, identifies coalitions. How coalitions and CMCR II can model agreement in a negotiation are explained and illustrated.

3) **Risk-Based Management in the Hanford Tank Waste Remediation Privatization Program: A Case Study, Mark A. Robershotte**, Battelle Pacific NW Lab., 224 Sitka Ct., Richland, WA 99352, ma\_robshotte@pnl.gov, Peter D. McLaughlin

DoE privatization of the processing of highly toxic and radioactive tank waste at Washington State's Hanford Nuclear Reservation provides an ideal environment for real world programmatic risk management. The efforts to develop, implement and maintain a comprehensive risk management program provide some significant lessons detailed in this presentation.

4) **Incorporating Diversity/Equity in Decision Models, Hayri Onal**, Univ. of IL, 305 Mumford Hall, Dept. of Ag. & Cons. Econ., Urbana, IL 61801, h-onal@uiuc.edu

We present a diversity/equity measure based on absolute deviations of outcomes from a uniform distribution, which is assumed to represent ultimate diversity/equity. Relations to group decision making and multiobjective decision making problems will be discussed. We also present empirical applications in resource management.

### TB28 PANEL: Multimedia Medical Informatics

**Cluster:** Health Care Technology, Policy & Applications

#### Invited Session

**Chair:** Ian G. Rawson, Allegheny General Hospital, 320 E North Ave., Pittsburgh, PA 15212-4772, rawson@asri.edu

1) **PANEL: Multimedia Medical Informatics, Wesly Hutchison**, Allegheny Health, Arnold Smolen, Allegheny Univ. of the Health Sciences, Warren Sterling, NCR Parallel Systems, Mark Tarlton, NCR Human Interface Tech. Ctr., Scott Stevens, Carnegie Mellon Univ.

Panelists will present trends in ITs such as digital libraries, national information infrastructure, capture and use of multimedia information and trends and applications in related fields.

### TB29 Barriers & Benefits to Supply Chain Integration

**Cluster:** Inventory Management

#### Invited Session

**Chair:** Karen Donohue, Univ. of PA, The Wharton School, Philadelphia, PA 19104-6366, donohuek@opim.wharton.upenn.edu

1) **Overcoming the Behavioral Barriers that Inhibit Integrated Logistics System Performance, James A. Narus**, Wake Forest Univ., Babcock Grad. Sch. of Mgmt., Ste. 150, 1 Morrocroft Ctr., Charlotte, NC 28211

Integrated logistics has spawned new forms of marketing channels

arrangements. While the technologies required to implement them are readily available, a variety of behavioral issues, i.e., interfirm coordination, commitment, trust and conflict, stand as barriers to widespread adoption. Based on a research stream, I offer operational definitions of these constructs, discuss their relationships and suggest ways to address them.

2) **Inventory Contracts in a Multi-Firm Supply Chain, Ananth Raman**, Harvard Bus. Sch., Morgan Hall, Boston, MA 02163, V. G. Narayanan

Frequently, firms in a supply chain have different incentives for stocking inventory, promoting demand or conducting market research. We explore inventory contracts when such differences are present and examine how trends such as better IT and weakening brands would affect the results of our study.

3) **The Impact of Information Technology on the Management of Supply Chain Inventories, Gerard Cachon**, Duke Univ., Fuqua Sch. of Bus., Box 90120, Durham, NC 27708-0120, Marshall Fisher

Using a 1 supplier-N retailer model of a supply chain, we investigate the relative and absolute impact of IT on supply chain inventory costs. Furthermore, we study how these innovations alter the allocation of costs among supply chain members. Our principle finding is that while information sharing lowers supply chain costs, this benefit is marginal relative to potential saving from the automation of current practice.

### TB30 Marine Corps Evolutions Research

**Sponsor:** INFORMS Military Applications Society

#### Sponsored Session

**Chair:** Gary E. Horne, US Marine Corp. Combat Development Command, Studies & Analysis Div., 3300 Russell Rd., Quantico, VA 22134-5130, horneg1@mqg-smtp3.usmc.mil

1) **USMC Experimentation Involving Evolutions on a Dispersed Battlefield, Jay M. Barger**, US Marine Corp Combat Development Command, Studies & Analysis Div. C45, 3300 Russell Rd., Quantico, VA 22134-5130, bargeronj@mqg-smtp3.usmc.mil

The future battlefield is likely to be lethal, asymmetric and dispersed. We present our analysis and synthesis of data from recent USMC efforts to test operational concepts, supporting tactics, techniques, procedures and technology during evolutions on an extended non-contiguous battlefield.

2) **USMC Ammunition Requirements Research, Donald R. Bates**, US Marine Corp Combat Development Command, Studies & Analysis Div. C45, 3300 Russell Rd., Quantico, VA 22134-5130, batesd@mqg-smtp3.usmc.mil

Various ground ammunition requirements determination methodologies have been used in the past. We present the results of our research regarding new methods and their current use in the USMC.

3) **Analyzing Military Operations in Urban Terrain (MOUT), Kevin W. Brown**, US Marine Corp Combat Development Command, Studies & Analysis Div. C45, 3300 Russell Rd., Quantico, VA 22134-5130, brownk@mqg-smtp3.usmc.mil

More than 60% of the world will be "urbanized" by the year 2020. This presentation provides the results, methodology and lessons learned from a recent MOUT analysis. Additionally, a synopsis of the tools and techniques used in other MOUT analyses will be provided along with overall suggestions for future improvements.

4) **Robustness of Various Information Processing C2 Topologies, Gary E. Horne**, US Marine Corp. Combat Development Command, Studies & Analysis Div., 3300 Russell Rd., Quantico, VA 22134-5130, horneg1@mqg-smtp3.usmc.mil, Stephan C. Upton

We present our attempt to increase understanding of the benefits of various command and control configurations across a diverse scenario space. We look at centralized vs. decentralized and other characteristics of the command and coordination of military evolutions.

### TB31 Military Operations Research: An International Perspective

**Sponsor:** INFORMS Military Applications Society

#### Sponsored Session

**Chair:** Kurt Grau, Ind.-Betriebsgesellschaft mbH OR, Einsteinstrasse 20, Ottobrun, D85521, Germany

**Co-Chair:** Roy Willoughby

1) **Operations Research Support to Strategic Defence Planning Process, Rene F. W. M. Willems**, TNO Physics & Electronics Lab., OR & Bus. Mgmt., PO Box 96864, Oude Wallsdorperweg 63, The

Hague, 2509 JG, The Netherlands, r.f.w.m.willems@fel.tno.nl

Strategic planning processes concern the development of envisaged future force structures and capabilities that match the political and military strategic ambition levels with financial-economical, technological and personnel constraints. We address a structured approach to support this planning process through strategic scenario-development, generation of force alternatives and decision making processes.

**2) Use of Operations Research Methods & Models in the German Armed Forces, Bernd F. Wegener,** Amt für Studien & Übungen der Bundeswehr, Bereich OR, Einsteinstrasse 20, Ottobrunn, D85521, Germany

The German Armed Forces used OR methods and models in connection with analysis, training and weapon system evaluation. We address the current status of OR models, capabilities and restrictions of those models, the plans for further development and the possibilities of further use in the German Armed Forces with an emphasis on training, analysis and planning process.

**3) Design of a C3I System for the Norwegian Army: Lessons Learned For the Application of OR Methods to a Complex Problem, Tor Langsaeter,** Norwegian Defence Research Establishment, PO Box 25, Kjeller, N-2007, Norway, tor.langsaeter@ffi.no

The ongoing Norwegian Army C3I study will be completed by July 1997. This study is a challenge both in terms of methodology and project organization. The approach chosen is discussed and our current experience reported. The main items are communication with customers, problem definition, modeling detail and the study process itself.

**4) Effective Use of Combat Simulation in the US Army Material Acquisition Process, Roy Willoughby,** USA TRAC, WSMR, NM 88002-5502, willough@trac.wsmr.army.mil

In a time of limited resources, the use of simple constructive combat simulation models can be one of the most effective ways of determining the operational effectiveness of proposed new weapon systems. We address the most current constructive combat simulation models available to the TRADOC Analysis Center along with a Longbow study example.

## TB32 New Methods in Telecommunication Systems Research

Cluster: Telecommunications  
Invited Session

Chair: June S. Park, Univ. of IA, Dept. of MS, Coll. of Bus Adm., Pappajohn B.A.B., Iowa City, IA 52242-1000, june-park@uiowa.edu

**1) On the Causes of the Fractal Behavior of TCP Traffic, Bong Kyun Ryu,** Hughes Research Labs., 3011 Malibu Cyn Rd., Malibu, CA 90265, tru@isl.hrl.hac.com

We present a traffic model that reveals the conditions under which TCP traffic exhibits fractal behavior over a wide range of time scales. The proposed model is the randomly filtered point processes, which capture the TCP connection arrival rate, connection duration and the amount of information transmitted in a parsimonious way.

**2) Data-Driven Decision Modeling & Its Application to Client/Server Configuration Software, June S. Park,** Univ. of IA, Dept. of MS, Coll. of Bus Adm., Pappajohn B.A.B., Iowa City, IA 52242-1000, june-park@uiowa.edu, **Hong Mook Choi, Mark Clark**

Data-driven decision modeling is a new methodology to formulate optimization problems based on the conceptual schema of relational databases containing the model data. We will discuss the methodology and its application to developing a decision software to help system administrators with the configuring and tuning of a complex client/server system.

**3) A Methodology for Designing Reliable, Traffic Insensitive WANS Using Chordal Ring Graphs, Gordon Bolt,** Make Systems Labs., 107A Fountain Brook Cir., Cary, NC 27511, gbolt@makesys.com

We discuss a methodology for network designs that addresses reliability, performance, traffic insensitivity and cost. A family of graph structures providing good performance with respect to certain graphical measures is used to provide the logical topology. Optimization methods are used to map it into the physical network. Real-world wide-area network designs are presented.

## TB33 OR/MS in Forestry II

Sponsor: OR/MS in Forestry  
Sponsored Session

Chair: Peter Lohmander, Swedish Univ. of Agricultural Sci., Dept. of Forest Econ., Fac. of Forestry, Umea, S901 83, Sweden, peter.lohmander@sekon.slu.se

**1) The Impact of Uncertain Fire Occurrence on the Production of Timber in a Managed Forest, David L. Martell,** Univ. of Toronto, Fac. of Forestry, 33 Willcocks St., Toronto, Ontario, M5S 3B3, Canada, martell@smokey.forestry.utoronto.ca

Fire and forest managers must develop integrated planning systems that address investment in fire management and silviculture and their uncertain impact on timber production. We develop a simulation model of a forest in which a variety of planning models are used to resolve harvest flow decisions and investigate the impact of different planning strategies on harvest flow and the state of the forest.

**2) Timber Harvest Scheduling Under Price Risk, Robert G. Haight,** USDA Forest Service North Central, Forest Experiment Station, 1992 Folwell Ave., St. Paul, MN 55108, haight003@maroon.tc.umn.edu, **Laurence Reeves**

Forest investment decisions are based on predicted variability in financial return as well as mean return. Using data for loblolly pine, we estimate different stochastic price processes, determine their effects on risk and return of forest investments and examine the relative performance of forest and stock market investments.

**3) Optimal Economic Harvesting of Individual Trees in Stands, Peter Lohmander,** Swedish Univ. of Agricultural Sci., Dept. of Forest Econ., Fac. of Forestry, Umea, S901 83, Sweden, peter.lohmander@sekon.slu.se

The economically optimal forest harvest decision is analyzed at the individual tree level. The effects on neighbor trees are considered. General qualitative rules and conclusions are analytically derived. Quantitative results for Norwegian spruce harvesting under Swedish conditions are derived. Price adaptive harvesting is optimized for an estimated stochastic price process.

**4) Economic & Environmental Impacts of Harvesting Methods in Forest Planning, Ilan Vertinsky,** Univ. of British Columbia, Forest Econ./Policy Analysis, 2206 East Mall, Vancouver, BC, V6T 1Z3, Canada, fepa@unixg.ubc.ca, **Emina Krmar-Nozic, Cornelis Van Kooten, Shelby Brumelle**

A hierarchical approach to forest planning is formulated, where harvest schedules are first determined, followed by a decision about harvest methods. The choice of harvest methods is particularly important due to concerns about harvest-related soil disturbance. In the decision model developed, determination of a harvest system regime is expressed as a multiple-objective decision.

## TB34 PANEL: Use of Collaborative Technology to Manage Change in a Liberal Arts College

Cluster: Management Information Systems  
Invited Session

Chair: Mari M. Heltne, Luther Coll., MIS Dept., Decorah, IA 52101, heltmemm@luther.edu

**1) PANEL: Use of Collaborative Technology to Manage Change in a Liberal Arts College, David J. Roslien,** Luther Coll., rosliend@luther.edu, **Conrad Royksund,** Luther Coll., **Mari M. Heltne,** Luther Coll., **Liang Chee Wee,** Luther Coll.

The adoption of group decision technology at Luther, a private liberal arts college, coincided precisely with a major change in administration. Use of the Collaborative Round Table Room throughout administration and instruction is resulting both in far-reaching proposals for administrative and academic changes and is changing approaches to problem solving.

## Tuesday 13:00-14:30

### TC02 Optimization on the Internet I

Sponsor: INFORMS CSTS  
Sponsored Session

Chair: Thomas R. Elken, Silicon Graphics Inc., 2011 N Shoreline Blvd., MS 580, Mountain View, CA 94043-1389

**1) Experience with a Client/Server Implementation of CPLEX, Thomas R. Elken,** Silicon Graphics Inc., 2011 N Shoreline Blvd., MS 580, Mountain View, CA 94043-1389

Problem: Users of Windows modeling or vertical market applications can generate huge LPs or MIPs but they may take days or weeks to solve on a PC. Solution: Application developers can use a client/server library for CPLEX to enable solves at a parallel-processing server while maintaining their user

interface.

**2) Optimization Modeling on the Internet Using Client/Server Technologies, Thomas R. Elken**, Silicon Graphics Inc., 2011 N Shoreline Blvd., MS 580, Mountain View, CA 94043-1389

The MPL Modeling System is currently being developed to include client/server technologies which will give the user new ways to solve optimization problems. The user will be able to dispatch, directly from his desktop, large optimization problems to a solver located on a server that has extended computing capabilities. All the connections will be handled automatically by the modeling system.

**TC04 Managing Government Operations**

**Cluster: Public Sector Applications**

**Sponsor: INFORMS Section on Public Programs & Processes**

**Invited/Sponsor Session**

**Chair: Michael E. Gleeson**, IN Univ., Sch. of Public/Environ. Affair, Indianapolis, IN 46202-5152, gleeson@iupui.edu

**1) Public Sector Model Implementation Experiences, Ananth V. Iyer**, Purdue Univ., Krannert Grad. Sch., 1310 Krannert Bldg., W Lafayette, IN 47907-1310, aiyer@mgmt.purdue.edu, **Donald D. Eisenstein**

We summarize experiences in data analysis, model building and implementation at 2 public sector agencies. At the Chicago school system distribution system, model suggestions were implemented and data regarding the impact collected. At the Department of Streets & Sanitation, initial data analysis was used, but model suggestions await implementation.

**2) A "Parallel Approach Path" to Estimating Collision Risk During Simultaneous Landings, Arnold Barnett**, MIT, Sloan Sch. of Mgmt., OR Ctr., E53-379, Cambridge, MA 02139-4307, abarnett@sloan.mit.edu

Airport capacity could increase if, even during inclement weather, independent landings could occur on parallel runways only about 1/2 a mile apart. A key question about such operations is whether the collision risk they entail is acceptably low. We consider the question and some vexing statistical issues that it raises.

**3) Optimizing Base Realignment & Closure Implementation, Robert F. Dell**, Naval Postgrad. Sch., OR Dept., Monterey, CA 93943-5000, dell@or.nps.navy.mil

In 1995, the US Army obtained approval to close or realign 42 installations at an estimated cost of approximately 1 billion dollars. We describe an MILP, BRACAS, used by the Army to help determine yearly budget levels and corresponding implementation schedules for closure and realignment.

**4) A Model for Measuring & Improving the Effectiveness of Public Libraries, Michael E. Gleeson**, IN Univ., Sch. of Public/Environ. Affair, Indianapolis, IN 46202-5152, gleeson@iupui.edu, **Jonathan P. Caulkins**

We develop a model of public library circulation which incorporates patrons browsing and substitution behaviors. The model is tested using data from the Indianapolis-Marion County Public Library. We illustrate the use of the model to provide performance measures and to aid in setting circulation and acquisitions policies.

**TC05 LP Applications in the Electrical Power Industry**

**Cluster: Linear Programming**

**Invited Session**

**Chair: Charles H. Rosa**, Argonne Ntl. Lab., 9700 S Cass Ave., Bldg. 900, Bldg. 11, Argonne, IL 60439, rosa@dis.anl.gov

**1) Portfolio Management in a Deregulated Hydropower-Based Electricity Market, Stein-Erik Fleten**, Norwegian Univ. of Sci. & Tech., Dept. Mngl. Econ. & OR, Trondheim, N-7034, Norway, sef@iok.unit.no

We present an asset/liability model for a hydropower producer operating in a deregulated electricity market. The industry is based on hydropower, making spot prices correlated with the amount of water inflow to reservoirs. There are functioning forward and futures markets, providing instruments for portfolio management.

**2) An Integrated Approach to Modeling Power Station Energy & Reserve Capability, Glenn R. Drayton-Bright**, Univ. of Canterbury, Dept. of Mgmt., Private Bag 4800, Christchurch, New Zealand, g.drayton@mang.canterbury.ac.nz

Covering for a sudden loss of generating capacity requires other plants to provide reserve in addition to energy. We describe an LP formulation, the

fan-approximation, for optimizing the station-level dispatch of energy and reserve in response to targets or prices, taking account of the efficiency effects and physical limits.

**3) Head-Dependent Hydro Power Scheduling, Stefan Feltenmark**, Royal Inst. of Technology, Div. of Opt. & Systems Theory, Dept. of Math., Stockholm, 100 44, Sweden, stefanf@math.kth.se

We consider the short-term hydro-power scheduling problem where hourly power prices are given and one seeks to maximize the total income from a system of stations over 1 week, under some terminal conditions. The output function of a hydro-power station depends on the flow through the turbines and the head, i.e., the difference in height between the forebay and the afterbay, in a non-linear, non-convex way...

**TC06 Linear Programming in Branch & Cut II**

**Cluster: Linear Programming**

**Invited Session**

**Chair: Manfred Padberg**, NYU, Stern Sch. of Bus., 44 W 4th St., Ste. MEC 8-68, New York, NY 10012-1126, mpadberg@rd.stern.nyu.edu

**1) Telecommunications Network Synthesis from Leased Lines, Dimitris Alevras**, KZZ fuer Informationstechnik Berlin, Heilbronner Str. 10, Berlin, 10711, Germany, alevras@zib-berlin.de, **Martin Groetschel, Roland Wessaely**

The problem of telecommunications network synthesis from leased lines gives rise to a MIP model which is difficult to solve due to the complexity of its structure and its size. We discuss implementation issues of a cutting plane algorithm and report on computational results for "real world" data provided by a German mobile phone company.

**2) The QAP from the Polyhedral Point of View: Theoretical & Computational Aspects, Volker Kaibel**, Univ. zu Koeln, Inst. fuer Informatik, Pohligstr. 1, Koeln, 50969, Germany, kaibel@informatik.uni-koeln.de

We describe new results about the QAP-polytope concerning its facial structure as well as certain projections of it. In particular, we report on different ways of exploiting these structural insights in order to derive lower bounds for the QAP.

**3) Exact & Heuristic Algorithms for 2-Layer Straightline Crossing Minimization, Michael Juenger**, Univ. zu Koeln, Inst. fuer Informatik, Pohligstrasse 1, Koeln, 50696, Germany, mjuenger@informatik.uni-koeln.de

Two layer straightline crossing minimization is receiving a lot of attention in automatic graph drawing. The problem consists of aligning the 2 shores  $V_1$  and  $V_2$  of a bipartite graph  $G=(V_1, V_2, E)$  on 2 parallel straight lines (layers) such that the number of crossings between the edges in  $E$  is minimized when the edges are drawn as straight lines connecting the endnodes...

**TC07 Queueing Applications in Manufacturing Systems & Decision Process**

**Cluster: Estimation & Approximation in Queueing Systems**

**Invited Session**

**Chair: Sudha Jain**, Univ. of Toronto, Dept. of Stats., Toronto, Ontario, M5S 1A1, Canada, jainsu@utstat.utoronto.ca

**1) Use of Finite Buffer Approximations, Richard M. Feldman**, TX A&M Univ., IE Dept., College Station, TX 77843-3131, richf@tamu.edu, **Rex Liquigan**

There has been an increasing interest in improving queueing approximations, especially in the context of networks. One of the major weaknesses in these approximations is their utilizations for networks containing finite buffers. We discuss the applicability of various approximation techniques and suggest an approach useful in some modeling domains.

**2) Polling Models with Server Vacations, Diwakar Gupta**, McMaster Univ., DeGroot Sch. of Bus., 1280 Main St. W, Hamilton, Ontario, L8S 4M4, Canada, guptad@mcmaster.ca

We analyze a system in which a server that services multiple classes of customers with roughly equal priority, takes a vacation to attend to other tasks such as preventive maintenance, job training, service to high priority customers, etc. Different types of vacations, triggering mechanisms and service policies are investigated.

**3) Simultaneous Improvements to a Manufacturing System & Effects on Investment Decisions, Tim Nye**, Univ. of Waterloo, Dept. of MS, Waterloo, Ontario, N2L 3G1, Canada, tjnye@mansi.uwaterloo.ca, **Elizabeth M. Jewkes, David M. Dills**

Setup time reduction and quality improvement are 2 common practices being

implemented in manufacturing. Normally, such practices are treated as independent projects for investment decisions, but via a queueing model, this research shows that optimal investment decisions can change dramatically when improvements are considered simultaneously.

**4) A Daily Airtanker Deployment Model for Forest Fire Control, Kazi M. Saiful Islam**, Univ. of Toronto, Dept. of Mech. & IE, 30 Charles St. W, Toronto, Ontario, M4Y 1R5, Canada, islam@ie.utoronto.ca, *David L. Martell*

Daily airtanker deployment entails deciding upon the number and deployment of airtankers so that average initial attack response time is minimized. We show how we modified the hypercube queueing model to limit the dispatch radius for individual servers and describe how the model is being used in Ontario.

#### TC08 Business Applications I Contributed Session

**Chair:** Bob Daniel, DASH Assoc./Univ. of Buckingham, Blisworth House, Church Ln., Blisworth, Northants, NN7 3BX, UK, rcd@dash.co.uk

**1) Parallel Optimization with PC Networks, Bob Daniel**, DASH Assoc./Univ. of Buckingham, Blisworth House, Church Ln., Blisworth, Northants, NN7 3BX, UK, rcd@dash.co.uk

Cheap fast PCs are now the platform of choice for some parallel optimization tasks. We present results on solving large hard problems using Dash's Xpress-MP parallel optimizers.

**2) An OR Modeling Framework for Reliability & Availability of Transaction-Intensive Services, Michael Tortorella**, Bell Labs, Lucent Technologies, 101 Crawfords Corner Rd., Rm. 2L-538, Holmdel, NJ 07733, mtortorella@lucent.com, *Norman A. Marlow*

Users of transaction-intensive telecommunications services perceive the effects of network equipment failures in different ways. We describe a framework for quantitatively modeling service continuity/accessibility based on their relationships to equipment reliability/availability and the distribution of network connection types. We give examples from old and new service types.

**3) A Reservoir-Based Model for Analyzing North American Natural Gas Storage, Steven A. Gabriel**, ICF Kaiser Intl., 9300 Lee Hwy, Fairfax, VA 22031-1207, sgabriel@icfkaiser.com, *Shree Vikas, Edwin F. Hardy*

Results are presented for natural gas storage in North America based on our gas systems analysis model, GSAM. GSAM, which computes market equilibrium prices and quantities of gas, uses 16,000 production reservoirs and several hundred storage reservoirs together with an integrating LP that balances supply and demand of gas.

#### TC09 Machine Scheduling I Contributed Session

**Chair:** P. M. Dearing, Clemson Univ., Dept. of Math. Sci., Clemson, SC 29634-1907, pmdrn@clemson.edu

**1) Scheduling Cable Production on Several Lines with Setup Times in Order to Meet Due Dates, P. M. Dearing**, Clemson Univ., Dept. of Math. Sci., Clemson, SC 29634-1907, pmdrn@clemson.edu, *Matthew J. Saltzman*

A 0-1 linear model is presented for scheduling the production of cables on several lines with changeover times between cables in order to minimize the deviation between cable completion and due date. Additional constraints on equipment changeovers are included in the model. Computational experience is presented.

**2) Performance Enhancements to Tabu Search for the Early/Tardy Scheduling Problem, Ross J. James**, Univ. of Canterbury, Private Bag 4800, Christchurch, New Zealand, r.james@mang.canterbury.ac.nz, *John T. Buchanan*

We present techniques for improving the performance of TS in solving large early/tardy scheduling problems, with a view to developing generalized TS enhancement strategies. Three specific techniques are investigated. Results show that these performance enhancements are all significantly better than the standard techniques.

**3) A Branch & Bound Algorithm for Flowshop Scheduling with Setup Times, Roger Z. Rios-Mercado**, Univ. of TX, OR Group, ETC 5.160, Austin, TX 78712-1063, roger@bajor.me.utexas.edu, *Jonathan F. Bard*

We present a B&B enumeration scheme for the flowshop scheduling problem with sequence-dependent setup times and makespan minimization criteria. This includes a discussion on lower bounding procedures, heuristics and dominance elimination criteria and a presentation of computational results.

**4) Scheduling in a Hierarchical Vision Machine, Ceyda Oguz**, Hong Kong Polytech. Univ., Dept. of Mgmt., Hung Hom, Kowloon, Hong Kong, msceyda@polyu.edu.hk

We consider the scheduling problem in a hierarchical vision machine with 3 processing levels. Since the problem is NP-hard, we develop a heuristic algorithm for scheduling the tasks to equalize the loads of the layers. The results show that the heuristic algorithm performs well.

#### TC10 Supply Chains: Models for Material Management

**Cluster:** Supply Chain  
**Invited Session**

**Chair:** Michael J. Magazine, Univ. of Cincinnati, Dept. of QAOM, PO Box 210130, Cincinnati, OH 45221-0130, mike.magazine@uc.edu

**1) Logistics Chain Modeling: A Conceptual Framework for Planning in the Downstream Petroleum Industry, Anthony Ross**, TX A&M Univ., Dept. of Bus. Analysis & Res., Coll. of Bus., College Station, TX 77843-4217

A firm can frequently reduce manufacturing or service delivery costs by improving efficiencies at crucial activity points along its logistics supply chain. We present a methodology and case study in which traditional OR modeling fully supports the integrated performance analysis and measurement of a logistics chain. The research paradigm assesses the operations data available...

**2) Closed Loop Real-Time Consignment, David Curry**, Univ. of Cincinnati, Dept. of Mktg., 325 CBA, Cincinnati, OH 45221-0145, *Edward Thompson, George A. Becus, Norman T. Bruvold*

We develop a closed-loop solution for assigning multi-item arrays to warehouses to control inventory levels. Arrays arrive in real-time and exhibit inter-item production dependencies. Demand is multivariate by item group. We combine saturated variational optimization and a hybrid annealing-genetic algorithm and discuss implications for improving efficiency at interfaces in the supply chain.

**3) The Impact of Information on Materials Planning in Supply Chains, Ram Ganeshan**, Univ. of Cincinnati, Dept. of QAOM, PO Box 210130, Cincinnati, OH 45221, *Alan J. Stenger, Terry P. Harrison*

Managing material flow in a supply chain is inextricably linked to the amount of information shared among the companies that make up its various echelons. The prevalent thought is the better the coordination between echelons, the better the performance of the supply chain. We compare the impact of 2 different inventory planning systems, DRP and ROP, on supply chain performance under various conditions...

**4) Demand Information & Lead Times in a Multi-Echelon Repairable Service Parts System with Multi-Class Services, Morris A. Cohen**, Univ. of PA, Wharton Sch., OPIM Dept., Philadelphia, PA 19104-6366, cohen@opim.wharton.upenn.edu, *Yu-Sheng Zheng, Yunzeng Wang*

We model the operations of a multi-echelon system for repairables. The system is complicated by the interaction of multi-class customer services - each with a different stochastic repair lead time and demand due date. We characterize system performance metrics and consider the optimal allocation of inventory within the network.

#### TC11 Tourism Planning

**Cluster:** Tourism  
**Invited Session**

**Chair:** David Edgell, 612 B NE 5th Ave., Blue Springs, MO 64014

**1) Conducting Quality Research in Support of Tourism Planning for the Future, Daniel R. Fesenmaier**, Univ. of IL, 104 Huff Hall, Rm. 207, 1206 S 4th St., Champaign, IL 61820

We look at quality inter- and multi-disciplinary research in the varied aspects of tourism to support planning needs. What are the kinds of research that are needed by state agencies and businesses to support tourism policies and plans? Current research available in anticipation of tourism issues of tomorrow is presented.

**2) Strategies for Effective Community Planning & Management of Casino Gambling, Patrick T. Long**, Univ. of CO, CB 419, Boulder, CO 80309-0419, patrick.long@colorado.edu

We give an overview of policy and planning issues faced by states and communities considering casino gambling as an economic revitalization strategy, based upon research conducted with casino owners/managers, state and local government officials and community residents. Results of current planning policies are reviewed and suggestions made for policies useful in

meeting future needs.

### 3) Developing a Tourism Plan Based on Market Trends, *William Gartner*, Univ. of MN

We identify key tourism trends in order to plan tourism marketing strategies and policies and research the motivations for travel. For example, how does a community, state or nation make plans in a dynamic tourism market?

### 4) Human Resource Development in Building Tourism Planning Toward the 21st Century, *Ginger Smith*, Sch. of Intl. Tourism & Hotel Mgmt., PO Box 2010, Carolina, PR 00984-2010

The more global and complex the tourism plans, the more the tourism industry should look to its educational institutions for direction. What kinds of skills will be needed as the industry plans for future tourism growth? How does the academic community interact with the needs of the tourism industry?

## TC12 Frontiers in Knowledge Reuse & Adaptation

Sponsor: INFORMS CSTS

Sponsored Session

Chair: LiWu Chang

, liwu@aic.nrl.navy.mil

### 1) Retrieval & Merge of Multiple Plans in Mixed-Initiative Planning, *Manuela M. Veloso*, Carnegie Mellon Univ., Dept. of Comp. Sci., WeH 7122, Pittsburgh, PA 15213-3892, veloso@cs.cmu.edu

The combination of planning and case-based reasoning is introduced as a learning method for planners to improve their performance with experience. Planning episodes are stored, retrieved and reused. Algorithms are presented to effectively retrieve and merge multiple planning cases in mixed-initiative planning environments, in which users and machines plan jointly.

## TC13 OR Applications of Java I

Sponsor: INFORMS CSTS

Sponsored Session

Chair: Arnold H. Buss, Naval Postgrad. School, OR Dept.,

Monterey, CA 93943-5000,

bussa@minerva.or.nps.navy.mil

### 1) Java: Introduction & Short Tutorial, *Gordon H. Bradley*, Naval Postgrad. Sch., OR Dept., Monterey, CA 93943, bradley@nps.navy.mil

Java, a powerful object-oriented language, compiles to code that downloads over the internet and efficiently executes without modification. It is used for research and education and is taught to all NPS OR students. Before and after the meeting, see <http://vislab-www.nps.navy.mil/gbradley> for information on all the Java papers.

### 2) Java-Enabled Network Optimization, *Collette R. Coullard*, Northwestern Univ., 2225 N Campus Dr., Evanston, IL 60208-3119, *Jonathan H. Owen*, *David Dilworth*

We describe and demonstrate our software environment for network optimization, Graphical Implementation Development Environment for Networks. GIDEN features interactive graphical display and basic algorithm animation for network optimization problems. The environment has proven to be useful for teaching, implementing and developing network optimization algorithms. For more information, see <http://www.iems.nwu.edu/giden>.

### 3) A Java Library for Network & Graph Algorithms, *Leroy A. Jackson*, Naval Postgrad. Sch., OR Dept., Monterey, CA 93943, jacksonl@mtry.trac.nps.navy.mil, *Gordon H. Bradley*, *Kirk A. Stork*

We present an object-oriented design and partial implementation in Java of a class library that supports the implementation and analysis of network and graph algorithms. We demonstrate the capability to input graphs, generate random graphs, code graph algorithms, present algorithm results and analyze the execution of algorithms.

## TC14 Environment

Sponsor: INFORMS Section on Environment

Sponsored Session

Chair: Eleni Pratsini, Miami Univ., Dept. of DSC/MIS, 311 Upham, Oxford, OH 45056, pratsi@muohio.edu

### 1) Parallel Optimization with PC Networks, *Bob Daniel*, DASH Assoc./Univ. of Buckingham, Blisworth House, Church Ln., Blisworth, Northants, NN7 3BX, UK, rcd@dash.co.uk

Cheap fast PCs are now the platform of choice for some parallel optimization

tasks. We present results on solving large hard problems using Dash's XPRESS-MP parallel optimizers.

### 2) Using Geostatistical Techniques to Locate Valuable Trees in Pennsylvania, *Susan L. King*, USDA Forest Service, 100 Matsonford Rd., Radnor, PA 19087, sking@hpl.nena.org

Geostatistics is a branch of applied statistics concerned with the description of spatial patterns and estimating values at unsampled locations. One hypothesis is that high value trees are located near other high value trees. This hypothesis is tested using geostatistics and forest inventory data from the Northeastern Forest Inventory and Analysis unit of the USDA Forest Service.

### 3) Environmental Analysis Using Linear Programming, *Eleni Pratsini*, Miami Univ., Dept. of DSC/MIS, 311 Upham, Oxford, OH 45056, pratsi@muohio.edu

An LP model is used to obtain the primary contribution of motor vehicles to carbonaceous particles in the atmosphere. The model is applied at 2 sites in Los Angeles and the motor vehicle contribution to organic carbon is calculated. The results are compared to those obtained by ratio analysis.

## TC15 Network Flows I

Contributed Session

Chair: Dorit S. Hochbaum, Univ. of CA, Dept. of IE/OR, Haas

Sch. of Bus., Berkeley, CA 94720-1777,

dorit@hochbaum.berkeley.edu

### 1) A New Algorithm for Maximum Flow in Closure Graphs, *Dorit S. Hochbaum*, Univ. of CA, Dept. of IE/OR, Haas Sch. of Bus., Berkeley, CA 94720-1777, dorit@hochbaum.berkeley.edu

We describe the first algorithm solving the maximum flow problem without employing any concept of flow. Instead, it relies on a previously unknown certificate of optimality called "normalized tree." The algorithm's complexity is  $O(mn \log n)$ . The idea for the algorithm was unearthed during our work on mining applications.

### 2) Some Strategies to Find Steiner Points in $R^2$ , *Murilo Tito Pereira*, Univ. Estadual do Ceara, R Pe Leopoldo Fernandes, 108 Fatima, Fortaleza CE, 60411-180, Brazil, murilo@uece.br, *Marcos Jose Negreiros*

We show a heuristic algorithm, based on Beasley's algorithm for Euclidean and Manhattan Steiner trees, that achieves results very close to the state-of-the-art ones, considering reductions on the time complexity. We explore strategies we use to find these results from literature using PCs and RISC stations.

### 3) An $O(nm)$ -Time Network Simplex Algorithm for the Shortest Path Problem, *Zhiying Jin*, GTE Labs., 40 Sylvan Rd., Waltham, MA 02254, zjin@gte.com, *Donald Goldfarb*

We present a  $O(nm)$ -time network simplex algorithm for solving the shortest paths problem in a network of  $n$  nodes and  $m$  directed arcs. The worst-case running time of this algorithm is as fast as that proved for any algorithm and faster than that proved for any previously proposed simplex algorithm for this problem.

### 4) An Empirical Study of Aggregation Error Bounds for Multicommodity Transportation Problems, *James R. Evans*, Univ. of Cincinnati, PO Box 210130, Cincinnati, OH 45221-0130, evans@email.uc.edu, *Sriram Kannan*

We investigate the strength of a priori and a posteriori error bounds that result from aggregating nodes in multicommodity transportation problems. The effects of different clustering methods will also be examined.

## TC16 Concept & Platform Development in New Product Development

Sponsor: INFORMS Section on Technology Management

Sponsored Session

Chair: Anil Khurana, Boston Univ., 595 Commonwealth Ave., Boston, MA 02215, akhurana@acs.bu.edu

### 1) The Concept of Concept Development in the Process Industry, *Brent D. Barnett*, Brigham Young Univ., Willard/Marriott Sch. of Mgmt., 687 TNRB, PO Box 23131, Provo, UT 84602-3131, acad.po1.bdbarnet@byugate.byu.edu

What does concept development mean in the development of a process-based product? Data from a world-wide study of product development projects in the process industries suggest that due to the "embeddedness" of process development, product concepts are subject to frequent change and evolution in the course of scale-up.

### 2) New Product Development: Comparing the Development of Physical Products & Software, *Mohan V. Tatikonda*, Univ. of NC,

Kenan-Flagler Bus. Sch., CB 3490, Carroll Hall, Chapel Hill, NC 27599-3490

We present results from an ongoing study of new product development. We then consider how software development differs from traditional physical new product development, characterizes different types of software development efforts and explores effective methods for execution of different software development projects.

**3) Platform Development: An Efficient Form of New Product Development, Mark Myer**, Northeastern Univ., Coll. of Bus. Admin., 214 Hayden Hall, Boston, MA 02115

Platform development is a planned, efficient approach to new product development. At the same time, it challenges management and technical people to develop a balance between both strategic and systems development. I will describe the application of platform ideas to software and Internet products and discuss challenges for concept development.

**4) Multi-Objective Scheduling of Concurrent/Simultaneous Engineering Projects, John F. Hebert**, Univ. of Akron, Dept. of Mgmt., Akron, OH 44325-4801, **Richard F. Deckro**

We explore the tradeoffs confronting decision-makers as they attempt to maximize total revenue by getting their product to market more quickly (shortening the product development cycle) and increasing product quality (which usually implies being more deliberate during the product development cycle).

### TC17 Modeling Applications in Energy

Sponsor: INFORMS Section on ENRE

Sponsored Session

Chair: Susan H. Shaw, US Dept. of Energy, E1-811, Rm. 2F-081, 100 Independence Ave. SW, Washington, DC 20585, sshaw@eia.doe.gov

**1) Electricity Prices in a Competitive Environment: Determinants & Impacts, Arthur S. Holland**, Energy Information Admin., US Dept. of Energy, 1000 Independence Ave. SW, Washington, DC 20585, aholland@eia.doe.gov

The Energy Information Administration is developing a competitive pricing algorithm for the National Energy Modeling System to analyze issues surrounding the restructuring of the US electric power industry. Although electricity models have traditionally performed cost-based pricing, supply and demand interactions are central in a competitive market. Background research will be presented.

**2) Competitiveness of Renewable Technologies in the Future California Power Market, Chris Marnay**, Lawrence Berkeley Lab., 90-400 Energy Analysis Program, Berkeley, CA 94720, c\_marnay@lbl.gov, **Suzie Kito, Alexandra K. Pligavko**

The major California utilities will soon begin a transition to a restructured industry featuring both purchases from a competitive pool and direct access contracts. This study attempts to gauge the competitiveness of renewable generation technologies in this restructured electricity market using the Environmental Defense Fund's Elfin simulation model.

**3) Modeling Coal Markets & the 1990 Clean Air Act Amendments, Frederic H. Murphy**, Temple Univ., Sch. of Bus. & Mgmt., 323 Speakman Hall, Philadelphia, PA 19123, v5256e@vm.temple.edu, **Melinda Hobbs, Thanh Luong, Reginald Sanders, Peter C. Whitman**

The National Energy Modeling System provides energy projections, solving for an economic equilibrium across energy sectors represented by individual fuel models. The Clean Air Act Amendments of 1990 tightly link electricity and coal, necessitating redesign of the coal model. We describe the design, its implementation, convergence properties and results.

### TC18 TUTORIAL: Fractional Programming, Generalized Convexity & Generalized Monotonicity

Invited Session

Chair: Siegfried Schaible, Univ. of CA, Grad. Sch. of Mgmt., Riverside, CA 92521, schaible@ucr1.ucr.edu

**1) TUTORIAL: Fractional Programming, Generalized Convexity & Generalized Monotonicity, Siegfried Schaible**, Univ. of CA, Grad. Sch. of Mgmt., Riverside, CA 92521, schaible@ucr1.ucr.edu

In many models of management and economics, the rigid assumption of convexity can be relaxed to various types of generalized convexity without losing properties important for solving such models. An example is single- and multi-ratio fractional programs. More recently, the rigid assumption of

monotonicity has been replaced by different kinds of generalized monotonicity...

### TC19 Optimization IV

Contributed Session

Chair: Wiesława T. Obuchowska, Univ. of NE, Dept. of Math., Omaha, NE 68182, tobuchow@unomaha.edu

**1) An Algorithm to Determine Existence of the Exceptional Family of Elements & Complementarity Problem, Wiesława T. Obuchowska**, Univ. of NE, Dept. of Math., Omaha, NE 68182, tobuchow@unomaha.edu

We propose an algorithm to determine whether there exists an EFE for some class of linear functions, which by the result proved by Isac, Bulavski & Kalashnikov, allows us to formulate sufficient conditions for the existence of the solution to the corresponding complementarity problem. We also consider a class of convex functions...

**2) The Corrugator Combining Problem Revisited, Robert Haessler**, Univ. of MI, Business Sch., 701 Tappan, Ann Arbor, MI 48109-1234, robertwh@umich.edu, **Brian Talbot**

We review work done on the corrugator combining problem over the last 20 years and propose an extension to the widely used set partitioning approach developed by the authors. The new approach eliminates the need to split orders in order to develop setups which will produce the complete order.

**3) Efficient Algorithms for Energy Process Models with Dynamic Demand, Y. J. Wu**, Ryerson Polytech. Univ., Sch. of IE, Dept. of Mech. Eng., Toronto, Ontario, M5B 2K3, Canada, jwu@acs.ryerson.ca, **J. David Fuller, A. Sham**

Efficient versions of decoupling algorithms are developed for solving process models in which demands depend on both present prices and previous prices through a distributed lag representation. Efficient algorithms are required in order to save computation time especially for large-scale energy planning. Examples illustrating convergence properties of algorithms are discussed.

### TC20 World Wide Web & Transportation

Sponsor: INFORMS Transportation Science Section

Sponsored Session

Chair: David Bernstein, Princeton Univ., Dept. of Civil Eng. & OR, Princeton, NJ 08544

**1) An Internet-Based Transit Information System, Athanasios Ziliaskopoulos**, Northwestern Univ., Dept. of Civil Eng., Evanston, IL 60208, **Steve Waller, Whit Wardell**

We discuss a Web application for a transit IS. The components include an intermodal optimum path algorithm, a CGI communication program and a client module implemented in Java. The client module interacts with the user and obtains the x-y coordinates of the desired O-D node and time of departure. The client module passes the information to the CGI, which activates the intermodal optimum path algorithm...

**2) Using the Internet to Provide Multimodal Travel Information, David Bernstein**, Princeton Univ., Dept. of Civil Eng. & OR, Princeton, NJ 08544

We consider ways in which the Internet and the WWW can be used to provide travel information and guidance on a multimodal network. Specific attention is given to the use of CGI and Java, data management and distributed processing.

**3) A Web Site for the Nationwide Personal Transportation Survey, Pat Hu**, Oak Ridge Ntl. Lab., Ctr. for Transport. Analysis, Bldg. 3156, MS 6073, Box 2008, Oak Ridge, TN 37831-6073, **R. Goeltz**

The FHWA conducts the NPTS about every 5 years. The primary objective is to collect trip-based data on the nature and characteristics of personal travel. Due to the complexity of this survey, a website was developed to assist users to customize and analyze their data sets based on the 1990 and 1995 NPTS data. For example, one of the analysis tools developed allows the user to specify variables...

**4) PANEL: World Wide Web & Transportation, David Bernstein**, Princeton Univ., **Athanasios Ziliaskopoulos**, Northwestern Univ., **Pat Hu**, Oak Ridge Ntl. Lab.

No abstract supplied.

### TC21 Research in Artificial Intelligence

Sponsor: INFORMS College on Artificial Intelligence

Sponsored Session

**Chair:** Jan Vanthienen, Katholiek Univ. of Leuven, Dept. of Applied Economics, Naamsestraat 60, Leuven, 3000, Belgium, jan.vanthienen@econ.kuleuven.ac.be

**1) Table-Based Verification & Validation of Knowledge, Jan Vanthienen,** Katholiek Univ. of Leuven, Dept. of Applied Economics, Naamsestraat 60, Leuven, 3000, Belgium, jan.vanthienen@econ.kuleuven.ac.be, **G. Wets, Selwyn Piramuthu**

In knowledge discovery, many techniques are proposed to extract knowledge from data. Currently, however, research to verify the extracted knowledge is rather limited. We describe the knowledge development cycle starting from raw data until the consultation phase.

**2) Research Themes & Trends in AI: A Cocitation Analysis, W. Raghupathi,** CA State Univ., Dept. of Acct. & MIS, Chico, CA 95929-0011, rp@ecst.csuchico.edu, **Sridhar P. Nerur, Someswar Kesh**

We seek to address the various research themes and trends in AI. As we head toward the next century, the debate as to what is AI and what is not is intensifying. Further, other terminology such as computational intelligence, machine learning and soft computing imply the existence of many different fields. We present a framework of research themes.

**3) Use of Bootstrapping & Cross Validation for Model Selection, Murali Shanker,** Kent State Univ., Coll. of Bus., Kent, OH 44242-0001, mshanker@scorpio.kent.edu, **Michael Hu, Ming Hung**

With availability in computing power, bootstrapping and cross-validation are now frequently used techniques for model selection and prediction. We discuss their use and importance for model selection in neural network classifiers.

**4) From Inductive Learning to Knowledge Discovery & Data Mining, H. Michael Chung,** CA State Univ., Dept. of Info. Systems, Coll. of Bus. Admin., Long Beach, CA 90840-8506, hmchung@csulb.edu

We describe the evolution and categorization of inductive learning research applied to management domains and discuss its impact/implications as well as its future directions. We analyze the relationship between the domain task characteristics and the nature of modeling algorithms.

## TC22 Practical Realities of Logistics Providers in the Global Environment

**Cluster:** Global Manufacturing Practice  
**Invited Session**

**Chair:** Ricardo Ernst, Georgetown Univ., Grad. Sch. of Bus., 201 Old North, Washington, DC 20057, ernstr@gunet.georgetown.edu

**1) Operational Experiences with Global Logistics Providers, Michael B. Edwards,** Fritz Inst. of Global Logistics, 706 Mission St., Ste. 1000, San Francisco, CA 94103, medwards@fritz.com

The Fritz Institute of Global Logistics is a non-profit educational center dedicated to the enhancement of professionalism in the field of global logistics management. The Institute seeks to improve the quality of management and to enhance the value of research in global logistics issues around the world through its focused educational programs, its specific applied research programs and its quality recognition programs...

**2) Implementation of an Open LTL System for Service Parts Support, Michael Voelk,** Schneider Logistics, 3101 S Packerland Dr., PO Box 2666, Green Bay, WI 54306-2666, mvoelk@prodigy.com

We describe an open LTL system as a paradigm change from current distribution schemes. We detail open LTL as an interaction between break bulk hubs, end-of-line terminals, dealers, depots, couriers and truckload carriers. We separate national and regional system types and describe benefits in terms of information flow, simplicity, service, cost and speed.

**3) Service Parts Distribution at CASE, Ken Votry-Kundich,** CASE Corp., 7000 Durand Ave., Racine, WI 53406

CASE Corporation is one of the leading companies in the world for agricultural and construction equipment. We will discuss some of the logistics issues involved in the management of an extensive and complex network of dealers and depots for supporting the distribution of service parts.

**4) What is the Value Added of a Global Logistics Provider?, Ricardo Ernst,** Georgetown Univ., Grad. Sch. of Bus., 201 Old North, Washington, DC 20057, ernstr@gunet.georgetown.edu

The trend towards outsourcing logistics providers companies is increasing rapidly. It is estimated that by the end of 1996, logistics will be a \$25 billion-a-year business, growing by 6% annually and reaching \$50 billion in revenue by the year 2000. We present a strategic framework to quantify the

value added by logistics providers to justify outsourcing.

## TC23 FMS Design & Planning Problems

**Cluster:** Flexible Manufacturing Systems  
**Invited Session**

**Chair:** Kathryn E. Stecke, Univ. of MI, Sch. of Bus. Admin., 701 Tappan St., Ann Arbor, MI 48109-1234, kstecke@umich.edu

**1) Scope vs. Focus: Issues of Flexibility, Capacity & Number of Production Facilities, Mehdi Sheikhzadeh,** Univ. of MN, Dept. of Mech. Eng., Minneapolis, MN 55455, mehdi@me.umn.edu, **Saifallah Benjaafar, Diwakar Gupta**

How should a multi-product manufacturing firm design production facilities? How many facilities should it have? How many and which products should be assigned to each facility? What batch sizes/scheduling rules are appropriate for facilities making more than 1 product? We present analytical models that can help operations managers answer the above questions.

**2) A Methodology to Improve FMS Saturation, Raffaele Pesenti,** Univ. di Trieste, DEEI-Univ. di Trieste, Via Valerio 10, Trieste, 34100, Italy, jpesenti@univ.trieste.it, **Marino Nicolich, Piero Persi, Walter Ukovich**

The problem of improving the saturation of an FMS is considered, when limited tool buffer capacity is a relevant constraint. A hierarchic approach is formulated, contemplating at the higher level, the determination of sets of parts concurrently processable. At lower levels, such sets are sequenced, linked and scheduled.

**3) Business Process Reengineering: Issues on Design & Manufacturing in a Flexible Manufacturing Environment, Koty Lapid,** PO Box 3317, Beer Sheva, Israel, kolap@magnet.hu

We use FMS models to explore conditions under which radical changes in system structure (from bureaucratic to innovative, from multiple layer management to thin layer management systems) are likely to happen. Several cases are discussed to describe the process and pace of change in the system structure of different Hungarian organizations.

## TC24 Applications of Decision Analysis in the Oil & Gas Industry

**Sponsor:** INFORMS Decision Analysis Society  
**Sponsored Session**

**Chair:** David C. Skinner, Conoco/DuPont, 1000 S Pine, Research W 4669, PO Box 1267, Ponce City, OK 74602-1267, skinnerdc@aol.com

**1) Use of Decision Analysis for Operational Planning: A Proactive Approach, Ellen Coopersmith,** Conoco Inc., 600 N Dairy Ashford, Houston, TX 77079-6651, ellen.m.coopersmith@conoco.dupont.com

Conoco is using DA to take a proactive approach to implementing high-risk investment opportunities. This presentation will discuss the use of value of information and probability to sensitivity analysis techniques to develop exploration implementation and contingency plans.

**2) Implementing Decision Quality in Amoco's Exploration & Production Sector, Stephanie Meadows,** Amoco, 3700 Bay Area Blvd., Houston, TX 77058, **James Hoffman, James McCuish**

The focus of this presentation is to share Amoco's learnings to-date in implementing the decision quality process in our world-wide Exploration and Production Sector. The presentation summarizes lessons learned in key areas including implementation strategy, implementation organizational structure and critical success factors.

**3) Using Decision Analysis as a Catalyst for Change, David C. Skinner,** Conoco/DuPont, 1000 S Pine, Research W 4669, PO Box 1267, Ponce City, OK 74602-1267, skinnerdc@aol.com

DA helps organizations improve their decision-making processes and enhances communication among internal and external partners. Organizations often view it as a tool to be employed, rather than a catalyst for change. I will discuss DA with other methodologies which can effectively change an organization's culture.

**4) Trying to Tie it All Together Usefully, Bill Haskett,** Unocal, 14141 Southwest Freeway, Sugar Land, TX 77478, o5319wjh@discovery1.unocal.com

Portfolio analysis techniques, when applied practically, allow management to understand the potential outcomes of their strategic plans. They offer the ability to assess project desirability and portfolio value through time, to institute portfolio goaling and to test the validity of alternate strategies. Portfolio

optimization methods are more academic than practical.

#### TC25 PANEL: OR/MS in Business School Education II - Rising from the Ashes?

Sponsor: INFORMS Forum on Education

Sponsored Session

Chair: Patrick S. Noonan, Emory Univ., Goizueta Bus. Sch., Dec. & Info. Analysis, Atlanta, GA 30322, patrick\_noonan@bus.emory.edu

1) PANEL: OR/MS in Business School Education II - Rising From the Ashes?, *Thomas L. Magnanti*, MIT, magnanti@mit.edu, *James S. Dyer*, Univ. of TX, *Dana R. Clyman*, Univ. of VA, *Patrick S. Noonan*, Emory Univ.

Amid the burst bubbles, famous failures and rampant retrenchment of OR/MS in management education are success stories of renewal and rejuvenation. As a counterpoint to the INFORMS Task Force and Deans' report on the widespread demise of OR/MS presence, we discuss examples of significant success at business schools where OR/MS ideas are playing a major role in business education...

#### TC26 Matrix-Analytic Methods I

Sponsor: INFORMS Applied Probability Section

Sponsored Session

Chair: Attahiru S. Alfa, Univ. of Manitoba, Dept. of Mech. & IE, Winnipeg, Manitoba, R3T 2N2, Canada, alfa@cc.umanitoba.ca

1) Algorithms for Implementing the Operator Geometric Approach for Quasi Birth & Death Processes, *Bo Friis Nielsen*, Technical Univ. of Denmark, Inst. of Math. Modeling, Bldg. 321, Lyngby, DK-2800, Denmark, bfn@imm.dtu.dk, *V. Ramaswami*

Recently, the interest in quasi birth and death processes with a continuum of phases has increased due to the importance of heavy tailed stationary distributions and long range correlations in important applications such as ATM. We develop algorithms for implementing Tweedie's extension of the matrix-geometric solution to an operator geometric solution and demonstrate some examples...

2) Monotone Algorithms in Probability Modeling, *Ling Shen*, Univ. of AZ, SIE Dept., PO Box 210020, Tucson, AZ 85721, *Ferenc Szidarovszky*

Many problems in AP can be reduced to the numerical solution of nonlinear equations. Under special conditions, globally convergent methods can be developed which provide monotonic iterations sequences. In addition to determining a solution, monotonic algorithms can also be used to check for the uniqueness of the solution. Theoretical issues will be discussed and applications presented...

3) QBDs: Beyond the Stationary Distribution, *Guy Latouche*, Univ. Libre de Bruxelles, Seminaire de Theorie Probab., Blvd. du Triomphe, CP 212, Bruxelles, 1050, Belgium

The traditional approach to QBDs has been to assume (or prove) that they are ergodic and analyze their stationary distribution; this has led to the matrix-geometric distribution. In other cases where the states are transient or some level is absorbing, the matrix-analytic approach may be still followed and yields unexpected results.

4) The Use of Non-Linear Programming in Matrix Analytic Methods, *Attahiru S. Alfa*, Univ. of Manitoba, Dept. of Mech. & IE, Winnipeg, Manitoba, R3T 2N2, Canada, alfa@cc.umanitoba.ca, *Bhaskar Sengupta*

We present a new method for finding the R and G matrices which play a crucial role in determining the steady-state distribution of Markov chains of the GI/M/1 and M/G/1 type respectively. The method involves finding a solution to an NLP problem.

#### TC27 Strategy II

Contributed Session

Chair: Chen-Lu Meng, Univ. of KY, Gatton Coll. of Bus. & Econ., DSIS, Sch. of Mgmt., Lexington, KY 40506-0034, cmeng@pop.uky.edu

1) Iterated Prisoner's Dilemma Models for Examining Agent Interactions within Groups, *Chen-Lu Meng*, Univ. of KY, Gatton Coll. of Bus. & Econ., DSIS, Sch. of Mgmt., Lexington, KY 40506-0034, cmeng@pop.uky.edu, *Ramakrishnan Pakath*

In group interaction situations, agent behavior/performance impacts group behavior/performance. Some situations may be modeled as iterated prisoner's

dilemma games. Participants use strategies that may be fixed, responsive or adaptive. We examine several situations where 1 player is a learning classifier system-based adaptive agent with other agents following non-adaptive strategies.

2) Roundtable Mentoring for Entrepreneurs, *Jamaluddin Husain*, Purdue Univ., A351 E Ctr., Hammond, IN 46323-2094, jhhusain@calumet.purdue.edu

We discuss experiences in roundtable mentoring in peer groups of entrepreneurs as initiated experimentally at Purdue University Calumet. Initial results are very encouraging.

3) A Cross-Cultural Study of Corporate Management Style & Organizational Effectiveness, *Won P. Shim*, Andong National Univ., 388 Song-Chun Dong, Andong, South Korea

We investigate how the management style of overseas corporations affect their organizational effectiveness under different cultures, through the individual perceptions of host country employees at Korean firms in the US and Japan, and at American firms in Korea.

4) Enriching Media Richness Theory: Introducing Dimensions of Knowledge as Sources of Uncertainty & Equivocality, *Eric ten Pierick*, Erasmus Univ. of Rotterdam, Rotterdam Sch. of Mgmt., PO Box 1738, Rotterdam, 3000 DR, The Netherlands, epierick@fac.fbk.eur.nl, *Paul R. Beije*

Media richness theory is enriched by introducing dimensions of knowledge as sources of equivocality. Furthermore, dimensions of knowledge are proposed to influence uncertainty and therefore, the amount of communication. The enriched theory is applied to an interorganizational context: the interaction between different types of subcontractors and their outsourcing partners.

#### TC28 Exploring Efficiency Frontiers in the Hospital Industry: Stochastic Models vs. DEA Models

Cluster: Health Care Technology, Policy & Applications

Invited Session

Chair: Jon A. Chilingirian, Brandeis Univ., Heller Sch., Box 9110, Waltham, MA 02254-9110, chilingirian@binah.cc.brandeis.edu

1) The Evolution of HMO Efficiency, 1985 - 1994, *Douglas R. Wholey*, Carnegie Mellon Univ., Dept. of Social & Dec. Sci., Pittsburgh, PA 15213, wholey+@andrew.cmu.edu, *Cindy L. Bryce*

We compare DEA and stochastic production function based on measurements of HMO efficiency over the period 1985-94 using a national sample of HMOs. Using the generated efficiency measures, we present descriptive statistics of HMO efficiency over time and a model of the determinants of the evolution of HMO efficiency.

2) An International Comparison of Hospital Efficiency: Does Institutional Environment Matter?, *John Magnussen*, Stanford Univ., Ctr. for European Studies, Bldg. 160, Stanford, CA 94305-2044, jonm@leland.stanford.edu, *Lee Rivers Mobley*

We examine empirical evidence from US and Norwegian hospitals to ascertain whether institutional environment and level of market competition significantly affect the degree of technical efficiency in hospitals. We compare 4 similar sets of hospitals, matched in the dimensions of sample and hospital size and length of stay. Heterogeneity in output definition is used to control for case-mix.

3) The Determinants of Hospital Efficiency: An Analysis of X-Efficiency, *Michael D. Rosko*, Widener Univ., Health & Med. Services Admin., One University Pl, Chester, PA 19013, *Jon A. Chilingirian*

A 3-stage approach is used in a stochastic frontier analysis of factors affecting the efficiency of 195 Pennsylvania acute hospitals. After controlling for patient-level severity of illness data and input prices, results suggest that inefficiency is positively associated with teaching mission, service-based competition and inversely associated with regulatory pressures.

#### TC29 New Perspectives in Supply Chain Modeling

Cluster: Inventory Management

Invited Session

Chair: Paul H. Zipkin, Duke Univ., Fuqua Sch. of Bus., Durham, NC 27708-0120, zipkin@mail.duke.edu

1) Infinite Horizon Production Planning in Time Varying Systems with Convex Production & Inventory Costs, *Robert L. Smith*, Univ. of MI, Dept. of IOE, Ann Arbor, MI 48109-2117, *Rachel Q. Zhang*

We consider the planning of production over the infinite horizon in a system with time varying convex production and inventory holding costs. We show that under very general conditions, a finite horizon version of the problem exists that

leads to an optimal production level at any decision epoch.

**2) Economics of Multi-Plant Production Systems in a Changing Environment, Lode Li, Yale Univ., Sch. of Mgmt., Box 208200, New Haven, CT 06520-8200**

Production people tend to think of variability as an enemy and try to reduce variability wherever they can in areas of demand, supply, production processes and product or service quality. On the other hand, finance people have long recognized that option has value only when there is variability in stock prices. The observation gives rise to the demand for a general theory about economics of variability...

**3) Competitive & Cooperative Selection of Inventory Policies in a Serial Supply Chain, Gerard Cachon, Duke Univ., Fuqua Sch. of Bus., Box 90120, Durham, NC 27708-0120, Paul H. Zipkin**

We study a 2-firm serial supply chain with stochastic demand and no setup costs. Both firms are charged holding costs and wish to avoid consumer backorders. We compare the firms' choices of base-stock levels in the system-optimal solution and in Nash equilibria. We also present simple contracts that ensure the firms can implement the optimal solution in a decentralized setting.

**TC30 Readiness, Training & Scheduling**

**Sponsor: INFORMS Military Applications Society**

**Sponsored Session**

**Chair: John F. Raffensperger, 5832 N Wayne Ave., Chicago, IL 60660-3479, pjraffen@gsbphd.uchicago.edu**

**1) Characterization of Military Unit Training Status, Craig Moore, RAND, cmoore@rand.org, Larry Hanser**

Because they must sometimes concentrate on other responsibilities or they have limited time and resources in peacetime, many military units cannot constantly maintain their capabilities at the high levels needed for war. They would need time and additional resources in order to hurriedly raise their capabilities to the desired levels. The DoD currently has no comprehensive way of identifying these needs in peacetime...

**2) The Navy Class Scheduling System, Mark D. Chipman, Navy Personnel R&D Ctr., 53335 Ryne Rd., San Diego, CA 92152-7250, mchipman@nprdc.navy.mil**

The Navy trains several thousand personnel each year in order to ensure readiness and meet its mission. To provide training, the Navy offers different classes at multiple sites in the US throughout the year. Often, multiple convenings of classes at 1 site must share limited resources, e.g., rooms, instructors, equipment. As the Navy downsizes and consolidates, training resources have shrunk...

**3) The Readiness Problem: Solving a Selection & Scheduling Problem with Dynamic Programming & Column Generation with Policy Implications, John F. Raffensperger, 5832 N Wayne Ave., Chicago, IL 60660-3479, pjraffen@gsbphd.uchicago.edu**

An Army tank battalion scheduling training events cover an on-going peacetime readiness and a potential emergency horizon. The objective is to minimize the makespan in the emergency horizon, subject to a peacetime budget in the peacetime horizon. We discuss measuring readiness and trade-offs of resources to readiness, with contributions in DP and column generation.

**TC31 Metaheuristics: Military Applications**

**Sponsor: INFORMS Military Applications Society**

**Sponsored Session**

**Chair: Phillip A. Djang, USA TRAC-White Sands, WSMR, NM 88002-5502, djang@trac.wsmr.army.mil**

**1) Using a Genetic Algorithm to Solve Generalized Assignment Problems with Multiple Prioritized Objective Criteria, Barbara A. Dixon, US Army TRADOC Analysis Ctr., ATRC-WJB, WSMR, NM 88002, dixonb@trac.wsmr.army.mil, David S. Dixon**

A class of resource allocation problems deal with allocation of groups of resources to groups of tasks. Allocation problems of this type can often be formulated as binary programming problems with multiple optimization criteria. Podinyski & Gavrilov developed an algorithm addressing the solution of such problems for the former Soviet Armed Forces...

**2) Solving the Unit Training Strategy Problem with Tabu Search, Phillip A. Djang, USA TRAC-White Sands, WSMR, NM 88002-5502, djang@trac.wsmr.army.mil**

The unit training strategy problem is to construct a training strategy such that all mission essential tasks are trained to standard at minimum cost. The tasks can be trained by various methods: simulation, field training, live fire, etc. The effectiveness of these methods are based on learning curves, which yield a

nonlinear model...

**3) System Design & Optimization Using Genetic Algorithms, Jack E. Parker, Jr., Nichols Res. Corp., Attn: 3-2-09, 4040 S Memorial Parkway, Huntsville, AL 35815-1502, ncboyant@nichols.com**

An introduction to the concept and uses of GAs is presented prior to a discussion of work done in support of the Theater Missile Defense Attack Operations Working Group. This work involved the analysis and optimization of fire support smart munitions concepts for the Attack Operations mission in a counterfire role against threat ballistic missiles...

**TC32 Broadband Network Design & Routing**

**Cluster: Telecommunications**

**Invited Session**

**Chair: June S. Park, Univ. of IA, Dept. of MS, Coll. of Bus Adm., Pappajohn B.A.B., Iowa City, IA 52242-1000, june-park@uiowa.edu**

**1) Optical Fiber Network Design & Routing for a Multimedia Telecommunication Service, Byung H. Lim, Univ. of IA, Dept. of MS, Pappajohn CBA, Pappajohn BAB, Iowa City, IA 52242, June S. Park, Youngho Lee**

The problem is to provide video-on-demand services based on the existing fiber optic network. We must determine what types of fiber cable to add to which existing links and which route to use from the video gateway to each central office. An IP and problem-specific solution methods are discussed.

**2) A SONET Intra-Ring Design Problem, Youngho Lee, US WEST Advanced Tech., 4001 Discovery Dr., Ste. 280, Applied Research, Boulder, CO 80303, yhlee@advtech.uswest.com, June S. Park**

We present a new SONET intra-ring design problem arising from the design of telecommunication inter-office facility networks. We develop alternate mixed (quadratic) integer programming formulations and devise new heuristic procedures that exploit inherent structures of the models.

**3) Routing in Wide Area Communication Networks with Response Time Dependent Offered Traffic, Larry J. LeBlanc, Vanderbilt Univ., Owen Grad. Sch. of Mgmt., 401 21st Ave. S, Nashville, TN 37203-9865, leblancl@ctrvax.vanderbilt.edu, Sridhar Narasimhan, Bin Ran**

We develop routing models for telecommunication networks which recognize that some but not all users will tolerate delays. This is important in internetworking because LANs modeled as nodes often contain different types of users and it may be too expensive to design capacity for instantaneous transmissions that only some users need.

**TC33 OR/MS in Forestry III**

**Sponsor: OR/MS in Forestry**

**Sponsored Session**

**Chair: John G. Hof, US Dept. of Agriculture, 3825 E Mulberry St., Ft. Collins, CO 80524, /s=j.hof/ou1=s28A@mhs-fswa.attmail.com**

**1) Generating Alternatives in Forestry Modeling, Richard L. Church, Univ. of CA, Ntl. Ctr. Geog. Info./Analysis, Dept. of Geog., Santa Barbara, CA 93106-4060, church@geog.ucsb.edu, Klaus Barber, Michael A. Figueroa, Alan T. Murray**

A number of models have been developed for the management of forest resources. Many solution methodologies involve identifying an optimal or near optimal solution for such models, without attempting to identify spatially different alternatives. We address the need to search for good but spatially different alternatives and present an application.

**2) Algorithms for Assigning Aggregate Mathematical Programming Solutions to Land Type Polygons for Spatial Analysis in a GIS, Tara Barrett, Univ. of MT, Sch. of Forestry, Missoula, MT 59812, tara@forestry.umt.edu, Lawrence S. Davis**

Systematic, stochastic and goal driven algorithms are compared to assign non-spatial optimal mathematical programming solutions to land type polygons in a GIS database. Explicit assignment is essential for assessment of many aspects of ecological sustainability. Criteria of economic efficiency, pattern, habitat and structural dynamics are considered.

**TC34 Groupware: Improving Electronic Meetings**

**Cluster: Management Information Systems**

**Invited Session**

**Chair:** Gail Corbitt, CA State Univ., Acct. & MS, Dept. 0011, Chico, CA 95929-0011, gcorbitt@busipo.csuchico.edu

1) **Consensus & Other Ground Rules for the Electronic Environment, Ben Martz**, CA State Univ., Acct. & MS, Dept. 0011, Chico, CA 95929-0011, bmartz@busipo.csuchico.edu

Meeting groundrules are fundamental requirements for effective and efficient groups. Classic manual meeting groundrules are identified and discussed as to their practical application in electronic meeting environments. Specifically, the concept of group consensus is reviewed and discussed in regard to its explicit and implicit nature in the electronic environment.

2) **The Challenges of Facilitating in a Distributed Environment, Morgan Shepherd**, Univ. of CO, Coll. of Bus., IS Dept., 1420 Austin Bluffs Parkway, Colorado Springs, CO 80933-7150, msheper@brain.uccs.edu

With the rapidly expanding growth in today's technologies, many businesses are starting to work in the different time/different place environment and to realize advantages associated with distributed electronic meetings. This environment creates additional challenges that need to be addressed by meeting facilitators, who influence the success of electronic meetings.

3) **Electronic Meetings: Lessons Learned in Multi-Cultural Settings, Gail Corbitt**, CA State Univ., Acct. & MS, Dept. 0011, Chico, CA 95929-0011, gcorbitt@busipo.csuchico.edu, **Lauren Wright**

As environments become more team-oriented and business interactions become more global and diverse, multi-cultural teams are increasingly more common. Group behavior, on the other hand, is culture bound and this study examines some issues and solutions in working with multi-cultural groups by comparing electronic and non-electronic group interactions.

## Tuesday 14:45-16:15

### TD02 Optimization on the Internet II

**Sponsor:** INFORMS CSTS

**Sponsored Session**

**Chair:** Joseph Czyzyk, Argonne Ntl. Lab., Math. & Comp. Sci. Division, Argonne, IL 60439-4844, czyzyk@mcs.anl.gov

1) **NEOS: The Network-Enabled Optimization, Joseph Czyzyk**, Argonne Ntl. Lab., Math. & Comp. Sci. Division, Argonne, IL 60439-4844, czyzyk@mcs.anl.gov

We will focus on the NEOS Server, a distributed interactive optimization solver. The server solves LP and stochastic LP problems; unconstrained, bound- and nonlinearly-constrained optimization, network problems and complementarity problems. We will also feature the NEOS Guide (optimization tree, software guide, case studies) and NEOS Tools (available software).

2) **Integrating Mathematical Programming Tools Using Client/Server Technology, Jamie Cruise**, Unicom Consultants, **Gautam Mitra**

Tools such as MPL provide a rich interactive environment for developing mathematical programming models. We illustrate a production application which uses MPL as an embedded component of a distributed programming/modeling system. We also show software extensions which integrate client/server capability into MPL. The scope of extending this approach to internet/intranet computing paradigm is also discussed.

### TD04 Efficiency in Health Care

**Cluster:** Public Sector Applications

**Sponsor:** INFORMS Section on Public Programs & Processes

**Invited/Sponsor Session**

**Chair:** Stefanos A. Zenios, Stanford Univ., Grad. Sch. of Bus., Stanford, CA 94305-5015, stefzen@leland.stanford.edu

1) **University/Industry Collaborations: Good for Our Health?, Arni G. Hauksson**, MIT, OR Ctr., Cambridge, MA 02139, agh@mit.edu, **Arnold Barnett, Stan Finkelstein**

We will explore whether creative ideas at the university are not reaching fruition as marketable products, either because of overt obstacles or poor technology transfer. Particular attention will be paid to such areas as medicine, physics and engineering.

2) **Analysis of FDA-Approved Automated Pap Smear Screening Policies for Cervical Cancer, James C. Benneyan**, Univ. of MA, Dept. of Mech. & IE, Amherst, MA 01003, benneyan@ecs.umass.edu

Mathematical and economic models compare automated vs. conventional screening of Pap smears to indications of cervical cancer. In particular, the

automated screening policy recently approved by the FDA is shown to not always be advisable.

3) **Genetic Testing: A Decision Analysis, Tammy O. Tengs**, Univ. of CA, Sch. of Social Ecology, Irvine, CA 92697-7075, tengs@uci.edu

Women who carry the BRCA1 breast-ovarian cancer gene have an 85% chance of developing breast cancer and a 63% chance of developing ovarian cancer. Many will elect to have their breasts and/or ovaries surgically removed. We develop a Markov decision model to evaluate which women would benefit from BRCA1 testing.

4) **Doing Cost-Beneficial Trials in the Era of Managed Care, John Hornberger**, Stanford Univ., Sch. of Medicine, Stanford, CA 94305-5092, jeh@osiris.stanford.edu

Competition in US health care has created incentives for organizations to distinguish themselves on cost and quality. Compared to database research, organizations seem to invest relatively little in trials that could inform clinical practice policies. Methods based on Bayesian statistical and decision theory are described for designing and doing cost-beneficial trials.

### TD05 LP Models in Telecommunications

**Cluster:** Linear Programming

**Invited Session**

**Chair:** Moshe Segal, AT&T Labs., 101 Crawfords Corner Rd., Rm. 1L-226, PO Box 3030, Holmdel, NJ 07733-1988, moshe@buckaroo.att.com

1) **Routing in a Passive Optical Ring, Bruce Shepherd**, London Sch. of Econ., Ctr. for Discrete/Appl. Math., Houghton St., London, WC2A 2AE, UK, bshep@lse.ac.uk, **Vivek Tandon**

Recently, an optical ring has been promoted for use in the local access layer which uses passive optical nodes together with absorbers. We consider several problems related to the development of an on-line routing algorithm for such an architecture. Our results are primarily based on design principles derived from a static multicommodity flow theorem for a node-capacitated network.

2) **Design of Virtual Paths in ATM Networks, Iraj Saniee**, BELLCORE, 445 South St., MCC1A-328B, Morristown, NJ 07960

ATM VPs are dedicated trunks that grab capacity from the transport layer and simplify routing and reduce delay of the switched virtual circuits. We discuss design of VPs for realistic-sized networks and present computational results for heuristics as well as large-scale non-linear multi-commodity flow models using iterative LP solutions.

3) **Combining Call & Force Management: New Challenges, Moshe Segal**, AT&T Labs., 101 Crawfords Corner Rd., Rm. 1L-226, PO Box 3030, Holmdel, NJ 07733-1988, moshe@buckaroo.att.com

Automatic call distributors manage the flow of calls to multi-team complexes where agents provide several services. Combining call and workforce management gives rise to new optimization models.

### TD06 TUTORIAL: Recent Advances in Deterministic Global Optimization

**Cluster:** Global Optimization

**Invited Session**

**Chair:** Panos Pardalos, Univ. of FL, Ctr. Applied Opt. & ISE Dept., 303 Weil Hall, Gainesville, FL 32611-6595, pardalos@ufl.edu

1) **TUTORIAL: Recent Advances in Deterministic Global Optimization, C. A. Floudas**, Princeton Univ., Dept. of Chem. Eng., Princeton, NJ 08544-5263, floudas@titan.princeton.edu

No abstract supplied.

### TD07 Queuing

**Contributed Session**

**Chair:** Lev Abolnikov, Loyola Marymount Univ., 5460 White Oak Ave., Apt. K-307, Encino, CA 91316

1) **Group Screening: Queuing Approach, Lev Abolnikov**, Loyola Marymount Univ., 5460 White Oak Ave., Apt. K-307, Encino, CA 91316, **Alexander Dukhovny**

A quality control problem is treated and studied in terms of queuing theory. Items to be inspected form a compound Poisson process and are served according to either group-individual or group-subgroup service procedures with an arbitrary distribution of group and individual service times. Applications to HIV-screening are considered.

**2) On Transient Delays of M/G/1 Queues, Chia-Li Wang**, Ntl. Dong Hwa Univ., Shoufeng, Taiwan, 974, ROC, cwang@cc.ndhu.edu.tw

We study the expected transient delay (actual waiting time in a queue) of the M/G/1 queue. The approach we take is to combine coupling and light traffic limit theorem, which allows us to obtain approximations and bounds that are asymptotically exact as either the traffic intensity goes to 0 or the queueing process approaches stationarity.

**3) On the Role of Rouche's Theorem in Queueing Analysis, Douglas G. Down**, GA Inst. of Tech., Sch. of ISyE, Atlanta, GA 30332, ddown@isye.gatech.edu, **J. W. Cohen**

In analytic queueing theory, Rouche's theorem can lead to results concerning ergodicity and performance analysis. For more complicated models, this can become difficult. We consider a queueing problem which can be modeled by coupled random walks and for which the use of Rouche's theorem may be avoided.

**4) Some Results for a Finite State-Dependent Queue, Meckinley Scott**, Western IL Univ., Math Dept., 1 University Cir., Macomb, IL 61455, scottm@ccmail.wiu.edu, **William J. Gray, P. Patrick Wang**

This presentation is concerned with the transient behavior of a finite state-dependent queue. Results obtained include the distributions of the number of customers lost (blocked) and the number of times the system is blocked during an arbitrary time interval.

**5) Bulk Queues, Matrix-Analytic Methods & Complex-Analytic Factorization, Alexander Dukhovny**, San Francisco Univ., 323 24th Ave., Apt. 1, San Francisco, CA 94121

On an example of M/G/1 queues with group service, we show how solution formulas based on complex-analytic factorizations help to apply matrix-analytic methods to analyze cases where service group sizes are not bounded and to solve the related characteristic equations.

## TD08 Business Applications II Contributed Session

**Chair:** William M. Bowen, Cleveland State Univ., Levin Coll. of Urban Affairs, Cleveland, OH 44118, bowen@wolf.csuohio.edu

**1) A Data Envelopment Analysis of Polish Industrial Cogeneration, William M. Bowen**, Cleveland State Univ., Levin Coll. of Urban Affairs, Cleveland, OH 44118, bowen@wolf.csuohio.edu, **Geoffrey Rothwell**

A DEA of 50 Polish industrial cogeneration plants for the years 1991-93 is presented. Inputs include labor, capital, type and amount of coal. Outputs include amounts of electricity and heat as well as particulate emissions. The use of DEA for estimating pollution prevention frontiers is illustrated.

**2) Economic Evaluation of a System, Burris D. Wolsieffer**, US Military Acad., PO Box 4024, West Point, NY 10097-1779

We will make an economic evaluation of producing a new material handling system for a depot and submit a bid for a contract with the Army. We will choose the best system by looking at the net present value of proposed handling systems.

**3) On an Evaluation of Small Business Loan Applications, Dat-Dao Nguyen**, Concordia Univ., DS & MIS Dept., 1455 de Maisonneuve Blvd. W, Montreal, Quebec, H3G 1M8, Canada, datao@vax2.concordia.ca, **Dennis Kira, Dale Doreen**

We describe how ANNs are used to determine the acceptance or rejection of small business loan applications. Results obtained through traditional statistical means such as discriminant analysis and logistic regression are used to compare with the performance of neural networks.

**4) Long Term Planning in the Automobile Industry: Data Processing, Modeling & Decision Making, Hernan Wurgaft**, EDS, 750 Tower Dr., MS 6D, Troy, MI 48098

We report our experience designing and supporting long term planning processes in one of the Big 3. Planning processes offer unique challenges being global and cross-functional in scope. Mathematical models embedded within the planning processes enable executives to make better decisions. We suggest that lessons learned are applicable in many industries.

## TD09 Machine Scheduling II Contributed Session

**Chair:** Samir V. Amiouny, Concordia Univ., 1455 de Maisonneuve Blvd., Rm. H-549, Montreal, Quebec, H3G 1M8, Canada, amiouny@alcor.concordia.ca

**1) A Shifting Bottleneck Procedure for Minimizing Costs in Job Shops, Samir V. Amiouny**, Concordia Univ., 1455 de Maisonneuve Blvd., Rm. H-549, Montreal, Quebec, H3G 1M8, Canada, amiouny@alcor.concordia.ca

We adapt the shifting bottleneck procedure of Adams, Balas & Zawack to job shop problems where the objective is to minimize the sum of earliness, tardiness and WIP penalties for all jobs. We present the computational performance of the resulting heuristic and compare it to that of others.

**2) Scheduling of Job Families on Parallel Machines, Michael X. Weng**, Univ. of South FL, 4202 E Fowler Ave., ENB 118, Tampa, FL 33620, weng@eng.usf.edu

We discuss the problem of scheduling job families on unrelated or uniform parallel machines. Upon completion, the jobs of the same family are delivered all at once to the next destination, e.g., a customer or the downstream workstation. The scheduling objective is to minimize the sum of job completion times. Solution procedures are presented and experimental results reported.

**3) A Bicriterion Objective for Mixed-Model JIT Scheduling, J. Scott Yeomans**, York Univ., 333 SSB, 4700 Keele St., North York, Ontario, M3J 1P3, Canada, as000147@orion.yorku.ca, **George Steiner**

We present a bicriterion, min-max, min-sum objective for leveling the schedule of a mixed-model JIT assembly process. This approach combines the desirable properties of both criteria. It will be shown that several Pareto optimal solutions may be efficiently determined.

**4) Parallel Machine Earliness-Tardiness Scheduling with Additional Resources, Daechol Kim**, PA State Univ., 207 Hammond Bldg., Dept. of IE, University Park, PA 16802, dxk130@psu.edu, **Jose A. Ventura**

We address the problem of scheduling jobs on parallel machines with an unrestricted due date and additional resources to minimize total earliness and tardiness cost. It is shown that the problem is polynomial if there is one resource type and 0-1 resource requirements.

## TD10 Supply Chain Integration

**Cluster: Supply Chain  
Invited Session**

**Chair:** Laura Rock Kopczak, Stanford Univ., IE/EM Dept., Terman 351, Stanford, CA 94305-4024, kopczak@leland.stanford.edu

**1) Supply Chain Integration in the Computer Industry, Laura Rock Kopczak**, Stanford Univ., IE/EM Dept., Terman 351, Stanford, CA 94305-4024, kopczak@leland.stanford.edu

We present results of field research conducted during the summer of 1996 into supply chain integration in the computer industry. A survey of companies throughout the supply chain was used to quantify the level of integration and to attempt to link the level of integration to financial performance. Case studies of 10 companies were used...

**2) Supply Chain Integration: A View From the Trenches, Tom Davis**, Hewlett-Packard Co., 5301 Stevens Creek Blvd., Santa Clara, CA 95051-8059, tdavis@hp.com

We will turn from high-level survey work and models to examine in detail how these advanced supply chain concepts have affected a single business. We will highlight a handful of "unique" integration problems and how they were addressed in a manner consistent with a high-level supply chain strategy.

**3) Information, Inventory & Postponement in a Supply Chain, Krishnan S. Anand**, Northwestern Univ., Kellogg Sch. of Bus., 1503 Oak Ave., Apt. 314, Evanston, IL 60201, panand@leland.stanford.edu, **Haim Mendelson**

We consider alternative structures for a multiproduct supply chain: the products are differentiated early and the supply chain delays (or postpones) differentiation to better exploit demand information. We compare the firm's optimal production, shipment and inventory policies under the 2 structures and study the properties of the value of postponement.

**4) Integrated Decision Support Systems for Supply Chain Management, Can A. Dogan**, Supply Chain Consultants, Inc., 2604 Eastburn Ctr., Newark, DE 19711, **Koray Dogan**

Managing the supply chain involves many activities including demand management, production/distribution planning and inventory management. We will present a framework of a DSS based on the ingestion of MIMI family of products. Furthermore, we will present and demonstrate the capabilities of 2 of these products developed by supply chain consultants: MIMI/DM and MIMI/IMP.

**TD11 Information & Technology Issues in the Restaurant Industry**

Cluster: Tourism

Invited Session

Chair: Honorio Padron, Pepsico Restaurant Intl., 14841 Dallas Parkway, Dallas, TX 75240

1) **Technology: The Competitive Edge**, *Honorio Padron*, Pepsico Restaurant Intl., 14841 Dallas Parkway, Dallas, TX 75240, *William W. Swart*

No abstract supplied.

**TD12 Solving Complex Planning Problems**

Sponsor: INFORMS CSTS

Sponsored Session

Chair: LiWu Chang

, liwu@aic.nrl.navy.mil

1) **Decision-Theoretic Planning: AI Meets Stochastic Optimization**, *Steve Hanks*, Univ. of WA, Comp. Sci. & Eng. Dept., Box 352350, Seattle, WA 98195-2350, hanks@cs.washington.edu

Traditional work in AI planning has made 2 main assumptions: the planning agent is omniscient (no uncertainty) and its only objective is to achieve an input goal. Recent work has relaxed both these assumptions. I will discuss our techniques and their relation to work in decision sciences and stochastic optimization.

2) **Planning in a Real-Time Collaborative & Adversarial Environment: A Case Study in Robotic Soccer**, *Manuela M. Veloso*, Carnegie Mellon Univ., Dept. of Comp. Sci., WeH 7122, Pittsburgh, PA 15213-3892, veloso@cs.cmu.edu

Robotic soccer involves multiple agents that collaborate in an adversarial real-time continuous environment to achieve specific objectives. Techniques are presented on how training data is gathered to learn the preconditions of the available planning actions. Different levels of actions build upon each other to create reactive planning templates to apply in the real-time process.

**TD13 OR Applications of Java II**

Sponsor: INFORMS CSTS

Sponsored Session

Chair: Gordon H. Bradley, Naval Postgrad. Sch., OR Dept., Monterey, CA 93943, bradley@nps.navy.mil

1) **Discrete Event Simulation on the World Wide Web Using Java**, *Arnold H. Buss*, Naval Postgrad. School, OR Dept., Monterey, CA 93943-5000, busa@minerva.or.nps.navy.mil

The emergence of Java and the WWW opens up many exciting possibilities for OR simulation modeling. Utilizing our Java class library, SimKit, we explore some of the consequences of an internet-aware toolkit. Implications include a potential paradigm shift in the way simulation models are designed and constructed.

2) **Java: Some Examples**, *Chris Jones*, Univ. of WA, Sch. of Bus. Admin., Seattle, WA 98195, cvj@u.washington.edu

We discuss examples of the use of Java for teaching and for presenting research results. Since Java provides a device independent graphics imaging model, it is ideal for delivering interactive visualizations to a wide audience. We discuss an applet for teaching LP and an applet for the TSP.

3) **SimKit: A Toolkit for Simulation on the Internet**, *Kirk A. Stork*, Naval Postgrad. Sch., OR Dept., Monterey, CA 93943, kastork@nps.navy.mil, *Arnold H. Buss*

We present Simkit, a Java class library for discrete event simulation. Models constructed with Simkit can easily be implemented as Java applets and executed in a Web browser. Models can exploit Java's built-in user interface and network facilities to rapidly create distributed simulations with intuitive user interfaces.

**TD14 The Remedial Dilemma: Defensible Data, Validated Results - Mathematical Theory, Application & Case Studies**

Sponsor: INFORMS Section on Environment

Sponsored Session

Chair: Delmar Long, HAZWRAP, PO Box 2003, MS 7607, Oak Ridge, TN 37831-7606, d61@ornl.gov

1) **The Mathematical Theory Behind Defensible Data, Validated Results**, *Mic Jackson*, HAZWRAP, PO Box 2003, MS 7607, Oak Ridge, TN 37831-7606, d61@ornl.gov

Transforming punctuated data into a continuous surficial model is mathematically difficult. To validate any model, the test must be against new data. Our system follows an adaptive sampling procedure that insures a sufficient and relatively minimal set of data has been generated to establish the reliability of the model.

2) **The Application of the Mathematical Theory**, *George Brumbaugh*, HAZWRAP, PO Box 2003, MS 7606, Oak Ridge, TN 37831-7606, d61@ornl.gov

Applying a state-of-the-art minimum tension modeling system compared to a linear interpolation to contaminated data allows for the acquisition of a minimal, high quality data best representing the volumetrics of subsurface contaminant configurations. Our system tends toward optimized data quality using interactive sample acquisition, modeling and validation.

3) **Results of the Mathematical Theory: Case Studies**, *Delmar Long*, HAZWRAP, PO Box 2003, MS 7607, Oak Ridge, TN 37831-7606, d61@ornl.gov

Confirmation of the discussed mathematical hypothesis is demonstrated with the presentation of several field applied case studies. Comparatives to conventional methodologies as well as conclusions from discussed data will be made.

**TD15 Network Flows II**

Contributed Session

Chair: Lisa Fleischer, Cornell Univ., 288 Rhodes Hall, Ithaca, NY 14853, lisaf@orie.cornell.edu

1) **A Faster Algorithm for the Quickest Transshipment Problem**, *Lisa Fleischer*, Cornell Univ., 288 Rhodes Hall, Ithaca, NY 14853, lisaf@orie.cornell.edu

I describe a faster algorithm to solve the dynamic transshipment problem where capacities are upperbounds on flow rates. The algorithm simultaneously minimizes the amount of excess left in the network at every time step. It was not known that such a flow exists.

2) **A Two-Phase Resource Constrained Shortest Path Algorithm**, *Tsevi Vovor*, Ecole Polytech., Dept. of Math. & IE, CP 6079, Succ. Centre-ville, Montreal, Quebec, H3C 3A7, Canada, tsevi@cr.umontreal.ca, *Brigitte Jaumard*, *Frederic Semet*

We consider an extension of the resource constrained shortest path problem where resources are expressed using windows on the arcs with updating based on threshold and resetting values at the vertices. Effective 2-phase algorithms are proposed for acyclic and non-acyclic networks.

3) **Separating Classes of TSP Inequalities in Polynomial Time**, *Robert D. Carr*, Carnegie Mellon Univ., GSIA, Pittsburgh, PA 15235, rc1a@andrew.cmu.edu

We partition the class of facet-defining inequalities of the TSP into a collection of inequality subclasses. For example, 1 of these subclasses is the class of 3-tooth comb inequalities. We then show an easy method for separating over each subclass of inequalities in polynomial time but with the complexity varying from subclass to subclass.

4) **Engineering Applications of the Resource Constrained Shortest Path Problem**, *David A. Kohler*, San Francisco State Univ., 1600 Holloway Ave., Bus. Analysis & Comp. Systems, San Francisco, CA 94132, *A. A. Elimam*

Two widely differing engineering problems are described: determining the optimal sequence of wastewater treatment processes and finding the minimum-cost energy-efficient structure of a composite wall or roof. Each is modeled as a resource constrained shortest path problem. We present various solution methods and give comparative computational experience.

**TD16 Mobilizing Information Technology to Communicate with Front-Line Workers**

Sponsor: INFORMS Section on Technology Management

Sponsored Session

Chair: Mustafa V. Uzumeri, Auburn Univ., Sch. of Bus., Dept. of Mgmt., Auburn University, AL 36849-5358, uzumeri@business.auburn.edu

1) **Applications of Learning Curve Analysis to Agile Manufacturing**, *Steve Clark*, Chrysler Corp., Huntsville Electronics Div., 100 Electronics Blvd., Huntsville, AL 35824-6401, jsc3@infoctr.chrysler.com, *John Evans*, *David A. Nembhard*

As manufacturing grows more automated and complex, empirical patterns of human worker performance are shifting. An empirical study of data from hundreds of thousands of inspection cycles suggests that companies must pay far more attention to coordinating the mental elements of the task.

2) **Simulating the Effects of Worker Learning on Production**

Cost, *Scott M. Shafer*, Auburn Univ., Dept. of Mgmt., 415 W Magnolia St., Auburn, AL 36849-5241, shafer@business.auburn.edu, *Harriet Nembhard, David A. Nembhard*

Production systems are composed of workers with widely varied learning behaviors. We use empirical data on learning and forgetting to simulate the effect that these factors have on production cost. The simulations allow us to evaluate the effects of various operating policies such as starting up a new line and job rotation.

3) **The Changing Cost Structure of Video Delivery**, *Jim Long*, Starlight Networks, 205 Ravendale Dr., Mountain View, CA 94043, jim1@starlight.com

Increasing demand for mixed media applications is a fact of life in corporations, from factory floor to boardroom. Delivery of live and stored video on-demand is now easy to cost-justify and brings a competitive advantage to business. This discussion focuses on the forces driving down the cost of digital.

4) **Systems Architectures to Inform Front-Line Workers**, *Edly Hurt*, BDM Engineering Services Co., 950 Explorer Blvd., Huntsville, AL 35806, ehurt@bdm.com, *Mustafa V. Uzumeri*

With global competition, work processes evolve faster, products vary and change and workers switch tasks far more often. Companies must increase the bandwidth of the systems that tell workers what to do, where and when. We examine the new opportunities and challenges that face information system architects.

#### TD17 Economic Instruments for Energy & Environmental Policy

Sponsor: INFORMS Section on ENRE  
Sponsored Session

Chair: Todd Strauss, Yale Sch. of Mgmt., Box 208200, New Haven, CT 06520-8200, tps@homey.som.yale.edu

1) **Infinite Horizon Optimization, the Welfare Theorems & Climate Policy**, *Alan R. Sanstad*, Lawrence Berkeley Ntl. Lab., Berkeley, CA 94720

We discuss several issues raised by climate policy applications of infinitely-lived representative agent models, including the relations between economic equilibria and optimal solutions and the truncation problem. We also compare the use of this standard model with an overlapping generations approach.

2) **Evolving Regulation & Incentives in Electricity**, *Joseph A. Doucet*, Univ. of FL, Public Utility Research Ctr., Dept. of Economics, Gainesville, FL 32611-2017

Regulated utilities now include demand- as well as supply-side resources in their planning. Regulatory treatment, i.e., rate base, tariffs, etc., may have an impact on the utilities resource choices. Using a simple model of regulation, we analyze impacts of changes in the regulatory framework of electric utilities on the relative efficiency of resource allocation.

3) **Internet-Based Market for Emission Credits: The Southern California Experience**, *Charles Polk*, Net Exchange, PO Box 1861, Avalon, CA 90704, polk@cerf.net, *Takashi Ishikida, John Ledyard, Mark Olson, David Porter*

The Regional Clean Air Incentives Market program in Southern California established ownerships on air pollution credits in 1994. We have been providing an internet-based market for credits exchange for each quarter since April 1994. We report the unique features of the market and its performance.

#### TD18 TUTORIAL: Robust Discrete Optimization & Its Operations Management Applications

Invited Session  
Chair: Panos Kouvelis, Washington Univ., Olin Sch. of Bus., One Bookings Dr., St. Louis, MO 63130-4899, kouvelis@wuolin.wustl.edu

Co-Chair: Gang Yu

1) **TUTORIAL: Robust Discrete Optimization & Its Operations Management Applications**, *Panos Kouvelis*, Washington Univ., Olin Sch. of Bus., One Bookings Dr., St. Louis, MO 63130-4899, kouvelis@wuolin.wustl.edu, *Gang Yu*

We deal with decision making in environments of significant data uncertainty, with particular emphasis on operations and production management applications. For such environments, we suggest the use of the robustness approach to decision making, which assumes inadequate knowledge of the decision maker about the random state of nature and develops a decision that hedges against the worst contingency that may arise...

#### TD19 Cross-Cultural Negotiation & Computer Technologies

Sponsor: INFORMS Section on Group Decision & Negotiation  
Sponsored Session

Chair: Gregory E. Kersten, Carleton Univ., Ctr. for Comp. Assisted Mgmt., Ottawa, Ontario, Canada, gregory@business.carleton.ca

1) **InterNeg: A Web Site & a Web-Based Negotiation Support System**, *Gregory E. Kersten*, Carleton Univ., Ctr. for Comp. Assisted Mgmt., Ottawa, Ontario, Canada, gregory@business.carleton.ca, *Sunil J. Noronha*

InterNeg is a system that supports negotiations on the Web, primarily used to conduct and study international negotiations. InterNeg supports 3 main phases of negotiations and provides several software services. It can be used as a support system, research and training, simulation package and a game. The architecture of the system, its uses and services provided through the InterNeg Web site are discussed.

2) **Negotiating via the World Wide Web: A Cross-Cultural Perspective**, *Sunil J. Noronha*, Carleton Univ., Ctr. for Comp. Assisted Mgmt., Ottawa, Ontario, Canada, *Gregory E. Kersten, Madan Mohan*

Several researchers have suggested the effectiveness of negotiation support systems may be strongly influenced by the cultural identities of the negotiators. Web-based technology has now made it feasible to test this hypothesis empirically by hooking together people from all over the world via the Internet and recording their characteristics and behavior during a complete negotiation...

#### TD20 Vehicle Routing Problems

Sponsor: INFORMS Transportation Science Section  
Sponsored Session

Chair: Michel Gendreau, DIRO & CRT, Univ. of Montreal, Montreal, Quebec, H3C 3J7, Canada

1) **Tabu Search Diversification Strategies for a Stochastic Vehicle Routing Problem**, *Michel Gendreau*, DIRO & CRT, Univ. of Montreal, Montreal, Quebec, H3C 3J7, Canada, *Rene Seguin, Josephine Pelleu, Patrick Soriano*

We address a VRP where the demands are stochastic as well as the presence of customers. The objective is to design a priori routes that minimize the expected cost of routing and penalties. The problem is solved using a TS heuristic where cross-exchange moves are used in a diversification phase. Comparisons with an optimal algorithm and another TS heuristic are presented.

2) **New Improvement Procedures for the Undirected Rural Postman Problem**, *Gilbert Laporte*, CRT, Univ. of Montreal, Montreal, Quebec, H3C 3J7, Canada, *Alain Hertz*

We present new improvement heuristics for the RPP. Tests on several types of instances show that these heuristics consistently produce optimal or quasi-optimal solutions within moderate computing times.

3) **A Tabu Search Heuristic for the Capacitated Arc Routing Problems**, *Michel Gendreau*, DIRO & CRT, Univ. of Montreal, Montreal, Quebec, H3C 3J7, Canada, *Srimathy Gopalakrishnan, Jean-Marc Rousseau*

The CARP is one of the most important problems in arc routing with numerous applications; it is also one of the most difficult because it includes capacity restrictions on routes. We propose a TS heuristic based on the idea of balancing demands on routes by moving capacity excesses of deficits among neighboring routes.

#### TD21 Decision Support Systems in Health Care

Sponsor: INFORMS College on Artificial Intelligence  
Sponsored Session

Chair: W. Raghupathi, CA State Univ., Dept. of Acct. & MIS, Chico, CA 95929-0011, rp@ceest.csuchico.edu

1) **Using Neural Networks for Breast Cancer Detection**, *Murali Shanker*, Kent State Univ., Coll. of Bus., Kent, OH 44242-0001, mshanker@scorpio.kent.edu, *Michael Hu, Ming Hung, Eddy Patuwo*

In recent years, ANNs have been widely used for classifications. We discuss the application of ANNs for breast-cancer prediction. Comparisons are made with LP and other classifiers.

2) **Clinical Decision Support Systems: A Framework for Applications**, *W. Raghupathi*, CA State Univ., Dept. of Acct. & MIS, Chico, CA 95929-0011, rp@ceest.csuchico.edu

As more researchers and practitioners explore the potential of DSSs in clinical settings, there is a growing need for a framework/taxonomy of potential applications. The framework will enable researchers to focus on the more critical issues related to the design and use of DSSs in health care in general.

**3) Assessing the Value of Decision Support Systems in Health Care, W. Raghupathi**, CA State Univ., Dept. of Acct. & MIS, Chico, CA 95929-0011, rp@ecst.csuchico.edu, **Samir Nissan**

As hospitals and other health care agencies develop and use DSSs, particular attention must be drawn to measuring the benefits and costs associated with the systems. We discuss the potential of ABC in identifying benefits and costs and contrast it with the more traditional approaches.

## TD22 Issues in Global Logistics

**Cluster: Global Manufacturing Practice**  
**Invited Session**

**Chair: Ricardo Ernst**, Georgetown Univ., Grad. Sch. of Bus., 201 Old North, Washington, DC 20057, ernstr@gunet.georgetown.edu

**1) Technology Selection in Global Manufacturing Companies, Vedat Verter**, McGill Univ., 1001 Sherbrooke St. W, Fac. of Mgmt., Montreal, Quebec, H3A 1G5, Canada, verter@management.mcgill.ca, **Ricardo Ernst**

We present a systematic approach that could be useful for selecting manufacturing technology in global firms. The methodology ensures that the selected technology will facilitate achievement of the firm's manufacturing strategy objectives. The differentiating features of technology selection in an international environment will be addressed.

**2) Service Parts Logistics Benchmarking: US & European Practice, Shuren Zhang**, Univ. of PA, Wharton Sch., OPIM Dept., Philadelphia, PA 19104-6366, zhang68@opim.wharton.upenn.edu, **Morris A. Cohen, Ricardo Ernst, Philippe-Pierre Dornier, Janghyuk Lee**

We report on findings if an in-depth benchmarking study of service parts logistics systems. Large variations in operational and financial performance metrics were observed, including inventory turnover, job completion rate and communication patterns. Significant differences in practice emerged, by region and industry class.

## TD23 Automation Control Issues

**Cluster: Flexible Manufacturing Systems**  
**Invited Session**

**Chair: Kathryn E. Stecke**, Univ. of MI, Sch. of Bus. Admin., 701 Tappan St., Ann Arbor, MI 48109-1234, kstecke@umich.edu

**1) Making OR/MS On Line for Process Design & Control, Tsong-how Chang**, Univ. of WI, Dept. of IE, PO Box 784, Milwaukee, WI 53201, thchang@csd.uwm.edu

Through integration of contemporary SPC, we suggest extending some of the OR/MS applications to the design and control of manufacturing processes, from the traditional off-line one-time decision analysis. Examples are presented to illustrate the SPC integration in the modeling of queues for shop-floor applications.

**2) Engineering Multimedia for FMSs, Paul G. Ranky**, NJIT, Dept. of IE, University Heights, Newark, NJ 07102, ranky@admin.njit.edu

Engineering multimedia methods, tools and technologies are presented as excellent research and industrial application opportunities for academia and industry. The presentation will include several computer/CD-ROM demonstrations.

**3) Rapid Prototyping of Auction-Based Shop-Floor Control Software Using Parallel & Distributed Simulation, Kung-Jeng Wang**, Univ. of WI, Dept. of IE, 1513 University Ave., Madison, WI 53706, raj@ie.engr.wisc.edu, **Raj Veeramani**

We describe a methodology for the modeling and simulation of auction-based shopfloor control systems in a parallel and distributed computing environment using parallel virtual machines. This approach allows more accurate modeling and evaluation of the shopfloor behavior and enables rapid prototyping and development of the actual control software.

## TD24 Applications of Decision Analysis in the Pharmaceutical Industry

**Sponsor: INFORMS Decision Analysis Society**  
**Sponsored Session**

**Chair: Cynthia S. Sushak**, Eli Lilly & Co., Lilly Corporate Ctr., Indianapolis, IN 46285-2120, sushak@lilly.com

**1) Proactive Treatment for Decision Analysis "Growing Pains", Stuart Harris**, Glaxo Wellcome Inc., 5 Moore Dr., Research Triangle Pk, NC 27709

The introduction and institutional acceptance of DRA is examined at a major pharmaceutical company. The study looks at critical success factors for corporate acceptance of DRA, strategies aimed at gaining acceptance and positive changes that have been taking place. The corporate setting included a portfolio of "risky" R&D projects and ongoing changes in the health care industry and technology...

**2) Dynamically Managing Pharmaceutical R&D Using Option Valuation, Gregg S. Talbert**, Eli Lilly & Co., Lilly Corporate Ctr., Indianapolis, IN 46285-2120, talbert@lilly.com

Option valuation using discrete time dynamic programming is applied to the selection and evolution of a firm's R&D portfolio. Using a simulation model, we show how periodically updating the firm's beliefs about its chances of technical success with a pool of risky projects can significantly alter its decision making and improve return on R&D portfolios.

**3) Portfolio Management Processes in the Pharmaceutical Industry, Cynthia S. Sushak**, Eli Lilly & Co., Lilly Corporate Ctr., Indianapolis, IN 46285-2120, sushak@lilly.com, **Christopher M. McReynolds**

Portfolio management is increasingly becoming a lifeline to the future for companies that invest heavily in R&D. This presentation discusses the design and implementation of R&D portfolio processes in the pharmaceutical industry, based on a benchmarking survey that was conducted over the last year.

## TD25 The Best OR/MS Cases

**Sponsor: INFORMS Forum on Education**  
**Sponsored Session**

**Chair: Peter C. Bell**, Univ. of Western Ontario, Ivey Bus. Sch., London, Ontario, N6A 3K7, Canada, pbell@novell.business.uwo.ca

### 1) The Best OR/MS Cases

Several teachers from business schools and OR departments will distribute copies of their favorite OR/MS cases, briefly describe the cases and review how they use them in the classroom.

## TD26 Matrix-Analytic Methods II

**Sponsor: INFORMS Applied Probability Section**  
**Sponsored Session**

**Chair: Srinivas R. Chakravarthy**, GMI Eng. & Mgmt. Inst., Dept. of Sci. & Math., 1700 W Third Ave., Flint, MI 48504

**1) Matrix-Analytic Methods for the Reflected Brownian Approximation to Queues, Colm O'Cinneide**, Purdue Univ., Sch. of IE, Grissom Hall, W Lafayette, IN 47907-1287

We give a space and time transformation of an RBM in a cone which produces a Markov additive process. This is a continuous version of a quasi-birth-and-death process. Matrix-analytic methods, applied heuristically, give insight into the behavior of the RBM near the vertex.

**2) Further Transient Analysis of the BMAP/G/1 Queue, David M. Lucantoni**, IsoQuantic Technologies, 10 Oak Tree Ln, Wayside, NJ 07712

We continue the transient analysis of the BMAP/G/1 queue by deriving explicit expressions for the transforms of the queue length at the  $n$ -th departure (assuming a departure at time 0) and the delay of the  $n$ -th arrival (keeping track of appropriate phase changes). Also, the departure process is characterized by the double transform of the probability that the  $n$ -th departure occurs at time less than or equal to time  $x$ .

**3) Markovian Models for Non-Negative Random Variables, Shi Dinghua**, Shanghai Univ. of Sci. & Tech., Dept. of Math., Shanghai, 201800, PR of China, **Danielle Liu**

We consider Markovian models for random variables defined on  $(0/\infty)$ . A general ladder model is constructed. Many existing distribution classes are derived from the general framework and a new distribution class BHR is introduced. This new class includes PH, SPH (PH with countable number of phases) and distributions with rational LS transform as special cases...

**4) Performance Evaluation of a Parallel System with Program Overlap, Saroja P. Kanchi**, GMI Eng. & Mgmt. Inst., 1700 W 3rd Ave., Flint, MI 48504, **Srinivas R. Chakravarthy**

We develop a queuing model to evaluate the performance of parallel systems.

The model incorporates discrete arrivals, discrete service times, batch arrivals and precedence constraints within the tasks of a program. We introduce an overlap parameter  $K$  that denotes a number of program executions that can overlap. We analyze this queueing model and show that the stationary probability vector is of the matrix-geometric type...

### TD27 Strategic Planning I Contributed Session

**Chair:** Swagata Saha, Hewlett Packard, 16399 W Bernardo Dr., MS 711, San Diego, CA 92127, swagata\_saha@hp.com

#### 1) Cost of Supply Chain Under Non-Standardization, *Swagata Saha*, Hewlett Packard, 16399 W Bernardo Dr., MS 711, San Diego, CA 92127, swagata\_saha@hp.com, *Eric S. Talle*

In a virtual organization, we choose product/process designs and assign suppliers for new product introductions so supply chain cost is optimized. We wish to leverage standard product formulations and manufacturing processes. Suppliers, technology and contractual constraints lead to non-standardized solutions. We present a model to determine product/process characteristics...

#### 2) SCAFI: A Model for Measuring Sustainable Competitive Advantage & Financial Impact, *James N. Vedder*, Syracuse Univ., Sch. of Mgmt., Ste. 400, Syracuse, NY 13244-2130, jvedder@som.syr.edu

Measures of competitive advantage have been recently developed (Sethi & King, 1994). These measures need to be linked backward to strategies and forward to financial impacts. A model, SCAFI, which meets these specifications is developed and an example application shown in the area of IS.

#### 3) Time-to-Market Strategies, *Gerhard Plenert*, Brigham Young Univ., IBM 660 TNRB, Provo, UT 84602, gerhard\_plenert@byu.edu

We discuss research on why time-to-market has become such an important strategy in the 1990s. We discuss where time-to-market changes are made, how they are implemented and how they affect competitiveness.

#### 4) Deterministic Chaos in the Capacity Expansion Race: A Study of the Airline Industry (R), *Raghav Rao*, SUNY, 325 Sch. of Mgmt., Jacobs Ctr., Buffalo, NY 14260, mgmtrao@acsu.buffalo.edu, *Yong I. Song*, *Srinivasan Rajagopalan*

The dynamic and complex nature of the capacity expansion race in the airline industry is depicted by a non-linear dynamic system that parsimoniously captures the market moves of firms and their collective impacts on each firm and the industry as a whole.

### TD28 Revolutionary Technologies in Health Care: INFOMEDICS (Intelligent Voice Response Systems & Clinical Care)

**Cluster:** Health Care Technology, Policy & Applications  
Invited Session

**Chair:** Jon A. Chilingierian, Brandeis Univ., Heller Sch., Box 9110, Waltham, MA 02254-9110, chilingierian@binah.cc.brandeis.edu

#### 1) Research on Improving Productivity & Outcomes with Telephone Linked Care Systems, *Gene Guselli*, INFOMEDICS, 800 W Cummings Park, Ste. 4950, Woburn, MA 01801, information@infomedics.com

TLC systems and intelligent voice response technology make it possible to shift the delivery of routine services from the clinician's office to the patient's home. Clinical trials suggest that changes in health status will receive prompt attention when a clinical intervention is required. The potential clinical impacts and cost savings are discussed.

#### 2) Understanding Intelligent Voice-Response Systems, *Robert Friedman*, Brandeis Univ., Medical Sch., Boston, MA

IVRSs can be used in health care to collect, monitor and report health status information on patients with chronic diseases and other conditions. Computer-controlled telephone interviews can be synthesized in the voice of the caregiver. IVRS technology can help compliance with treatment regimens while improving outcomes.

#### 3) A Clinical Reaction to Telephone-Linked Care Technology, *Sarita Bhalotra*, Brandeis Univ., Inst. for Health Policy, Heller Grad. Sch., Waltham, MA 02254-9110, bhalotra@binah.cc.brandeis.edu

We will critique the clinical evidence on computer-controlled telephone interviews and discuss the implications from a clinical standpoint.

### TD29 Issues in Assembly Manufacturing Systems

**Cluster:** Inventory Management  
Invited Session

**Chair:** Jeannette Song, Columbia Univ., Dept. of IE/OR, New York, NY 10027, song@ieor.columbia.edu

#### 1) Response-Time Bottlenecks, *Paul Glasserman*, Columbia Bus. Sch., 403 Uris Hall, New York, NY 10027, *Yashan Wang*

We consider assemble-to-order systems with serial production of components and intermediate inventories. The facility that most constrains the finished-goods service level, as measured by the fill rate, need not be the most highly utilized facility. We propose and justify alternative criteria for response-time bottlenecks.

#### 2) Sequential Inspection of Components in an Assembly System, *Jinfa Chen*, Columbia Univ., IEOR Dept., New York, NY 10027, *David D. Yao*, *Shaohui Zheng*

Two batches of components are independently produced. One unit from each batch will be assembled into an end product, which will be supplied to customers under warranty or some service contract. We study the optimal inspection policy of the 2 batches so as to minimize the overall inspection, repair and warranty costs.

#### 3) Single Period Inventory Models with Component Commonality & Constrained Supply, *Alper Sen*, Univ. of Southern CA, IOM Dept., Sch. of Bus. Admin., Los Angeles, CA 90007, *Alex Zhang*

We consider a single period inventory problem in an assemble-to-order system with 2 products and 3 components. A company's relation with its suppliers or its production environment may cause a limited supply of the common or the product-specific components. With commonality and fixed supply on some of the components, we derive the order quantities which maximize expected profit.

#### 4) Structural Properties in an Assemble-to-Order Inventory System, *Susan H. Xu*, PA State Univ., Dept. of MSIS, Coll. of Bus., University Park, PA 16802, shx@psuvm.psu.edu, *Jeannette Song*

We explore the structural properties of an assemble-to-order system in which individual items are made-to-stock but final products are assembled to customer orders. Each item is produced by a dedicated machine under an independent base-stock inventory-control policy. Based on the structural properties, we develop upper and lower bounds for the order-based performance measures and suggest simple heuristics to evaluate those quantities.

### TD30 Reliability & Maintainability Models in Communication & Logistics

**Sponsor:** INFORMS Military Applications Society  
Sponsored Session

**Chair:** Yupo Chan, AFIT/ENS, 2950 P St., WPAFB, OH 45433, ychan@afit.af.mil

#### 1) Performance Analysis of Preemption Algorithms in an Integrated-Digital-Network-Exchange (IDNX) Circuit-Switch Communication-Network, *Eric Gumbs*, AFIT/ENS, 2950 P St., WPAFB, OH 45433, egumbs@afit.af.mil, *Richard Raines*, *Yupo Chan*

We analyze the system performance of 4 preemption algorithms in a 20-node IDNX circuit-switch communication-network. Specifically, it compares and contrasts the average number of preemption/priority, grade-of-service and average connection-time per successfully-connected call.

#### 2) Improving Information Network Performance: Reliability vs. Vulnerability, *David Lyle*, AFIT/ENS, 2950 P St., WPAFB, OH 45433, dlyle@afit.af.mil, *Yupo Chan*, *James Chrissis*

A different definition of component vulnerability is derived. Sensitivity of various analytic methods for determining system reliability and vulnerability is studied. Importance sampling using DPL and multicriteria DA techniques are used to optimize reliability and invulnerability improvement to networks subject to budgetary constraints.

#### 3) A Specific Communication Network Link & Path Likelihood Prediction Tool, *Gary K. Moy*, AFIT/ENS, 2950 P St., WPAFB, OH 45433, gmoy@afit.af.mil

Generalized network analyzer, GNA, users can construct a small 25-node network with given source and sink nodes to predict the most likely path used. The queuing network analyzer, QNA, provides congestion calculations for use in Dijkstra's algorithm, which will determine the "shortest" route in GNA.

#### 4) Component Availability for an Age Replacement Preventive Maintenance Policy, *W. Paul Murdock, Jr.*, AFIT/ENS, 2950 P St., WPAFB, OH 45433, wpmurdock@afit.af.mil

We use a renewal-theory approach to develop the availability function for a continuously-demanded component which is maintained by an age-replacement preventive-maintenance-policy. Results show that the optimum infinite-time-horizon age-replacement period does not maximize average availability for all finite values of component-economic-life.

### TD31 Value-Added Applications for Army Issues

**Sponsor:** INFORMS Military Applications Society

**Sponsored Session**

**Chair:** Niki C. Deliman, Waterways Experiment Station, CEWES-GM-J, 3909 Halls Ferry Rd., Vicksburg, MS 39180, deliman@ex1.wes.army.mil

1) **Value-Added Methodology for Automated Inspection Routine Generation**, *J. Rene Villalobos*, Univ. of TX, Mech. & IE Dept., El Paso, TX 79968, renev@vlobos.me.utep.edu

The automated visual inspection of surface mounted devices in the assembly line presents time constraints that are difficult to overcome if in-line inspection is desired. The presentation focuses on a method to allocate the total inspection time available in such a way that cycle time requirements are met. The method uses the value-added per component inspected to generate the inspection routine...

2) **Relating In-Process Intelligence Preparation of the Battlefield Team Performance to End-Process Results**, *Alex Baylot*, Waterways Experiment Station, CEWES-GM-J, 3909 Halls Ferry Rd., Vicksburg, MS 39180, baylote@ex1.wes.army.mil

Tactical assessments in the IPB process are time intensive procedures typically performed manually. The objective of this research thrust was to develop a robust mathematical approach that will relate the elements of a team process to the end results of the process. Various methods were combined to achieve this approach.

3) **A Prioritization Scheme for Value-Added Assessment Applied to Automating the IBP Process**, *Niki C. Deliman*, Waterways Experiment Station, CEWES-GM-J, 3909 Halls Ferry Rd., Vicksburg, MS 39180, deliman@ex1.wes.army.mil, *Laura Bunch*, *Alex Baylot*, *Jeff Williamson*

As part of a study to assess value added, Army officers were asked to rank order various mobility-related IPB process elements and rate importance of automating at brigade and below. Categorical data and cluster analysis techniques were applied in determining resultant priority classifications. Approach, rationale and results will be presented.

### TD32 Internet, Java & Distributed Computing: The Future of OR Practice?

**Cluster:** Telecommunications

**Invited Session**

**Chair:** Hemant K. Bhargava, Naval Postgrad. Sch., Code SM-BH, 555 Dyer Rd., Monterey, CA 93943, bhargava@cs.nps.navy.mil

1) **Remote Execution of Computational Services on Internet & Intranets: Global Access to Decision Support Technologies**, *Hemant K. Bhargava*, Naval Postgrad. Sch., Code SM-BH, 555 Dyer Rd., Monterey, CA 93943, bhargava@cs.nps.navy.mil, *Ramayya Krishnan*

The DecisionNet project treats OR-based decision technologies as objects that are globally accessible for browsing and execution, which can be "rented" for use over computer networks. We examine the possibilities this raises for the practice of OR/MS within organizations and for inter-organizational electronic commerce in decision technologies.

2) **DecisionNet Brokers for Publishing OR-Based Content on the World Wide Web**, *Hemant K. Bhargava*, Naval Postgrad. Sch., Code SM-BH, 555 Dyer Rd., Monterey, CA 93943, bhargava@cs.nps.navy.mil, *Ramayya Krishnan*, *David Kaplan*, *Rudolf Mueller*

While authoring static content (documents containing text, images, sound, etc.) on the WWW is relatively easy, publishing executable software such as OR models and algorithms is not. We discuss the design of broker software that facilitates placement of computational decision technologies for global access via DecisionNet.

3) **Interconnecting Decision Technologies Distributed Over the Internet**, *Hemant K. Bhargava*, Naval Postgrad. Sch., Code SM-BH, 555 Dyer Rd., Monterey, CA 93943, bhargava@cs.nps.navy.mil, *Ramayya Krishnan*

Model-based decision support relies on the interoperable use of decision technologies. However, differences in data forms, invocation protocols and

implementation on distributed platforms raise a number of difficulties. We discuss our work in DecisionNet which addresses some of these problems with an object-oriented modeling framework.

### TD33 OR/MS in Forestry IV

**Sponsor:** OR/MS in Forestry

**Sponsored Session**

**Chair:** David L. Martell, Univ. of Toronto, Fac. of Forestry, 33 Willcocks St., Toronto, Ontario, M5S 3B3, Canada, martell@smokey.forestry.utoronto.ca

1) **Static Spatial Optimization Based on Empirical Relationships from Simulation: A Case Study of the Northern Spotted Owl**, *John G. Hof*, US Dept. of Agriculture, 3825 E Mulberry St., Ft. Collins, CO 80524, /s=j.hof/ou1=s28A@mhs-fswa.attmail.com

A case study of the northern spotted owl in the Olympic Peninsula of Washington state is summarized. Because the habitat choice variables involve semi-permanent retention of old growth, a static model was used. Carrying capacity and connectivity functions are developed from an extant simulation model. Both models are used together in evaluating the current owl plan.

2) **Dynamic Spatial Optimization Based on Biodiffusion**, *Michael Bevers*, USDA Forest Service, Rocky Mountain Station, 3825 E Mulberry, St. Collins, CO 80524, /s=m.bevers/ou1=s28A@mhs.fsbo.attmail.com

After becoming extinct in the wild, black-footed ferrets from a captive-breeding recovery program are being reintroduced on public grasslands. A case study of optimal habitat complex design based on dynamic reaction-diffusion and carrying capacity limited modeling is presented for the Bradlands National Park/Bufalo Gap National Grassland reintroduction site.

3) **Habitat Conservation Plans for Washington State's Trustlands: What Role Management Science?**, *Bruce Bare*, Univ. of WA, Coll. of Forest Resources, Box 352100, Seattle, WA 98195-2100, bare@u.washington.edu

We describe the planning environment within which habitat conservation plans are being prepared. Modeling approaches for examining the consequences of alternatives, the treatment of regulatory risk and the incorporation of multiple outputs and objectives are discussed. Numerical results are presented for a few scenarios.

### TD34 Managing the Facilitation of GSS Groups

**Cluster:** Information Management Systems

**Invited Session**

**Chair:** Peggy M. Beranek, GA State Univ., CIS Dept., Atlanta, GA 30303, pberanek@gsu.edu

1) **What is Consensus, Anyway?**, *Ben Martz*, CA State Univ., Acct. & MS, Dept. 0011, Chico, CA 95929-0011, bmartz@busipo.csuchico.edu

Offering as the basic characteristics, the ability of group members to move on in the group's decision making process without discomfort, we offer 1 definition of group consensus. An example of identifying a group's consensus and using that level of consensus as a facilitation tool will be demonstrated.

2) **Facilitating Strategic Sensemaking in Electronic Environments**, *Melissa Glynn*, Univ. of AZ, MIS Dept., Tucson, AZ 85721, melissa\_s\_glynn@cmi.arizona.edu

Sensemaking refers to how meaning is constructed at both the individual and group levels. The use of a GSS in a structured environment provides a mechanism for sharing thought and building shared understanding. We will report on how GSSs enhance the facilitation of strategic planning using sensemaking processes.

3) **GSS Non-Success**, *Steven Hayne*, AZ State Univ., Business Programs, Phoenix, AZ 85069-7100, hayne@asu.edu

Meetings supported by GSSs have been enhanced through shortened meeting times and increased participation. Although many studies report on these successes, there are times when the use of a GSS hasn't worked or when the process was difficult to manage. We report on GSS non-success and reasons behind it.

4) **Managing Convergence in GSS Meetings**, *Peggy M. Beranek*, GA State Univ., CIS Dept., Atlanta, GA 30303, pberanek@gsu.edu

GSS tools often enhance idea generation, or divergence, within meetings. Subsequently, during convergence, these ideas need to be discussed, merged and integrated. Convergence tends to be difficult and requires unique skills on the part of the meeting manager or facilitator. We examine how convergence can be effectively managed.

**Tuesday 16:30-18:00****TE02 PANEL: Optimization on the Internet III**

Sponsor: INFORMS CSTS

Sponsored Session

Chair: Bjarni Kristjansson, Maximal Software Inc., 2111 Wilson Blvd., Ste. 700, Arlington, VA 22201, bjarnik@site.gmu.edu

1) **PANEL: Optimization on the Internet III**, *Gautam Mitra*, Brunel Univ., *Jamie Cruise*, Unicom Consultants, *Joseph Czyzyk*, Argonne Ntl. Lab., *Michael Trick*, Carnegie Mellon Univ., *Ramesh Sharda*, OK State Univ., *Thomas R. Elken*, Silicon Graphics Inc.

Over the last few years, the Internet and the WWW have become increasingly more important and popular in the computer world as a new way of interfacing with the user. The panel will discuss the current status of optimization on the Internet to include client/server technologies, parallel computing and creating optimization applications on the Web.

**TE04 AIDS Modeling I**

Cluster: Public Sector Applications

Sponsor: INFORMS Section on Public Programs &amp; Processes

Invited/Sponsor Session

Chair: Margaret L. Brandeau, Stanford Univ., IE/EM Dept., Stanford, CA 94305-4024, brandeau@leland.stanford.edu

1) **Costs & Benefits of Nationwide HIV Screening of Newborns**, *Margaret L. Brandeau*, Stanford Univ., IE/EM Dept., Stanford, CA 94305-4024, brandeau@leland.stanford.edu, *Douglas K. Owens*, *Gregory Zaric*

In the US, newborns are routinely screened for a number of diseases. Now, federal lawmakers are considering instituting mandatory HIV screening of newborns. We analyze the costs and benefits of such a policy.

2) **Developing a Computer-Based Resource Planning Decision Support System For HIV/AIDS Services**, *Paul Forte*, Keele Univ., Ctr. for Health Plan. & Mgmt., 67 Barker Dr., London, NW1 0JG, UK, paul@paul40.demon.co.uk, *Tom Bowen*

Assessing the potential service and cost implications of the wide range of HIV/AIDS care options for a population, such as drug therapies, is a major issue. A PC-based DSS is presented to assist local resource managers in these strategic planning aspects.

3) **Long-Survivors in the AIDS Epidemic: Modeling & Estimation by EM Methods**, *Carla Rossi*, Univ. di Roma La Sapienza, Dept. Geoecon. & Stats., Via del Castro Laurenziano 9, Rome, 00161, Italy, rossi@mat.uovrm.it, *Giuseppe Schinaia*

The AIDS long-survivor problem has already been introduced by the 2 authors in other papers. In this presentation, the estimation of the risk function in diagnostic (survival) classes is considered, with particular reference to a latent, indicator variable, regarded as a missing value and estimated via EM procedures.

**TE05 Renewable & Nonrenewable Resources in Project Scheduling**

Cluster: Project Management

Invited Session

Chair: Bajis M. Dodin, Univ. of CA, Anderson Grad. Sch. of Mgmt., Riverside, CA 92521-0203, bajis.dodin@uck.edu

1) **A Thorough Comparison of Lower Bounds for the Resource-Constrained Project Scheduling Problem**, *Erik Demeulemeester*, Katholieke Univ. of Leuven, Dept. of Applied Econ., Naamsestraat 69, Leuven, 3000, Belgium, *Willy S. Herroelen*

Recently, it has been shown that improved lower bound calculations have a definite impact on the required computation time for solving the RCPSP. We present a computational comparison of the traditional lower bounds for the RCPSP. We will also present a new lower bound that forms a combination of a resource-based and a precedence-based lower bound. Extensive computational experience will be reported...

2) **Contracts, Payment Structures & Project Network Models with Discounted Cash Flows: A Guided Tour Through the Literature**, *Willy S. Herroelen*, Katholieke Univ. of Leuven, Dept. of Applied Econ., Naamsestraat 69, Leuven, B-3000, Belgium, *Erik Demeulemeester*

We offer a guided tour through the research on deterministic and stochastic

project network models with discounted cash flows. Subsequent to a close examination of the rationale behind the net present value objective, we offer a taxonomy of the problems studied in the literature and critically review major contributions from the perspective of the underlying assumptions about the type of contact and payment structure used...

3) **A Solution Procedure for a General Type of Resource-Constrained Project Scheduling Problems**, *Bert De Reyck*, Katholieke Univ. of Leuven, Dept. of Applied Econ., Naamsestraat 69, Leuven, 3000, Belgium, *Willy S. Herroelen*

We present a solution procedure for a general type of resource-constrained project scheduling problem with multiple activity modes (including time/resource and resource/resource trade-offs) and generalized precedence relations (with arbitrary minimal and maximal time lags between activities) in order to optimize various types of regular and non-regular objective functions...

4) **Totally Optimized Project Systems - TOPS**, *Bajis M. Dodin*, Univ. of CA, Anderson Grad. Sch. of Mgmt., Riverside, CA 92521-0203, bajis.dodin@uck.edu, *A. A. Elimam*, *Erik Rolland*

We present the modeling structure of TOPS that integrates all practical decision making issues in project management. TOPS models the impact of overhead, activity duration, crashing, resources inventory and complete activities worth on the overall project cost. We investigate solving these models using exact and heuristic methods using TS.

**TE06 Applications of Global Optimization**

Cluster: Global Optimization

Invited Session

Chair: Nick Sahinidis, Univ. of IL, Dept. of Mech. &amp; IE, 1206 W Green St., Urbana, IL 61801, nikos@uiuc.edu

1) **Applications of Linear Multiplicative Programming in Decision Making**, *Hong Ryoo*, Univ. of IL, 140 MEB, 1206 W Green St., Urbana, IL 61821, *Nick Sahinidis*

The LMP has a variety of applications: multiple objective decision making problems, multi-stage financial planning problems and polyhedral separability. We present extensive computational results with a finite global optimization algorithm for LMP on various applications.

2) **Global Optimization of Blending & Pooling Problems**, *Nilanjan Adhya*, Univ. of IL, Dept. of Mech. & IE, 1206 W Green St., Urbana, IL 61801, adhya@archimedes.me.uiuc.edu, *Nick Sahinidis*

The pooling problem arises in blending materials such as crude or refined petroleum to produce products. Modeling this often results in non-convex non-linear relationships. We present a B&B global optimization algorithm for the pooling problem and extensive computational results. The algorithm exploits the special structure of the problem.

**TE08 Business Applications III**

Contributed Session

Chair: Robert Richardson, Iona Coll., MS &amp; Systems Dept., 715 North Ave., New Rochelle, NY 10801-1890, rjrphd@aol.com

1) **A Case Study of the Price/Quantity Relationship in Contract Pricing**, *Robert Richardson*, Iona Coll., MS & Systems Dept., 715 North Ave., New Rochelle, NY 10801-1890, rjrphd@aol.com

A competitor's behavior is studied to determine if their next bid is predictable and follows a pattern based upon the number of units in the contract. When the pattern is detected and the competitor loses several bids, the situation deteriorates into a price war without regard for the quantity involved.

2) **The Bionomic Algorithm in the Tax Structuring Problem**, *Elias Elia*, Imperial Coll., Ctr. for Quant. Finance, Exhibition Rd., London, SW7 2BX, UK, e.elia@ic.ac.uk, *Gerry Salkin*, *Nicos Christofides*

We discuss the corporate structuring problem which is concerned with the determination of near-optimal/optimal flow of funds from subsidiaries to the parent company. All double tax relief systems are incorporated and only dividend flows are considered. The bionomic algorithm is used for the solution of the problem.

3) **Effects of Incentive Schemes & Probabilistic Management Audit on Profit Center Managers' Transfer Price Negotiation Task (R)**, *Sakthi Mahenthiran*, Butler Univ., Coll. of Bus. Admin., 4600 Sunset Ave., Indianapolis, IN 46208-9221, mahenthiran@butler.edu

The presence or absence of a budget goal and a management audit are manipulated to observe its effects on profit center manager's transfer price

negotiation task. Studies have documented the relationship between budget goals and improved performances, e.g., Brownell, 1982; Chow et al. 1994. Misrepresentations by profit center managers can result in sub-optimal firm performance...

**4) How to Implement Process Management to Academic Departments, Omer Saatcioglu, TX Tech. Univ., 1617 27th St., # 902, Lubbock, TX 79405**

A process management approach to an academic department is explained and its implementation issues discussed. Critical processes of the department are identified and a method of analysis is demonstrated on one of these processes. An organizational structure is proposed to facilitate the implementation of the process management system. Responsibilities and authorities of the units are presented...

**TE09 Machine Scheduling III  
Contributed Session**

**Chair:** Chen-Sin Lin, Bradley Univ., IMET Dept., Peoria, IL 61625, clin@bradley.bradley.edu

**1) On a 2-Machine Flowshop Bicriterion Scheduling Problem Involving Total Completion Time & Total Tardiness, Chen-Sin Lin, Bradley Univ., IMET Dept., Peoria, IL 61625, clin@bradley.bradley.edu**

A B&B algorithm is developed for the 2-machine flow shop problem with the objective of minimizing a linear combination of the total job completion time and total job tardiness. Lower bounds are obtained by a Lagrangian relaxation of the problem.

**2) A Rule-Based Scheduling Model with Integrated Routing Operation for Queue Reducing in Job-Shop Environment, Emin Gundogar, Sakarya Univ., Fen Bilimleri Enstitüsü, Esentepe Kampüsü, Sakarya, 54040, Turkey, gun@bim.sau.edu.tr, H. Resit Yazgan**

If there are many machines similar or alternatives for operations in a job-shop, balanced distribution of loads among the machines isn't possible while entering record of routing data for each part. Besides this, during the scheduling process on some machines, queues may occur according to the route of orders. A rule-based scheduling process is introduced that will remove the defects mentioned.

**3) A Heuristic for Parallel Machine Scheduling with Time Windows, Siwate Rojanasoonthon, Univ. of TX, PO Box 8724, Austin, TX 78713-8724, siwate@bajor.me.utexas.edu, Jonathan F. Bard**

The scheduling problem of the tracking and data relay satellite system was formulated as a parallel machine scheduling with time windows. The objective is to maximize the number of assigned jobs. A 2-phase heuristic and its computational experience will be presented.

**4) Optimization of Stochastic Flow Shop Scheduling Problems, Mohammed Al Wakeel, Kuwait Univ., Dept. of Stats. & OR, PO Box 5969, Safat, 13060, Kuwait, Talal Al Khamis**

We consider the permutation flowshop scheduling problem of  $n$  jobs and  $m$  machines where the processing times are stochastic and the cost function is nonlinear. We present a simulation optimization algorithm with some computational results.

**TE10 Retail Inventory**

**Cluster: Supply Chain  
Invited Session**

**Chair:** Richard Metters, Vanderbilt Univ., Owen Grad. Sch. of Mgmt., Nashville, TN 37203, metterrd@ctrvax.vanderbilt.edu

**1) Optimal Retail Inventory Policies for Products with Substitutes & Complements, Narendra Agrawal, Santa Clara Univ., DIS Dept., Leavey Sch. of Bus., Santa Clara, CA 95053, nagrawal@mailers.scu.edu, Stephen A. Smith**

In retail inventory systems, customers often purchase complementary sets of items where substitution is possible if some items are unavailable. This affects item demand as well as customer service level. We present a model to determine optimal assortments and inventory levels and discuss key insights.

**2) A Category Management Model for Retail Space Allocation & Assortment, Norm Borin, CA Polytech. State Univ., Coll. of Bus., San Luis Obispo, CA 93407, nborin@cymbal.aix.calpoly.edu, Paul Farris**

Retailer space/assortment decisions are modeled. The model incorporates consumer and competitive parameters such as search loyalty, preference, space

responsiveness and cross space elasticity. The model is solved using SA and tested against a category with a known optimum. Results are evaluated against commonly used rules of thumb.

**3) What Drives Assortment Variety in Retailing?, Garrett J. van Ryzin, Columbia Univ., Grad. Sch. of Business, 412 Uris Hall, New York, NY 10027, gvanryzi@research.gsb.columbia.edu, Siddharth Mahajan**

We analyze a theoretical model of the trade-off between the market benefits and inventory costs of variety in retail assortments. The model provides theoretical insights into various factors that determine optimal levels of variety, including margin, scale, nearness of competitors and level of fashion in the category.

**4) Retail Inventory Policy Under Time-Based Logistics, Michael Ketzenberg, Univ. of NC, Kenan-Flagler Bus. Sch., Chapel Hill, NC 27599, Richard Metters, Vicente A. Vargas**

Inventory replenishment heuristics are evaluated utilizing data from a leading grocer. Although only inventory replenishment is studied, the results have implications for product allocation and assortment.

**TE11 Tourism Research II**

**Cluster: Tourism  
Invited Session**

**Chair:** Abraham Pizam, Univ. of Central FL, Dept. of Hospitality Mgmt., PO Box 161400, Orlando, FL 32816-1400, abraham.pizam@bus.ucf.edu

**1) Quantitative Methods in Tourism Marketing Research, Josef Mazanec, Vienna Univ. of Econ. & Bus. Admin., Inst. Tourism/Leisure Studies, Augasse 2-6, Vienna, A-1090, Austria, josef@mazanec@wu-wien.ac.at**

Analytical tools are required if tourist marketing efforts are to be guided by theory and empirical data. Contemporary marketing science applications in tourism include fairly advanced methods such as structural equation modeling or MNL choice models, and more recent GAs and neurocomputing techniques to cope with the wealth of data generated by automated check-in/check-out systems.

**2) Econometrics & Forecasting in Tourism, Stephen F. Witt, Swansea, Wales, European Bus. Mgmt. Sch., Singleton Park, Swansea, Wales, SA2 8PP, UK**

Tourism demand modeling and forecasting have attracted attention since the pioneering studies of the mid-60s. The empirical findings are presented and discussed. Recent developments in econometric methodology which focus on the specification of the dynamic structure of time series are only now starting to appear in the tourism literature.

**TE12 Intelligent Methods for Vehicle Routing & Scheduling Problems**

**Sponsor: INFORMS CSTS  
Sponsored Session**

**Chair:** Sam R. Thangiah, Slippery Rock Univ., AI & Robotics Lab., Comp. Sci. Dept., Slippery Rock, PA 16057, thangiah@samuel.cpsc.sru.edu

**1) Real-Time Dispatching of Pick-Up & Delivery Vehicles, Michel Gendreau, DIRO & CRT, Univ. of Montreal, Montreal, Quebec, H3C 3J7, Canada, Francois Guertin, Jean-Yves Potvin, Rene Seguin**

We address the problem of dispatching in real-time a fleet of vehicles to service many-to-many pickup and delivery requests with no vehicle capacity restrictions. The problem is solved as a sequence of static problems using a parallel TS procedure with a complex neighborhood structure based on ejection chains.

**2) A Neural Network Model for the Generalized Traveling Salesman Problem, Jean-Yves Potvin, Univ. de Montreal, CRT, CP 6128 Succ Centre-Ville, Montreal, Quebec, H3C 3J7, Canada, potvin@crt.unomtreil.ca, Ricardo Andresol, Michel Gendreau**

A Hopfield-Tank neural network model is developed to address an extension of the TSP known as the GTSP. Here, the set of vertices is partitioned into clusters and the aim is to determine a least-cost Hamiltonian cycle passing through each cluster at least once.

**3) An Implementation of GA & Tabu Search on a Real-World Multi-Depot VRP, Lars Rust, Univ. of Giessen, BWL Wirtschaftsinformatik, Licher Str. 70, Giessen, 35394, Germany, lars.rust@wirtschaft.uni-giessen.de**

A technique based upon Grouping GAs is developed to solve multi-depot VRPs.

**4) An Adaptive Clustering Approach for Multi-Depot Vehicle Routing Problems Using Genetic Algorithms, Sam R. Thangiah, Slippy Rock Univ., AI & Robotics Lab., Comp. Sci. Dept., Slippy Rock, PA 16057, thangiah@samuel.cpsc.sru.edu, Said Salhi, Faruq Rahman**

An adaptive clustering method, using GAs, is introduced to solve multi-depot VRPs. The clustering method combined with local optimization methods gives promising results to a set of problems obtained from the literature.

**TE14 Industrial Production, Environment & Energy I**

**Sponsor:** INFORMS Section on Environment

**Sponsored Session**

**Chair:** Hans-Dietrich Haasis, Univ. of Bremen, Fac. FB7, Bibliothekstrasse, Bldg. GW2 Rm. B3510 Box 330440, Bremen, D2834, Germany, haasis@uni-bremen.de

**1) New Product Policies & their Consequences on Production Management, Hans-Dietrich Haasis, Univ. of Bremen, Fac. FB7, Bibliothekstrasse, Bldg. GW2 Rm. B3510 Box 330440, Bremen, D2834, Germany, haasis@uni-bremen.de**

In line with the discussion of combined production and remanufacturing strategies, new product policies are already implemented in selected industries. The consequences of these new product policies on production management are discussed.

**TE15 Network Flows III**

**Contributed Session**

**Chair:** K. P. K. Nair, Univ. of New Brunswick, Fac. of Admin., PO Box 4400, Fredericton, NB, E3B 5A3, Canada, nairk@fac.fadmin.unb.ca

**1) On Capacitated Stochastic Chain Problems in a Network, K. P. K. Nair, Univ. of New Brunswick, Fac. of Admin., PO Box 4400, Fredericton, NB, E3B 5A3, Canada, nairk@fac.fadmin.unb.ca, L. Ganapathy**

We consider 2 basic problems relating to capacitated chains in a stochastic network in which each arc has a discrete arbitrary probability distribution for its capacity. Given a source-sink pair, the first problem is to find an optimal capacity chain subject to a chance constraint. The second is to find a chain with the highest expected capacity.

**2) Solving the Undirected Multicommodity Flow Problem, Richard D. McBride, Univ. of Southern CA, Sch. of Bus., Los Angeles, CA 90089-1421, rmcbrude@kecknet.usc.edu, John Mamer**

The undirected multicommodity flow problem is encountered when dealing with communication, computer, railroad or other situations when flows on arcs are undirected. We show how to formulate this problem as a separable piecewise convex LP. We present computational experience using EMNET to efficiently solve these problems using shortest path pricing.

**3) The Monotonic Diameter of Traveling Salesman Polytype, Fred J. Rispoli, Dowling Coll., Dept. of Math. & Comp. Sci., Oakdale, NY 11769, rispolif@dowling.edu**

The monotonic diameter of a polytype P is a generalization of the diameter requiring monotonicity of all linear objective functions defined on P. The monotonic diameter of the polytypes arising in both the symmetric and asymmetric TSP are solved.

**4) Algorithms for Weighted Packing Problems, Dicky Yan, AT&T Labs., 101 Crawfords Corner Rd., Rm. HO 3J-314, Holmdel, NJ 07733-3030, yan@att.com, Jeffery Westbrook**

The problems of packing edge-disjoint and vertex-disjoint copies of paths of fixed length, or "chains," and trees into weighted graphs are studied. Polynomial time algorithms for computing a maximum edge-disjoint packing of 2-chains into general graphs and for packing chains and trees into trees are given.

**TE16 Management of Technology: Methodology Issues & Examples**

**Sponsor:** INFORMS Section on Technology Management

**Sponsored Session**

**Chair:** Richard L. Smith, AZ State Univ., IMSE Dept., Coll. of Eng., Tempe, AZ 85287, dick.smith@asu.edu

**1) A Technology Assessment Primer for Management of Technology, Anne De Piante Henriksen, Univ. of NM, Anderson Schs. of Mgmt., Albuquerque, NM 87131-1221**

Effective MOT requires tools and techniques that contribute to a clearly defined

MOT methodology. Technology assessment is an important component of such a methodology. A comprehensive tool kit of technology assessment techniques will be presented and each will be briefly described.

**2) Creating a Competitive Advantage Through Management of Technology, Lee Maginniss, Price Waterhouse, lee\_maginniss@notes.pw.com**

Organizations will continue to operate within increasingly complex environments responsiveness pressures. As a result, technological resources will continue to be an essential means of managing this complexity and enabling organizations to rapidly make sound business decisions. Given technology's critical role, organizations that develop a MOT approach to define and accomplish its objective will thrive...

**3) Reflections on the Subject of Multiple Methodologies for the Management of Technology, William T. Flannery, Univ. of TX, MOT Program, 6900 N Loop 1604 W, San Antonio, TX 78249-0634, flannery@lonestar.utsa.edu**

MOT is emerging as an unique and distinct discipline linking multiple disciplines from traditional business and engineering fields of study and application. Evolving disciplines are normally characterized by the development of a dominant methodology that lags slightly the emergence and integration of a body of knowledge. MOT, however, is likely to develop multiple methodologies, reflecting unique environmental needs.

**4) Management of Technology Methodologies: Past, Present & Future, Richard L. Smith, AZ State Univ., IMSE Dept., Coll. of Eng., Tempe, AZ 85287, dick.smith@asu.edu**

A primary requirement for the deployment of MOT is methodology that can be documented and communicated to individuals working in organizations. The 21st century distributed organization will itself depend on enabling technology. A broadened array of technologies including not only process, material and technology but also IT, people technology, organizational technology and customer technology must be treated as technological resources...

**TE17 Financial Analysis & Risk Management in Energy Markets**

**Sponsor:** INFORMS Section on ENRE

**Sponsored Session**

**Chair:** Shmuel S. Oren, Univ. of CA, Dept. of IE/OR, Berkeley, CA 94720-1777, oren@ieor.berkeley.edu

**1) Evaluating Oil & Gas Divestitures, Musa Essayad, Univ. of AK, Sch. of Business, 3211 Providence Dr., Anchorage, AK 99508, afimme@acad2.alaska.edu**

We test recently published findings by Anslinger & Copeland, dispelling the "common wisdoms." Specifically, the authors have found that nonsynergistic strategy is profitable; financial buyers don't necessarily buy assets at a low price and sell them at a high price; and high financial leverage associated with restructuring wouldn't discipline managers.

**2) Probabilistic Assessment of Timing of Access to the US Retail Power Market, Anne Ku, Enron Capital & Trade Resources, Research Group, 1400 Smith St., Houston, TX 77002, aku@ect.enron.com**

The transition to a fully competitive retail power market depends on a myriad of factors through a process which is largely political and highly uncertain. States vary widely in terms of the pace of decision making and issues in restructuring. The timing of deregulation is assessed probabilistically via influence diagrams and decision trees...

**3) Managing Risk Using Renewable Energy Technologies: A Case Study, Thomas E. Hoff, Stanford Univ., Pacific Energy Group, 108 C Escondido Village, Stanford, CA 94305, tomhoff@leland.stanford.edu**

We use a case study to evaluate the risk-mitigation potential of renewable energy technologies. It illustrates how an investment decision is affected when the attributes of fuel costs, environmental costs, modularity, lead time, location flexibility, availability, initial capital costs and investment reversibility are included in the evaluation.

**TE18 TUTORIAL: Tabu Search for Discrete, Nonlinear & Stochastic Optimization**

**Invited Session**

**Chair:** Fred W. Glover, Univ. of CO, Sch. of Bus., CB 419, Boulder, CO 80309-0419, fred.glover@colorado.edu

**1) TUTORIAL: Tabu Search for Discrete, Nonlinear & Stochastic Optimization, Fred W. Glover, Univ. of CO, Sch. of Bus., CB 419, Boulder, CO 80309-0419, fred.glover@colorado.edu,**

**James P. Kelly, Manuel Laguna**

The hallmark of TS is an integrated collection of search strategies based on creating and exploiting adaptive memory structures. The flexibility of adaptive memory structures has long been emphasized as the key to the success of TS approaches. Such memory contrasts with the rigid memory structures of classic OR and AI procedures such as B&B and its various tree search incarnations...

**TE19 Group Decision & Negotiation**  
Contributed Session

**Chair:** Mustafa R. Yilmaz, Northeastern Univ., 219 Hayden Hall, 360 Huntington Ave., Boston, MA 02115

**1) Can We Improve Upon Approval Voting?, Mustafa R. Yilmaz,** Northeastern Univ., 219 Hayden Hall, 360 Huntington Ave., Boston, MA 02115

Approval voting has serious shortcomings in its ability to represent multichotomous voter preferences. For example, it can elect a Condorcet loser or fail to elect a Condorcet winner. We present an alternative voting procedure which avoids some of these shortcomings.

**2) Intelligent Facilitation in Small Group Decision Making: Experience from the Lab, George P. Papamichail,** Athens Univ. of Econ. & Bus., Spirou Loui 23, Marousi-Athens, 15124, Greece, pmichael@dias.aueb.gr, **Dimitris P. Papamichail**

GDSSs have evolved in the last decades to prove a most valuable tool in modern management. In a first attempt, we implemented a facility to support small groups of decision makers in complex tasks. We examine the effects that the usage of case-based reasoning, an intelligent method, has on the efficient facilitation of such small groups.

**3) The Effect of Communication Modality on Student Team Performance, William H. Rybolt,** Babson Coll., Math./Sci. Dept., Babson Park, MA 02157, rybolt@babson.edu, **David P. Kopcsó, Leo Pipino**

We report on 2 experiments that compared the performance of groups, which utilized different intragroup communication modalities to the performance of individuals. The effect of media on group performance was studied. The results show that groups outperform individuals and no difference in performance is observed across groups using different media.

**4) An E-Mail-Based Debate & Voting System, Thaddeus W. Usowicz,** San Francisco State Univ., 1600 Holloway Ave., Bus. Analysis & Comp. Systems, San Francisco, CA 94132, usowicz@sfsu.edu, **David A. Kohler**

We describe a system developed by an academic department whereby electronic meetings may be held over the Internet. The system is simple and based primarily on electronic mail. Practical experience with the system is described.

**TE20 Routing, Resource Allocation & Transportation Networks**

**Sponsor:** INFORMS Transportation Science Section  
Sponsored Session

**Chair:** Warren B. Powell, Princeton Univ., Dept. of Civil Eng. & OR, Princeton, NJ 08544

**1) Dynamic Routing Under Uncertainty, Warren B. Powell,** Princeton Univ., Dept. of Civil Eng. & OR, Princeton, NJ 08544, **Mike Towns**

We use a new simulation environment to test the impact of uncertainty on dynamic routing. We compare local and global optimization methods and compare their performance under varying degrees of uncertainty. We also measure the impact of user non-compliance on solution quality and measure solution robustness.

**2) Carrier Fleet Operations Under Real-Time Information: Dynamic Assignment & the Effect of Congestion, Amelia C. Regan,** Univ. of TX, Dept. of Civil Eng., Austin, TX 78703, **Hani S. Mahmassani, Patrick Jaillet**

Of tremendous importance in dynamic fleet management are the issues of how congestion and the spatial and temporal variability of demands should be managed. A model of a carrier fleet operation is introduced and both analytic and simulation results related to the dynamic assignment of vehicles to loads and the estimation of congestion presented.

**3) A Dynamic Programming Algorithm for Ultra-Large Scale Resource Allocation Problems, Warren B. Powell,** Princeton Univ., Dept. of Civil Eng. & OR, Princeton, NJ 08544, **Joel Shapiro**

We describe a dynamic programming approximation for solving ultra-large scale resource allocation problems. The method is extremely flexible and easily handles complex work rules and operating constraints. We review system

performance and describe how the system adapts to complex operating environments.

**4) System Optimal & User Equilibrium Modeling of Hub & Spoke Networks, Guoqiang Shen,** East Carolina Univ., Sch. of Ind. & Tech.

The hub-and-spoke network is a special network in which hubs serve as transshipping points and spokes connects hubs and non-hub points. Existing hub-and-spoke network design models assume exogenous number of hubs, single path for each O-D pair and now flow congestion on spokes and at hubs. We develop a hub-and-spoke network design model within the framework of traditional network equilibrium modeling...

**TE21 Advanced Manufacturing System Design**

**Sponsor:** INFORMS College on Artificial Intelligence  
Sponsored Session

**Chair:** Ali K. Kamrani, Univ. of MI, IMSE Dept., 4901 Evergreen Rd., Dearborn, MI 48128-1491, kamkode@umich.edu

**1) How to Estimate Manufacturing Costs Quickly & Accurately, Raj Veeramani,** Univ. of WI, Dept. of IE, 1513 University Ave., Madison, WI 53706, raj@ie.engr.wisc.edu, **Pawan Joshi**

We will challenge some traditional beliefs regarding manufacturing cost estimation and present new paradigms that enable rapid and accurate cost estimation for modified-standard and custom-made products. Insights gained from applications in industry will also be discussed.

**2) A Cellular Manufacturing System Based on New Similarity, Geonwook Jeon,** Univ. of Louisville, Dept. of IE, Louisville, KY 40292

A 2-phase procedure for configuring a cellular manufacturing system is presented. The proposed objective is to minimize the total sum of operating, investment cost and late finish penalty cost due to the deviations between average completion time and the optimum due date of each part.

**3) A Variant Approach for Integrated Product & Process, Ali K. Kamrani,** Univ. of MI, IMSE Dept., 4901 Evergreen Rd., Dearborn, MI 48128-1491, kamkode@umich.edu

Most efforts to enable concurrent engineering to date have focused on developing the tools and techniques for designing complete new products. However, design in many industries is evolutionary, consisting primarily of incremental changes to existing products. We focus on developing new products using the variant design approach.

**TE22 Global Operations Management**

**Cluster:** Global Manufacturing Practice  
Invited Session

**Chair:** Arnd H. Huchzermeier, WHU, Otto-Beisheim-Hochschule, Burgplatz 2, Vallendar, 56179, Germany, ah@whu-koblenz.de

**1) Evolution of Japanese Production Networks in East Asia, Jaeyong Song,** Univ. of PA, The Wharton Sch., Mgmt. Dept., 2100 Steinberg Hall, Philadelphia, PA 19104, song05@wharton.upenn.edu, **Bruce Kogut**

We investigate how firm capabilities affect sequential foreign direct investment, FDI, decisions of multinational corporations. From a real options perspective, FDIs can be viewed as platform investments to upgrade or downgrade activities in response to environmental changes. Results from an empirical case study at the product level are reported.

**2) Pareto-Optimal Supply Contracts for Products with Fluctuating Prices, Sriram Dasu,** Univ. of Southern CA, Sch. of Bus. Admin., Los Angeles, CA 90089-1421, dsasu@sba.usc.edu

There are many industries such as the synthetic fiber industry, in which the prices of the products fluctuate but there are no futures markets. Often the buyer and seller may be located in different countries. We study the structure of Pareto optimal bi-lateral contingent price contracts.

**3) Application of Real Option Valuation Techniques to Global Manufacture, Morris Cohen,** Univ. of Chicago, Grad. Sch. of Bus., 1101 E 58th St., Chicago, IL 60637, ah@whu-koblenz.de, **Arnd H. Huchzermeier**

We analyze how operational flexibility within a global supply chain network can be evaluated as a compound real option. Moreover, we provide an analytic framework for the analysis and evaluation of such options, considering multiple sources of uncertainty. A comparative study with respect to financial hedging is conducted.

**TE23 Manufacturing System Design**

Cluster: Flexible Manufacturing Systems

Invited Session

Chair: Sema Alptekin, CA Polytech. State Univ., IME Dept., Bldg. 26, Rm. 103, San Luis Obispo, CA, salpteki@calpoly.edu

1) **A Decision Support System for the Generation of Process Plans for CIM in a Shipyard**, *Derya Jacobs*, Old Dominion Univ., Dept. of Eng. Mgmt., 43rd St. Modulares, Norfolk, VA 23529, dajloof@oduym.cc.odu.edu, *William Keene*, *Charles Keating*

A feasibility study was conducted to investigate the effectiveness of a knowledge-based DSS for a local shipyard's job shop for automation. A prototype knowledge-based system was developed for selected parts to demonstrate feasibility. The resultant system was designed to determine the appropriate part family for the given part based on its main features and attributes and to generate a process plan.

2) **Development of FMSs: Using the Integration of the Scheduling of Shop Floor Data Collection Systems**, *Albert Jones*, NIST, Rm. 113a, Bldg. 220, Gaithersburg, MD 20899, jonesa@cma.nist.gov, *Frank Riddick*, *Luis Rabelo*

A virtual manufacturing environment that implements an FMS has been developed. This environment has served as a testbed for investigating the integration of scheduling and shop floor data collection systems.

3) **Achieving Effective Rapid Production Ramp-Up**, *M. Gregg Blankenship*, Cymer Laser Technologies, 16275 Technology Dr., San Diego, CA 92127

ABC Inc. provides high value state-of-the-art capital equipment for use in semiconductor device fabrication. The demand for ABC's product has more than doubled between 1995 - 1996. Stochastic simulation was utilized as the tool to achieve an effective ramp-up of the factory's production capacity.

4) **Fuzzy Production Rules for Flexible Manufacturing Cost Estimates**, *Anthony K. Mason*, CA Polytech. State Univ., IME Dept., San Luis Obispo, CA 93444, amason@boe.aix.calpoly.edu, *Alfio Levy*

Because of uncertainties in product mix and lot sizes, cost estimating at early stages of production planning in FMSs can be difficult. This presentation illustrates several advantages to fuzzy production rules for performing the cost estimating function when linguistic assertions rather than traditional cost models are employed.

**TE24 Applications of Decision Analysis in Research & Development**

Sponsor: INFORMS Decision Analysis Society

Sponsored Session

Chair: James E. Matheson, Strategic Decisions Group, 2440 Sand Hill Rd., Menlo Park, CA 94025-6900, jmatheson@sdgnet.com

1) **Decision Analysis in Agricultural Technology**, *Jeff L. Fraser*, Monsanto Agricultural Group, 800 N Lindbergh Blvd., St. Louis, MO 63167, jlfrasc@ccmail.monsanto.com, *Konrad Knell*

Genetic engineering holds the promise of transforming agriculture by providing higher yields, pest control and quality improvements. Monsanto faces the challenges of managing a portfolio of genetic engineering technologies and developing integrated strategies for each major crop. DA provides a powerful framework for making decisions about R&D targeting, prioritization and commercialization.

2) **Thinking Outside the Box: Discovering Hidden Value in the R&D Portfolio at SmithKline Beecham**, *Paul C. Sharpe*, SmithKline Beecham Pharmaceuticals, New Frontiers Science Park, Third Ave., Harlow, Essex, CM19 5AW, UK, paul\_sharpe@sbphrd.com, *Sandra Wrobel*, *Thomas W. Keelin*

The traditional view of R&D constrains the innovation of R with the "get it done" of D. These are managed accordingly, focusing creativity on R and practicality on the D. At SmithKline Beecham, we demonstrated a value added over \$2 billion if creativity (normally reserved for R) supported with analysis were applied systematically in managing D.

3) **Valuation of Research Using Options Pricing & Decision Analysis Methods**, *Robert K. Perdue*, Westinghouse Electric Corp., Sci. & Tech. Ctr., 1310 Beulah Rd., Pittsburgh, PA 15235-5098, perdue.r.k@wec.com

We describe an application of a practical R&D project valuation model that integrates options pricing and DA methods to correctly value both decision "flexibility" and outcome uncertainty. This model, which produces implications

strikingly different from those generated by the standard NPV rule, is illustrated using a real application.

4) **The Principles of Smart R&D**, *James E. Matheson*, Strategic Decisions Group, 2440 Sand Hill Rd., Menlo Park, CA 94025-6900, jmatheson@sdgnet.com, *David Matheson*

What enables an organization to make high-quality decisions routinely? Some organizations are able to rapidly adopt best practices, others are not. The key to success lies in the foundation principles by which an organization operates. Nine principles of smart R&D are the foundation conducive to decision quality.

**TE25 TUTORIAL: The Use of Inclass Games in Teaching Operations Management**

Sponsor: INFORMS Forum on Education

Sponsored Session

Chair: Salwa H. Ammar, Le Moyne College, Dept. of Bus., Syracuse, NY 13214, ammars@palm.lemoyne.edu

Co-Chair: Ronald H. Wright

1) **TUTORIAL: The Use of In-Class Games in Teaching Operations Management**, *Salwa H. Ammar*, Le Moyne College, Dept. of Bus., Syracuse, NY 13214, ammars@palm.lemoyne.edu, *Ronald H. Wright*

The most effective feature of teaching OM is the experiential component that allows students to better comprehend theoretical concepts. We demonstrate a series of games/exercises which illustrate topics such as line balancing, demand forecasting, resource allocation, project management and production planning. The activities feature team competition...

**TE26 Stochastic Modeling**

Sponsor: INFORMS Section on Applied Probability

Sponsored Session

Chair: Danielle Liu, AT&amp;T Labs., Holmdel, NJ 07733

1) **Heavy-Tailed Time Series Modeling**, *Sidney I. Resnick*, Cornell Univ., School of OR/IE, Rhodes Hall, Ithaca, NY 14853

We review attempts to fit black box, stationary time series models to real heavy-tailed teletraffic data. Good methods for estimation of coefficients of autoregressive models have been developed as have associated techniques for selecting the order of the autoregression. However, it seems heavy-tailed data has a dependency structure too complicated to be captured by autoregressions...

2) **Stationarity Properties of Neural Networks**, *Soren Asmussen*, Univ. of Lund, Dept. of Math. Stats., Lund, Sweden

A neural model with N interacting neurons is considered. Firing neuron i delays the firing times of all other neurons by the same random variable  $O(i)$  and in isolation, the firings of the neuron can occur according to a renewal process with generic interarrival time  $Y(i)$ . The stationary distribution of the N vector of inhibitions at a firing time is computed...

3) **Asymptotic Analysis of Stochastic Systems with Slow & Fast Switches & Feedback**, *Vladimir V. Anisimov*, Kiev Univ., Kiev, Ukraine

A class of systems of a Markov type working in different scales of time and their local intensities can be dependent on the current value of another process which can be a functional on a trajectory of the system itself or some external random environment is studied. Average type limit theorems for additive functionals and the behavior of transition probabilities in the "quasi-ergodic" situation are proven...

4) **Random Environments: A Paradigm for Future Warfare?**, *Peter Purdue*, Naval Postgrad. Sch., Monterey, CA 93943

For 50 years, US military planners inhabited a deterministic world. The USSR collapsed and their world turned from order to chaos. Today's planner's face great uncertainty and a growing awareness of a true revolution in military affairs. Do we now face warfare in random environment? Let's see!

**TE27 Strategic Planning II**

Contributed Session

Chair: Beth Spellman Munson, AT&amp;T Labs., 101 Crawfords Corner Rd., Room 3K-327, Holmdel, NJ 07733-3030, bsm@mailnet.ho.att.com

1) **High-Level Planning of Workforce Allocation**, *Beth Spellman Munson*, AT&T Labs., 101 Crawfords Corner Rd., Room 3K-327, Holmdel, NJ 07733-3030, bsm@mailnet.ho.att.com

A model is presented for planning workforce allocation in an environment of multiple work types across multiple locations. The model takes into account the different skill sets for employees at each location. When locations are found where the skills and numbers of resources available are insufficient to meet the

workload, other locations are examined for surpluses which can be used to reduce the gaps.

**2) A Strategic Planning Approach for Small Business Operations, Julio Bucatinsky, Tech-Mar Consulting Group, Ltd., 123 Pierrepoint St., Brooklyn, NY 11201, 72223.2363@compuserve.com**

Small businesses need to integrate their technology plan with their business strategy. Methodologies used with large enterprise are not appropriate. We describe a simple but powerful model - developed by management technology practitioners who focus on small enterprises. It encompasses the entire enterprise, from operations to marketing to human resources to finance.

**3) Timetable Generation for Strategic Planning of Railway Infrastructure, Michiel A. Odijk, Delft Univ. of Tech., Mekelweg 4, ET 05.040, Delft, 2628 CD, The Netherlands, m.a.odijk@twi.tudelft.nl**

Generating many timetables is an important step in the strategic planning of railway infrastructure at stations. Mathematically, generating timetables reduces to the difficult problem of generating at random integral points in a polytope which is described by a separation algorithm. We will address this problem.

**4) Identification of Strategic Groups Based on Strategic Interactions: A Network-Analytic Approach (R), Yong I. Song, SUNY, 325N Sch. of Mgmt., Jacobs Ctr., Buffalo, NY 14260, yongsong@acsu.buffalo.edu**

We introduce a strategic interaction perspective in strategic group identification processes in which we use rivalrous moves of competitors for group identification and explore the implications of strategic grouping by the patterns of competitive dynamics in the airline industry.

## TE28 Comparing the Nature of Errors in Health Care with Errors in Other Industries: What Lessons Can We Learn?

**Cluster: Health Care Technology, Policy & Applications  
Invited Session**

**Chair: Jon A. Chilingerian, Brandeis Univ., Heller Sch., Box 9110, Waltham, MA 02254-9110, chilingerian@binah.cc.brandeis.edu**

**1) The Incidence of Medical Errors & the Production of Clinical Care by Temporary Firms, Jon A. Chilingerian, Brandeis Univ., Heller Sch., Box 9110, Waltham, MA 02254-9110, chilingerian@binah.cc.brandeis.edu, Mitchell Glavin**

Each year, medical errors are at least partly responsible for the deaths of 100,000 patients. In commercial aviation, 100,000 deaths annually is the equivalent of 3 jumbo jets crashing every 4 days. This presentation introduces a framework for understanding medical errors by analyzing clinical work as a production process.

**2) Learning from Experience in Nuclear Power & Chemical Industries, John S. Carroll, MIT, Sloan Sch., 77 Mass Ave., Cambridge, MA 02138**

Nuclear power plants and chemical process plants utilize various mechanisms to learn from failures, e.g., incident reviews, and successes, e.g., best practices. I discuss needed organizational mechanisms to encourage more systematic understanding of operating experience and more comprehensive design and implementation in order to address recurrent problems and avoid cyclical crises.

**3) Learning from Mistakes in Teams: Social Psychological & Organizational Factors Enabling Detection & Correction of Error by Work Teams, Amy Edmondson, Harvard Business Sch., Tech. & Op. Mgmt. Group, Cambridge, MA 02138**

We describe a model of team learning that specifies group and organizational factors enabling learning-oriented behaviors in work teams. The first study examined errors in administering drugs in 8 hospital patient-care teams. The second study examined learning-oriented behaviors in 51 manufacturing work teams. Team learning behaviors mediate between team safety and team performance.

**4) Computers, Trust & Medicine, Nancy Leveson, Univ. of WA, Comp. Sci. & Eng. Dept., Box 352350, Seattle, WA 98195-2350, leveson@cs.washington.edu**

Computers are being introduced into nearly every aspect of medicine. Few engineering techniques exist to provide assurance that safety is not being degraded by the substitution of digital systems for human or electromechanical designs that have been perfected through decades of experience. Are we putting too much trust in computers?

## TE29 Inventory & Coordination

**Cluster: Inventory Management  
Invited Session**

**Chair: David F. Pyke, Dartmouth Coll., Amos Tuck Sch. of Bus., Hanover, NH 03755-1798, david.pyke@dartmouth.edu**

**1) Supply Chain Reengineering Through Information Sharing & Replenishment Coordination, Hau L. Lee, Stanford Univ., IE/EM Dept., Stanford, CA 94305-4024, ng.hll@forsythe.stanford.edu, Kut C. (Rick) So, Christopher S. Tang**

Information sharing and replenishment coordination are often the key initiatives pursued by partners in a supply chain. Many innovations, such as EDI, VMI, third-party logistics and consolidation can be described as components of these 2 initiatives. We aim at quantifying the benefits of these initiatives, as well as understanding the drivers of such benefits.

**2) Disposal of Excess Stock at the End of a Project When Facing On-Going Operational Usage, Edward A. Silver, Univ. of Calgary, Fac. of Mgmt., 2500 University Dr. NW, Calgary, Alberta, T2N 1N4, Canada, silver@mgmt.ucalgary.ca, Keith Willoughby**

We consider an important decision faced in many large-scale, construction projects. There is a surplus stock of an item at the end of the construction phase. Moreover, the item is to be used (as a spare part or for routine replacement) in the on-going operations of the facility. There is an opportunity to dispose of some of the stock but the marginal salvage value is not necessarily constant...

**3) Effect of Different Leadtime Demand Distributions on the Performance of Simple (Q,R) Heuristics with Service Level Constraints, Lawrence W. Robinson, Cornell Univ., 527 Malott Hall, Johnson Grad. Sch. of Mgmt., Ithaca, NY 14853-4201**

Assuming that the leadtime demand is normally distributed is convenient, if not always justifiable. We examine the sensitivity of simple, non-interactive (Q,R) heuristics to errors in specifying the distribution of leadtime demand. Using the 4-parameter Ramberg-Schmeiser distribution allows us to investigate the effects of misspecifying the skewness and kurtosis of the leadtime demand distribution.

**4) An Application of (s,nQ) Policies for Production Scheduling at a Pharmaceutical Manufacturer, David F. Pyke, Dartmouth Coll., Amos Tuck Sch. of Bus., Hanover, NH 03755-1798, david.pyke@dartmouth.edu**

We report on the use of periodic reviews (s,nQ) policies to initiate production at a pharmaceutical manufacturer which faces sequence dependent setups and fixed batch sizes. The proposed system is designed to supplement the firm's MRP system.

## TE30 Picatinny Arsenal & West Point Joint Relationship II

**Sponsor: INFORMS Military Applications Society  
Sponsored Session**

**Chair: Julie C. Chu, Armament Research Development Eng. Ctr., Picatinny Arsenal, NJ 07806-5000, Chair**

**Co-Chair: John A. Marin**

**1) Designing an Infantry Platoon for the 21st Century, Julie C. Chu, Armament Research Development Eng. Ctr., Picatinny Arsenal, NJ 07806-5000, Chair, John A. Marin**

This research focuses on effects of new weapon systems on the organization, employment and training of infantry platoons within the Army of the 21st century. Specifically, we address the impact of 2 conceptual weapons systems on the infantry platoon. The weapons systems are the objective individual combat weapon and the objective crew-served combat weapon...

**2) A New Field Artillery System to Support Light Unit Operations, Robert Lindsey, APM Fire Support, Quantico, VA, David D. Briggs**

This research focuses on replacements for the current 155mm Howitzer used by the US Army and the US Marine Corp. Alternatives analyzed include the current system, the M198 155mm Howitzer; a proposed replacement for the M198 designated as the lightweight 155mm advance towed cannon system and a naval 5 inch gun (127mm) placed upon the carriage of a Soviet D-30 (122mm) Howitzer...

**3) Designing Smart Munitions for the 21st Century Main Battle Tank, Tony Sebasto, Armament Res. Development Eng. Ctr., Picatinny Arsenal, NJ 07806**

Current US Army main battle tanks engage enemy targets at ranges of 2-3 km. We investigate the possibilities of applying 21st century technology to extending the ability of an armor system to engage enemy targets at distances in excess of 10 km. Alternative systems, to include a tank extended range munition and a

smart indirect fire system, are modeled using the Janus combat simulation...

### TE31 Analysis in Support of Development of Virtual Training

Sponsor: INFORMS Military Applications Society  
Sponsored Session

Chair: Jeffery Wilkinson, TRADOC, ATTN: ATZL-CT-TSM,  
Ft. Leavenworth, KS 66027-1306,  
jeff\_sme-wilkinson@stricom.army.mil

1) **The Use of Computer-Based Planning to Enhance the Effectiveness & Efficiency of Simulation-Based Team Training, George F. Stone, III, US Army Ntl. Simulation Ctr., ATTN: AMCPM-SAMS, 12350 Research Parkway, Orlando, FL 32826, stoneg@stricom.army.mil, James M. Ragusa**

To ensure user acceptance and success of technology-enhanced training in an era of declining budgets and scarce resources, civilian and military organizations must exploit effective and efficient planning and evaluation tools as part of simulation-based training. We validate the hypothesis that computer-based (automated) planning tools will improve training planning effectiveness...

2) **Close Combat Tactical Trainer Semi-Automated Forces: Behavior Verification & Validation, Charles W. Mullis, US Army TRADOC Analysis Ctr., ATTN: ATRC-WEC, WSMR, NM 88002-5502, mullis@trac.wsmr.army.mil**

We present an approach for evaluating SAF behaviors within the context of performing V&V functions in computer generated force evaluations. A brief synopsis of the benchmark metric, the combat instruction set, precedes a presentation of the general flow of the process necessary to verify adequate behavioral functional coverage and validate model performance against a real-world standard.

3) **Data Collection in Support of Verifications, Validation & Accreditation of the Close Combat Tactical Trainer, Raymond L. Miller, Resource Consultants, Inc., 12249 Science Dr., Ste. 140, Orlando, FL 32826-3266, miller@magicnet.net, Jeff Browning**

We discuss the use of APROBE software tool to support the verification, validation and accreditation of the CCTT. We describe how the APROBE tool was used for debugging and analyzing data used in the software code for the simulation. It was used to collect data points within the CCTT software code for target acquisition, delivery accuracy, reliability, vulnerability, mobility and rate of fire...

### TE32 Network Database Security

Cluster: Telecommunications  
Invited Session

Chair: George T. Duncan, Carnegie Mellon Univ., Heinz Sch.,  
Pittsburgh, PA 15213, gd17@andrew.cmu.edu

1) **Belief Networks for Distributed Database Security, Sumitra Mukherjee, Nova Southeastern Univ., Sch. of Comp. & Info. Sci., 3100 SW 9th Ave., Ft. Lauderdale, FL 33315, sumitra@scis.nova.edu**

Traditional security policies that are set and implemented on individual databases fail to provide adequate protection for client server systems linked via global networks. We investigate security risks in such distributed environments. Belief networks are employed to model the database administrator's uncertainty about the users' ability to access network databases.

2) **Disclosure Detection in Online Categorical Databases, George T. Duncan, Carnegie Mellon Univ., Heinz Sch., Pittsburgh, PA 15213, gd17@andrew.cmu.edu, Ramayya Krishnan, Rema Padman, Stephen Roehrig, Phyllis Reuther**

The growth of online data warehouses raises concerns about the protection of privacy and confidentiality. We discuss efficient methods which can be used to assess if the release of categorical data, e.g., frequency data, will result in disclosure.

3) **Disclosure Limitation in Online Categorical Databases, George T. Duncan, Carnegie Mellon Univ., Heinz Sch., Pittsburgh, PA 15213, gd17@andrew.cmu.edu, Ramayya Krishnan, Rema Padman, Stephen Roehrig, Phyllis Reuther**

We present work on methods to limit disclosure by suppressing data cells in the data warehouse. This complements our previous work on methods for disclosure detection and adapts the methods to meet the needs of disclosure limitation.

### TE34 Understanding Trust in the Networked Organization

Cluster: Management Information Systems  
Invited Session

Chair: Suzanne Weisband, Univ. of AZ, MIS Dept., Tucson,  
AZ 85721, sweisband@pba.arizona.edu

1) **Relational Model of Trust in Organizations: A Social Identity Theory Perspective, Roderick Kramer**

No abstract supplied.

2) **Authority & Trust in Electronic Support Groups, Lee Sproull, Sara Kiesler, Jolene Galegher**

No abstract supplied.

3) **The Development of Trust in Temporary Electronic Teams, Suzi Iacono, Boston Univ., Dept of MIS, 704 Commonwealth Ave., Boston, MA 02215, Suzanne Weisband**

No abstract supplied.

4) **Make, Buy or Collaborate: Building Trust in Biotechnology Alliances, Walter Powell**

No abstract supplied.

### Wednesday 08:00-09:30

#### WA02 No Title Supplied

Sponsor: INFORMS CSTS  
Sponsored Session

Chair: To be announced

1) **Application Development with OML, Joe Creegan, Ketron, 1755 Jefferson Davis Hwy., # 901, Arlington, VA 22202**

Ketron's OML contains a linear and a mixed-integer optimizer plus model development and management functions for model generation, solution retrieval, data management, optimization control, etc. You have access to your entire model environment. The functions of this library are callable from C or FORTRAN; the DLL version can be used in application generators such as Visual Basic...

2) **New Developments in MIMI, Thomas E. Baker, Chesapeake Dec. Sci., Inc., 200 South St., New Providence, NJ 07974**

MIMI is a toolkit for planning, scheduling and supply chain applications that combines OR, expert systems, graphics and database technologies. We trace the evolution of MIMI over a period of 10 years and demonstrate some of the most recent developments in the areas of distributed computing, light client interfaces and internet/intranet capabilities.

#### WA04 AIDS Modeling II

Cluster: Public Sector Applications

Sponsor: INFORMS Section on Public Programs & Processes  
Invited/Sponsor Session

Chair: Anke Richter, Research Triangle Inst., 3040 Cornwallis Rd. Hobbs Bldg, PO Box 12194, RTP, NC 27709-2194, anke@rti.org

1) **Application of a Bernoulli Process Model of HIV Transmission to Cost-Utility Analysis, Steven D. Pinkerton, Medical Coll. of WI, Ctr. AIDS Intervention Res., 1249 N Franklin Pl., Milwaukee, WI 53202, pinkrton@post.its.mcw.edu, David R. Holtgrave**

Sexual behavior outcome data, i.e., number of partners, condom use, etc., can be translated into an estimate of the number of infections averted by an HIV prevention intervention using a Bernoulli process model of HIV transmission. This estimate can then be combined with cost data to evaluate the economic efficiency of the intervention.

2) **Optimal Resource Allocation for Epidemic Control in Multiple Independent Populations, Anke Richter, Research Triangle Inst., 3040 Cornwallis Rd. Hobbs Bldg, PO Box 12194, RTP, NC 27709-2194, anke@rti.org, Margaret L. Brandeau**

Previous theoretical results about optimal epidemic control are extended to the M-population case and tied to a practical application of HIV/AIDS epidemic control for the Palo Alto/Menlo Park VA Hospital.

#### WA05 Hospitality Decision Making

Sponsor: INFORMS Social Science Applications Section  
Sponsored Session

**Chair:** Myron Hatcher, CA State Univ., Info. Systems & Dec. Sci., Craig Sch. of Bus., Fresno, CA 93740-0007, myron\_hatcher@csufresno.edu

1) **A Hospitality Decision Support System**, *Myron Hatcher*, CA State Univ., Info. Systems & Dec. Sci., Craig Sch. of Bus., Fresno, CA 93740-0007, myron\_hatcher@csufresno.edu

A DSS is presented for the lodging industry with conceptual problems discussed. Within the model, uncertainty for input information and output measures are defined and considered.

2) **Measuring Productivity in the Lodging Industry**, *Jerry L. Jones*, CA State Univ., Mgmt. Dept., Craig Sch. of Bus., Fresno, CA 93740

Concepts on definition, scale development and application of productivity measures will be presented. Productivity is defined as the quality of the product as seen from the customer point of view.

3) **The Role of Information Flow on Tourism Demand**, *Rafael Solis*, CA State Univ., Dept. of IS/DS, Craig Sch. of Bus., Fresno, CA 93720, rafael@csufresno.edu

We describe a theoretical model of the role of information flow between tourists and their destinations. The model is an adaptation of similar marketing research theories that are used to explain the mechanics of the information flow between a product and new customers. The model is based on a rational and economic analysis of the way tourists may acquire about their destination...

4) **No Title Supplied**, *Warren Lieberman*, Decision Focus Inc., 650 Castro St., Ste. 300, Mountain View, CA 94041-3656, warren@dfi.com

No abstract supplied.

#### WA06 Bi-Level Programming

**Cluster:** Global Optimization  
**Invited Session**

**Chair:** Gilles Savard, Ecole Polytech. & GERAD, 3000 Cote-Ste.-Catherine, Montreal, Quebec, H3C 3A7, Canada, gilles@crt.umontreal.ca

1) **Bilevel Linear Program with Multiple Inner Decision Makers**, *Yi-Hsin Liu*, Univ. of NE, Dept. of Math. & Comp. Sci., 60th & Dodge Sts., Omaha, NE 68182-0243, liu@cwis.unomaha.edu

We study the bilevel LP with multiple inner decision makers and a solution algorithm is developed.

2) **A Bilevel Programming Approach to Provide Incentives for Crop Conversion to Fuels**, *Jonathan F. Bard*, Univ. of TX, OR Group, Dept. of Mech. Eng., ETC 5.160, Austin, TX 78712-1063, jbard@mail.utexas.edu, *John C. Plummer, Jean Claude Sourie*

The government as leader would like to minimize the annual subsidy it pays to industry to produce biofuels from crops grown on land now set aside and subsidized through a different support program. The agricultural sector is the follower. A number of algorithms are discussed for this bilevel programming problem.

3) **Sequential Approximation Algorithms for the Nonlinear Bilevel Problem**, *Patrice Marcotte*, DIRO, Univ. de Montreal, CP 6128, Succ. Centre-Ville, Montreal, Quebec, H3C 3J7, Canada, marcotte@iro.umontreal.ca, *Gilles Savard, Luis N. Vicente*

We present a sequential approximation scheme to solve the NLBP. First and second order "bilevel approximation" are used together with a trust region approach to derive a globally convergent sequential algorithm for the NLBP.

#### WA07 Quality Control

**Contributed Session**

**Chair:** Benjamin H. Eichhorn, Rider Univ., 17 Ivy Lane, Cherry Hill, NJ 08002-1611, eichhorn@rider.edu

1) **Tolerancing Using a Parametric Model**, *Carolina C. Barcenas*, GA Inst. of Tech., 30282 GA Tech. Station, Atlanta, GA 30332-1315, cbarcena@isye.gatech.edu, *Paul M. Griffin*

A method to test form and size conformance of manufactured parts is presented. The method consists of a modeling stage and a statistical verification stage. The modeling stage is based on parametric curves known as superquadrics. The statistical analysis is based in confidence regions compared to minimum zone requirements.

2) **Reduced Inspection of Piles in Construction**, *Benjamin H. Eichhorn*, Rider Univ., 17 Ivy Ln, Cherry Hill, NJ 08002-1611, eichhorn@rider.edu

A 100% inspection of piles is customary in construction. While a defective pile could render the construction unsafe, inspection is expensive. Under certain assumptions on distribution of defectives and restrictions on risks, we consider reducing the number of piles inspected.

3) **Bayesian Control Charts for Variables**, *George Tagaras*, Aristoteles Univ. of Thessaloniki, Dept. of Mech. Eng., Thessaloniki, 54006, Greece, tagaras@olymp.ccf.auth.gr, *John Nikolaidis*

We propose and analyze a control chart for the mean of a quality characteristic, based on Bayesian updating of the state of the process after each sample mean is recorded. The chart is adaptive in that the sampling interval and the sample size are allowed to change in real time.

#### WA08 Business Applications IV

**Contributed Session**

**Chair:** Christiano Lyra, State Univ. of Campinas, FEEC/UNICAMP, Campinas - SP, 13083-970, Brazil, christi@densis.fee.unicamp.br

1) **Sizing Hydroelectric Plants with Multiple Non-Energy Users**, *Christiano Lyra*, State Univ. of Campinas, FEEC/UNICAMP, Campinas - SP, 13083-970, Brazil, christi@densis.fee.unicamp.br, *Roberto Castro*

Sizing hydroelectric plants is a quest to achieve the best compromise between energy benefits and costs. We discuss an approach to set up sizes of reservoir and facilities when non-energy users are important actors in the scene. Concepts of MCDM and dynamic programming are adopted.

2) **World Class Subcontracting in the Aerospace Industry**, *Elisabeth Lefebvre*, Ecole Polytech. de Montreal, CP 6079, Succ. Centre-Ville, Montreal, Quebec, H3C 3A7, Canada, *Louis A. Lefebvre, Carl St.-Pierre*

Results of an international study conducted in subcontracting firms in the aerospace industry in the US, Canada and the UK on critical dimensions of competitiveness are presented. Special attention is paid to the alignment between technological and organizational capabilities.

3) **Make-or-Buy Decisions in the Semiconductor Industry**, *Jose M. Padillo*, TEFEN USA, 2 W Alameda Dr., Ste. 3, Tempe, AZ 85282-3565, tefenaz!tefenaz!jpadillo@tefenaz.attmail.com, *Moustapha Diaby*

We discuss the widely known make-or-buy problem in the context of the semiconductor manufacturing industry. A multiple-based methodology is developed along 4 principal dimensions: strategic competitive performance; managerial performance; sourcing risks and financial performance. The methodology is illustrated through a case study.

#### WA09 Machine Scheduling IV

**Contributed Session**

**Chair:** Chiahung Lin, Univ. of AZ, 1322 E 7th St., # A, Tucson, AZ 85719, chia@sie.arizona.edu

#### WA10 Multicriteria Decision Making I

**Contributed Session**

**Chair:** Thomas L. Morin, Purdue Univ., Dept. of IE, 1287 Grissom, W Lafayette, IN 47907-1287, morin@ecn.purdue.edu

1) **Towards Finding Global Representations of the Efficient Set in Multiple Objective Mathematical Programming (R)**, *Harold P. Benson*, Univ. of FL, Dept. of Dec. & IS, 351 BUS Bldg., Box 117169, Gainesville, FL 32611-7169, cyeonwc@nervm.nerd.c.ufl.edu, *Serpil Sayin*

We propose and justify the proposition that finding truly global representations of the efficient sets of multiple objective mathematical programs is a worthy goal. We summarize a general global shooting procedure that we have developed for this purpose. The procedure illustrates the potential benefits to be gained if we achieve this goal.

2) **Augmented Lagrangian & Tchebycheff Approaches in Multiple Objective Programming**, *Margaret M. Wiecek*, Clemson Univ., Dept. of Math Sci., Clemson, SC 29634, wmalgor@clemson.edu, *Jorgen Tind*

Relationships between the Tchebycheff scalarization and the augmented Lagrange multiplier technique are examined in the framework of general MOPs. It is shown that the Tchebycheff method is equivalent to a quadratic weighted-sums scalarization of the MOP. Resulting applications in MCDM are discussed.

3) **Proper Efficiency & Cardinal Utilities in Multicriteria**

**Decision Making, Zhimin Huang**, Adelphi Univ., Sch. of Mgmt. & Bus., Garden City, NY 11530, huang@sable.adelphi.edu, **Susan Li**

We investigate proper efficiency in MCDM when it is possible to represent the decision maker's risk attitudes and preferences by cardinal utilities. Proper efficiency is characterized by optimizing associated utility-related scalar optimization problems. More detailed relationships among proper efficiency, measure of risk aversion and allocation strategies are discussed.

**4) Optimal Algorithm for Discrete Multiple Objective Optimization, Thomas L. Morin**, Purdue Univ., Dept. of IE, 1287 Grissom, W Lafayette, IN 47907-1287, morin@ecn.purdue.edu, **V. Choudhary, Joe Walter**

We present an algorithm for finding the subset of efficient points from a given set of  $k$  points. The algorithm is shown to be optimal for the case of 2 objectives. It is extended to the general case of  $p$  objectives and computational experience is reported.

## WA12 Toward an Empirical Science of Algorithms

Sponsor: INFORMS CSTS

Sponsored Session

Chair: **John N. Hooker**, Carnegie Mellon Univ., Grad. Sch. of Ind. Admin., Pittsburgh, PA 15213, jh38+@andrew.cmu.edu

**1) On the Use of Formal Statistical Methods for the Empirical Analysis of Algorithms, Richard S. Barr**, SMU, Dept. of Comp. Sci. & Eng., Dallas, TX 75275-0122, barr@seas.smu.edu, **Mohammad M. Amini**

The application of experimental design principles to the empirical testing of algorithms provides a convenient structure for selecting test problems, gleaning insights into an algorithm's behavioral characteristics and deriving statistically justifiable conclusions about the computational results. Example experiments and philosophical issues are presented.

**2) Searching for Optimal Algorithm Parameters, James P. Kelly**, Univ. of CO, Coll. of Bus., CB 419, Boulder, CO 80309-0419, james.kelly@colorado.edu, **Fred W. Glover, Manuel Laguna**

Many algorithms require fine-tuning to optimize their performance. We introduce a technique based on scatter search and TS called OptQuest that can automate this tedious and time-consuming process. Furthermore, OptQuest can often reveal parameter sets that are superior to those derived from manual explorations. We demonstrate OptQuest as applied to a typical TS algorithm.

**3) Why are Knapsack Problems with Correlated Coefficients Harder to Solve?, Charles H. Reilly**, Univ. of Central FL, Dept. of IE & Mgmt. Systems, PO Box 162450, Orlando, FL 32816-2450, reilly@iems.engr.ucf.edu

The difficulty of knapsack problems is related to the correlation between their objective and constraint coefficients. We use a general form of bivariate distribution with uniform marginals to show how the objective-constraint correlation affects the moments of the coefficient ratios and the dispersion of solution values. Computational evidence is provided to support the analysis.

## WA16 The Integration of Product Design & Process Development in the Race to Market

Sponsor: INFORMS Section on Technology Management

Sponsored Session

Chair: **Russell W. Wright**, Univ. of IL, Dept. of Bus. Admin., 350 Commerce W Bldg., Champaign, IL 61820, rwwright@uiuc.edu

**1) Technology Planning & Development in High Technology Firms, Nile W. Hatch**, Univ. of IL, Dept. of Bus. Admin., 339 Commerce W Bldg., Champaign, IL 61820

We study the tradeoffs between reduced complexity and future capabilities in developing modular process technologies. We demonstrate that developing new modules for the current technology development project reaps benefits that can be incorporated into future generations of technologies, making possible new technologies that may not have been feasible otherwise.

**2) Product, Process & Knowledge Architectures, Ron Sanchez**, Univ. of Western Australia, Grad. Sch. of Mgmt., Nedlands, Perth, 6009, Australia, rsanchez@ecel.uwa.edu.au

We explore ways in which product architectures can be used to define process architectures within organizations and product and process architectures provide frameworks for defining the knowledge architecture of an organization. The primary examples are illustrated through a case study of a large producer of industrial automation controls.

**3) Innovation & Joint Venture, Jean-Marc Xuereb**, ESSEC,

Dept. of Strategy & Mgmt., BP 105, Cergy Pontoise, 95021, France

This is a study of joint ventures of high-tech firms across France. The most promising and lowest risk type of alliance is one involving large with small firms. In an alliance involving 2 large firms, the task of overcoming strategic differences frequently offset the expected advantages of jointly developing an innovation.

**4) New Product Introduction Timing: Matching Firm Readiness & Market Receptivity, Scott Dacko**, Univ. of IL, Dept. of Bus. Admin., 339 Commerce W Bldg., Champaign, IL 61820, **Ben Liu, D. Sudharshan, Russell W. Wright**

We present a framework for assessing the success of a new product introduction based on the match between firm readiness and market receptivity. The factors that contribute to the 2 critical states of readiness and receptivity are identified and examined comprehensively. This examination sheds light on the effective managerial coordination of the 2 states.

**5) The Development of Product Design & Process Development from a Knowledge-Based View of the Firm, Russell W. Wright**, Univ. of IL, Dept. of Bus. Admin., 350 Commerce W Bldg., Champaign, IL 61820, rwwright@uiuc.edu

We look at the development of product design and process development capability within the semiconductor industry. We argue that firms are biased in the way they develop and structure knowledge. These biases enable and constrain firms in their product design and process development efforts.

## WA17 Economics

Contributed Session

Chair: **Thomas A. Grossman**, Univ. of Calgary, 2500 University Dr. NW, Fac. of Mgmt., Calgary, Alberta, T2N 1N4, Canada, grossman@mgmt.ucalgary.ca

**1) Using Flexibility in Setting Tolls that Induce Self-Optimizing Users to Select the Socially-Optimal Facility Assignment, Thomas A. Grossman**, Univ. of Calgary, 2500 University Dr. NW, Fac. of Mgmt., Calgary, Alberta, T2N 1N4, Canada, grossman@mgmt.ucalgary.ca

Self-optimizing users receive service at multiple facilities for which users have distinct preferences. Facility tolls can be used to induce users to achieve the socially-optimal facility assignment.

**2) Modeling Economic Behavior in Electrical Networks, William R. Stewart**, Coll. of William & Mary, Sch. of Bus., Williamsburg, VA 23185, wrstew@dogwood.tyler.wm.edu, **Benjamin Hobbs, Carolyn Berry**

We analyze strategic behavior on an electrical grid under varying assumptions about competition and capacity in the network. The presence of Kirchoff's laws dramatically changes the strategic position of power producers as opposed to comparable competition on a network without these constraints.

**3) Development & Use of a Dynamic Computable General Equilibrium Global Model in Evaluating Trade Reforms (R), Agapi Somwaru**, USDA, ERS, 1301 New York Ave. NW, Rm. 712A, Washington, DC 20005, agapi@econ.ag.gov, **Xinshen Diao**

An intertemporal CGE model of the US and MERCOSUR is developed to analyze the dynamic adjustments in both region's commodities and capital markets after trade liberalization. Simulation results show that tariff reductions initiated by MERCOSUR have small positive effects on US trade and investment while stimulating MERCOSUR's growth and improving its current account.

**4) Product Relatedness, Interindustry Takeovers & Market Returns, Chander Shekhar**, Univ. of Melbourne, Melbourne Bus. Sch., 200 Leicester St., Carlton, Victoria, 3053, Australia, c.shekhar@mbs.unimelb.edu.au

This research establishes the relationship between relatedness of the acquirer and target product lines (both at the horizontal as well as the conglomerate levels) and the market returns to such mergers. It is shown that this influence is significant and may explain the bidding strategies followed by potential acquirers.

**5) Statistical Inference Using a Bounded Asymmetric Loss (BLINEX), Daling Wen**, Univ. of Cincinnati, Dept. of QAOM, Cincinnati, OH 45221-0130, wend@ucbeh.san.uc.edu, **Martin S. Levy**

We define a bounded asymmetric loss function, BLINEX, derived from the well-known LINEX loss that can be used in decision problems where symmetry and unboundedness are not appropriate. Admissibility of several estimators relative to a variety of losses including BLINEX, loss robustness and predictive inference applications of BLINEX are explored.

**WA18 TUTORIAL: Constraint Programming**

Invited Session

**Chair:** Carol Tretkoff, Brooklyn Coll., Ctr. for Logic Based Systems, Brooklyn, NY 11210**Co-Chair:** Ken McAloon**1) TUTORIAL: Constraint Programming, Carol Tretkoff, Brooklyn Coll., Ctr. for Logic Based Systems, Brooklyn, NY 11210, Ken McAloon**

Constraint programming supports constraints as first-class objects in programming systems. We will show how to use constraint programming to build hybrid discrete and continuous models to solve problems at the AI/OR interface. Problem solving methods presented and demonstrated include constrained quadratic regression, the injury method, branching on the dual side, least discrepancy search and randomized shuffle algorithms...

**WA19 Productivity & Competitiveness**

Contributed Session

**Chair:** Stephen E. Garrett, Garrett Global Consulting, 10 Park Place, Ste. 224, Morristown, NJ 07960, garretste@aol.com**1) The Royal Society for Encouragement of Arts, Manufactures & Commerce & Tomorrow's Company: Applying the Inclusive Approach, Stephen E. Garrett, Garrett Global Consulting, 10 Park Place, Ste. 224, Morristown, NJ 07960, garretste@aol.com**

The RSA recently completed an inquiry into Tomorrow's Company to enhance the competitiveness of British business. Their "inclusive approach" shares much with the systemic perspective of OR/MS. This presentation reviews the approach, its application internationally and the RSA's ongoing catalytic efforts.

**2) Constructs for Leadership & Management and Their Effect on Employee Morale, Customer Satisfaction & Productivity, Patrick J. Johanns, Melbourne Bus. Sch., 200 Leicester St., Carlton, Victoria, 3053, Australia, p.johanns@mbs.unimelb.edu.au, Danny Samson**

Using the 1994 Australian Manufacturing Council survey of more than 200 manufacturing sites, separate constructs were generated for the concepts of leadership and management using structural equation modeling. While these constructs were highly correlated, only leadership was found to have a strong impact on employee morale.

**3) Implied Assumptions of Desirability Function Opt., Douglas N. Fuller, 4018 Clinton Ave., Richmond, VA 23227, dnf8h@virginia.edu, William T. Scherer**

The use of a "desirability function" in conjunction with response surface methodology is a common approach to multi-attribute response process design. This method was introduced in 1965 and is incorporated in such computer packages as Design Expert. This presentation will explore ramifications of assumptions implicit in the desirability function.

**4) Planning for Competitive Electric Power Systems, Scott Rogers, Univ. of Toronto, Dept. of Mech. & IE, 5 Kings College Rd., Toronto, Ontario, M5S 3G8, Canada, rogers@mie.utoronto.ca**

We describe a model for planning electric power supply under competitive bidding conditions. We show the effects of different numbers and types of competitors. Data for the Ontario system are used to illustrate the magnitude of the effects.

**WA20 Analysis of Urban Transit Systems**

Sponsor: INFORMS Transportation Science Section

Sponsored Session

**Chair:** Matthew G. Karlaftis, Purdue Univ., Dept. of Civil Eng., W Lafayette, IN 47907**1) Transit Network Simulations & Line Selection Behavior, R. Jayakrishnan, Univ. of CA, Civil & Env. Eng., Irvine, CA 92697, Ana Fill**

We present a dynamic simulation model developed to study the effect of information and real-time traffic congestion on transit line operations and the resulting ridership. The model operates within a real-world research testbed for advanced transportation and is capable of studying the validity of route and line selection assumptions made in conventional ridership assignment models using candidate behavioral structures.

**2) Electronic Payment Systems in Public Mass Transit, Joachim R. Daduna, Fachhochschule Konstanz, FB Wirtschaft & Sozial., Braunegegerstrasse 55 D, Konstanz, D-78462, Germany**

In public mass transit, the mode of payment affects considerably on operations and commercial administration. Therefore, during the last years, different

concepts have been analyzed to deduce the required cost, especially the use of electronic payment. Some existing solutions are presented and advantages as well as disadvantages are discussed.

**3) The Cost Structure of a Mass Transit Firm, Matthew G. Karlaftis, Purdue Univ., Dept. of Civil Eng., W Lafayette, IN 47907, Patrick S. McCarthy**

Utilizing time-series data from the Indianapolis Public Transit Corporation, we estimate a general cost model that places very few a priori restrictions on the transit system's production structure. Results pertaining to economies of scale, factor substitution, separability and homotheticity are presented.

**WA21 Artificial Intelligence I**

Contributed Session

**Chair:** Fatemeh Mariam Zahedi, Univ. of WI, PO Box 742, Sch. of Bus., Milwaukee, WI 53201, zahedi@csd.uwm.edu**1) Meta-Analysis of Neural Networks in Financial Decision Making, Fatemeh Mariam Zahedi, Univ. of WI, PO Box 742, Sch. of Bus., Milwaukee, WI 53201, zahedi@csd.uwm.edu**

We present a meta framework for the application of NNs in financial decision making. Applications of NNs in finance could be categorized into: pure applications, comparative studies of NN with statistical methods and hybrid systems. We generalize from these applications and identify areas that need further research.

**2) Combining Qualitative & Quantitative Aspects for Knowledge Representation: The Case of Real Estate Appraisal, Ranga Naras, Acadia Univ., Sch. of Bus., Wolfville, NS, B0P 1X0, Canada, rmaras@ace.acadia.ca**

We describe a methodology for combining qualitative and quantitative aspects in the acquisition and representation of knowledge in an unstructured decision making context such as real estate appraisal with regard to residential properties.

**3) Simulation Metamodels Using Dynamic Architecture Radial Basis Function Neural Networks, Seth Flanders, Ntl. Inst. of Justice, 633 Indiana Ave. NW, Washington, DC 20531, flanders@ojp.usdoj.gov**

Simulation metamodels, or models of models, are gaining acceptance in the simulation community. A specific type of neural network, a DARBF neural network, is used for the creation of the metamodel. Training is by the method of temporal differences.

**4) Network Analysis & Neural Network Approach for the Formation of Machine Cells & Part Families, Hongchul Lee, Korea Univ., IE Dept., 15-Ka Anam-dong, Sungbuk-Ku, Seoul, 136-701, Korea, hlee@kucenx.korea.ac.kr, Sung-Schick Kim**

We present a network flow analysis to form machine cells and a neural net model to form part families. The operational sequences and production volume of the part and the number of cells are taken into consideration for a 0-1 quadratic programming formulation. A network flow-based solution procedure is developed. After designing the machine cells, a neural network approach for the integration of part families is proposed...

**WA22 Manufacturing II**

Contributed Session

**Chair:** David H. Sparling, Univ. of Guelph, Dept. of Ag. Econ. & Bus., Guelph, Ontario, N1R 5S6, Canada, dsparlin@agec.uoguelph.ca**1) Mixed-Model U-Line Balancing, David H. Sparling, Univ. of Guelph, Dept. of Ag. Econ. & Bus., Guelph, Ontario, N1R 5S6, Canada, dsparlin@agec.uoguelph.ca, John Miltenburg**

Mixed-model production presents significant challenges to manufacturing firms, particularly in finding an effective line balance. The use of U-lines in mixed-model production provides opportunities not available in other configurations. The advantages of U-lines for mixed-model production and algorithms for mixed-model U-line balancing will be examined.

**2) Employee Training & Assignment for Cellular Manufacturing, Yuanshu Huang, Univ. of AZ, Dept. of SIE, Tucson, AZ 85721, yuanshu@sie.arizona.edu, Ronald G. Askin**

The cellular configuration of manufacturing facilities requires the assignment of workers to cells and the education of these workers to operate as a self-directed cellular team. We provide and compare integer programming models for guiding the assignment of workers and the selection of a training program to each employee.

**3) Operating Manufacturing Cells, Anand Iyer, i2 Technologies, Inc., 909 E Las Colinas Blvd., Ste. 1600, Irving, TX 75039,**

anand\_ayer@i2.com, **Ronald G. Askin**

Four families of operating policies are compared under different environmental conditions. We explicitly consider worker cross-training and the use of transfer batches.

**4) Cell Formation in Dynamic Manufacturing Environment, Mingyuan Chen**, Univ. of Regina, Fac. of Eng., Regina, Sask., S4S 0A2, Canada, mingyuan.chen@uregina.ca

Designing a sustainable cellular manufacturing system in a dynamic environment is studied. A MIP model is developed to minimize inter-cell travel and cell reconfiguration costs for multiple time periods. Decomposition and dynamic programming are used to solve this NP-complete problem. Numerical examples are presented.

#### WA24 Applications of Decision Analysis in Environmental Management

Sponsor: INFORMS Decision Analysis Society  
Sponsored Session

Chair: Miley W. Merkhofer, Applied Decision Analysis, Inc., 2710 Sandhill Rd., Menlo Park, CA 94025-7020, lmerkhofer@adainc.com

**1) Applications of Decision Analysis in Environmental Management, Kenneth S. Redus**, MACTEC, 189 Lafayette Dr., Ste. C, Oak Ridge, TN 37830

An MIP is used to determine the optimal portfolio of environmental restoration and waste management projects that minimizes total life cycle given annual budget constraints, human health and environmental risk reduction requirements and risk management issues associated with project combination, schedule, regulatory compliance and technological constraints.

**2) A Method for Evaluating & Comparing Relative Risk Reduction Among Environmental Remediation Project Alternatives, Edward C. Leach**, CH2M HILL, 777 108th Av NE, PO Box 91500, Bellevue, WA 98009-2050, eleach@ch2m.com

Health risk assessment, HRA, is intended to inform environmental risk management decisions. However, HRA results have been criticized recently for being expressed in terms that are not useful for economic analysis. We present a proposed method for integrating HRA results into a DA framework.

**3) Valuing Billions of Dollars, Ralph L. Keeney**, Univ. of Southern CA, 101 Lombard St., Ste. 704W, San Francisco, CA 94111

Valuing large economic costs is difficult, as it may matter who pays the costs, how they pay and whether costs are direct or indirect, statistical or identifiable and known for sure or uncertain. We describe how large economic costs are valued and suggests guidelines to more appropriately value them.

**4) Valuing Environmental R&D Benefits for Electric Utilities, John Kadwany**, Applied Decision Analysis, Inc., 2710 Sand Hill Rd, Menlo Park, CA 94025, jkadwany@adainc.com

While the electric utility industry supports research on several major environmental problems, industry deregulation is leading to critical appraisals of major research programs. This presentation summarizes decision-analytic approaches used by industry to characterize the value of environmental research for business planning.

**5) Environmental Risk Management & Corporate Strategy: Doo-Wop - It's an Aria!, Dan Brooks**, Applied Decision Analysis, Inc., 2528 E Emerald Ave., Mesa, AZ 85204

The implications that risk management decisions have for corporate strategy are often not incorporated into the strategic budget allocation process for a corporation. This presentation shows how one corporation closed that gap by formally defining and incorporating the risk management decision process into the annual budget prioritization process.

#### WA25 TUTORIAL: Team Learning I

Sponsor: INFORMS Forum on Education  
Sponsored Session

Chair: J. L. Madrigal, Brigham Young Univ., Dept. of Stats., 222 TMCB, Provo, UT 84602-2675, madrigal@byu.edu

Co-Chair: Terry N. Lee

**1) TUTORIAL: Team Learning I, J. L. Madrigal**, Brigham Young Univ., Dept. of Stats., 222 TMCB, Provo, UT 84602-2675, madrigal@byu.edu, **Judith S. Liebman**

The team learning approach emphasizes teamwork and learning by doing and was developed to promote active learning. Its application involves a 6-step instructional sequence conducive to the development of higher cognitive skills.

Participants will have the opportunity to experience first hand the application of this approach. Examples of activities and reading quizzes will be given...

#### WA27 Telecommunications I

Contributed Session

Chair: Bruce C. Hartman, Univ. of AZ, MIS Dept., 430 McClelland Hall, Tucson, AZ 85721, bhartman@bpa.arizona.edu

**1) Resource Allocation for Mobile Computing Networks, Bruce C. Hartman**, Univ. of AZ, MIS Dept., 430 McClelland Hall, Tucson, AZ 85721, bhartman@bpa.arizona.edu, **Anindya Datta**

A mobile computing network has servers in a fixed network and mobile users which may attach at several servers for transactions during a time period. We present an MIP model to allocate resources (data files), mobile clients and mobile bandwidth, a decomposition method for solving it and computational results.

**2) Optimization Models for Transition to ATM-Based LANS, Varadharajan Sridhar**, OH Univ., 197 RTVC, 9 S College St., Athens, OH 45701-2979, sridhar@ouvaxa.cats.ohiou.edu, **Hans Kruse**

Business organizations are changing their existing LANs to ATM-based architecture to support evolving bandwidth intensive applications. Existing products such as routers and hubs have to be migrated. We present mathematical models to determine the optimal transition architecture that minimizes the total investment cost over a given planning period.

**3) Web Analysis of the Telephone Service Providers' Internet Strategies, Drew C. Hwang**, CA Polytech. Univ., CIS Dept., 3801 W Temple Ave., Pomona, CA 91768, dhwang@csupomona.edu, **Steven R. Powell**

It has become apparent that the internet may be a significant competitor to the public switched telephone network for the communication of multimedia information. By analyzing the content of their Web sites, we investigate how the telephone service providers are positioning themselves for this competition.

**4) Web-Site Development Life Cycle, Arthur A. Rasher**, Univ. of Tulsa, 600 S College Ave., Tulsa, OK 74104-3189, mis\_aarthur@utulsa.edu, **Sean P. Alexander**

The development of an internet web-site follows its own development life cycle. We compare and contrast the WDLC with the system development life cycle. The WDLC is then fully explored through a case study of the development of an award-winning site.

#### WA28 Health Applications II

Contributed Session

Chair: M. O. Oloumi, Science Application Intl. Corp., 10260 Campus Point Dr., MS D6, San Diego, CA 92121, oloumi@hctg.saic.com

**1) Health Care Information Management Architecture, M. O. Oloumi**, Science Application Intl. Corp., 10260 Campus Point Dr., MS D6, San Diego, CA 92121, oloumi@hctg.saic.com, **Fred Raafat**

We present an architecture of a health care information management system. This information is to help researchers and scientists in the field of OR and management in pursuing research works related to health care information management to enhance quality of care and to reduce patient care cost.

**2) Artificial Intelligence & Its Applications in Medicine, Aviad Armoni**, 19 Yehuda Hanasy St, Tel-Aviv, 69206, Israel, armonia@post.tau.ac.il

We present a general review of the main areas of AI and its applications to the medical domain. The review will focus on AI applications to radiology, robotically-operated surgical procedures, speech recognition, computerized vision, neural networks and different kinds of medical expert systems.

#### WA29 Military Applications I

Contributed Session

Chair: Robert L. Armacost, Univ. of Central FL, Dept. of IE & Mgmt. Systems, Orlando, FL 32816, armacost@pegasus.cc.ucf.edu

**1) Scheduling Training Scenarios at the Close Combat Tactical Trainer, Robert L. Armacost**, Univ. of Central FL, Dept. of IE & Mgmt. Systems, Orlando, FL 32816, armacost@pegasus.cc.ucf.edu, **Ray Pettit**

We present a heuristic method for scheduling training scenarios for multiple units in the CCTT. The method accounts for available simulators, control center

and SAF as well as training levels.

2) **Markov Process Models of Combat**, *K. R. McNaught*, Cranfield Univ., Appl. Math. & OR Dept., RMCS Shrivenham, Swindon, SN6 8LA, UK

We review the application of Markov processes to combat modeling and present some new models based on the author's own work. Tactical duels of various sizes up to 3 on 2 are presented.

3) **Design & Solution to Fire Allocation Problems in Combat Analysis**, *Yoon Gee Hong*, Hansung Univ., Dept. of IE, 389-2 Ka, Sansum-Dong, Sungbuk-Ku, Seoul, 136-792, Korea

An analytic problem-solving method for 3 proposed fire allocation strategies is developed. The well known theories in stochastic combat were applied and the results of the study may provide important preliminary information on the combat networking issue. Some current features of the combat networking problem will be briefly introduced.

4) **The Installation Decision Support Model**, *Thomas O'Hara*, US Military Acad., Dept. of Systems Eng., West Point, NY 10996, *Elizabeth A. Lind*

The IDSM is an automated installation level budgeting priority tool for use by US Army installation and garrison commanders in allocating infrastructure funds using Installation Status Report data and commander's priorities.

### WA30 Decision Analysis at the Center for Army Analysis

Sponsor: INFORMS Military Applications Society

Sponsored Session

Chair: Daniel T. Maxwell, US Army Concepts Analysis Agency, 8210 Woodmont Ave., Bethesda, MD 20814-2797, maxwell@caa.army.mil

1) **What is the Value of Destroying a Target? An Application of Decision Analysis in Support of the Deep Attack Weapons Mix Study**, *Daniel T. Maxwell*, US Army Concepts Analysis Agency, 8210 Woodmont Ave., Bethesda, MD 20814-2797, maxwell@caa.army.mil

Military commanders engaged in combat care about destroying targets for many reasons. Specific sets of targets may be important to protect military forces and noncombatants. Some targets enable achievement of the CINC's operational objectives, as well as the strategic and political objectives. Many targets support multiple objectives. We describe the process and mathematics that were used to identify these objectives...

2) **Simulating the Battle of the Ardennes: Simulation in Support of Historic Analysis**, *Walter J. Baumann*, US Army Concepts Analysis Agency, 8210 Woodmont Ave., Bethesda, MD 20814-2797, bauman@caa.army.mil

The Ardennes Campaign Simulation study was performed to improve the credibility of the Stochastic Concepts Evaluation Model, STOCEM, simulation by comparing a STOCEM simulation of the WWII Ardennes campaign of 1944-45 with historical results. Simulation results are compared with historical results. Stochastic variability of average model outcomes are quantified in terms of confidence limits and bounds...

3) **Automated Planning & Decision Support to 3rd US Army: A Progress Report**, *William Forrest Crain*, US Army Concepts Analysis Agency, 8210 Woodmont Ave., Bethesda, MD 20814-2797, crain@caa.army.mil

The US Army concepts Analysis Agency has developed a warfighting analytical support team which has demonstrated the capability to provide a deployable, responsive, real time warfighting campaign analysis to the theatre level commander in the field. This significant accomplishment is the result of combining several advancements in OR techniques, DA methods, state-of-the-art hardware and software development packages...

### WA31 PANEL: Special Operations - Theory, Applications & Future Needs

Sponsor: INFORMS Military Applications Society

Sponsored Session

Chair: Mac McCausland, USAF SOS/EDO, 357 Tully St., Hurlburt, FL 32544-5800, shmccau@hqafsoc.afsoc.af.mil

1) **PANEL: Special Operations - Theory, Applications & Future Needs**, *Bill McRaven*, USAF SOS/EDO, wmcraven@hqafsoc.afsoc.af.mil, *Dave Loar*, USAF SOS/EDO, *Teresa Dicks*, USAF SOS/EDO, *Mac McCausland*, USAF SOS/EDO

This panel will present the US Air Force view of special operations. Several

panelists have recently returned from Eastern Europe and will discuss their experiences in this challenging environment. They will also discuss the special operations theory, special operations (current) in third world countries and logistics support to special operations forces. The panel will conclude by presenting some current and future needs of special operations forces.

### WA32 Emerging Technologies

Cluster: Telecommunications

Invited Session

Chair: Deb Ghosh, LA State Univ., 3174 CEBA, Dept. of IS & Dec. Sci., Baton Rouge, LA 70803, qmghos@lsuvm.sncc.lsu.edu

1) **Impact of Information Technology on Collaborative Learning in Distance Education**, *Ramu Kannan*, Coppin State Coll., 2500 W North Ave., Baltimore, MD 21216, rkannan@coe.coppin.umd.edu

Many universities are investing huge amounts in distance education technology. Education in America is undergoing a paradigmatic shift from the traditional teacher-oriented education theories to the more student-oriented constructivist and collaborative learning theories. We examine how synchronous and asynchronous ITs can be used to increase effectiveness.

2) **Group Enabled Reengineering Workbench**, *Kenneth R. Walsh*, LA State Univ., Dept. of ISDS, 3186 CEBA Bldg., Baton Rouge, LA 70803, kwalsh@unix1.sncc.lsu.edu

Reengineering is difficult. Creating models of business processes helps but modeling is time consuming and often creates models that are difficult to understand by people who are not modeling experts. With computer support, groups of end users can work together to develop models directly and collaboratively, mitigating these problems.

3) **An Accounting Perspective of the Effect of Telecommunication on a Disposable Work Force**, *Raymond A. Patterson*, Univ. of TX, Sch. of Mgmt., PO Box 830688, MS J043, Richardson, TX 75083-0688, rpatters@utdallas.edu, *Mark C. Anderson*

Telecommunications allows an employer to outsource service functions into a competitive employment market of contract laborers and small firms. Economic theory suggests that contracting through the firm is less expensive but accounting rules that impose an age penalty on the employees may encourage outsourcing and independent contracting.

### WA33 Reliability I

Contributed Session

Chair: David W. Jacobson, IBM Corp., Dept. HQZ, Bldg. 040-3, 3605 Highway 52 N, Rochester, MN 55901-4114, jake@archvmx.vnet.ibm.com

1) **Simultaneous Reliability & Redundancy Allocation Using Simplex Search Method**, *David W. Jacobson*, IBM Corp., Dept. HQZ, Bldg. 040-3, 3605 Hwy 52 N, Rochester, MN 55901-4114, jake@archvmx.vnet.ibm.com, *Sant Ram Arora*

The existing work in reliability apportionment and redundancy allocation is extended by considering a solution technique to a problem which requires finding the optimal level of subsystem reliability as well as an integer solution for the number of redundant subsystems. The solution technique combines simplex search and a heuristic approach.

2) **Optimal Allocation of Spares to Subsystems Connected in Series**, *V. Rajendra Prasad*, TX A&M Univ., Dept. of IE, College Station, TX 77843, rajendra@ie-gate.tamu.edu, *Oh Kim, Way Kuo*

A fixed number of spares are to be allocated to k subsystems connected in series so as to maximize the system reliability. Spares have random lifetime distributions and each subsystem uses the allocated spares one after another. Exact and heuristic methods are developed.

3) **Shotgun**, *Laurence L. George*, Triad Systems Corp., 3055 Triad Dr., Livermore, CA 94550-9559

Should you test before replacement? Which test(s) should you do in which order? How long? Which part should you replace if no indication? If indication is imperfect? Should you verify the fix? How long? Should you remove a part if it didn't fix the problem? Answers depend on age-specific parts reliability.

4) **Policy Issues Under Combination Warranties**, *Hakan Polatoglu*, Suffolk Univ., Sawyer Sch. of Mgmt., 8 Ashburton Pl., Boston, MA 02108, hpolatog@acad.suffolk.edu, *Izzet Sahin*

We will examine policy issues under a fully-renewing, free-replacement/pro-rata combination warranty. In particular, we will introduce various performance measures, including the risk-of-loss and risk-of-warranty and demonstrate the

impacts of policy parameters on these measures.

### Wednesday 10:00-11:30

#### WB04 AIDS Modeling III

Cluster: Public Sector Applications

Sponsor: INFORMS Section on Public Programs & Processes  
Invited/Sponsor Session

Chair: Margaret L. Brandeau, Stanford Univ., IE/EM Dept.,  
Stanford, CA 94305-4024, brandeau@leland.stanford.edu

1) **Public Health Impact & Cost Effectiveness of HIV Interventions: A Research Agenda**, *Margaret L. Brandeau*, Stanford Univ., IE/EM Dept., Stanford, CA 94305-4024, brandeau@leland.stanford.edu

We present a research agenda for assessing the public health impact and cost-effectiveness of HIV interventions and discuss ongoing research on OR-based AIDS modeling as it fits into that agenda.

2) **Some Recent Work in Modeling Contact Structures in Stochastic Models of the HIV/AIDS Epidemic in Heterogeneous Populations**, *Charles J. Mode*, Drexel Univ., Dept. of Math. & Comp. Sci., Philadelphia, PA 19104, cmode@mcs.drexel.edu, *Candace K. Sleeman*

A basic problem in constructing models of the HIV/AIDS epidemic is that of formulating sexual contact structures in heterogeneous populations. Several authors have considered such problems, primarily within deterministic paradigms. Sexual contact structures will be formulated entirely within a stochastic framework. Results of some computer experiments will be given to illustrate the concepts.

3) **HIV Control Strategies: Vaccination & Cross-Immunity**, *Travis C. Porco*, Univ. of CA, Ctr. for AIDS Prevention, 74 New Montgomery St. Ste. 510, San Francisco, CA 94105, porco@psg.ucsf.edu, porco@stat.berkeley.edu

Triple-drug therapy regimens for HIV-disease may improve the prognosis for many patients. We present a mathematical model of the generation and transmission of drug-resistant HIV strains, focusing on 2 questions: what fraction of incident infections would result from drug-resistant strains over time? How may improvement of treatment compliance affect this?

#### WB05 PANEL: Future Impact of Information Technology in the Hospitality Industry

Sponsor: INFORMS Social Science Applications Section  
Sponsored Session

Chair: Myron Hatcher, CA State Univ., Info. Systems & Dec. Sci., Craig Sch. of Bus., Fresno, CA 93740-0007, myron\_hatcher@csufresno.edu

1) **PANEL: Future Impact of Information Technology in the Hospitality Industry**, *Myron Hatcher*, CA State Univ., myron\_hatcher@csufresno.edu, *Jerry L. Jones*, CA State Univ.

Change in the hospital industry will be discussed. The impact of IT and international markets will be the focus. Where are we going?

#### WB06 Interior Point Methods in Global Optimization

Cluster: Global Optimization  
Invited Session

Chair: Theodore B. Trafalis, Univ. of OK, Sch. of IE, 202 W Boyd, Rm. 124, Norman, OK 73019, trafalis@mailhost.ecn.uoknor.edu

1) **Stochastic Logarithmic Barrier Functions & Application to Neural Network Training**, *Theodore B. Trafalis*, Univ. of OK, Sch. of IE, 202 W Boyd, Rm. 124, Norman, OK 73019, trafalis@mailhost.ecn.uoknor.edu

We propose a stochastic logarithmic barrier method for training feedforward neural networks. Specifically, we consider neural network training as a constrained global optimization problem by putting constraints on the weight. Supervised and unsupervised neural network training and connections with interior point methods are discussed.

2) **A Hybrid Affine Scaling Scatter Search Approach for Continuous Global Optimization**, *Ibrahim M. Al-Harkan*, Univ. of OK, Sch. of IE, 202 W Boyd, Rm. 124, Norman, OK 73019, *Theodore B. Trafalis*, *Suat Kasap*

We propose a hybrid affine scaling tabu and scatter approach for constrained global optimization. This approach combines the characteristics of affine scaling

methods and the following metaheuristics: scatter search, GAs and TS. Computational results are also reported.

#### WB07 Quality

Contributed Session

Chair: Philippe Chevalier, Univ. Catholique de Louvain, Place des Doyens 1, Louvain-La-Neuve, 1348, Belgium, chevalier@qant.ucl.ac.be

1) **Quality Improvements through Inspection**, *Philippe Chevalier*, Univ. Catholique de Louvain, Place des Doyens 1, Louvain-La-Neuve, 1348, Belgium, chevalier@qant.ucl.ac.be

An important aspect of quality management is to inspect WIP after each operation. We present a new model of the effect of inspection on quality improvement in a production line. The inspection policy derived from this model gives a good insight on how learning influences the economic decision to inspect or not.

2) **A Conceptually Simple Statistical Basis for SPC**, *Michael J. Wood*, Univ. of Portsmouth, Portsmouth Bus. Sch., Locksway Rd., Milton, Southsea, Hants, PO4 8JF, UK, woodm@pbs.port.ac.uk

We describe some "user friendly" statistical concepts, techniques and terminology for statistical process control. These are designed to be conceptually simpler and in some cases, more powerful and robust, than the conventional methods. They include a resampling approach to estimating action and warning limits for control charts.

3) **Stock Market Reaction to Baldrige Award Announcements: Does Quality Pay?**, *Zbigniew H. Przasnyski*, Loyola Marymount Univ., 7900 Loyola Blvd., Los Angeles, CA 90045, zprzasny@lmumail.lmu.edu, *Lawrence S. Tai*

We examine the stock performance of Malcolm Baldrige Award recipients. Analyses used include an event study to determine the reaction of the stock market to the announcement and calculation of annualized returns after controlling for market and industry factors.

#### WB08 Business Process Reengineering I

Contributed Session

Chair: Germaine H. Saad, Widener Univ., One University Pl., Chester, PA 19013

1) **Reengineering: Rules & Results**, *Germaine H. Saad*, Widener Univ., One University Pl., Chester, PA 19013

Key decision rules are developed for conducting business process reengineering. Empirical evidence from different industries is used as a source for this development. When and how each rule should be implemented will be discussed along with application examples from practice.

2) **Business Process Integration: The Essence of BPR**, *Ari Vepsalainen*, Helsinki Sch. of Econ., Runeberginkatu 22-24, Helsinki, 00100, Finland, vepsalai@hk.fi, *Jukka Kallio*, *Timo O. Saarinen*

We present the means for realizing the radical improvements in BPR efforts. They usually require the integration of transactions in value chains or value systems. Media of integration of varying scope are introduced and illustrated by case examples.

3) **A Model of Efficient BPR Strategies**, *Timo O. Saarinen*, Helsinki Sch. of Economics, Runeberginkatu 14-16, Helsinki, 00100, Finland, saarinen@hk.fi, *Jukka Kallio*, *Saku Salo*

Efficient ways of implementing different types of BPR initiatives are developed. The model shows that internal inefficiency yields to streamlining existing business processes, while changes in customer requirements may result in divergent processes for each segment. Radical changes in external environments usually urge the restructuring of the whole business...

4) **Designing Workflow Coordination: Centralized vs. Market-Based Mechanism**, *Jui C. Tan*, Univ. of PA, Dept. of Systems Eng., 220 S 33rd St., Rm. 279, Philadelphia, PA 19104, juichiew@seas.upenn.edu, *Patrick T. Harker*

Research in market-based distributed scheduling methods rarely address the question of when such an approach is appropriate. Using a model of workflow coordination, we derive analytical guides as to when this approach should be implemented and show how changes in systems characteristics would impact market-based system design choices.

#### WB09 Machine Scheduling V

Contributed Session

Chair: Jay B. Ghosh, Bilkent Univ., Fac. of Bus. Admin., Bilkent, Ankara, 06533, Turkey, ghosh@bilkent.edu.tr

**1) Scheduling a Batch Processing Machine to Minimize Total Completion Time, Jay B. Ghosh,** Bilkent Univ., Fac. of Bus. Admin., Bilkent, Ankara, 06533, Turkey, ghosh@bilkent.edu.tr

We address the problem of scheduling a batch processing machine with a view to minimizing the total completion time. The problem is of open complexity and has no efficient solution algorithm. We propose a Lagrangian heuristic.

**2) A Branch & Bound Algorithm to Minimize the Total Weighted Flowtime for m-Machine Flowshop Problems, Chia-Shin Chung,** Cleveland State Univ., Dept. of Op. Mgmt./Bus. Stats., Cleveland, OH 44115, **Omer Kirca**

We develop a B&B algorithm to solve an m-machine flowshop problem. The objective is to minimize the total weighted flowtime. Machine-based lower bounds and a dominance criterion are incorporated to improve the efficiency of the algorithm. Computational experiments show that the algorithms handle the test problems very well.

**3) Multiple Machine Scheduling to Minimize Total Weighted & Unweighted Tardiness, T. Jaideep Naidu,** Univ. of MS, Dept. of Mgmt. & Mktg., University, MS 38677, mknaiduWvm.cc.olemiss.edu, **Bahram Alidaee, Ed L. Gillenwater**

We address multiple-machine scheduling with the objective of minimizing total weighted and unweighted tardiness. New rules based on the noising method and the space smoothing method will be presented. These rules will be computationally compared with the GA and a variety of simple rules including the AU covert class of rules.

**WB10 Multicriteria Decision Making II**  
Contributed Session

**Chair:** N. K. Kwak, St. Louis Univ., 3674 Lindell Blvd., St. Louis, MO 63108

**1) A Multicriteria Decision-Making Approach to University Resource Allocations, Changwon Lee,** St. Louis Univ., 3674 Lindell Blvd., St. Louis, MO 63108, leec2@sluvca.slu.edu, **N. K. Kwak**

We present an application of 0-1 goal programming as an aid for resource allocations for information infrastructure planning in a university. The GP model is developed and analyzed to address the dramatic growth in IT use and network planning. The GP model application adds insight to the university's planning functions.

**2) Power Relations, Fairness & Equity, Freerk A. Lootsma,** Delft Univ. of Tech., Fac. of Tech. Math & Info., Mekelweg 4, Delft, 2628 CD, The Netherlands, f.a.lootsma@twi.tudelft.nl

Proportionality is a widely used principle of fairness and equity. Hence, we use several concepts of the multiplicative AHP to propose a fair allocation of benefits and costs in a distribution problem. By truncating the desired cost-benefit ratios, we avoid that powerful parties totally overrule the weaker ones.

**3) Computer-Aided Performance Evaluation: A Group Decision Support System, Majid Tavana,** La Salle Univ., Mgmt. Dept., Philadelphia, PA 19141, tavana@lasalle.edu, **Dennis Kennedy, Jack Rappaport**

We present a multicriteria performance evaluation system, CAPE. CAPE is a GDSS that utilizes the AHP, quadratic scaling and retranslation for performance evaluation. An actual case study is used to describe the model.

**WB12 OR Applications on the Internet & Using Java**

**Sponsor:** INFORMS CSTS

**Sponsored Session**

**Chair:** Gordon H. Bradley, Naval Postgrad. Sch., OR Dept., Monterey, CA 93943, bradley@nps.navy.mil

**1) Baseball Playoff Eliminations with "Wildcard" Teams, Ilan Adler,** Univ. of CA, Dept. of IE/OR, Berkeley, CA 94720, **Dorit S. Hochbaum, Alan Erera, Eli V. Olinick**

We address the playoff elimination and clinching problem for leagues with divisions and "wildcard" teams. Using LP, IP and parametric maximum flow formulations, we determine minimum team performance to remain in playoff races. An internet Web site using these procedures to solve interactive "what-if" scenarios is described.

**2) Mining on the Web & Other Optimization Applets, Dorit S. Hochbaum,** Univ. of CA, Dept. of IE/OR, Haas Sch. of Bus., Berkeley, CA 94720-1777, dorit@hochbaum.berkeley.edu

The open-pit mining problem is to determine the mine pit to excavate in order to maximize the net benefits of the operation. The basic trade-offs involved are described in a WWW site with a Java applet in 2D. The user-devised "mine" is

solved on-line and the optimal pit is presented.

**3) Course Allocation, Classroom Scheduling & Lecture Timetabling Algorithms Implemented in Java, Cosimo Spera,** Univ. of CA, Dept. of IE/OR, Berkeley, CA 94720, **Marco Gliardi**

Course allocation, classroom scheduling and lecture timetabling are 3 interrelated combinatorial problems faced by academic institutions at the beginning of every term. Average size formulations for these problems involve more than 200 integer variables. We address several issues concerning implementations that motivate the choice of Java. A comparative study with the equivalent C++ code is also reported.

**WB14 Forecasting**

**Contributed Session**

**Chair:** Zahid Y. Khairullah, St. Bonaventure Univ., Sch. of Bus., St. Bonaventure, NY 14778, zyk@sbu.edu

**1) Predicting the Size of a Freshman Class at a College, Zahid Y. Khairullah,** St. Bonaventure Univ., Sch. of Bus., St. Bonaventure, NY 14778, zyk@sbu.edu

We discuss approaches used in a case study attempting to predict the size of an incoming freshman class at a relatively small private educational institution. Problems encountered in developing a model and outcomes are described.

**2) An Intelligent Forecasting System for Strategic Business Planning, Xiang Li,** Nanyang Tech. Univ., 71 Nanyang Dr., Singapore, 638075, Singapore, gxli@ntuvax.ntu.ac.sg, **Cheng Leong Ang, Robert Gay**

We propose a new methodology for business forecasting applications. We describe a fuzzy rule-based neural network which can be used to perform historical data simulation, scenario generation and future trend prediction. A software tool, Intelligent Forecasting System, has been developed based on the proposed methodology.

**3) Contextual Information & Feedback Effects on Judgmental Forecasts, Dilek Onkal-Atay,** Bilkent Univ., Faculty of Bus. Admin., Ankara, 06533, Turkey, onkal@bilkent.edu.tr, **Serra Dirimtekin**

We examine the differences in forecasting accuracy that may stem from the differential contextual information and feedback type. Participants were assigned to groups based on the availability of contextual information and feedback. The task required participants to provide probabilistic forecasts for stock prices in 3 sessions.

**4) Inventory Management & Forecasting for Grocery Stores, Nathan Surrey,** US Military Acad., PO Box 3053, West Point, NY 10997, x85796a3@cadet2.usma.edu

Inventory management and prediction of future sales are the most important aspects of managing a grocery store. I attempt to minimize annual inventory costs and forecast future sales for 1 product over the first quarter of a fiscal year. The design accomplishes these tasks by evaluating several different forecasting and inventory models; therefore, choosing the best alternative policy.

**WB16 Management of Technology I**

**Contributed Session**

**Chair:** Herman P. Hoplin, Syracuse Univ., Sch. of Mgmt., Syracuse, NY 13244-2130, hphoplin@mailbox.syr.edu

**1) Managing IS Challenges Resulting from Emerging Technologies in the Next Millennium, Herman P. Hoplin,** Syracuse Univ., Sch. of Mgmt., Syracuse, NY 13244-2130, hphoplin@mailbox.syr.edu

Futurists predict that managing services will soon be completely transformed by IT. This presentation is structured around conducting research and future planning for the difficult task of managing challenges caused by emerging technologies. Items coming into focus include managing automation, innovations and the impacts of IT/IS on the organization.

**2) Competing on Convergence: Malaysia's Multimedia Super Corridor & the Transformation Towards the New Digital Economy, Chun K. Han,** Univ. Pertanian Malaysia, Fac. of Econ. & Mgmt., Serdang, Selangor, 43400, Malaysia, hckwong@econ.upm.edu.my

To achieve an industrialized national status by 2020, a new center for multimedia products and services will act as a springboard for world markets. A framework with a macro component comprising economic, legal, technological and social elements and an organizational transformation component is used to assess the conditions for success.

**3) Identifying Core Competences with Technological Portfolios,**

**Dominique Jolly**, Groupe ESC Grenoble, 12 rue Pierre-Semard, BP 127, Grenoble, 38003, France, jolly@esc-grenoble.fr

We show how the traditional technology portfolios may be revisited through the resource-based lens. As such they appear as a management tool for identifying those assets that will create and stretch market room, as well as a help for allocating resources to the development of core competences.

**4) Modern Manufacturing Technology Implementation, Ali R. Behnezhad**, CA State Univ., Dept. of MS, Northridge, CA 91330-8245, abehnezhad@csun.edu

Structural, human and technical issues concerning the implementation of automated manufacturing systems will be discussed. We investigate the critical factors necessary to ensure a successful transition to the new systems. Information on the degree of utilization of advanced manufacturing technologies in the US will be provided.

#### **WB18 TUTORIAL: Structural Equation Modeling Using LISREL**

**Invited Session**

**Chair:** George Marcoulides, CA State Univ., Dept. of MS/IS, Fullerton, CA 92364-9480

**1) TUTORIAL: Structural Equation Modeling Using LISREL, George Marcoulides**, CA State Univ., Dept. of MS/IS, Fullerton, CA 92364-9480

SEM is concerned with testing complex models for the structure of functional relationships between observed and latent variables. The functional relationships are described by parameters indicating the magnitude of the effect that independent variables have on dependent variables. As implemented in most computer packages, SEM includes as special cases, confirmatory factor analysis, multiple regression, path analysis, etc...

#### **WB19 TUTORIAL: Linguistic Geometry - Problems & Solutions**

**Contributed Session**

**Chair:** Boris Stilman, Univ. of CO, Dept. of Comp. Sci. & Eng., CB 109, Denver, CO 80217-3364

**1) TUTORIAL: Linguistic Geometry - Problems & Solutions, Boris Stilman**, Univ. of CO, Dept. of Comp. Sci. & Eng., CB 109, Denver, CO 80217-3364

To discover the inner properties of human expert heuristics which were successful in a certain class of complex systems, we develop a new approach, LG. This research includes the development of syntactic tools for knowledge representation and reasoning about large-scale hierarchical complex systems. The purpose of LG is to provide solutions to a variety of problems with huge state spaces...

#### **WB20 Demand Modeling & Activity Analysis in Transportation I**

**Sponsor:** INFORMS Transportation Science Section  
**Sponsored Session**

**Chair:** Michael G. McNally, Univ. of CA, Dept. of Civil & Env. Eng., Irvine, CA 92697

**1) A Model System for Stop Generation & Tour Formation for the Analysis of Travel/Activity Behavior, Chieh-Hua Wen**, Northwestern Univ., Civil Eng. & Transport. Ctr., Evanston, IL 60208, Frank S. Koppelman

Activity-based travel analyses have received more attention in recent years because they analyze travel from a broad perspective that takes into account the demand for activity participation, interrelationships among trips and interactions among household members. We propose a conceptual structure for the generation of travel/activity patterns defined in terms of stops and tours...

**2) A Model System for a Daily Activity Pattern Choice Behavior Based on Utility Theory, Satoshi Fujii**, Kyoto Univ., Dept. of Civil Eng., Sakyo-ky, Kyoto, 606-01, Japan

An individual's daily activity pattern, specified by activity locations, durations and sequence, is modeled based on utility theory. An individual is assumed to maximize his utility in a staged way. At first, he composes activity patterns choice set and allocates time to each activity, then chooses an activity pattern of which utility is the maximum...

**3) An Activity-Based Approach to Accessibility, Michael G. McNally**, Univ. of CA, Dept. of Civil & Env. Eng., Irvine, CA 92697, Chienho Chen, W. W. Recker

Initial formulation of an activity-based model structure is presented which

incorporates a microscopic measure of accessibility allowing for the evaluation of temporal transference effects in travel behavior. A network-based model, an extension of the pickup and delivery problem with time windows, incorporates household activity assignment, scheduling, model allocations and routing in a hybrid model...

**4) Forecasting the Effects of Advanced Electronic Home Shopping on Activities & Travel, Thomas F. Golob**, Univ. of CA, Inst. of Transport Studies, Irvine, CA 92697, Jane Gould

Activity patterns and travel are likely to change in response to advances in multi-media telecommunications that allow people to shop and perform personal business from their own homes. We explore activity-based travel demand concepts and methods which can be used to forecast interactions between telecommunications and travel.

#### **WB21 Artificial Intelligence II**

**Contributed Session**

**Chair:** Giacomo Patrizi, Univ. "La Sapienza", Dept. of Stats., Piazza Aldo Moro 5, Rome, 00185, Italy, patrizi@cam07a.sta.uniroma1.it

**1) A General Pattern Recognition Algorithm for Objects with Complex Combinatorial Structures, Luciano Nieddu**, Univ. "La Sapienza", Dept. of Stats., Piazza Aldo Moro 5, Rome, 00185, Italy, nieddu@kea.caspuir.it, Giacomo Patrizi

The recognition of objects by pattern recognition techniques can be effected by (non)linear optimization methods with excellent results. A GA to handle complex combinatorial conditions on the object set is given by transforming the resulting combinatorial problem into an equivalent continuous one. Computational results will be given and compared to other methods.

**2) Modeling the Dynamics of the Multiple-Choice Genetic Algorithm, James C. Bean**, Univ. of MI, 1205 Beal St., Ann Arbor, MI 48109-2117, james.bean@umich.edu

We present a probabilistic model of the dynamics of a particular GA. The model gives the distribution of the fitness of a typical chromosome and of the best chromosome for any given generation. Actual GAs are run to compare with the model prediction.

**3) Natural Language Motion Instruction Interpretation by Computer, Maria Pegou**, Athens Univ. of Econ. & Bus., 14 Matrosou, Megara, 19 100, Greece, mip@aueb.gr, John J. Kontos

When the management of employees' activities in using a tool needs to be optimized, a graphical presentation of alternative actions with natural language instructions is less costly. We propose a tool consisting of a natural language interface and an animation system, controlled by it. We studied motion verbs found in the Greek dictionary and corresponding English translations for expressing instructions addressed to employees.

**4) Vickrey-Based Auctions for Coordination in Multi-Agent-Systems, Peter Gomber**, Univ. of Giessen, Licher Strasse 70, Giessen, 35394, Germany, peter.gomber@wirtschaft.uni-giessen.de, Claudia Schmidt, Christof Weinhart

Coordination turns out to be the crucial issue concerning the quality of solution generated by multi-agent-systems. Different market-like coordination mechanisms are introduced and investigated due to their ability to assure an efficient allocation of jobs in business planning, especially transportation. Adequate mechanisms result from the Vickrey-auction as a common basis.

#### **WB22 Yield Management**

**Sponsor:** INFORMS Section on Manufacturing & Service Operations  
**Management**

**Sponsored Session**

**Chair:** Sriram Dasu, Univ. of Southern CA, Sch. of Bus. Admin., Los Angeles, CA 90089-1421, dsasu@sba.usc.edu

**1) Flexible Contracts in Manufacturing, R. Ahmadi**, UCLA, Anderson Grad. Sch. of Mgmt., Los Angeles, CA 90024-1481, rahmadi@agsm.ucla.edu

We study the structure of contracts that reserve production capacity for buyers. The contract specifies the capacity allocated to the buyer and the price. The buyer has the right to use all the capacity promised but is not required to use all of it. The study is motivated by the semi-conductor industry.

**2) No Title Supplied, Arvind Malhotra**, Univ. of Southern CA, Sch. of Bus., Los Angeles, CA 90089, Sampath Rajagopalan

Revenue management is being adopted in a number of industries. We report on the major issues in implementing revenue management at a large firm in the leisure industry. We discuss the use and value of a simulator for evaluating different policies and developing a module for forecasting reservations,

no-shows, etc.

**3) International Services Benchmarking Study: Preliminary Findings, Richard Chase**, Univ. of Southern CA, Sch. of Bus., Los Angeles, CA 90089-1421, rchase@sba.usc.edu, **Elizabeth L. Rose, Aleda V. Roth, Chris Voss**

We present preliminary findings from a benchmarking survey of 300 companies in a variety of service industries and service arms of manufacturing companies in the US and UK. The survey instrument is modeled after the European Quality Award and the Chase & Hayes 4-stage model of service competitiveness and focuses on how different practices in service management affect service performance.

**WB24 Applications of Decision Analysis in Capital Investment Planning**

**Sponsor:** INFORMS Decision Analysis Society  
**Sponsored Session**

**Chair:** Gregory L. Hamm, Applied Decision Analysis, Inc., 2710 Sand Hill Road, Menlo Park, CA 94025, ghamm@adainc.com

**1) A Service Facility Upgrade/Replace Decision, Gregory L. Hamm**, Applied Decision Analysis, Inc., 2710 Sand Hill Rd, Menlo Park, CA 94025, ghamm@adainc.com

Applications of DA in resource planning at utilities share a number of features that are common across utility applications. Based on experience with the application of DA at water, waste water and electric utilities, these unique features will be discussed.

**2) Capacity Planning for a Municipal Water Department, Randy Goss**, Austin Water & Wastewater Utility, PO Box 1088, Austin, TX 78767, **Scott Ahlstrom**

The Austin Water and Wastewater Utility needed to determine the future disposition of an aging water treatment plant. It also needed a plan for meeting significant water demand growth. DA aided the evaluation of alternatives and selection of a preferred strategy, but some difficulties in applying the technique were experienced.

**WB25 TUTORIAL: Team Learning II**

**Sponsor:** INFORMS Forum on Education  
**Sponsored Session**

**Chair:** J. L. Madrigal, Brigham Young Univ., Dept. of Stats., 222 TMCB, Provo, UT 84602-2675, madrigal@byu.edu

**Co-Chair:** Terry N. Lee

**1) TUTORIAL: Team Learning II, J. L. Madrigal**, Brigham Young Univ., Dept. of Stats., 222 TMCB, Provo, UT 84602-2675, madrigal@byu.edu, **Judith S. Liebman**

The team learning approach emphasizes teamwork and learning by doing and was developed to promote active learning. Its application involves a 6-step instructional sequence conducive to the development of higher cognitive skills. Participants will have the opportunity to experience first hand the application of this approach. Examples of activities and reading quizzes will be given...

**WB27 Telecommunications II**

**Contributed Session**

**Chair:** Jason E. Whitley, SMU, CSE Dept., PO Box 750122, Dallas, TX 75275-0122, whitley@seas.smu.edu

**1) The Allocation of Working & Spare Capacities Along a Telecommunications Network, Mona Abou-Sayed**, SMU, 3912 Jefferson Cir., Plano, TX 75023, sayed@seas.smu.edu

We describe 3 different models for allocating spare capacities in a telecommunications network: the working capacity model, the spare capacity model and the combined model. Empirical results are presented using several sample networks to compare the allocations of the individual models (working and spare) to the combined model allocation.

**2) Using Decomposition Approaches to Optimize Telecommunications Network Spare Capacity, Jason E. Whitley**, SMU, CSE Dept., PO Box 750122, Dallas, TX 75275-0122, whitley@seas.smu.edu, **Jeffery L. Kennington**

Telecommunications network survivability is achieved by building in spare capacity. Decomposition techniques, such as Bender's, show great promise for solving the minimum spare capacity problem. Algorithms using decomposition approaches that exploit the underlying network structure of the problem will be presented. Implementation considerations and empirical results will also be discussed.

**3) The Bounded Cycle Cover Problem, Eli V. Olinick**, Univ. of

CA, Dept. of IE/OR, 1615 Virginia St., Berkeley, CA 94703, olinick@cimsim.ieor.berkeley.edu, **Dorit S. Hochbaum**

In the design of telecommunications networks employing self-healing rings, one seeks a minimum cost cycle cover for the links in the network so that no cycle contains more than a given number of nodes. We present complexity results and polynomial-time heuristic algorithms for finding near-optimal solutions.

**4) A System for the Design of Packet-Switched Communication Networks with Economic Tradeoffs, Ali Amiri**, Weber State Univ., Sch. Bus. Admin., Coll. Bus., 3804 University Cir., Ogden, UT 84408-3804, aamiri@cc.weber.edu

We study the problem of designing a packet-switched communication network with tradeoffs between link costs and response time to users. The problem is formulated as a nonlinear integer programming model. An efficient heuristic solution procedure is developed. Computational experiments indicate that the solution procedure is effective for a wide range of traffic loads and cost structures.

**WB28 Health Applications III**

**Contributed Session**

**Chair:** Nathan P. Ritchey, Youngstown State Univ., Dept. of Math. & Stats., Youngstown, OH 44555, nate@math.yzu.edu

**1) Treatment of Early Stage Breast Cancer in the Elderly, Nathan P. Ritchey**, Youngstown State Univ., Dept. of Math. & Stats., Youngstown, OH 44555, nate@math.yzu.edu, **Kimbroe Carter, Frank Castro**

Varied opinions exist among multiple specialties regarding treatment options for early stage breast cancer in the elderly. Three models, Markov, analytic hierarchy and analytic network, were developed to follow a patient through a treatment program. The results show that a combination treatment of radiation and tamoxifen is optimal.

**2) A Dynamic Control Model for Hospital Service, Leonard MacClean**, Univ. of British Columbia, 2053 Main Mall, Vancouver, B.C., V6T 1Z2, Canada, maclean@gandolf.commerce.ubc.ca

We consider a stochastic model for a hospital system with the system dynamic defined by a diffusion. The decisions on admission and discharge generate a modulated renewal process for time between admissions, with the modulation depending on decision parameters. Models for parameter selection which optimize system performance are presented.

**3) Hospital Losses on Medicare Patients: Fact or Myth?, John E. Pickett**, GA Southern Univ., PO Box 8152, Dept. of Mgmt., Statesboro, GA 30460, jpickett@gasou.edu

The idea persists that hospitals are guilty of overcharging Medicare for inpatient treatment. Conversely, it is widely believed that Medicare underfunds inpatient treatment and hospitals overcharge others to compensate. We examine Medicare inpatient reimbursement and derive profiles on profit/loss and inflation on Medicare patients using actual hospital data.

**4) Dimensions of Health Care Quality, Fred N. Silverman**, Pace Univ., 1 Martine Ave., White Plains, NY 10606, fns1@pace.edu, **John C. Carter**

Managed care companies have continual pressure to cut costs, leading to a growing concern for quality. We examine the dimensions of health care quality from the perspectives of the patient, provider, health plan and employer with the goal of arriving at a comprehensive definition to guide measurement.

**WB29 Military Applications II**

**Contributed Session**

**Chair:** Robert S. Renfro, II, Ntl. Air Intelligence Ctr., Engagement Analysis Branch, 4180 Watson Way, WPAFB, OH 45433, rsr44@naic.wpafb.af.mil

**1) An Analysis of Cultural Components of Combat Decision Making, Robert S. Renfro, II**, Ntl. Air Intelligence Ctr., Engagement Analysis Branch, 4180 Watson Way, WPAFB, OH 45433, rsr44@naic.wpafb.af.mil, **Mickey Wilkinson**

When a pilot is confronted in air combat by an adversary with dissimilar capabilities, culture and objectives, he must decide on an irrevocable and dangerous course of action. The friendly pilot's decisions must balance victory against survivability. Further, his actions will be countered by an uncertain, possibly deadly, response.

**2) Modeling & Analysis Utilized in the Theater Medical Information Program, Aaron Dewispelare**, Southwest Research Inst., 2419 Crow Valley, San Antonio, TX 78232, USA, adewispelare@swri.edu

The mission of the TMIP is to provide integrated automation of the theater medical environment. This effort describes the modeling and analysis utilized to organize requirements and provide integrated direction from among more than 100 medical systems resulting in information linking all echelons of medical care to the theater commanders in support of critical time-sensitive decisions...

**3) Virtual Prototyping for Use in Battlefield Analysis, C. Brandon Agbayani**, US Military Academy, Dept. of Systems Eng., West Point, NY 10096-1779, 7260663@cadet2.usma.edu

With the advent of virtual reality, applications involving such technology have become the forerunners for research. Several Army simulation programs are currently in use for training purposes. Some of these incorporate virtual reality. This project focuses on the analytical side of the house, in an effort to effectively implement virtual prototyping into analysis.

**4) Maximizing the Effectiveness of the 21st Century Soldier, Samuel Yim**, US Military Acad., F2 USCC, West Point, NY 10996, x74865f2@cadet1.usma.edu

Maximizing the soldiers' effectiveness through increased survivability, increased firepower, better communication and reduction of loads is essential for the new American soldier. This design focuses on the implementation of the new technology that is available or will be available for the ground warrior.

### WB30 Scenario Analysis Modeling for the Army

Sponsor: INFORMS Military Applications Society

Sponsored Session

Chair: Richard R. Laferrriere, US Army TRADOC Analysis Ctr., ATTN: ATRC-WGA, WSMR, NM 88002-5502, laferrir@trac.wsmr.army.mil

**1) Army Combat Systems Mix Model Methodology, Richard R. Laferrriere**, US Army TRADOC Analysis Ctr., ATTN: ATRC-WGA, WSMR, NM 88002-5502, laferrir@trac.wsmr.army.mil

We have developed a 3-step process to evaluate future weapon systems for the Army. First, a statistical process is used to develop coefficients of capabilities for each system; second, scenario analysis modeling is conducted to optimize the mixes of combat systems under uncertainty and third, decision support is applied for presentation of results.

**2) Statistical Enhancements & Validation of a Mix Model Methodology, Bruce Gafner**, US Army TRADOC Analysis Ctr., ATTN: ATRC-WAB, WSMR, NM 88002, gafnerb@trac.wsmr.army.mil

Scenario analysis, a recent technique for modeling and optimizing decisions under uncertainty, employs linear programming to model multilevel nonlinear stochastic events. The US Army's TRAC-WSMR analysts are presently examining means and methods by which we can enhance scenario analysis and the entire mix model methodology process. Enhancements would allow a much larger percentage of time for analysis...

**3) Dynamic Scenario Analysis, Stephen M. Robinson**, Univ. of WI, Dept. of IE, 1513 University Ave., Madison, WI 53706-1572, smr@cs.wisc.edu

Scenario analysis has had significant applications in military force planning under uncertainty. We describe some modifications and extensions that can help in modeling repeated actions over time, accounting for enemy decisions and estimating system contribution to force effectiveness.

### WB31 PANEL: Markets, Competition & the Support Infrastructure - How's DoD Doing?

Sponsor: INFORMS Military Applications Society

Sponsored Session

Chair: Christopher H. Hanks, RAND, 1700 Main St., PO Box 2138, Santa Monica, CA 90407-2138, hanks@rand.org

**1) PANEL: Markets, Competition & the Support Infrastructure - How's DoD Doing?, Derek Trunkey**, Ctr. for Naval Analyses, David Glass, Logistics Mgmt. Inst., Steve G. Green, HQ USAFA/DFM

The 1990's have seen the emergence of a fundamental new policy in DoD aimed at capturing market efficiencies in the support infrastructure by adopting businesslike practices. The buyer-seller relationships of the DBOF, the expansion of public-private competitions and the ongoing efforts to improve financial reporting all reflect the new policy...

### WB32 Telecommunication Network & Service Planning

Cluster: Telecommunications

Invited Session

Chair: Sumit Dutta Chowdhury, Carnegie Mellon Univ., HbH 237, Pittsburgh, PA 15213

**1) Selection of Local Access Technologies: A Detailed Process, Scott Parrish**, US West Advanced Tech., 4001 Discovery Dr., Boulder, CO 80303, parrish@advtech.uswest.com

We look at a detailed and complex process for selecting local access technologies from the point of view of the service provider. Technology selection is modeled as a business process where you take into account the market demand for services, corporate strategies, corresponding economics of the technologies and the technical constraints imposed by the technology itself.

**2) Modeling New Telecommunications Services Payback, Carl Podlesny**, Scientific Atlanta, Strategic Mktg., Broadband Comm. Group, Norcross, GA, carl\_podlesny@sciatl.com

Estimating the economics of new service introductions is very important to any telecommunications service provider and OEM system developer/equipment manufacturer. We focus on a new modeling approach for analyzing the impact and interactions of the various complex factors that drive the profit or loss of new service introduction using different service distribution strategies.

**3) Access Technology Selection & Planning: Models & Related Issues, Sumit Dutta Chowdhury**, Carnegie Mellon Univ., HbH 237, Pittsburgh, PA 15213, Ramayya Krishnan, Rema Padman

We look at various models proposed in the literature and in industry for technology selection and subsequent use of the knowledge in actual planning and capital budgeting in a telecommunications service provider. We also look at how issues such as data integrity and demand forecasting affect the selection process and reasons for the current inability of the industry to deal with them...

### WB33 Reliability II

Contributed Session

Chair: Jayant Rajgopal, Univ. of Pittsburgh, Dept. of IE, Pittsburgh, PA 15261, rajgopal@engrng.pitt.edu

**1) Optimum System-Based Component Test Plans with Imperfect Interfaces, Jayant Rajgopal**, Univ. of Pittsburgh, Dept. of IE, Pittsburgh, PA 15261, rajgopal@engrng.pitt.edu, Subba Rao V. Majety, Mainak Mazumdar

We extend earlier work on system-based reliability test plans by explicitly accounting for imperfect interfaces between components. The plan attempts to optimally allocate test effort among components and the entire system so as to meet Type I and Type II requirements while minimizing total test costs.

**2) Combining Warranty & Maintenance: A Bayesian Perspective, Ta-Mou Chen**, Univ. of TX, OR/IE Group, Dept. of Mech. Eng., Austin, TX 78712, tomchen@blacksea.me.utexas.edu, Elmira Popova

For a fixed length warranty period, a maintenance program is designed to minimize the total expected cost. A combination of minimal repair and replacement strategies are analyzed both for known and unknown failure parameters. For the second case, the Bayesian type strategies will be discussed.

**3) Genetic Algorithms for Reliability Problems, Yi-Chih Hsieh**, Ntl. Yunlin Polytech. Inst., 64 Wen-Hua Rd., Huwei, Yunlin, 63208, Taiwan, yhsieh@sparc.nypi.edu.tw, Ta-Cheng Chen

We present GAs for solving various redundancy reliability problems which include series, series-parallel and complex (bridge) systems subject to 3 types of nonlinear constraints. Both integer and mixed integer reliability problems are studied. As shown, some solutions obtained by GAs are better than previous best-known solutions.

**4) Maintenance Interval Determination Using Expected Cost of System Breakdown for a Single Resource, Thomas K. Keyser**, Univ. of Southern CO, 2200 Bonforte Blvd., Pueblo, CO 81001-4901, keyser@uscolo.edu, Oliver Strate

A model for scheduling maintenance is developed and evaluated to find cost advantages over traditional methods of maintenance planning. Tardiness penalties are introduced using cumulative probabilities of equipment failure to weigh the expected cost of breakdown. Model feasibility is dependent upon equipment failure parameters and characteristics of the production facility...

**5) A Semi-Markov Dynamic Programming Approach to Optimal Repair/Replacement Decisions for Systems Experiencing Imperfect Repairs, C. E. Love**, Simon Fraser Univ., Fac. of Bus. Admin., 8888 University Dr., WMX 3302, Burnaby, BC, V5A 1S6, Canada, love@sfu.ca, Z. G. Zhang, R. Zitron, R. Guo

A system subject to random failures can either be replaced or it can be repaired. Repair impact lies between a good-as-new repair and a minimal or bad-as-old repair. To determine optimal repair/replacement policies under conditions of imperfect repair, we utilize a SMDP approach.

**Wednesday 13:00-14:30****WC07 Nonlinear Programming****Contributed Session**

**Chair:** Farqad AlKhal, Purdue Univ., 1293 Potter Ctr., Rm. 304A, W Lafayette, IN 47907-1293, alkhali@ecn.purdue.edu

1) **Function Smoothing Towards Global Optimization, Farqad AlKhal**, Purdue Univ., 1293 Potter Ctr., Rm. 304A, W Lafayette, IN 47907-1293, alkhali@ecn.purdue.edu, **F. T. Sparrow**

We look at an algorithm that uses the idea of smoothing nonlinear functions with multiple optima along with a gradient-based search technique to find the global optimum. Test examples are used to evaluate the performance of the proposed algorithm and compare it to that of the standard quasi-Newton approach and the SA approach to global optimization.

2) **On Quadratic Mathematical Programs & Linear Matrix Inequalities, Jelal Ezzine**, ENIT, BP 37, Tunis-Belvedere, 1002, Tunisia, rym.mhalla@irsit.rnrt.tn, **Rym M'Hallah**

QMP formulated as LMI programs found major numerical success. This is due to the linear structure and the use of interior point algorithms. It is shown that general QMPs can be reformulated as LMI problems; thus, inheriting the quasianalytic nature of the LMI results.

3) **A New Algorithm Using Interpolation for Unconstrained Derivative Free Optimization, Katya Scheinberg**, Columbia Univ., Dept. of IEOR, Mudd Bldg., 500 W 120th St. SW, Rm. 331, New York, NY 10027, katya@ieor.columbia.edu, **Andrew R. Conn**, **Philippe Toint**

We consider an unconstrained optimization problem in a framework where derivatives are not available and evaluations of the objective function are expensive. We design an algorithm that optimizes the objective function using a small number of function evaluations. Our method is a combination of a trust-region technique and polynomial interpolation using a basis of Newton fundamental polynomials...

**WC08 Business Process Reengineering II****Contributed Session**

**Chair:** Robert A. Russell, Univ. of Tulsa, 600 S College Ave., Tulsa, OK 74104-3189, russellra@utulsa.edu

1) **Optical Assignment of Referees to College Basketball Games, Robert A. Russell**, Univ. of Tulsa, 600 S College Ave., Tulsa, OK 74104-3189, russellra@utulsa.edu

We present a network model with side conditions to optimally assign referee crews to college basketball games. Constraints limit game assignments per team and per location. Applications to the previous Big 8 and WAC conferences are discussed.

2) **Product Development Process Modeling: A Review, Robert P. Smith**, Univ. of WA, Dept. of IE, Box 352650, Seattle, WA 98195, smith@ieng.washington.edu, **Jeffrey A. Morrow**

Process modeling is an important step towards being able to use MS models to make important managerial decisions. There is an increasing amount of attention being paid to the construction of process models for the design process. We describe the strengths and limitations of existing process models.

3) **Designing Compensation Adjustment Programs, Donald N. Stengel**, CA State Univ., Dept. of IS/DS, 5245 N Backer Ave., Fresno, CA 93740-0007, don\_stengel@csufresno.edu

Many employers adjust salaries using a combination of a cost-of-living increase plus a variable increment based on individual performance or professional development. We apply MS to the design of these programs, featuring the examination of a program recently adopted by the California State University system.

4) **Designing a Customer Satisfaction Database, G. Kent Webb**, San Jose State Univ., 13315 Simon Ln., Los Altos, CA 94022, gkwebb@ix.netcom.com

A case study is presented for a large hotel chain using a customer satisfaction database to maintain quality standards and provide guidelines for capital spending. Mail survey responses are summarized on a monthly basis for hotel managers but survey design problems limit the usefulness of the report.

**WC16 Management of Technology II****Contributed Session**

**Chair:** Edward T. Chen, Southeastern LA Univ., Box 350, Dept. of Mgmt., Hammond, LA 70402, echen@selu.edu

1) **Change Management of Information Technology Innovations, Edward T. Chen**, Southeastern LA Univ., Box 350, Dept. of Mgmt., Hammond, LA 70402, echen@selu.edu

Organizations have adopted IT as a competitive weapon. Often, the introduction of IT innovations into a complex human-machine system raises significant risks of confusion to system processing and reduction in service levels. We suggest a disciplined approach to streamline the change process and enhance the IT management.

2) **Lessons from the GEMPLUS Case Study, Marc Humbert**, Groupe ESC Grenoble, 12 rue Pierre-Semard, BP 127, Grenoble, 38003, France, humbert@esc-grenoble.fr, **Dominique Jolly**, **Francois J. Therin**

GEMPLUS is the creator and the world leading provider of smart cards. This presentation deals with the strategy developed by GEMPLUS to make the best of its core technology. We explain the success by a good synergy between marketing and technology policies and by an application of a resource-based strategy.

3) **Product Innovation in High-Tech Small Firms: A Conceptual Framework, Francois J. Therin**, Groupe ESC Grenoble, 12 rue Pierre-Semard, BP 127, Grenoble, 38000, France, therin@esc-grenoble.fr

Based on an in-depth literature review and on case studies, we propose an original conceptual framework to analyze the influence of the internal and external factors on product innovation and the effects of the interaction of the factors.

**WC20 Demand Modeling & Activity Analysis in Transportation II**

**Sponsor:** INFORMS Transportation Science Section

**Sponsored Session**

**Chair:** Thomas F. Golob, Univ. of CA, Inst. of Transport Studies, Irvine, CA 92697

1) **Developing an Object-Oriented Testbed for Modeling Transportation Networks, Reg Golledge**, Univ. of CA, Dept. of Geography, Santa Barbara, CA, **Mei-Po Kwan**

We present the development of an alternative representation of a transportation network using object-oriented GIS. Such an orientation can facilitate network algorithms such as path selection. Experiments are designed to apply the system under various behavioral assumptions.

2) **A Combined Household Activity & Travel Generation Model, Thomas F. Golob**, Univ. of CA, Inst. of Transport Studies, Irvine, CA 92697, **Michael G. McNally**

In this extension of conventional trip generation models used in urban transportation planning, durations of activities by type, at home and out-of-home and the amounts of travel needed to access activities can be forecasted using structural equations models. The model is estimated using activity diary data for Portland, Oregon.

3) **An Intelligent Learning-Based Activity Scheduling System, Harry Timmermans**, Eindhoven Univ. of Tech., Dept. Arch., Bldg. & Planning, Eindhoven, 5600, The Netherlands, **Theo Arentze**, **Chang Jo**, **Frans Hofman**

Scheduling decision constraints and heuristics are represented by rules in the knowledge-base of the system. These rules govern the construction and repair of a schedule in an intelligent search process. An inductive learning mechanism allows the system to adapt its rules based on interaction with the environment.

4) **Stated Preference of Route Choice Between Congestion Priced & Unpriced Alternatives Given Real-Time Traffic Information, Emily Parkany**, Univ. of CA, Inst. of Transport Studies, Irvine, CA 92697, **Kenneth Small**, **David Anderson**

State Route 91 in Southern California is the nation's first implementation of congestion pricing. We concentrate on 1 aspect of our mail-survey-based travel behavior study: models of the decision to use the priced, free-flowing road given information about real-time travel differences between the priced express lanes and the adjacent free road.

**WC24 Applications of Decision Analysis in Resource Allocation**

**Sponsor:** INFORMS Decision Analysis Society

**Sponsored Session**

**Chair:** Craig W. Kirkwood, AZ State Univ., Dept. of Mgmt., Tempe, AZ 85287-4006, craig.kirkwood@asu.edu

**Co-Chair:** Donald L. Keefer

**1) Choosing an Optimal Working Interest in an Oil & Gas Play, Dana R. Clyman, Univ. of VA, Grad. Sch. of Bus. Admin., PO Box 6550, Charlottesville, VA 22906-6550, Michael R. Walls, James S. Dyer**

We explore the calculation of the optimal working interest in an oil and gas play based on the evaluation of a simple 2-outcome lottery representing the payoffs of a commercial field and a dry hole using a corporate risk tolerance. These results may be counterintuitive and we discuss the consequences.

**2) Multiobjective Decision Analysis for Capital Budgeting in Health Care Organizations, Don N. Kleinmuntz, Univ. of IL, Dept. of Accountancy, 1206 S 6th St., Rm. 360, Champaign, IL 61821, dnk@uiuc.edu, Catherine E. Kleinmuntz**

Hospitals annually evaluate hundreds of proposed capital expenditures. Limited funds are allocated to projects while considering conflicting financial, strategic and quality objectives. We have developed an approach that used multiobjective value functions and constrained optimization to generate budget recommendations. Assessment and implementation issues are discussed.

**3) Capital Allocation in an Asset-Intensive Business, Mark Matousek, Strategic Decisions Group, 2440 Sand Hill Rd., Menlo Park, CA 94025, Leonard Bertrand**

The ability to allocate resources based on maximizing shareholder value requires an understanding of how investments in assets will affect asset, system and financial performance. We have developed methods to allocate capital and O&M budgets to create the greatest expected value for shareholders in the rapidly changing electric utility industry.

**4) Teaching Resource Allocation Using Decision Analysis, Craig W. Kirkwood, AZ State Univ., Dept. of Mgmt., Tempe, AZ 85287-4006, craig.kirkwood@asu.edu, Donald L. Keefer**

DA instruction emphasizes selection among a small number of alternatives where hand solution methods are feasible. With spreadsheet optimization systems, it is now straightforward to teach approaches that combine optimization and DA methods to address such resource allocation decisions as portfolio selection and budget allocation.

**WC25 Teaching Students to be Effective Modelers: Techniques & Success Stories**

**Sponsor:** INFORMS Forum on Education  
**Sponsored Session**

**Chair:** Jeffrey S. Stonebraker, US Air Force, HQ AMC/QI, Scott AFB, IL 62225, stonebrj@hqamc.safb.af.mil

**1) Learning to Learn, Jeffrey S. Stonebraker, US Air Force, HQ AMC/QI, Scott AFB, IL 62225, stonebrj@hqamc.safb.af.mil**

Students learn best when they become owners of the learning process. I discuss my approaches to motivate students to become active learners.

**2) How Do We Prepare Students to Become Effective Decision Makers And/Or Analysts?, Jeffrey S. Stonebraker, US Air Force, HQ AMC/QI, Scott AFB, IL 62225, stonebrj@hqamc.safb.af.mil**

Simply put, students must get their hands dirty. I share with you how students at the US Air Force Academy, in 1 semester, learn the principles of DA and then practice those principles with actual clients who are facing ill-defined problems.

**3) Application of Experimental Design in Developmental Flight Tests: The CV-22 Radar System, David Koewler, US Air Force Acad., PO Box 2248, USAFA, CO 80841-2248, koewlerda97.cs22@usafa.af.mil**

We propose to systematically design test flights for evaluating the terrain-following radar of the CV-22 aircraft. The designed experiment approach will ensure the radar is fully tested and will identify flight characteristics affecting radar performance. A general approach to flight test planning using designed experiments will also be discussed.

**4) Aircraft Vulnerability Assessment Using Design of Experiments, Justin Riddle, US Air Force Acad., PO Box 5629, USAFA, CO 80841-5629, riddleja97.cs18@usafa.af.mil**

The USAF seeks to reduce the likelihood of surface-to-air missile, SAM, radar lock by applying various electronic countermeasures, ECM, techniques. Each SAM can be configured thousands of different ways and ECM effectiveness depends upon SAM configuration. This study uses designed experiments to determine the best ECM technique, against all possible SAM configurations...

**WC30 Impact of Information Technology on the Education & Practice of Military OR II**

**Sponsor:** INFORMS Military Applications Society  
**Sponsored Session**

**Chair:** James E. Armstrong, Jr., US Military Acad., Dept. of Systems Eng., Mahan Hall, Rm. 419, West Point, NY 10996-1779, fj8305@exmail.usma.edu

**Co-Chair:** James F. Sullivan

**1) Applications of Symbolic Languages for Operations Research, Andrew G. Glen, US Military Acad., Dept. of Systems Eng., Mahan Hall, Rm. 419, West Point, NY 10996-1779, fa1275@exmail.usma.edu, Lawrence M. Leemis, John Drew**

Probabilistic modeling in OR has been significantly enhanced by some procedures programmed in the symbolic algebra language MAPLE. Through the use of a number of automated probabilistic theorems, we are able to create stochastic models for complex systems that, though not in closed form, are usable and much more adaptable than the existing typical stochastic models...

**2) Integrating a Groupware Laboratory into Operations Research & Systems Engineering Undergraduate Courses, Cathleen M. Brown, US Military Acad., Dept. of Systems Eng., Mahan Hall, Rm. 419, West Point, NY 10996-1779, fc6756@exmail.usma.edu**

Groupware, software that enables electronic collaboration for multi-disciplinary problem solving, has contributed greatly to the creative process and elicitation of information during the initial problem definition of the engineering design process. We focus on lessons learned from building a groupware lab facility and integrating it into undergraduate education in the Department of Systems Engineering, USMA, West Point, NY...

**3) Distance Learning Strategies for the Information Age, Paul Strassmann, 55 Talmadge Hill Rd., New Canaan, CT 06840, paul@strassmann.com**

This presentation reports on my experiences with the International School of Information Management, where I have served as a Board member for 4 years and where I taught a distance learning course. Lessons from these experiences are extended to the problems of applying distance learning to military operations, analysis and research.

**WC31 Undergraduate Research at the US Service Academies**

**Sponsor:** INFORMS Military Applications Society  
**Sponsored Session**

**Chair:** Andrew P. Armacost, USAF Acad., 2354 Fairchild Dr., Ste. 6H79F Academy, CO 80840, armacostap.dfm@usafa.af.mil

**1) Undergraduate Research at the US Service Academies, Andrew P. Armacost, USAF Acad., 2354 Fairchild Dr., Ste. 6H79, USAF Academy, CO 80840, armacostap.dfm@usafa.af.mil**

This session showcases the outstanding undergraduate OR projects from each of the US Service Academies. These presentations will focus on the application of OR to military and public sector problems.

**Wednesday 14:45-16:15**

**WD24 Decision Analysis VI  
Contributed Session**

**Chair:** I. N. Chengalur-Smith, Univ. of Albany, Dept. of MSIS, BA 310, Albany, NY 12222, lc307@cnisbm.albany.edu

**1) The Impact of Information Quality on Decision Making, I. N. Chengalur-Smith, Univ. of Albany, Dept. of MSIS, BA 310, Albany, NY 12222, lc307@cnisbm.albany.edu, Donald Ballou, Harold Pazer**

Data-tagging is the process of attaching quality indicators to fields in a database. This could facilitate the incorporation of information quality into the decision making process. Neither the efficacy of data-tagging nor the optimal method of implementing it has been studied. We empirically investigate the effect of data-tagging on decision making.

**2) Constructing Complex Scales for Evaluating Alternative Combinations of Multiattribute Items (R), Chen-Fu Chien, Ntl. Tsing Hua Univ., IE Dept., Hsinchu, 30043, Taiwan, cfchien@faculty.nthu.edu.tw, Francois Sainfort**

We address complex scaling problems in applying utility theory to measuring preferences over alternative combinations (or portfolios) of multiattribute items. By studying preferences over meals for a nursing home, we developed scales linking food level and meal level measurements. We tested the scales to capture a dietitian's professional judgments.

**3) Decision Analysis & Litigation Strategies, Arun Kumar, Montclair State Univ., 1 Normal Ave., Upper Montclair, NJ 07043,**

kumara@saturn.montclair.edu, *Zhongxian Wang, Qiyang Chen*

We discuss the application of DA in litigation and how the DA can be used as a powerful tool that will provide a comprehensive, logical methodology for making better litigation related decisions in the face of risk and uncertain outcomes. It also addresses the inherent uncertainties.

**4) Fuzzy Dynamic Hierarchical Decision Making, E. Stanley Lee,**  
KS State Univ., Dept. of IE, Manhattan, KS 66506, eslee@ksu.edu

Fuzzy approaches for solving dynamic hierarchical optimization or multi-level programming problems, which are decentralized dynamic planning problems with multiple decision makers, are proposed. The time or dynamic programming direction is combined with the multi-level or hierarchical direction, which is handled by the use of the tolerance of the membership functions.

**Sunday 08:00-09:30**

- SA04 DEA I  
 SA05 New Theoretical Developments in Linear & Semi-Definite Programming  
 SA06 GRASP  
 SA07 Variational Inequalities  
 SA08 Meta-Heuristics for Solving Integer, Nonlinear & Stochastic Problems  
 SA10 Production Scheduling I  
 SA12 OR/MS Applications in Transportation Systems I  
 SA13 Automatic Graph Drawing  
 SA15 Organizational Theory  
 SA16 Technology Management  
 SA17 Operations Management I  
 SA18 TUTORIAL: Health Care Information Systems  
 SA20 Transportation I  
 SA21 Aviation  
 SA22 Flexible Manufacturing Systems I  
 SA23 Stochastic Scheduling & Performance Analysis of Manufacturing Systems  
 SA24 Decision Analysis I  
 SA25 Education I  
 SA26 Optimization of Supply Chains  
 SA27 Marketing I  
 SA29 Services Management I  
 SA30 Modeling & Simulation without Validated Data  
 SA31 Manpower Analysis  
 SA32 Network Design  
 SA34 Accounting for Human Inference Characteristics in Developing Methods & Systems for Decision Support  
 SA37 George E. Nicholson Student Paper Prize Competition I

**Sunday 10:00-11:30**

- SB04 DEA II  
 SB05 Recent Developments in Linear Programming Software & Its Applications  
 SB06 Cooperative Search Applied to Combinatorial Optimization  
 SB07 Data Mining, Estimation & Search  
 SB08 Advances in Mixed-Integer Programming  
 SB10 Production Scheduling II  
 SB12 OR/MS Applications in Transportation Systems II  
 SB13 Graph Drawing Systems  
 SB14 Product Innovation & Introduction  
 SB15 Production Planning Methods & Applications  
 SB16 PANEL: Publishing Outlets for Research on the Management of Innovation  
 SB17 Operations Management II  
 SB18 TUTORIAL: Fair Division - From Cake-Cutting to Dispute Resolution  
 SB20 Transportation II  
 SB21 National Center of Excellence for Aviation OR  
 SB22 Flexible Manufacturing Systems II  
 SB23 New Practices in Yield Management  
 SB24 Decision Analysis II  
 SB25 Education II  
 SB26 PANEL: Some Perspectives on Queuing Theory  
 SB27 Marketing II  
 SB29 Service Management II  
 SB30 PANEL: The Future of Military Operational Analysis  
 SB31 Mobility Modeling  
 SB32 Traffic Management for Integrated Services  
 SB34 Conceptual Aspects of Decision Aid  
 SB37 George E. Nicholson Student Paper Prize Competition II

**Sunday 13:00-14:30**

- SC04 Optimization & Decision Analysis at Sandia  
 SC05 Approximation by LP

- SC06 Integer Programming  
 SC07 Variational Problems  
 SC08 Integer Programming by Branch & Cut I  
 SC09 Scheduling in Computer & Manufacturing Systems  
 SC10 Production Scheduling III  
 SC12 Neural Networks I  
 SC13 Hybrids of Heuristic Techniques with Artificial Intelligence for Combinatorial Optimization  
 SC14 Materials Management  
 SC15 Production Control of Manufacturing Systems  
 SC16 Global Networked Entrepreneurship  
 SC17 Operations Management III  
 SC18 TUTORIAL: Entropy Optimization & Mathematical Programming  
 SC20 Route Guidance in Urban Traffic Networks  
 SC21 Revenue Management Forecasting & Optimization Issues  
 SC22 Marketing - Manufacturing Coordination  
 SC23 The Design & Control of Furniture Manufacturing Systems  
 SC24 Decision Analysis III  
 SC25 PANEL: Trends & Critical Contents of a Core Operations Management Course for Fast Changing Ind. & Econ. Environments  
 SC26 Queuing Systems - Numerical Approaches  
 SC27 Simulation  
 SC28 Location  
 SC29 Service Management III  
 SC30 Military Economics  
 SC31 Evaluation of Military Telemedicine Applications  
 SC32 Economic Issues in Telecommunications  
 SC34 Risk & Perception  
 SC36 INFORMS New Member Welcome & Workshop

**Sunday 14:45-16:15**

- SD04 Threats to Life & Limb  
 SD05 Linear Programming  
 SD06 Applications of Combinatorial Optimization  
 SD07 Recent Advances in Complementarity & Related Problems  
 SD08 IP Column Generation Methods  
 SD09 Scheduling in Transportation Systems  
 SD10 Production Scheduling IV  
 SD12 Neural Networks II  
 SD13 Heuristics in Combinatorial Optimization  
 SD14 Planning  
 SD15 Scheduling & Logistics  
 SD16 PANEL: Publishing in IEEE Transactions on Engineering Management  
 SD17 Operations Management IV  
 SD20 Incident Detection Algorithms  
 SD21 Airline Pricing & Yield Management  
 SD22 Product Variety Management  
 SD23 Management of Paced Assembly Systems  
 SD24 Decision Analysis IV  
 SD25 The Use of Spreadsheets in Teaching OR/MS  
 SD26 Applied Probability  
 SD27 Analysis of Stochastic Systems Using Simulation  
 SD28 Continuous Location Problems  
 SD29 Service Management IV  
 SD30 Manpower & Personnel  
 SD31 Managing Change in a Turbulent Environment  
 SD32 Network Design Aspects about SONET  
 SD34 Consistency & the Analytic Hierarchy Process  
 SD36 How to Navigate a National Meeting

**Sunday 16:30-18:00**

- SE04 Criminal Justice & Drug Policy  
 SE05 Linear Programming & Decision Making  
 SE06 Sequential Diagnosis  
 SE07 Computation of Economic Equilibria

- SE08 OR/MS in Forestry I  
 SE09 Scheduling with Due Dates or Deadlines  
 SE10 Production Scheduling V  
 SE12 Neural Networks: Applications  
 SE13 Data Mining  
 SE14 Logistics I  
 SE15 Dynamic Programming  
 SE16 Japanese Manufacturing in North America  
 SE17 Operations Management V  
 SE18 TUTORIAL: Selected Developments in Supply Chain Management  
 SE20 Traffic Flow Theory  
 SE21 Airline Optimization  
 SE22 Supply Chain Inventory Management: Contracting & Coordination  
 SE23 Design & Control of Multi-Product Facilities with Setup Times  
 SE24 Decision Analysis V  
 SE25 PANEL: Myths, Heresies & Embarrassing Questions in OR Education  
 SE27 Statistical Methods for Increasing Simulation Efficiency  
 SE28 Location Models I  
 SE29 Inventory I  
 SE30 Resources & Readiness  
 SE31 Simulation & Analysis in Support of Army XXI  
 SE32 Network Design Aspects about ATM  
 SE34 Choices in Optimization  
 SE36 PANEL: Promotion & Tenure - Everything You Wanted to Know But Were Afraid to Ask

**Monday 08:00-09:30**

- MA04 Public Policy Analysis in the Netherlands  
 MA05 Recent Developments in Linear Programming  
 MA06 Heuristic Search for Operations Management  
 MA07 Frontiers of Optimization  
 MA08 Applications of Integer Programming in Planning & Scheduling  
 MA09 Project Scheduling  
 MA10 Multi-Stage Stochastic Programming & Applications  
 MA12 PANEL: Data Preparation for Neural Networks  
 MA13 Data Organization for OR-Based Decision Support Systems  
 MA14 Logistics II  
 MA15 Applications in Scheduling & Distribution  
 MA16 Current Research Issues in Innovation Management  
 MA17 Information Systems I  
 MA18 TUTORIAL: Nonlinear Programming  
 MA19 Railroad Applications  
 MA20 Computational Methods for Traffic Analysis & Management  
 MA21 What's Happening in Aviation OR: A Round Table Discussion  
 MA22 Design of Manufacturing Systems  
 MA23 Recent Developments in Manufacturing Operations Scheduling  
 MA24 Strategic Decision Modeling  
 MA25 PANEL: Entrepreneurial OR Practice in a Changing Client Environment  
 MA26 Queueing Networks  
 MA27 New Developments in Ranking & Selection Procedures for Simulation  
 MA28 Location Models II  
 MA29 Inventory II  
 MA30 Picatinny Arsenal & West Point Joint Relationship I  
 MA31 Future of Army Training Analysis  
 MA32 Global Network Design Issues  
 MA33 OR Applications I  
 MA34 Derivatives Risk Management

**Monday 10:00-11:00**

- MW35 Welcoming Session

**Monday 11:00-12:00**

- MP35 Plenary: Principles of Inference - In Theory & In Practice

**Monday 13:00-14:30**

- MB04 Evaluating Benefits of Government Aviation Technology Programs  
 MB05 Linear Programming: Strong Polynomiality & Related Issues  
 MB06 Integer Programming, Theory & Applications  
 MB07 Interior Point Column Generation Algorithms for Convex Programming  
 MB08 Applications of Discrete Optimization in Operations Management  
 MB09 Single Machine Scheduling  
 MB10 Stochastic Programs with Network Structure  
 MB12 OR in Telecommunications I: Design & Management Problems  
 MB13 Geographic Information Systems  
 MB14 Logistics III  
 MB15 Networks & Cuts  
 MB16 Technology Intensive Alliances  
 MB17 Information Systems II  
 MB18 TUTORIAL: Applied Conjugate Duality  
 MB19 Operations Research Applications in Passenger Rail  
 MB20 Dynamic Traffic Assignment I (Network Algorithms)  
 MB21 Aircraft & Passenger Choice  
 MB22 Modeling Retailer Strategies & Optimal Consumer Response  
 MB23 Manufacturing Technology Management: Models & Applications  
 MB24 Interpretations of Probability  
 MB25 Case Studies & Projects in Operations Research  
 MB26 Performance & Control of Multiclass Queueing Networks  
 MB27 Mathematical Models for Input & Output Processes & File Management Monte Carlo Simulation  
 MB28 Location Models III  
 MB29 Inventory III  
 MB30 Redstone Arsenal/Huntsville Military Operations Research Society  
 MB31 Operations Research in Theater Medical Modeling  
 MB32 Design & Routing for Telecommunication Networks  
 MB33 OR Applications II  
 MB34 Controlling Continuous Decision Spaces: New Statistical Methods in Quality Control

**Monday 14:45-16:15**

- MC04 What Can We Learn About Public Policy from Volunteer Organizations?  
 MC05 New Directions in Algebraic Modeling Languages  
 MC06 Heuristic Approaches to Routing & Scheduling Problems  
 MC07 Generalized Convexity/Monotonicity  
 MC08 Industrial Applications of Integer Programming  
 MC09 Scheduling of Manufacturing Systems  
 MC10 Simulation-Based Optimization  
 MC12 OR in Telecommunications II: Business, Capital & Budget Allocation Problems  
 MC13 Intelligent Systems for Spacecraft Operations I  
 MC14 Issues in Logistics  
 MC15 Linear Cost Network Flow Algorithms  
 MC16 Organizational Capabilities for Innovation  
 MC17 Information Systems III  
 MC18 TUTORIAL: Geometric Programming  
 MC19 Train Scheduling Algorithms  
 MC20 PANEL: Dynamic Traffic Assignment II - Development of Real-Time Systems & Control

- MC21 Air Cargo Yield Management
- MC22 Operations Strategy in Information Centered Industries
- MC23 Production Scheduling & Due Date Management
- MC24 Communicating About Probability & Uncertainty
- MC25 The Use of Projects to Teach OR/MS
- MC26 Stochastic Dynamic Programming
- MC27 Modeling & Simulation in Business Process Reengineering
- MC28 Location Analysis
- MC29 Designing Contracts in Supply Chain Systems
- MC30 Recent Operations Research Projects at the US Military Academy
- MC31 Future Main Battle Tank Simulation
- MC32 Network Design & Engineering of Emerging Telecommunication Systems
- MC33 Optimization Techniques I

### Monday 16:30-18:00

- MD04 How Good are Medical Records as a Basis for Cost Decisions
- MD05 Linear Programming in Approximation & Algorithms I
- MD06 A Heuristic Approach for Berth Planning
- MD07 Numerical Optimization
- MD08 Computational Mixed Integer Programming
- MD09 Production Scheduling & Capacity Reservation Systems
- MD12 Performance of Communications Systems
- MD13 Intelligent Systems for Spacecraft Operations II
- MD14 Management of Supply Chains
- MD15 Multicommodity Flows
- MD16 Distinguished Speaker: New Frontiers in Entrepreneurship Research
- MD17 Information Systems IV
- MD18 TUTORIAL: Operations Strategy in Service Management
- MD19 Optimization I
- MD20 PANEL: Dynamic Traffic Assignment III - Development of Real-Time Systems, Software Issues & Guidance Schemes
- MD21 Aviation Modeling & Simulation
- MD22 Manufacturing I
- MD23 Production Scheduling Models
- MD24 Decision Analysis Research: What Industry Needs from Academia & Vice Versa
- MD25 PANEL: Using Projects to Teach Modeling
- MD26 Optimal Design & Control of Queues
- MD27 Simulation Success Stories
- MD28 Health Applications I
- MD29 Policy Issues in Manufacturing
- MD30 The Impact of Information Technology on the Education & Practice of Military OR I
- MD31 JOP&E Modeling & Documentation
- MD32 Wireless Communication
- MD33 Optimization Techniques II
- MD34 PANEL: NSF Research Opportunities

### Tuesday 08:00-09:30

- TA02 Teaching Optimization Modeling on the Web: The MPL On-Line Tutorial
- TA04 Decision & Risk in the Public Sector
- TA05 Linear Programming in Approximation & Algorithms II
- TA06 CO Formulation & Meta-Heuristics in VLSI Layout
- TA07 Discrete Time Queueing
- TA08 Integer Programming I
- TA09 Scheduling I
- TA10 Supply Chain Management
- TA11 Restaurant Systems
- TA12 Computational Services in Information Networks
- TA13 Reports from the Front: Case Studies in Real-World OR Consulting I
- TA14 Environmental Decision & Risk Analysis
- TA15 Stochastic Networks

- TA16 Product Variety by Design
- TA17 Electric Power Markets
- TA18 TUTORIAL: Service Operations Management - An Agenda for Normative & Empirical Analysis
- TA19 Optimization II
- TA20 Freeway Traffic Congestion Dynamics
- TA21 Transportation III
- TA22 Managing Global Operations
- TA23 The Role of Flexibility in Managing Uncertainty: Manufacturing & Service
- TA24 Applications of Decision Analysis in Industry I
- TA25 Undergraduate Education
- TA26 Heavy Tails and/or Long Range Dependence
- TA27 Stochastic Processes
- TA28 Using Information Technology in Managed Care
- TA29 Coordination Issues in Inventory & Assembly Systems
- TA30 PANEL: The Utility of Modeling & Simulation in Operational Effectiveness Analysis
- TA31 Oak Ridge Military OR
- TA32 Business, Engineering & Modeling in Telecommunication Systems
- TA34 PANEL: Organizational Information Systems - Strategic Directions & Implications

### Tuesday 10:00-11:30

- TB01 Keynote: Marketplace Issues - Health Care in the 21st Century
- TB04 Emergency Service & Facility Location
- TB05 Multiobjective Linear Programming
- TB06 Solution of Combinatorial Problems
- TB07 Statistical Inference in Queueing Models
- TB08 Integer Programming II
- TB09 Scheduling II
- TB10 Supply Chains: Improving Customer Service Through Postponement
- TB11 Tourism Research I
- TB12 Advances in Computational Methods for Reasoning Under Uncertainty
- TB13 Reports from the Front: Case Studies in Real-World OR Consulting II
- TB14 Solid Waste Management Decision Support
- TB15 Network Optimization
- TB16 Technology Commercialization for Superior Performance
- TB17 Market Trading, Bidding & Settlement Models for Electric Power
- TB18 TUTORIAL: Bucket Brigades - An Example of Self-Organizing Logistic Systems
- TB19 Optimization III
- TB20 Traffic Control Techniques for Urban Networks
- TB21 Transportation IV
- TB22 Issues in Global Operations Management
- TB23 FMS Planning & Scheduling Problems
- TB24 Applications of Decision Analysis in Industry II
- TB25 PANEL: OR/MS in Business School Education I - Has the Bubble Burst?
- TB26 Descriptors for Point Processes
- TB27 Strategy I
- TB28 PANEL: Multimedia Medical Informatics
- TB29 Barriers & Benefits to Supply Chain Integration
- TB30 Marine Corps Evolutions Research
- TB31 Military Operations Research: An International Perspective
- TB32 New Methods in Telecommunication Systems Research
- TB33 OR/MS in Forestry II
- TB34 PANEL: Use of Collaborative Technology to Manage Change in a Liberal Arts College

### Tuesday 13:00-14:30

- TC02 Optimization on the Internet I

- TC04 Managing Government Operations  
 TC05 LP Applications in the Electrical Power Industry  
 TC06 Linear Programming in Branch & Cut II  
 TC07 Queuing Applications in Manufacturing Systems & Decision Process  
 TC08 Business Applications I  
 TC09 Machine Scheduling I  
 TC10 Supply Chains: Models for Material Management  
 TC11 Tourism Planning  
 TC12 Frontiers in Knowledge Reuse & Adaptation  
 TC13 OR Applications of Java I  
 TC14 Environment  
 TC15 Network Flows I  
 TC16 Concept & Platform Development in New Product Development  
 TC17 Modeling Applications in Energy  
 TC18 TUTORIAL: Fractional Programming, Generalized Convexity & Generalized Monotonicity  
 TC19 Optimization IV  
 TC20 World Wide Web & Transportation  
 TC21 Research in Artificial Intelligence  
 TC22 Practical Realities of Logistics Providers in the Global Environment  
 TC23 FMS Design & Planning Problems  
 TC24 Applications of Decision Analysis in the Oil & Gas Industry  
 TC25 PANEL: OR/MS in Business School Education II - Rising from the Ashes?  
 TC26 Matrix-Analytic Methods I  
 TC27 Strategy II  
 TC28 Exploring Efficiency Frontiers in the Hospital Industry: Stochastic Models vs. DEA Models  
 TC29 New Perspectives in Supply Chain Modeling  
 TC30 Readiness, Training & Scheduling  
 TC31 Metaheuristics: Military Applications  
 TC32 Broadband Network Design & Routing  
 TC33 OR/MS in Forestry III  
 TC34 Groupware: Improving Electronic Meetings

**Tuesday 14:45-16:15**

- TD02 Optimization on the Internet II  
 TD04 Efficiency in Health Care  
 TD05 LP Models in Telecommunications  
 TD06 TUTORIAL: Recent Advances in Deterministic Global Optimization  
 TD07 Queuing  
 TD08 Business Applications II  
 TD09 Machine Scheduling II  
 TD10 Supply Chain Integration  
 TD11 Information & Technology Issues in the Restaurant Industry  
 TD12 Solving Complex Planning Problems  
 TD13 OR Applications of Java II  
 TD14 The Remedial Dilemma: Defensible Data, Validated Results - Mathematical Theory, Application & Case Studies  
 TD15 Network Flows II  
 TD16 Mobilizing Information Technology to Communicate with Front-Line Workers  
 TD17 Economic Instruments for Energy & Environmental Policy  
 TD18 TUTORIAL: Robust Discrete Optimization & Its Operations Management Applications  
 TD19 Cross-Cultural Negotiation & Computer Technologies  
 TD20 Vehicle Routing Problems  
 TD21 Decision Support Systems in Health Care  
 TD22 Issues in Global Logistics  
 TD23 Automation Control Issues

- TD24 Applications of Decision Analysis in the Pharmaceutical Industry  
 TD25 The Best OR/MS Cases  
 TD26 Matrix-Analytic Methods II  
 TD27 Strategic Planning I  
 TD28 Revolutionary Technologies in Health Care: INFOMEDICS (Intelligent Voice Response Systems & Clinical Care)  
 TD29 Issues in Assembly Manufacturing Systems  
 TD30 Reliability & Maintainability Models in Communication & Logistics  
 TD31 Value-Added Applications for Army Issues  
 TD32 Internet, Java & Distributed Computing: The Future of OR Practice?  
 TD33 OR/MS in Forestry IV  
 TD34 Managing the Facilitation of GSS Groups

**Tuesday 16:30-18:00**

- TE02 PANEL: Optimization on the Internet III  
 TE04 AIDS Modeling I  
 TE05 Renewable & Nonrenewable Resources in Project Scheduling  
 TE06 Applications of Global Optimization  
 TE08 Business Applications III  
 TE09 Machine Scheduling III  
 TE10 Retail Inventory  
 TE11 Tourism Research II  
 TE12 Intelligent Methods for Vehicle Routing & Scheduling Problems  
 TE14 Industrial Production, Environment & Energy I  
 TE15 Network Flows III  
 TE16 Management of Technology: Methodology Issues & Examples  
 TE17 Financial Analysis & Risk Management in Energy Markets  
 TE18 TUTORIAL: Tabu Search for Discrete, Nonlinear & Stochastic Optimization  
 TE19 Group Decision & Negotiation  
 TE20 Routing, Resource Allocation & Transportation Networks  
 TE21 Advanced Manufacturing System Design  
 TE22 Global Operations Management  
 TE23 Manufacturing System Design  
 TE24 Applications of Decision Analysis in Research & Development  
 TE25 TUTORIAL: The Use of Inclass Games in Teaching Operations Management  
 TE26 Stochastic Modeling  
 TE27 Strategic Planning II  
 TE28 Comparing the Nature of Errors in Health Care with Errors in Other Industries: What Lessons Can We Learn?  
 TE29 Inventory & Coordination  
 TE30 Picatinny Arsenal & West Point Joint Relationship II  
 TE31 Analysis in Support of Development of Virtual Training  
 TE32 Network Database Security  
 TE34 Understanding Trust in the Networked Organization

**Wednesday 08:00-09:30**

- WA02 No Title Supplied  
 WA04 AIDS Modeling II  
 WA05 Hospitality Decision Making  
 WA06 Bi-Level Programming  
 WA07 Quality Control  
 WA08 Business Applications IV  
 WA09 Machine Scheduling IV  
 WA10 Multicriteria Decision Making I  
 WA12 Toward an Empirical Science of Algorithms  
 WA16 The Integration of Product Design & Process Development in the Race to Market  
 WA17 Economics

WA18 TUTORIAL: Constraint Programming  
 WA19 Productivity & Competitiveness  
 WA20 Analysis of Urban Transit Systems  
 WA21 Artificial Intelligence I  
 WA22 Manufacturing II  
 WA24 Applications of Decision Analysis in Environmental Management  
 WA25 TUTORIAL: Team Learning I  
 WA27 Telecommunications I  
 WA28 Health Applications II  
 WA29 Military Applications I  
 WA30 Decision Analysis at the Center for Army Analysis  
 WA31 PANEL: Special Operations - Theory, Applications & Future Needs  
 WA32 Emerging Technologies  
 WA33 Reliability I

### Wednesday 10:00-11:30

WB04 AIDS Modeling III  
 WB05 PANEL: Future Impact of Information Technology in the Hospitality Industry  
 WB06 Interior Point Methods in Global Optimization  
 WB07 Quality  
 WB08 Business Process Reengineering I  
 WB09 Machine Scheduling V  
 WB10 Multicriteria Decision Making II  
 WB12 OR Applications on the Internet & Using Java  
 WB14 Forecasting  
 WB16 Management of Technology I  
 WB18 TUTORIAL: Structural Equation Modeling Using LISREL  
 WB19 TUTORIAL: Linguistic Geometry - Problems & Solutions

WB20 Demand Modeling & Activity Analysis in Transportation I  
 WB21 Artificial Intelligence II  
 WB22 Yield Management  
 WB24 Applications of Decision Analysis in Capital Investment Planning  
 WB25 TUTORIAL: Team Learning II  
 WB27 Telecommunications II  
 WB28 Health Applications III  
 WB29 Military Applications II  
 WB30 Scenario Analysis Modeling for the Army  
 WB31 PANEL: Markets, Competition & the Support Infrastructure - How's DoD Doing?  
 WB32 Telecommunication Network & Service Planning  
 WB33 Reliability II

### Wednesday 13:00-14:30

WC07 Nonlinear Programming  
 WC08 Business Process Reengineering II  
 WC16 Management of Technology II  
 WC20 Demand Modeling & Activity Analysis in Transportation II  
 WC24 Applications of Decision Analysis in Resource Allocation  
 WC25 Teaching Students to be Effective Modelers: Techniques & Success Stories  
 WC30 Impact of Information Technology on the Education & Practice of Military OR II  
 WC31 Undergraduate Research at the US Service Academies

### Wednesday 14:45-16:15

WD24 Decision Analysis VI

- Abada, A. SD15  
 Abdel-Fatah, Akmal TB20  
 Abdulhai, Baher SD20  
 Abercrombie, Robert TA31  
 Abolnikov, Lev TD07  
 Abou-Sayed, Mona WB27  
 Abraham, Dolphy M. MD17  
 Acharya, Dharma SA12  
 Acharya, Suresh K. SB20  
 Achenie, Luke E. K. SD12  
 Adams, B. Mike MB34  
 Addo, Theo TA34  
 Adhya, Nilanjan TE06  
 Adler, Ilan WB12  
 Adu, Lily M. SB04  
 Agbayani, C. Brandon WB29  
 Aggarwal, Charu TB15  
 Aggarwal, Prabhu K. MC23  
 Aggarwal, Sumer SC25  
 Agnihothri, Sal R. SB29  
 Agrawal, Narendra MC29, TE10  
 Agrawal, Vipul MD09  
 Ahlstrom, Scott WB24  
 Ahmadi, R. WB22  
 Ahn, Sung-Ho SD04  
 Ahuja, Ravi MB05, TB15  
 Akar, Nail MD12  
 Akgun, Vedat SA12  
 Akkan, Can SC10  
 Aksin-Karaesmen, Zeynep O. SB29  
 Al-Harkan, Ibrahim M. WB06  
 Alevras, Dimitris TC06  
 Alexander, Sean P. WA27  
 Alexopoulos, Christos MB15, SE10  
 Alfa, Attahiru S. TC26  
 Ali, Agha Iqbal SD30  
 Ali, Ozden Gur SE13  
 Alidaee, Bahram WB09  
 AlKhal, Farqad WC07  
 Almeida, Paul MB16  
 Alpert, Charles J. TA06  
 Alptekin, Sema TE23  
 Altinkemer, Kemal SA32  
 Altman, Eitan MD26  
 Amaldi, Edoardo SB07  
 Amaldoss, Wilfred SA27  
 Amini, Mohammad M. MB13, WA12  
 Amiouny, Samir V. TD09  
 Amiri, Ali SA08, WB27  
 Ammar, Salwa H. TE25  
 Anadalingam, G. MA32  
 Ananad, K. MC14  
 Anand, Krishnan S. TD10  
 Andary, James MD13  
 Anderson, David TA20, WC20  
 Anderson, Mark C. WA32  
 Anderson, Michael R. SA31  
 Anderson, Timothy R. SA16  
 Andersson, Jonas MB29  
 Andradottir, Sigrun MC10, SD27  
 Andresol, Ricardo TE12  
 Andrews, Scott W. MA08  
 Ang, Cheng Leong WB14  
 Anily, Shoshana SD10  
 Anisimov, Vladimir V. TE26  
 Anupindi, Ravi MC14, MC29
- Apte, Aruna TB19  
 Apte, Uday M. MC22  
 Arariclo, Silio MA34  
 Arentze, Theo WC20  
 Arguello, Michael SD09  
 Armacost, Andrew P. TA25, WC31  
 Armacost, Robert L. MB33, SB17, SC36, SD36, WA29  
 Armoni, Aviad WA28  
 Armstrong, Jr., James E. MA30, MD30, WC30  
 Armstrong, Ronald MB05  
 Aronson, Jay E. MC06, MC15, SA17  
 Arora, Sant Ram WA33  
 Arreola-Risa, Tony MB29  
 Askin, Ronald G. WA22  
 Asmussen, Soren SD26, TE26  
 Assad, Arjang A. SA25  
 Ast, Richard SE31  
 Atamturk, Alper SE21  
 Aviv, Y. MB14  
 Awni, Ali H. MA05  
 Axsater, Sven MA29  
 Ayhan, Hayriye SA23, SB15  
 Aymett, Lois SA30  
 Babayev, Djangir MB12, MC12  
 Badawy, Michael K. MA16, SB16  
 Bai, David D. MB10  
 Bai, Sherman X. SB15  
 Bailey, Peter SA24  
 Baker, Steven F. SB31  
 Baker, Thomas E. WA02  
 Bakos, Yannis SC32  
 Balachandra, R. SD16  
 Balakrishnan, Anant MA22  
 Balakrishnan, Ramji MD14  
 Ball, Michael MD06  
 Ballenger, John P. MB30  
 Ballou, Donald MD17, WD24  
 Bander, James L. SE14  
 Bapna, Ravi SC29  
 Barber, Klaus TC33  
 Barcenas, Carolina C. WA07  
 Bard, Jonathan F. SD09, TC09, TE09, WA06  
 Bare, Bruce TD33  
 Barger, Jay M. TB30  
 Barkhi, Reza SA08  
 Barnes, J. Wesley MC06  
 Barnes-Schuster, Dawn SE22  
 Barnett, Arnold SD04, TC04, TD04  
 Barnett, Brent D. TC16  
 Barnhart, Cynthia SA12, SC06, SD08, SE21, SE36, TB21  
 Barr, Richard S. TB19, WA12  
 Barrett, Tara TC33  
 Barrows, Randolph C. SE13  
 Bartholdi, III, John J. TB18  
 Bartsch, Thomas MA09  
 Barzilai, Jonathan SD34  
 Bashyam, T. C. A. MC22  
 Bassok, Yehuda MC14, MC29  
 Bates, Donald R. TB30  
 Batta, Rajan SA12, SE28  
 Baumann, Walter J. WA30  
 Baveja, Alok MA28, SE04
- Bayer, David MB06  
 Baylot, Alex TD31  
 Bayyigit, Mete SA16  
 Bean, James C. WB21  
 Becker, Peter TA12  
 Becus, George A. TC10  
 Behnezhad, Ali R. WB16  
 Beije, Paul R. TC27  
 Beja, Avraham SD10  
 Belew, Richard K. SB07  
 Bell, David R. MB22  
 Bell, George MB12, MC12  
 Bell, Peter C. TD25  
 Bellinger, Hagood MA16  
 Belobaba, Peter P. SC21, SD21  
 Ben-Akiva, Moshe E. MC20, MD20  
 Ben-Kheder, Nejib MB19  
 Benchakroun, Abdelhamid MD07  
 Benjaafar, Saifallah SE23, TC23  
 Benjamin, Arthur T. MD25, TA25  
 Benli, Omer S. SA10  
 Bennett, Derek P. SD14  
 Bennett, Kristin P. SA08, SB07, SE13  
 Bennett, Robert SE31  
 Benneyan, James C. TD04  
 Benson, Harold P. TB05, WA10  
 Beranek, Peggy M. TD34  
 Berg, Menachem SE29  
 Bergeron, Francois MC17  
 Berk, Emre SE29  
 Berlin, Steve D. SA24  
 Berman, Oded MC28, SE28  
 Bernstein, David TC20  
 Berry, Carolyn WA17  
 Bertrand, Leonard WC24  
 Bertsekas, Dimitri P. MC15, MC26, TA15  
 Bertsimas, Dimitris MB26, MC26, SC05  
 Betz, Frederick SD16  
 Bevers, Michael TD33  
 Beyer, Dirk M. SE15  
 Bhadury, Joyendu MC28, SE28  
 Bhalotra, Sarita TA28, TD28  
 Bhargava, Hemant K. SE13, TD32  
 Bhat, U. Narayan SB26  
 Bhatia, Manjit MD13  
 Bhattacharjee, Debashish TA20  
 Bian, Wen-Qiang SA24  
 Bianchi, Monica MC07  
 Bienstock, Daniel MB06  
 Bier, Vicki M. SD27, SE24  
 Binato, S. SA06  
 Binder, Z. SD15  
 Binun, Maya MC27  
 Birge, John R. MC09  
 Bixby, Ann E. TA08  
 Bladt, Mogens SD26  
 Blanc, Hans SC26  
 Blanchard, James SB21  
 Blankenship, M. Gregg TE23  
 Blazewicz, Jacek SC09  
 Blood, Christopher MB31  
 Blue, Jennifer SA08  
 Blumstein, Alfred SD04
- Bock, Hans Georg SB08  
 Bodily, Samuel E. MA24  
 Bodin, Lawrence MD06  
 Bogdanowicz, Zbigniew MB32, SE32  
 Bohm, W. TA07  
 Boile, Maria P. SB20  
 Bolland, Peter SB24  
 Bolt, Gordon TB32  
 Boneh, Shahar TA07  
 Bookbinder, James H. MA14  
 Bordley, Robert F. MB24, TB24  
 Borenstein, Severin TA17  
 Borin, Norm TE10  
 Boros, Endre SE06  
 Borys, Bryan MC16  
 Bose, Indranil SA32  
 Bosse, E. SD05  
 Bossert, Beate TB23  
 Botimer, Theodore C. SD21  
 Boutilier, Craig TB12  
 Bouyssou, Denis SB34  
 Bowen, Tom TE04  
 Bowen, William M. TD08  
 Bowman, Hal A. SB17  
 Boyd, E. Andrew MA15, SC06  
 Boyer, F. MD07  
 Boyle, Frank MC19  
 Brachinger, Hans Wolfgang SC34  
 Bradford, Richard M. SD24  
 Bradley, Gordon H. TC13, TD13, WB12  
 Bradley, James R. MD29  
 Bradley, Paul S. SB07  
 Bramel, Julien D. SC10  
 Brams, Steven J. SB18  
 Brandeau, Margaret L. TE04, WA04, WB04  
 Brandenburg, Franz-J. SA13  
 Brannen, Mary Yoko SE16  
 Brauer, Klaus MB21  
 Braun, W. John TA07  
 Brauner, Erik SE12  
 Bricker, Dennis SB04  
 Briggs, David D. TE30  
 Brimberg, Jack MA28, MB28  
 Brine, Lin SC29  
 Brooks, Dan WA24  
 Brothers, Alan J. SC24  
 Brown, Cathleen M. WC30  
 Brown, Evelyn C. MA05  
 Brown, Kevin W. TB30  
 Browning, Jeff TE31  
 Brueggemann, Wolfgang TA27  
 Bruggink, Paul R. TA24  
 Brumbaugh, George TD14  
 Brumelle, Shelby TB33  
 Brunger, William G. SD21  
 Bruvold, Norman T. TC10  
 Bryce, Cindy L. TC28  
 Brynjolfsson, Erik SC32  
 Bucatinsky, Julio TE27  
 Buchanan, John T. TC09  
 Buckley, Earle N. MA16, SC16  
 Buclatin, Ben SD30  
 Budescu, David MC24, SD34  
 Bulusu, Srinivas SC20  
 Bunch, Laura TD31  
 Bunn, Derek W. SB24

- Burrough, Mark A. SE31  
 Bushnell, James TA17  
 Buss, Arnold H. TC13, TD13  
 Butler, John C. SA34, SD24  
 Butt, Steven E. SA10  
 Cachon, Gerard MC29, SC22, TB29, TC29  
 Cai, X. Q. MC09, SD23  
 Cameron, Grant MB10  
 Camm, Jeffrey D. SD25  
 Campbell, Gregory L. MA13  
 Cannon, Mark SE13  
 Cao, Buyang MD06  
 Cao, Jia-Ming SB21  
 Caporello, Thomas MC27  
 Cardinal, Laura B. MD28  
 Carducci, Olivia M. MD25  
 Carlyle, Matt MB25  
 Carpenter, Beth Kulick MC27, MD27  
 Carpenter, Tami SD06  
 Carr, Robert D. TD15  
 Carroll, John S. TE28  
 Carter, John C. WB28  
 Carter, Kimbroe WB28  
 Cassidy, Michael SE20  
 Castro, Frank WB28  
 Castro, Roberto WA08  
 Caulkins, Jonathan P. SD04, SE04, TC04  
 Cave, Jonathan MA04  
 Centeno, Grisselle SB17  
 Ceria, Sebastian MB06  
 Cetinkaya, Sila MA14  
 Chajakis, Emmanuel MA08, MC08  
 Chakravarthy, Srinivas R. TD26  
 Chakravarthy, Amiya TA22  
 Champoux, Yanick MC10  
 Chan, Lap Mui Ann TA10  
 Chan, Nathan Y. TB09  
 Chan, Yupo TD30  
 Chand, Suresh MA22  
 Chang, LiWu TC12, TD12  
 Chang, Tsong-how TD23  
 Chao, David D. MB17  
 Chao, Hung po TB17  
 Chardaire, P. MD15  
 Charnes, John M. MC27  
 Chase, Richard WB22  
 Chatwin, Richard E. SE15  
 Chaudhry, Sohail S. SC28  
 Chen, Anthony MB20  
 Chen, Chienho WB20  
 Chen, Edward T. WC16  
 Chen, Fangruo SC22, SD22  
 Chen, Fank TA10  
 Chen, Huifen MB27  
 Chen, Jinfu TD29  
 Chen, Lilly TA07  
 Chen, Mingyuan WA22  
 Chen, Qiyang SB25, TA19, WD24  
 Chen, Shu-Ching MA20  
 Chen, Ta-Cheng WB33  
 Chen, Ta-Mou WB33  
 Chen, Ye-Sho MB17, MD17  
 Chen, Zhi-Long MA23, TA23  
 Cheng, Chung-Kuan TA06  
 Cheng, Feng SE14  
 Cheng, Hilary MD23  
 Cheng, Hsing K. MC17  
 Chengalur-Smith, I. N. WD24  
 Cherry, Peter SB30  
 Cheung, Ki Ling SE29  
 Cheung, Raymond K. MB10  
 Chevalier, Philippe WB07  
 Chhajed, Dilip MB08  
 Chi, Paul MD13  
 Chiang, Jeongwen MB22  
 Chiang, Wen-Chyuan TA19  
 Chick, Stephen E. MB27  
 Chien, Chen-Fu WD24  
 Chien, Steve MC13, MD13  
 Chien, Steven SA20  
 Chilingierian, Jon A. TC28, TD28, TE28  
 Chin, Ke-Tsai Edward MA23  
 Chinneck, John W. MC33  
 Chipman, Mark D. TC30  
 Chiu, Steve Y. MB32, SD06, SE06, TA32  
 Chiu, Y. Stephen SB14  
 Cho, Geon MC32  
 Choi, David MC22  
 Choi, Hong Mook TB32  
 Chong, Juin SD22  
 Chong, P. Pete MB17  
 Choo, Eng Ung SD34, TB05  
 Choudhary, V. WA10  
 Choudhury, Gagan SC26  
 Chowdhury, Sumit Dutta WB32  
 Chrissis, James TD30  
 Christof, Thomas SC08  
 Christofides, Alexander SE15  
 Christofides, Nicos SA29, SE15, TE08  
 Chu, Julie C. MA30, TE30  
 Chung, Chia-Shin WB09  
 Chung, H. Michael MD32, TC21  
 Chung, Ping MD13  
 Chung, Tin Ming MD23  
 Church, Richard L. SE08, TC33  
 Clark, Mark TB32  
 Clark, Robert H. TB06  
 Clark, Sam SC31  
 Clark, Steve TD16  
 Clayton, Paul D. SE13  
 Clendenen, Gary W. SC14  
 Clewlow, Les MA34  
 Clifford, Karie MD28  
 Clyman, Dana R. TC25, WC24  
 Cohen, J. W. TD07  
 Cohen, Jacqueline SE04  
 Cohen, Morris TE22  
 Cohen, Morris A. TC10, TD22  
 Concelcao, Pedro SC16  
 Conn, Andrew R. WC07  
 Cooper, Ron MA31  
 Coopersmith, Ellen TC24  
 Corbett, Charles J. SE22  
 Corbitt, Gail TC34  
 Cordeau, Jean-Francois SA20  
 Cormier, Denis SC23  
 Cornuejols, Gerard P. MB06  
 Corritore, Cindy L. MA33  
 Coskun, Aysun SA16  
 Costa, Daniel MD33  
 Couellan, Nicolas P. SD12  
 Coughlan, Anne T. SB27  
 Coullard, Collette R. TA08, TC13  
 Cox, Jr., Louis A. SE06  
 Cox, Roger SC04  
 Cox, Tony MB12, MC12, SE06, TA32  
 Coyote, Sky TB12  
 Crain, William Forrest WA30  
 Crainic, Teodor Gabriel SB06  
 Creegan, Joe WA02  
 Cristiaanse, Ellen SD29  
 Croce, Federico Della SE09  
 Crouch, Bradley D. SD34  
 Crouzeix, Jean-Pierre MA07  
 Crovella, Mark TA26  
 Crowder, Alvin MC31  
 Croxton, Keely L. MA15  
 Cruise, Jamie TD02, TE02  
 Culbreth, C. Thomas SC23  
 Culioli, Jean-Christophe MA07  
 Cullick, A. S. SD14  
 Curry, David TC10  
 Cutler, Mark SC17  
 Czyzyk, Joseph TA12, TD02, TE02  
 D'Ambrosio, Bruce TB12  
 D'Angelo, Zachary D. MB33  
 Dacko, Scott WA16  
 Daduna, Joachim R. WA20  
 Daganzo, Carlos F. MB20  
 Dai, Jim MA26  
 Daim, Tugrul SA16  
 Damerджи, Halim MA27, MB27  
 Dangaltchev, Tchavdar MA29  
 Daniel, Bob TC08, TC14  
 Das, Chandrasekhar SD17  
 Daskin, Mark S. SE28  
 Dasu, Sriram TB22, TE22, WB22  
 Datta, Anindya SE10, WA27  
 Dauer, Jerald P. TB05  
 Davis, Lawrence S. TC33  
 Davis, Richard A. TA26  
 Davis, Tom TD10  
 Dawande, Milind MB06, TA29  
 Dayhoff, Judith SE12  
 de Matta, Renato E. MB08  
 de Mello, T. Homem MC10  
 de Morais, Paulo Renato SA22  
 De Piante Henriksen, Anne TE16  
 De Reyck, Bert TE05  
 de Sousa, Joao Tasso Borges SD15  
 de Vries, Sven MB15  
 Dean, Burton V. SD16  
 Dearing, P. M. SB17, TC09  
 Deckro, Richard F. TA14, TC16  
 DeCroix, Gregory A. MB29, SE17  
 Deiner, Adriana TB13  
 Deler, Bahar SC14  
 Deliman, Niki C. TD31  
 Dell, Robert F. TB19, TC04  
 Demeulemeester, Erik TE05  
 Demir, Muhittin Hakan TA08  
 Dentcheva, Darinka MA10  
 Desaulniers, Guy SA20, SA21, SE21, TA21  
 Deshpande, Aniruddha S. MA13  
 Deshpande, Vinayak V. TB08  
 Desrosiers, Jacques SA20, SA21, SD08, SE21  
 Dessouky, Maged M. SB12  
 Dethloff, Jan MB14  
 Deutsch, Frank MD05, TA05  
 Dewispelare, Aaron WB29  
 Diaby, Moustapha WA08  
 Diallo, Mamadou TA14  
 Diao, Xinshen WA17  
 Dicks, Teresa WA31  
 Dillon, Robin TA04  
 Dilts, David M. TC07  
 Dilworth, David TC13  
 Dincer, Cemal M. SC14  
 Ding, Xiaomei MB29  
 Dinghua, Shi TD26  
 Dinur, Adva SA15  
 Dirimtekin, Serra WB14  
 Dixon, Barbara A. TC31  
 Dixon, David S. TC31  
 Djang, Phillip A. TC31  
 Dodin, Bajis M. SC10, TE05  
 Dogan, Can A. TD10  
 Dogan, Koray TD10  
 Doggett, Allen SC30  
 Donohue, Karen TB10, TB29  
 Dooley, Kevin J. MC33  
 Doreen, Dale TD08  
 Dorf, Richard C. SD16  
 Dornier, Philippe-Pierre TD22  
 Doshi, B. MB32  
 Doucet, Joseph A. TD17  
 Dougherty, Deborah MC16  
 Down, Douglas G. TD07  
 Downey, Thomas J. SC12  
 Dravida, Subrahmanyam MB32, SE32  
 Drayton-Bright, Glenn R. TA17, TC05  
 Drew, John WC30  
 Drexl, Andreas MA09  
 Dreze, Xavier MB22  
 Drezner, Tammy MC28  
 Drezner, Zvi MA28, MB28, MC28, SD28, TA10  
 Driscoll, Patrick J. SC06  
 Dror, Moshe WA09  
 Drud, Arne S. MC33  
 Du, Yafeng SB12  
 Dukhovny, Alexander TD07  
 Dula, Jose H. SA04  
 Dulin, Johnathon L. TB14  
 Duncan, George T. TE32  
 Dunleavy, Hugh SD21  
 Dussault, Jean-Pierre MD07  
 Dyer, James S. SA34, SD24, TC25, WC24  
 Dyson, Robert G. SB04  
 Eaves, B. Curtis MB25, MD25, SE07  
 Eckstein, Jonathan SD07  
 Economides, Nicholas SC32  
 Edgell, David TC11  
 Edmondson, Amy TE28  
 Edwards, Michael B. TC22  
 Edwards, Ward MC24  
 Egeli, Birgul MA17  
 Eggemeyer, C. MC13  
 Ehrlich, Sanford TA34

- Eichhorn, Benjamin H. WA07  
 Eiselt, H. A. MC28, SE28  
 Eisenstein, Donald D. TC04  
 Eldred, Michael SC04  
 Elia, Elias TE08  
 Eliashberg, Josh SD22  
 Elimam, A. A. TD15, TE05  
 Elken, Thomas R. TC02, TE02  
 Ellison, David TA16  
 Elmaghraby, Wedad TA17  
 Elyassini, Khalid MD07  
 Embrechts, Mark SE13  
 Epelman, Marina SA05  
 Eppel, Thomas TA04  
 Epstein, L. TB21  
 Epstein, Rafael MC08, SE08  
 Erel, Erdal SD10  
 Erera, Alan SB12, WB12  
 Ernst, Ricardo TC22, TD22  
 Essayad, Musa TE17  
 Etheridge, Mel MB04  
 Ettl, Markus SA26  
 Evans, Gerald E. SA15  
 Evans, Gerald M. MB30  
 Evans, James R. TC15  
 Evans, John TD16  
 Evans, Roberta D. SA15  
 Everingham, Susan SE04  
 Ezzine, Jeiel WC07  
 Fandom, Roger MB34  
 Fang, Liping TB27  
 Fang, S.-C. SC18, SE05  
 Farris, George F. MB16, SD16  
 Farris, Paul TE10  
 Fathi, Yahya MA05  
 Fausnaugh, Carolyn J. MD16  
 Federgruen, Awi MB14, SB23, SC22  
 Feigin, Gerry SA26  
 Feinberg, Eugene A. SE15  
 Feldman, Richard M. TC07  
 Feltenmark, Stefan TC05  
 Fenaroli, Arthur L. MC08  
 Feng, Youyi SE29  
 Ferris, Michael C. SA07, SB05  
 Fesenmaier, Daniel R. TC11  
 Figueroa, Michael A. TC33  
 Fill, Ana WA20  
 Finke, Gerd SC09  
 Finkelstein, Stan TD04  
 Finzel, Martina TA05  
 Fischbeck, Paul S. SA24, SE24  
 Fischer, Andreas SD07  
 Fischer, Kathrin MB28  
 Fisher, Marshall TB29  
 Flanders, Seth WA21  
 Flannery, William T. TE16  
 Fleischer, Lisa TD15  
 Fleischer, Mark SB06  
 Fleten, Stein-Erik TC05  
 Florian, Michael MC15  
 Florida, Richard SE16  
 Floudas, C. A. TD06  
 Foessmeier, Ulrich SA13  
 Forkner, Emma SC31  
 Forte, Paul TE04  
 Fossett, Lawrence D. MA32  
 Fouser, Robert MC05  
 Fowler, Bruce W. MB30  
 Fox, Ken MB21  
 Francis, Richard L. SC28  
 Frankos, Dennis J. MB33  
 Frantzeskakis, Linos F. SD32  
 Fraser, Jeff L. TE24  
 Frauendorfer, Karl MA10  
 Frei, Frances X. MC22  
 Freund, Robert M. SA05  
 Friedman, Robert TD28  
 Friesz, Terry L. SC28  
 Fruin, Mark SE16  
 Fry, Chuck MC13  
 Fujii, Satoshi WB20  
 Fujii, Susumu TB23  
 Fuller, Douglas N. WA19  
 Fuller, J. David TC19  
 Futamura, Kenichi MC25, SB22  
 Futer, A. TB21  
 Fuxman, Leonora MD22  
 Gabarro, Jaime MC08  
 Gabriel, Steven A. TC08  
 Gadidov, Radu TA08  
 Gafner, Bruce WB30  
 Gagliardi, Marco WB12  
 Gail, H. R. MD12  
 Gaimon, Cheryl SD16, TA23  
 Galarneau, Michael R. MB31  
 Galegher, Jolene TE34  
 Gallagher, Richard J. SE13  
 Gallego, Guillermo SB23  
 Ganapathy, L. TE15  
 Ganeshan, Ram TC10  
 Garfinkel, Robert S. MB17  
 Garg, Amit MA29, TA16, TB10  
 Garrett, Stephen E. WA19  
 Gartner, William TC11  
 Gavirneni, Srinagesh TA29  
 Gavish, Bezalel SA32  
 Gay, David M. MC05  
 Gay, Robert WB14  
 Gazarik, M. SD15  
 Gehani, R. Ray TB16  
 Geis, Mark SE30  
 Geisler, Eliezer SD16  
 Gelenbe, Erol SB32  
 Gelman, Eric SE21  
 Gendreau, Michel SC12, TD20, TE12  
 Gendron, Bernard MA15  
 Genike, Dirk MC21  
 George, Ed MA31  
 George, Laurence L. WA33  
 George, Varghese MB16  
 Gerwin, Donald SD16  
 Gettman, Douglas M. TB20  
 Geunes, Joseph MA22  
 Ghanwani, Anoop SB32  
 Ghosh, Deb WA32  
 Ghosh, Jay B. WB09  
 Giannessi, Franco SA07  
 Gibbons, Luana TA13  
 Gibson, David MA16, SC16, SD16  
 Gilland, Wendell G. SA23  
 Gillenwater, Ed L. WB09  
 Ginther, Karl W. MB19  
 Glass, David WB31  
 Glasserman, Paul TD29  
 Glavin, Mitchell TE28  
 Gleason, Michael E. TC04  
 Glen, Andrew G. WC30  
 Glockner, Gregory MB10, TA15  
 Glover, Fred W. MB32, SA08, TA32, TE18, WA12  
 Glycer, J. David SE24  
 Glynn, Melissa TD34  
 Glynn, Peter W. MA27, MB27, MD29, TB07  
 Gob, Rainer MB34  
 Godfrey, Greg TA15  
 Godfrey, R. Michael MB13  
 Godward, Mark TA11  
 Goeltz, R. TC20  
 Goes, Paulo MB17  
 Goffin, Jean-Louis MB07  
 Gold, Bela SC25  
 Golden, Bruce L. SC12  
 Goldfarb, Donald MB06, TC15  
 Goldsman, David MA27, MD27, SE27  
 Goldszmidt, Moises TB12  
 Golledge, Reg WC20  
 Golob, Thomas F. WB20, WC20  
 Gomber, Peter WB21  
 Gomes, Carla P. MA23  
 Gomes, Francisco Negreiros MA33, SE14  
 Goncalves, Gil Manuel SD15  
 Gondzio, Jacek SB05  
 Gong, Wei-Bo SC26  
 Gonzalez, Miguel MB13  
 Good, David MB04  
 Gopal, Ram MB17  
 Gopalakrishnan, Mohan SB29  
 Gopalakrishnan, Shanthi TB16  
 Gopalakrishnan, Srimathy TD20  
 Gordon, Valery MB09, SE09  
 Gorr, Wilpen SE04  
 Gosling, Geoffrey D. SB21  
 Goss, Randy WB24  
 Gould, Jane WB20  
 Gower, Dan SC31  
 Goyal, S. K. SD10  
 Goyal, Shobhna SC10  
 Gradek, John J. MA19  
 Graman, Greg TB10  
 Grau, Kurt TB31  
 Gravel, Marc SB10  
 Graves, Stephen C. SA26  
 Gray, Ann TA22  
 Gray, Stan MC31  
 Gray, William J. TD07  
 Green, Steve G. WB31  
 Grell, Brian J. TA14  
 Griffin, Abbie TB16  
 Griffin, Paul M. SE10, WA07  
 Griffith, Terri L. MA16  
 Grigoriadis, M. D. MD15  
 Groetschel, Martin TC06  
 Gross, Donald MD34, TB07  
 Grossman, Thomas A. MC25, SD25, WA17  
 Grossmann, Ignacio E. MC33, SB08, SD14, TA19, TB09  
 Gruber, Brian SA31  
 Gruca, Thomas S. SB04  
 Guan, Xiaodong SE12  
 Guenther, Dirk P. MA08  
 Guertin, Francois TE12  
 Guignard, Monique SE08, TB06, TB08  
 Gullede, Thomas R. MD31  
 Gumbs, Eric TD30  
 Gundogar, Emin TE09  
 Gunluk, Oktay MD08  
 Gunn, Eldon A. SE08  
 Guo, R. WB33  
 Gupta, Babita SA17  
 Gupta, Diwakar TC07, TC23  
 Gupta, Rakesh SA32, SC13  
 Gurnani, Haresh B. SE22  
 Guselli, Gene TD28  
 Gustafson, Sigrid SC31  
 Gzara, Fatma MA08  
 Ha, Albert Y. MD27, SE17  
 Haas, Peter J. MB27  
 Haasis, Hans-Dietrich TE14  
 Hadjiconstantinou, Eleni SB20  
 Hadjinicola, George C. SD29, TB22  
 Hadjisavvas, Nicolas MC07  
 Hadley, Scott W. SC10  
 Haessler, Robert TC19  
 Hafez, Nevine SD15  
 Hafsi, Mohsen El SB15, SE23  
 Haglin, David J. SD05  
 Hahn, Ju-Ho SA10  
 Hahn, Peter M. TB06  
 Haight, Robert G. TB33  
 Hajek, A. MB24  
 Hale, Anne J. SE30  
 Hale, Leslie C. SC28  
 Hale, Trevor S. SC28  
 Hall, Leslie A. SD06  
 Hall, Michael TB11  
 Hall, Randolph W. SB12  
 Hollowell, Susan F. MC19  
 Hamdi, Abdelouahad MA07  
 Hamer, Richard TA28  
 Hamm, Gregory L. WB24  
 Han, Chun K. WB16  
 Hanks, Christopher H. WB31  
 Hanks, Steve TD12  
 Hanley, Kathleen SC12  
 Hansen, Mark SB21  
 Hansen, Pierre SD08  
 Hanser, Larry TC30  
 Hantler, Sidney L. MD12  
 Haouari, Mohamed WA09  
 Hardy, Edwin F. TC08  
 Harel, Arie MD23  
 Harker, Patrick T. MC19, SA10, SB29, TA18, WB08  
 Harris, Carl M. SB26  
 Harris, Stuart TD24  
 Harrison, J. Michael MB26, MD29, SA23  
 Harrison, Terry P. TC10  
 Harshavardhana, P. MB32, SE32  
 Hart, William SC04  
 Hartley, Dean S. TA31  
 Hartman, Bruce C. WA27  
 Hartman, Rebecca TB05  
 Hartvigsen, David MB15  
 Hasenbein, John J. MA26  
 Haskett, Bill TC24  
 Hasle, Geir MA06  
 Hatch, Nile W. WA16  
 Hatcher, Myron WA05, WB05  
 Hatfield, Donald E. MD28

- Haugen, Kjetil MA06  
 Hauksson, Arni G. TD04  
 Hausman, Warren H. SA26, SC22  
 Hawas, Yaser MC20, MD20, SC20  
 Hayne, Steven TD34  
 Hayya, Jack C. SB29  
 Hazra, Jishnu SA23  
 He, Xin X. SB29  
 Head, K. Larry SD20, TB20  
 Heath, David C. TA26  
 Hebert, John F. TC16  
 Heidari, Farzin SA25  
 Heitor, Manuel V. SC16  
 Helles, Finn SE08  
 Heltne, Mari M. TB34  
 Henderson, Shane SD27  
 Hendricks, Kevin B. MC23  
 Henrion, Max TB12  
 Herrmann, Jeffrey W. MC23  
 Herroelen, Willy S. TE05  
 Hertz, Alain MC06, TD20  
 Hery, W. SA06  
 Hess, James SB14  
 Hewitt, Richard L. MB12  
 Heyman, Daniel P. SB26  
 Hickman, Betty L. MA33, SA04  
 Hill, Russell MA12  
 Hillier, Mark S. SC17  
 Hiltunen, Jyrpekkä SE14  
 Himsolt, Michael SB13  
 Hines, Gail S. MB13  
 Hinson, Joe D. MB13  
 Ho, Teck H. MB22, SC22, SD22  
 Hobbs, Benjamin WA17  
 Hobbs, Melinda TC17  
 Hoch, Stephen J. MB22  
 Hochbaum, Dorit S. TC15, WB12, WB27  
 Hodgson, Thom J. SC23  
 Hof, John G. TC33, TD33  
 Hofer, Charles W. MD16  
 Hoff, Thomas E. TE17  
 Hoffman, James TC24  
 Hofman, Frans WC20  
 Hognas, Goran SB08  
 Holland, Arthur S. TC17  
 Holmes, Willard SA30  
 Holtgrave, David R. WA04  
 Hong, Yoon Gee WA29  
 Hong, Yushin SD10  
 Hooker, John N. WA12  
 Hoopes, Barbara J. MA15  
 Hoplin, Herman P. WB16  
 Hoppe, Paul P. SB25  
 Hopperstad, Craig A. MB21, SC21  
 Hordijk, Wim SB06  
 Horn, Jeffrey D. SB05  
 Hornberger, John TD04  
 Horne, Gary E. TB30  
 Horvitz, Eric TB12  
 Hosseini, Jamshid C. MB33  
 Houck, Christopher R. SC23  
 Hoyle, Steve TA13  
 Hripsak, George SE13  
 Hsieh, Yi-Chih WB33  
 Hsu, Arthur MC14, TB09
- Hu, C. F. SE05  
 Hu, Michael TC21, TD21  
 Hu, Pat TC20  
 Hu, Te Chiang TB15  
 Huang, Dennis J.-H. TA06  
 Huang, Philip SE17  
 Huang, Xiatao MA26  
 Huang, Yuanshu WA22  
 Huang, Zhimin WA10  
 Huang, Adam S. SA29  
 Hubble, Michael W. TB04  
 Huchzermeier, Arnd H. TE22  
 Hudak, James TB01  
 Hueter, Jackie TA11  
 Hughes, Charles R. MA31  
 Humbert, Marc WC16  
 Humes, Jr., Carlos SC15  
 Hung, Ming TC21, TD21  
 Hurley, W. MB28  
 Hurt, Edly TD16  
 Husain, Jamaluddin TC27  
 Hustad, Thomas P. SB16  
 Hutchison, Wesly TB28  
 Hwang, Drew C. WA27  
 Iacono, Suzi TE34  
 Iakovou, Lefteris SC29  
 Inkilainen, Aimo J. SB27  
 Ioffe, Sergey MC26  
 Ip, Chi SC29  
 Irani, Sandy MA20  
 Ishii, Hiroaki TB23  
 Ishikida, Takashi TA09, TD17  
 Islam, Kazi M. Saiful TC07  
 Iwata, Satoru MB15  
 Iyer, Anand SE10, WA22  
 Iyer, Ananth V. TC04  
 Iyer, Lakshmi SA17  
 Iyer, Ramaswamy R. SD14  
 Jackson, Jr., Jack A. TA14  
 Jackson, Leroy A. TC13  
 Jackson, Mic TD14  
 Jacobs, Derya TE23  
 Jacobson, David L. SE13  
 Jacobson, David W. WA33  
 Jacobson, Sheldon H. SA21, SB06, SD13  
 Jaillet, Patrick TE20  
 Jain, Nikhil T. SC17  
 Jain, Sudha TB07, TC07  
 Jain, Vipul TA19  
 James, Ross J. TC09  
 JAMIL, Mamnoon MA28  
 Jansen, Jorg SE29  
 Jarrah, Ahmad SE21, TB21  
 Jauffred, Francisco SC06  
 Jaumard, Brigitte MC08, SD08, TD15  
 Jayachandran, V. S. SC05  
 Jayakrishnan, R. MB20, SE20, TA20, TB20, WA20  
 Jayaraman, L.L. MD28  
 Jayaraman, Rangarajan TB10  
 Jefferson, Thomas MB18, MC07  
 Jeng, Chung-Gong MB27  
 Jenkins, Davis SE16  
 Jenzarli, Ali SA17  
 Jeon, Geonwook TE21  
 Jewkes, Elizabeth M. TC07  
 Jia, Jianmin SA34, SD24
- Jianakoplos, Nancy SC34  
 Jin, Hong SA12  
 Jin, Zhiying MB05, TC15  
 Jo, Chang WC20  
 Johanns, Patrick J. WA19  
 Johnson, Alan W. SD13  
 Johnson, Ellis L. MA08, SB20, SE21  
 Johnson, Gordon D. TB09  
 Johnson, Jesse P. MB04  
 Johnson, R. MB28  
 Johnstone, Christine TA11  
 Johri, P. MB32  
 Joines, Jeffrey A. SC23  
 Joles, Jeff MD30  
 Jolly, Dominique WB16, WC16  
 Jones, Albert TE23  
 Jones, Chris TD13  
 Jones, Jerry L. WA05, WB05  
 Jones, Philip C. MD14  
 Jordan, Ellen S. MC25, MD25  
 Joshi, Pawan TE21  
 Jozefowska, Joanna MB09, SC09, SE09  
 Judd, Kenneth L. SE07  
 Juenger, Michael SC08, TC06  
 Juge, Susan W. SA22  
 Junor, Laura SE30  
 Juttijudata, Man TB07  
 Kabadi, Santosh N. MB05  
 Kacker, Manish SB27  
 Kadwany, John WA24  
 Kahn, Kenneth B. TB16  
 Kahng, Andrew B. TA06  
 Kaibel, Volker TC06  
 Kailasammani, Lenin TB08  
 Kaku, Bharat K. TB08  
 Kalakota, Ravi MC22  
 Kaliski, John A. SD05  
 Kall, Peter MA10  
 Kallio, Jukka SD29, WB08  
 Kalvenes, Joakim SC32  
 Kaminsky, Philip TA10  
 Kamrani, Ali K. TE21  
 Kanafani, Adib SB21  
 Kanchi, Saroja P. TD26  
 Kang, Keebom MD27  
 Kang, Seung-min SE20  
 Kannan, Ramu WA32  
 Kannan, Sriram TC15  
 Kanzow, Christian SC07, SD07  
 Kao, Edward P. C. SD26  
 Kaplan, David TD32  
 Kaplan, Edward H. SD04  
 Kapsky, Alexey SC16  
 Karabati, Selcuk MC09  
 Karabuk, Suleyman SB22  
 Karlaftis, Matthew G. WA20  
 Karmarkar, Uday S. MC22, MD18  
 Kasap, Suat WB06  
 Kashper, A. MA32  
 Katiriciogulu, Kaan MA29  
 Katok, Elena SB29  
 Kaufmann, Michael SA13, SB13  
 Keating, Charles TE23  
 Kececioglu, John SC08  
 Kedem, Benjamin SE12  
 Keefer, Donald L. WC24  
 Keelin, Thomas W. TE24
- Keene, William TE23  
 Keeney, Ralph L. WA24  
 Keilson, Julian MC17  
 Keller, L. Robin MD34, SA24  
 Kelly, James P. TE18, WA12  
 Kelton, W. David MB27, TB10  
 Kennedy, Dennis WB10  
 Kenney, Martin SE16  
 Kennington, Jeffery L. SD30, WB27  
 Kenny, M. TB21  
 Kenyon, George N. MB33  
 Kersten, Gregory E. TD19  
 Kesh, Someswar TC21  
 Ketzenberg, Michael TE10  
 Keyser, Thomas K. WB33  
 Khairullah, Zahid Y. WB14  
 Khamis, Talal Al MD22, TE09  
 Khedkar, Pratap SE13  
 Khoshnevis, Behrokh TB08  
 Khurana, Anil TC16  
 Kiesler, Sara TE34  
 Kilgour, Marc TB27  
 Kim, Bowon MD22  
 Kim, Chaiho MD22  
 Kim, Chang-Hyun SD10  
 Kim, Chang-Ouk MA33  
 Kim, Daecheol TD09  
 Kim, Daeki SD08  
 Kim, Bungab SB10  
 Kim, Hu-gon MC32  
 Kim, Il-Woon SA27  
 Kim, Ilhyung MA22  
 Kim, Kwang-Jae TA19  
 Kim, Oh WA33  
 Kim, Seong-Lyun MC32  
 Kim, Seongbae MA15  
 Kim, Siwhan TB06  
 Kim, Sung-Schick MA33, WA21  
 Kim-Winch, Janice SD23  
 King, Russell E. SC23  
 King, Susan L. TC14  
 Kira, Dennis SD14, TD08  
 Kiran, Ali S. TA11, TE23  
 Kirca, Omer WB09  
 Kirkwood, Craig W. WC24  
 Kishi, Yoji MA32  
 Kito, Suzie TC17  
 Klastorin, Theodore D. SC17, SE17  
 Klein, Cerry M. SB17  
 Kleindorfer, Paul R. TB17  
 Kleinmuntz, Catherine E. WC24  
 Kleinmuntz, Don N. WC24  
 Kleywegt, Anton J. MB10  
 Kloeber, Jack TA14, TB14  
 Klose, Andreas SE34  
 Klutke, Georgia-Ann MD34  
 Knell, Konrad TE24  
 Kniker, Timothy S. TB21  
 Knowles, Thomas W. MA33  
 Knutson, David TA28  
 Kobza, John E. SA21  
 Kocaoglu, Dunder F. SA16, SD16  
 Kochenberger, Gary A. MA06  
 Koewler, David WC25  
 Kogan, L. MC26  
 Kogut, Bruce TE22  
 Kohler, David A. TD15, TE19

- Kok, A. Gurhan SD10  
 Kok, M. MA04  
 Kondo, Asuka SD28  
 Konheim, Alan MD12  
 Konishi, Satoshi MA32  
 Konoske, Paula J. MB31  
 Kontogiorgis, Spyros SB20  
 Kontoravdis, George SD09  
 Kontos, John J. WB21  
 Koo, Hyeng K. MA22  
 Kopcsó, David P. TE19  
 Kopczak, Laura Rock MC25, TD10  
 Koppelman, Frank S. WB20  
 Kortanek, Kenneth O. MC18  
 Kostiuk, Peter MB04  
 Kostreva, Michael M. TB05  
 Koulamas, Christos P. SC29  
 Koutsopoulos, Haris MC20, MD20  
 Kouvelis, Panos MC09, MD23, TA19, TA22, TB22, TD18  
 Kraft, Chip MB19  
 Kramer, Roderick TE34  
 Krass, Dmitry MC28  
 Krass, Iosif A. TB19  
 Krau, Stephane SD32  
 Kremer-Nowic, Emina TB33  
 Krinik, Alan TA07  
 Krishnamurthy, Satish SA21  
 Krishnan, Ramayya TD32, TE32, WB32  
 Krishnan, Viswanathan TA16  
 Kristjansson, Bjarni TA02, TE02  
 Krogmeier, James TA20  
 Kruse, Hans WA27  
 Ku, Anne TE17  
 Kubiak, Wieslaw MB09  
 Kuehner, Warren MC12  
 Kumar, Arun SB25, TA19, WD24  
 Kunde, Dietmar TB19  
 Kunkel, Scott W. MD16  
 Kunreuther, Howard SC24  
 Kuo, Way WA33  
 Kusy, Martin I. SD14  
 Kwak, N. K. WB10  
 Kwan, Mei-Po WC20  
 Kwit, Robert C. TA24  
 L'Ecuyer, Pierre MC10  
 Lacoste, Denis TB27  
 Ladet, P. SD15  
 Laferriere, Richard R. WB30  
 Laframboise, Kevin SB29  
 Laguna, Manuel MB12, MC06, SA08, TA32, TE18, WA12  
 Lai, Danh T. MD32  
 Laliotis, Dimitrios SA29  
 Lam, Raymond MD13  
 Lam, S. Monica SE12  
 Langevin, Andre MA14  
 Langsaeter, Tor TB31  
 Lapid, Koty TC23  
 Laporte, Gilbert MC06, MC28, TD20  
 Lariviere, Martin MC29, SC22  
 Laroche, Jean-Francois SB27  
 Lasdon, Leon S. MA18  
 Lash, Susan TB09  
 Lasry, A. SE21  
 Latouche, Guy TC26  
 Lauer, Harald SB13  
 Lawler, Robert W. SD24  
 Lawrence, Steve MC23  
 Leach, Edward C. WA24  
 Lebeuf, Denis MC15  
 LeBlanc, Larry J. MB32, TC32  
 Lechner, Jan-Peter SA34  
 Ledyard, John TD17  
 Lee, Alex Y. SD21  
 Lee, Changwon WB10  
 Lee, Chul SA10  
 Lee, Chung-Yee MC09, MD23, SD23  
 Lee, Dah Nain MA32  
 Lee, David MB04  
 Lee, E. Stanley WD24  
 Lee, Eva K. MB06, MB07, MD08  
 Lee, Hau L. MD29, SD23, TE29  
 Lee, Hongchul WA21  
 Lee, Janghyuk TD22  
 Lee, Jingo MA16  
 Lee, Sungjoon SE20  
 Lee, Sunhee SC34  
 Lee, Terry N. WA25, WB25  
 Lee, Youngho MC32, TA32, TC32  
 Leemis, Lawrence M. WC30  
 Lefebvre, Elisabeth WA08  
 Lefebvre, Louis A. WA08  
 Lei, Lei MA23  
 Leland, Jon MD34  
 Lemarechal, Claude MA07  
 Lena, Ettore Di SA27  
 Lenard, Melanie L. SB25  
 Leon, Linda MD17  
 Lerssiruriya, Panupol TA29  
 Lettovsky, Ladislav SB20  
 Leu, Andrew SA20  
 Leung, Janny MA15, MB08  
 Leung, Joseph Y.-T. WA09  
 Leung, Vitus MA20  
 Leveson, Nancy TE28  
 Levi, Moti SB24  
 Levy, Alfio TE23  
 Levy, Martin S. WA17  
 Lewis, Adrian MD05  
 Ley-Borras, Roberto SD24  
 Li, Chung-Lun MC09, MD23, SD23  
 Li, G. SE05  
 Li, Lode SB15, TC29  
 Li, Shanling TA23  
 Li, Susan WA10  
 Li, Vincent SC06  
 Li, Wei TA07  
 Li, Wu TA05  
 Li, X. SD05  
 Li, Xiang WB14  
 Li, Yanlin SA20  
 Liang, Ping SA20  
 Lidstrom, N. SA06  
 Lieberman, Warren WA05  
 Liebman, Judith S. WA25, WB25  
 Lieu, Henry MC20, MD20  
 Liker, Jeffrey MD16, SD16, SE16  
 Lillis, John TA06  
 Lim, Byung H. MB32, TC32  
 Lin, Binshan SB27  
 Lin, Carrie Ka Yuk MA06  
 Lin, Chen-Sin TE09  
 Lin, Cheng-Chang TB21  
 Lin, Chiahung WA09  
 Lin, Dennis K. J. TA19  
 Lin, Grace SA26  
 Lin, Jienjou SB22  
 Lind, Elizabeth A. WA29  
 Lindsey, Robert TE30  
 Lingaya, Norbert SA20, SA21  
 Linville, Charles D. SA24, SE24  
 Liou, Fang-Chyi TA21  
 Liguigan, Rex TC07  
 Lissner, A. MD15  
 Liu, Ben SB14, WA16  
 Liu, Danielle TD26, TE26  
 Liu, Jiming SD06  
 Liu, John J. MB23, SD23  
 Liu, M. L. SB08  
 Liu, Yi-Hsin TB05, WA06  
 Liu, Zhen MD26  
 Lo, A. MC26  
 Loar, Dave WA31  
 Loewenstern, D. L. SA06  
 Logi, Filippo MA20  
 Lohmander, Peter TB33  
 Lokketangen, Arne MA06  
 Long, Delmar TD14  
 Long, Jim TD16  
 Long, John A. SC30  
 Long, Patrick T. TC11  
 Lootsma, Freerk A. SD34, WB10  
 Lopomo, Giuseppe SC32  
 Love, C. E. WB33  
 Love, Robert F. MB28  
 Lovejoy, William SD22  
 Lovgren, Robin H. MA17  
 Lowe, James K. TA25  
 Lowe, Timothy J. MB08  
 Lowell, David G. MD24  
 Lu, Leonard SE29  
 Lucantoni, David M. TD26  
 Lucas, Marilyn T. SB14  
 Luo, Zhi-Quan MB07, SD05  
 Luong, Thanh TC17  
 Lurie, Peter SD04  
 Luss, Hanan SD32  
 Lyle, David TD30  
 Lyles, Alan TA28  
 Lynn, Larry SE30  
 Lyra, Christiano WA08  
 M'Hallah, Rym WA09, WC07  
 Ma, Lizhi SE28  
 MacClean, Leonard WB28  
 MacLeod, Charles MD06  
 Maculan, Nelson MA33  
 Madanat, Samer M. SD20  
 Madden, Brendan SB13  
 Madhusudan, Therani N. SC17  
 Madrigal, J. L. WA25, WB25  
 Magazine, Michael J. TB10, TC10  
 Maginniss, Lee TE16  
 Magnanti, Thomas L. MA15, SC07, TB25, TC25  
 Magnussen, John TC28  
 Mahajan, Siddharth TB06, TE10  
 Mahenthiran, Sakthi TE08  
 Mahey, Philippe MA07, MD07  
 Mahmassani, Hani S. MC20, MD20, SC20, TB20, TE20  
 Mahmoodi, Farzad SB10  
 Mahoney, Kevin J. MB31  
 Majety, Subba Rao V. WB33  
 Malandraki, Chryssi MB08  
 Malhotra, Arvind WB22  
 Malley, James H. M. SD31  
 Mallik, Suman SA10  
 Malone, Kerry M. MA04  
 Mamer, John TE15  
 Manda, Bhaskar SA12  
 Mandell, Marvin B. TB04  
 Mangasarian, Olvi L. SB07, SC07  
 Mann, T. MC13  
 Marar, Arun G. MA19  
 Marcotte, Patrice WA06  
 Marcoulides, George WB18  
 Marin, John A. MA30, TE30  
 Marklund, Johan MB29  
 Markowitz, Harry MP35  
 Marlow, Norman A. TC08  
 Marnay, Chris TC17  
 Marohn, C. MA10  
 Marshall, William M. SE10  
 Marsten, Roy TA13  
 Martell, David L. TB33, TC07, TD33  
 Martin, Alexander MD08  
 Martin-Vega, Louis A. MD34  
 Martinez-Legaz, Juan Enrique MC07  
 Martz, Ben TC34, TD34  
 Marx, Roberto SA17  
 Mason, Andrew J. TA08  
 Mason, Anthony K. TE23  
 Mason, Robert M. SB16  
 Mastro Monaco, Randy MC08  
 Masuda, Teruo TB23  
 Matheson, David MA24, TE24  
 Matheson, James E. MA24, TE24  
 Matousek, Mark WC24  
 Matsumoto, Hirotoda TB23  
 Matsuo, Hirofumi SC17  
 Mattavelli, Marco SB07  
 Maxwell, Daniel T. WA30  
 Mayer, Janos MA10  
 Mazanec, Josef TE11  
 Mazumdar, Mainak WB33  
 Mazumder, Pinaki TA06  
 Mazur, David SD06  
 McAllister, William J. TB24  
 McAloon, Ken WA18  
 McBride, Richard D. TE15  
 McCallum, Jr., Charles J. TB13  
 McCarthy, Patrick S. WA20  
 McCausland, Mac WA31  
 McClain, John O. TA29  
 McCormick, S. Thomas MB15  
 McCuish, James TC24  
 McDonough, III, Edward F. TB16  
 McFadden, Kathleen L. SA21  
 McGill, Jeffrey I. SA37, SB23, SB37, SC21  
 McGinnis, Michael L. MC30

- McKendall, Jr., Alan R. SB17  
 McLaughlin, Peter D. TB27  
 McNally, Michael G. WB20, WC20  
 McNaught, K. R. WA29  
 McRaven, Bill WA31  
 McReynolds, Christopher M. TD24  
 Meadows, Stephanie TC24  
 Mehrotra, Sanjay MD08, SC06  
 Mehrotra, Vijay TA13  
 Melavin, Paul SC31  
 Mendel, Amit SD10  
 Mendelson, Haim TD10  
 Meng, Chen-Lu TC27  
 Mensz, Pawel SD17  
 Meredith, Jack R. SD17  
 Merkhofer, Miley W. WA24  
 Metters, Richard TE10  
 Meybodi, Mohammad Z. SA25  
 Meyer, D. J. SC12  
 Meyer, Jennifer L. SD24  
 Meyer, Robert J. SA27  
 Miaou, Shaw-Pin MC20, MD20  
 Mikosch, T. TA26  
 Miles, Jr., Ralph F. MB24  
 Miller, Alan MD21  
 Miller, C. Chet SA15  
 Miller, George SC31  
 Miller, Raymond L. TE31  
 Miller, Tan SC28  
 Miller-Hooks, Elise D. SC20  
 Milosevic, Dragan SA16  
 Miltenburg, John WA22  
 Mirchandani, Dinesh A. MD33  
 Mirchandani, Pitu B. SD20, SE28, TB20  
 Mishalani, Rabi MC20, MD20  
 Misund, Gunnar MA06  
 Mitchell, John E. MB07  
 Mitra, Amitava SA27  
 Mitra, Gautam TD02, TE02  
 Mittaz, Michel MC06  
 Mizuike, Takeshi MA32  
 Mobley, Lee Rivers TC28  
 Mode, Charles J. WB04  
 Mohan, Madan TD19  
 Mohan, Sunil MC13  
 Mohanty, S. G. TA07  
 Mohri, Shintarou TB23  
 Moinzadeh, Kamran MC29  
 Mokhtarian, Faranak Sharifi MB07  
 Moley, Vin MD24  
 Mollaghasemi, Mansoor SB10  
 Molle, Mart L. MD12  
 Molloy, Michael K. MD12  
 Monteiro, Brian SA21  
 Monteiro, Marcia A. SA22  
 Monteiro, Renato D.C. SA05  
 Montgomery, David B. SC22  
 Montulet, Pierre MA14  
 Moon, Il-Kyeong SA10  
 Moore, Bill SC29  
 Moore, Craig TC30  
 Moore, J. B. TB13  
 Morgan, Thomas W. MB19  
 Morin, Thomas L. WA10  
 Morita, Hiroshi TB23  
 Morris, Peter A. MD24, TA04
- Morrow, Jeffrey A. WC08  
 Mosallaie, Mitra TA07  
 Moy, Gary K. TD30  
 Mrochek, Jason SC14  
 Mueller, Rudolf TA12, TD32  
 Muenz, Robert MA19  
 Mukherjee, Sumitra TE32  
 Mukhopadhyay, Amit MD32  
 Muller-Merbach, Heiner E. SE34  
 Mullis, Charles W. TE31  
 Mulvey, John M. MA34, MB10  
 Munson, Beth Spellman TE27  
 Muratore, John F. TB14  
 Murdock, Jr., W. Paul TD30  
 Muriel, Ana TA10  
 Murphy, Frederic H. MA08, MC08, TC17  
 Murphy, Gerard TB04  
 Murray, Alan T. SE08, TC33  
 Muscetola, Nicola MC13  
 Mutzel, Petra SA13, SB13, SC08  
 Myer, Mark TC16  
 Nag, Barin N. MC13, MD13  
 Nagarajan, R. MB32  
 Nagurney, Anna SE07  
 Nahmias, Steven MC29  
 Naidu, T. Jaideep WB09  
 Nair, K. P. K. TE15  
 Nair, Suresh K. SC29  
 Nakayama, Marvin MA27, SD27  
 Nam, Seong-Hyun MB23  
 Nanry, William MC06  
 Naras, Ranga WA21  
 Narasimhan, Sridhar TC32  
 Narayanan, Anupama SB20  
 Narayanan, V. G. TB29  
 Narus, James A. TB29  
 Nathan, Leena P. MD13  
 Nathan, Sri SE32  
 Natraj, N. R. TA32  
 Nau, Robert F. SC24  
 Nayak, Nitin TB10  
 Negreiros, Marcos Jose MA33, SE14, TC15  
 Nehmer, Robert A. SA15  
 Nelson, Barry L. MA27, SE27  
 Nemati, Hamid R. MC06  
 Nembhard, David A. TD16  
 Nembhard, Harriet TD16  
 Nemeec, Joseph Edward MA26  
 Nemhauser, George L. MB10, SB20, SE21, TA15  
 Nerur, Sridhar P. TC21  
 Neuts, Marcel F. SB26, TB26  
 Newman, Alexandra M. SB12  
 Newton, Harry N. SA12  
 Ng, Shu-Ming MD23  
 Nguyen, Dat-Dao TD08  
 Nguyen, Vien MA26  
 Nickerson, Robert C. MB17  
 Nicolich, Marino TC23  
 Nieddu, Luciano WB21  
 Nielsen, Bo Friis TB26, TC26  
 Nieto, Enrique MC08  
 Nikali, Heikki SD29  
 Nikolaidis, John WA07  
 Nino-Mora, Jose MB26  
 Nissan, Samir TD21  
 Nixon, William Brent TB14
- Noble, James S. SB17  
 Noonan, Patrick S. MC24, TC25  
 Norkin, Vladimir I. MC10  
 Noronha, Sunil J. TD19  
 Nowroozi, Ali SB12  
 Nunez, Manuel SA05  
 Nuttle, Henry L. W. MA05  
 Nye, Tim TC07  
 O'Conneide, Colm TD26  
 O'Connor, Thomas SD04  
 O'Hara, Thomas WA29  
 O'Neil, Dan TA11  
 O'Neill, Liam SA04  
 Obenschain, Arthur MD13  
 Obuchowska, Wieslawa T. TC19  
 Ockerman, Daniel H. SE27  
 Odijk, Michiel A. TE27  
 Odubiyi, Jide MC13  
 Oguz, Ceyda TC09  
 Ohashi, Kazumasa SA22  
 Okabe, Atsuyuki SD28  
 Okeson, Victoria Corlew SD06  
 Okunuki, Kei-ichi SD28  
 Olafsson, Siggi MD33  
 Oleska, Anna MA23  
 Olinick, Eli V. WB12, WB27  
 Olligschlaeger, Andreas SE04  
 Oloumi, M. O. WA28  
 Olsen, Tava Lennon SA23  
 Olson, Mark TD17  
 Olson, Michael MC24  
 Olstad, Asmund MA06  
 Onal, Hayri TB27  
 Onculer, Ayse SC24  
 Onkal-Atay, Dilek WB14  
 Onvural, Raif SB32  
 Ordoobadi, Sharon M. SB24  
 Oren, Shmuel S. TA17, TE17  
 Orlin, James B. MB05, TB15  
 Ornaty, A. TB06  
 Owen, Jonathan H. TC13  
 Owens, Douglas K. TE04  
 Ozturan, Meltem MA17  
 Padberg, Manfred SC08, TC06  
 Padillo, Jose M. WA08  
 Padman, Rema MB17, SA18, TA28, TE32, WB32  
 Padmanabhan, V. MB22  
 Padron, Honorio TD11  
 Paige, Kerrie MC12  
 Painton, Laura A. SC04  
 Pakath, Ramakrishnan MD33, TC27  
 Pal, Raktim TA21  
 Palekar, Udatta S. SA12  
 Pandit, Ram SA12, SB12  
 Pang, Jong-Shi SC07, SD07  
 Papamichail, Dimitris P. TE19  
 Papamichail, George P. TE19  
 Papanicolaou, Vassilis G. TA07  
 Papastavrou, Jason D. MB10  
 Papatyi, Anthony TA14  
 Pardalos, Panos SA06, TD06  
 Parija, Gyana R. TB06  
 Park, Daesu TA27  
 Park, June S. MB32, TB32, TC32  
 Park, Taeho SB22  
 Parkany, Emily WC20
- Parker, Jennifer MC12  
 Parker, Jr., Jack E. TC31  
 Parker, Mark SD06  
 Parnell, Gregory S. TA14  
 Parrish, Scott MB12, MC12, WB32  
 Pascoa, Ana MA34  
 Pasik-Duncan, Bozenna SC15  
 Pataki, Gabor MB06  
 Patankar, Jayprakash G. SA27  
 Pate-Cornell, M. Elisabeth TA04  
 Patel, Rahul H. SC23  
 Patrizi, Giacomo MD19, SA27, WB21  
 Patterson, Raymond A. SC13, WA32  
 Patuwo, Eddy TD21  
 Pawlak, Grzegorz SC09  
 Pazer, Harold WD24  
 Peak, Daniel MA33  
 Pearsall, Diana SC31  
 Peck, Stephen C. TB17  
 Peeta, Srinivas MA20, MB20, SC20  
 Pegou, Maria WB21  
 Pelleu, Josephine TD20  
 Pelot, Ronald P. MD19  
 Peng, Xiaoyong TB27  
 Pentland, Brian T. MC16  
 Perakis, Georgia SC07  
 Perdue, Robert K. TA24, TE24  
 Pereira, Fernando Lobo SD15  
 Pereira, Murilo Tito TC15  
 Perkins, James R. SC15  
 Persi, Piero TC23  
 Pesch, Erwin MA09, MB09, SC09  
 Pesenti, Raffaele TC23  
 Pet-Edwards, Julia MB33, SC36, SD36  
 Peterson, Elmor L. MA05  
 Pettit, Ray WA29  
 Petty, Karl SD20  
 Pflug, Georg MC10  
 Phelan, Jr., Robert G. MC30  
 Phillips, Robert MC21, SB23, SE25, TB13  
 Pickett, John E. WB28  
 Pierick, Eric ten TC27  
 Pierskalla, William P. TB25  
 Piersma, Nanda MA08  
 Pinar, Mustafa C. MA08  
 Pinedo, Michael MD09  
 Pinheiro, Mark SC16  
 Pinkerton, Steven D. WA04  
 Pinter, Janos D. MD19  
 Pipino, Leo TE19  
 Piramuthu, Selwyn TC21  
 Pirkul, Hasan SA32, SC13  
 Pirlot, Marc SB34  
 Pitsoulis, L. S. SA06  
 Pizam, Abraham TB11, TE11  
 Plener, Gerhard TD27  
 Pligavko, Alexandra K. TC17  
 Plummer, John C. WA06  
 Podlesny, Carl WB32  
 Polak, George G. MD19  
 Polatoglu, Hakan WA33  
 Polk, Charles TD17  
 Pollack, Harold SD04

- Pollock, Stephen M. SE15, SE25  
 Popova, Elmira TA09, WB33  
 Porco, Travis C. WB04  
 Porter, David TD17  
 Porteus, Evan L. SE18  
 Portugal, L. F. MD15  
 Posner, Marc E. MB15  
 Potapneva, Elena MB09  
 Potvin, Jean-Yves TE12  
 Powell, Steven R. WA27  
 Powell, Walter TE34  
 Powell, Warren B. MA23, TA15, TE20  
 Prasad, V. Rajendra WA33  
 Pratsini, Eleni TC14  
 Price, Rumi Kato SC12  
 Price, Wilson SB10  
 Profeta, Joe MC19  
 Proth, Jean-Marie SD15  
 Provan, J. Scott MB15  
 Pryor, Katherine MB14  
 Przasnyski, Zbigniew H. WB07  
 Pugh, Jamis K. MB31  
 Pugh, William M. MB31  
 Pullman, Madeleine E. SC29  
 Purdue, Peter TE26  
 Puterman, Martin L. MA29, MB29  
 Pyke, David F. TE29  
 Qian, Tianbing MD14, SA06  
 Raafat, Fred MW35, WA28  
 Rabadi, Ghaith SB10  
 Rabelo, Luis TE23  
 Rabideau, G. MC13  
 Racer, Michael MB13  
 Raffensperger, John F. TC30  
 Raffo, David M. SA16  
 Raghavachari, Madabhushi SE13  
 Raghupathi, W. TC21, TD21  
 Ragusa, James M. TE31  
 Rahman, Adnan MA04  
 Rahman, Faruq TE12  
 Raines, Richard TD30  
 Rajagopal, Srinivas MD26  
 Rajagopalan, Sampath TA23, WB22  
 Rajagopalan, Srinivasan TB24, TD27  
 Rajaram, Kumar TB08  
 Rajasekera, Jay R. SC18  
 Rajgopal, Jayant WB33  
 Raju, Jagmohan S. SA27  
 Rakita, Ian SD14  
 Rakshit, Ananda MA13  
 Raman, Ananth TB29  
 Raman, Narayan TB23  
 Ramana, Motakuri V. SA05  
 Ramaswami, V. TB26, TC26  
 Ramaswamy, Sanjay E. MA29  
 Ramaswamy, Sridhar SE15  
 Ran, Bin TC32  
 Rana, Arif MC25, TA25  
 Rancourt, Eric SA21  
 Rand, Daniel R. MC33  
 Rangaswamy, Balu SA08  
 Ranky, Paul G. TD23  
 Rao, Raghav TD27  
 Rapp, Jeffrey MD13  
 Rappaport, Jack WB10  
 Rasher, Arthur A. WA27  
 Rathi, Ajay K. MC20, MD20  
 Ratliff, H. D. MA14, MB15  
 Raulas, Mika SB27  
 Rawson, Ian G. TB28  
 Rayco, M. Brenda R. SC28  
 Read, E. Grant TA17  
 Reardon, Timothy SC31  
 Rebentisch, Eric MB16  
 Recker, W. W. WB20  
 Reddoch, Russell MB32  
 Redmond, Michael SE04  
 Redus, Kenneth S. WA24  
 Reeb, Jennifer SE21  
 Reeves, Laurence TB33  
 Regan, Amelia C. TE20  
 Reilly, Charles H. WA12  
 Reinelt, Gerhard SB08, SC08  
 Reinhardt, Gregory R. SD08  
 Reisman, Arnold SD16  
 Renaud, Arnaud MA07  
 Renfro, II, Robert S. WB29  
 Resende, Lucia I. MA32  
 Resende, Mauricio G. C. MA32, MD15, SA06  
 Resnick, Sidney I. TA26, TE26  
 Reuther, Phyllis TE32  
 Reynolds, Roy TA30  
 Rhyne, Lawrence TA34  
 Richards, Evelyn SE08  
 Richardson, Robert TE08  
 Richetta, Octavio SA17  
 Richter, Anke WA04  
 Riddick, Frank TE23  
 Riddle, Justin WC25  
 Riggs, William M. MA16  
 Righter, Rhonda L. MD26  
 Rinaldi, Giovanni SC08  
 Riopel, Diane MA14  
 Rios-Mercado, Roger Z. TC09  
 Rispoli, Fred J. TE15  
 Ritchey, Nathan P. WB28  
 Ritchie, Brent TB11  
 Ritchie, Stephen G. MA20, SD20, TA20  
 Ritter, Stanley C. MA31  
 Robershotte, Mark A. TB27  
 Roberts, Daron SB20  
 Roberts, Eileen MB04  
 Robertson, Steven J. SC12  
 Robinson, Lawrence W. TE29  
 Robinson, Randall S. MC04  
 Robinson, Stephen M. MA07, SA07, WB30  
 Rochette, Denis SA31  
 Roehrig, Stephen TE32  
 Rogalev, Nikolay SC16  
 Rogers, Dale MB14  
 Rogers, Scott WA19  
 Rojanasoonthon, Siwate TE09  
 Rolland, Erik SA08, SC10, SC13, TE05  
 Romack, Catherine A. TB09  
 Romero, Raul SD14  
 Romero, Vicente SC04  
 Romisch, Werner MA10  
 Roos, C. SD05  
 Rosa, Charles H. TC05  
 Rose, Christopher MD32  
 Rose, Elizabeth L. WB22  
 Rosenberg, Eric MB32  
 Rosenblatt, Meir J. SD23  
 Rosenkopf, Lori MB16  
 Rosenthal, Richard E. SB31  
 Rosenthal-Sabroux, Camille SA34  
 Rosenwein, Moshe SD32, SE32  
 Rosewater, Alysse TA23  
 Rosko, Michael D. TC28  
 Roslien, David J. TB34  
 Ross, Anthony TC10  
 Rossi, Carla TE04  
 Roth, Aleda V. SC22, WB22  
 Rothberg, Edward E. SB05  
 Rothblum, Uriel G. MC26  
 Rothwell, Geoffrey TD08  
 Rouquie, Jr., Gabriel TA30  
 Rousseau, Jean-Marc TD20  
 Rovinsky, Robert B. MA21  
 Royksund, Conrad TB34  
 Ruben, Robert A. SB10  
 Rump, Christopher M. MD26, SA12  
 Runger, George C. SC12  
 Rupe, Jason TA32  
 Russell, Robert A. WC08  
 Rust, Lars TE12  
 Rustagi, Mukesh TA24  
 Ruszczynski, Andrzej MC10  
 Ryan, David M. SA10  
 Ryan, Jennifer K. TA10  
 Ryan, Jennifer M. SD06  
 Rybolt, William H. TE19  
 Rydell, Peter SE04  
 Ryoo, Hong TE06  
 Ryu, Bong Kyun TB32  
 Saad, Germaine H. WB08  
 Saarninen, Timo O. SD29, WB08  
 Saatcioglu, Omer TE08  
 Sabuncuoglu, Ihsan SB22, SD10  
 Sachitano, Joe SB25  
 Saha, Swagata TD27  
 Sahin, Izzet MC17, WA33  
 Sahinidis, Nick SB08, TE06  
 Saigal, Sanjay MC05, TA13, TB13  
 Sainfort, Francois WD24  
 Saksena, Vikram SE32  
 Salewski, Frank MB09  
 Salhi, Said MA28, TE12  
 Salkin, Gerry SA29, SE15, TE08  
 Salman, Fatma Sibel TA08  
 Salo, Saku WB08  
 Saltzman, Matthew J. TC09  
 Samorodnitsky, Gennady TA26  
 Samson, Danny WA19  
 Samuelson, Douglas MC04, MD04  
 Sanchez, Ron WA16  
 Sanders, Reginald TC17  
 Sanjee, Iraj SD32, TD05  
 Sanlaville, Eric SC09  
 Sanso, Brunilde SB27, SD32  
 Sanstad, Alan R. TD17  
 Santer, Benjamin D. TA27  
 Santucci, Alan MA30  
 Sapountzis, Ted MC21  
 Sapunar, Pedro MC08  
 Sarathy, Kishore SD09  
 Saraydar, C. MD32  
 Sarrico, Claudia S. SB04  
 Sauer, Nathalie SD15  
 Savage, Sam L. SB31  
 Savard, Gilles SA21, WA06  
 Sayin, Serpil WA10  
 Schachter, Aliza SB23  
 Schaible, Siegfried MC07, TC18  
 Scharbrodt, Mark SE10  
 Scheinberg, Katya WC07  
 Scheller-Wolf, Alan SD17  
 Scherer, William T. TA27, WA19  
 Schiemann, Robert SD31  
 Schinaia, Giuseppe TE04  
 Schinelli, Bruce G. MC19  
 Schmedders, Karl MB25, SE07  
 Schmeiser, Bruce W. SE27  
 Schmidt, Claudia WB21  
 Schmidt, Craig W. TB09  
 Schmidt, Guenter J. SC09  
 Schmidt, Peter TA12  
 Schoner, Bertram SD34, TB05  
 Schraner, Erika SA26  
 Schreiber, Rob SB05  
 Schubert, Renate SC34  
 Schultz, Kenneth L. TA29  
 Schulz, Andreas S. SC05  
 Schwartz, Shawn TA28  
 Schweitzer, Paul J. SA23  
 Scott, Carlton H. MC07  
 Scott, Meckinley TD07  
 Scott, Steven S. MD13  
 Sebasto, Tony TE30  
 Sechi, G. MB05  
 Seffin, Lotfy Lewiz SA24  
 Segal, Moshe TE05  
 Seguin, Rene TD20, TE12  
 Seidel, Wilfried MB34  
 Seidmann, Abraham SA23  
 Semet, Frederic MC08, TD15  
 Sen, Alper TD29  
 Sen, Suvrajeet MA10  
 Sengupta, Bhaskar TC26  
 Sengupta, Jati K. SA04  
 Sengupta, Soumitra SE13  
 Serfozo, Richard MA26  
 Seshadri, Sridhar MD09, SB32  
 Sethi, Suresh P. SE15  
 Sethuraman, Kannan SD22, SE25  
 Sewell, Edward C. SD13  
 Shafer, Scott M. TD16  
 Shahabuddin, Perwez SD27  
 Sham, A. TC19  
 Shanker, Murali TC21, TD21  
 Shannon, Doug MD27  
 Shanthikumar, J. George MD09  
 Shapiro, Alexander MC10  
 Shapiro, Gerald W. MB04  
 Shapiro, Joel TE20  
 Sharda, Ramesh TE02  
 Sharpe, Paul C. TE24  
 Shaw, Susan H. TC17  
 Sheikhzadeh, Mehdi SE23, TC23  
 Shekhar, Chander WA17  
 Shelby, Steve TB20

- Shen, Guoqiang TE20  
 Shen, Ling TC26  
 Shepherd, Bruce TD05  
 Shepherd, Morgan TC34  
 Sherali, Hanif D. SC06  
 Sheu, Jih-Biing TA20  
 Sheu, Rucy-Lin MA05  
 Shi, Leyuan MD33  
 Shi, Ying MD17  
 Shigeno, Maiko MB15  
 Shih, Neng Hui SE27  
 Shim, Won P. TC27  
 Shing, M. T. TB15  
 Shoecraft, Michael R. SD30  
 Short, David SE12  
 Shrivastava, Prakash TB24  
 Shu, Jung-Huei SD13  
 Shunk, Dan L. MC27  
 Sickles, Robin MB04  
 Sigman, Karl SD26  
 Silva, John SC31  
 Silva, W. MA04  
 Silver, Edward A. MD33, TE29  
 Silverman, Fred N. WB28  
 Simchi-Levi, David TA08, TA10  
 Simester, Duncan I. MB22  
 Simmons, Julie SE15  
 Sims, Kenneth J. MD33  
 Singamsetti, Rao SB04  
 Singer, Ivan MC07  
 Singh, Rahul TA16  
 Sinha, Kumares C. TA20, TA21  
 Sinha, Sanjeev TB23  
 Sinha, Vikas TB22  
 Siokos, Stavros SE07  
 Siosis, Mikes MD22  
 Sitariski, Edward SC10  
 Skabardounis, Alex SD20  
 Skinner, David C. TC24  
 Sleeman, Candace K. WB04  
 Sloan, Thomas W. TA09  
 Slovic, Paul SC24  
 Slud, Eric SE12  
 Small, Kenneth WC20  
 Smallwood, Richard D. MA24  
 Smith, Barry C. MA24  
 Smith, Ben MC13  
 Smith, Ginger TC11  
 Smith, Neale R. SE10  
 Smith, Philip W. TA05  
 Smith, Richard L. TE16  
 Smith, Robert L. TC29  
 Smith, Robert P. WC08  
 Smith, Scott B. MA19  
 Smith, Stephen A. MC29, TE10  
 Smolen, Arnold TB28  
 Smunt, Timothy L. SD17  
 Sniezek, John MD06  
 Snyder, Patricia M. SE10  
 Snyder, Rob L. MA14  
 So, Kut C. (Rick) SC29, TE29  
 Soares, Joao MB06  
 Sobel, Matthew J. MD29  
 Sohraby, Khosrow MD12  
 Sokkalingam, P. T. MB05  
 Solis, Rafael WA05  
 Solis, Saul MC31  
 Solomon, M. SE21  
 Solow, Daniel SD13
- Sommer, Rainer MD31  
 Somwaru, Agapi WA17  
 Song, Jaeyong TE22  
 Song, Jeannette SC29, TA29, TD29  
 Song, Mark SD09  
 Song, Wheyming Tina SE27  
 Song, Yong I. TD27, TE27  
 Sonnenblick, Rich TB12  
 Soriano, Patrick SC12, TD20  
 Soroush, Hossein M. MC23  
 Soteriou, Andreas C. SA04  
 Soumis, Francois SA21, SD08, TA21  
 Sourie, Jean Claude WA06  
 Sparling, David H. WA22  
 Sparrow, F. T. WC07  
 Spasovic, Lazar N. SB20  
 Spearman, Mark L. MC23, MD29  
 Spera, Cosimo WB12  
 Spetzler, Carl S. MD24  
 Spidaliere, Peter MD13  
 Spielberg, Kurt TB06  
 Spitznagel, Edward L. SC12  
 Sprecher, Arno MA09  
 Sproull, Lee TE34  
 Sreenivas, Rama SC15  
 Sridhar, Suresh MD32  
 Sridhar, Varadharajan WA27  
 Srikant, R. SC15  
 Srikar, Bellur N. MB19  
 Srinivasan, Ashok MC14  
 Srinivasan, Vijay SB32  
 Srivastava, Sadanand MD13  
 St.-Pierre, Carl WA08  
 Stahly, Paul SE34  
 Stanford, David TB07  
 Stanford, Robert E. SB04  
 Staniec, Cyrus TA30  
 Stecke, Kathryn E. TB23, TC23, TD23  
 Steiner, George TD09  
 Stengel, Donald N. WC08  
 Stenger, Alan J. TC10  
 Sterling, Warren TB28  
 Stevens, Scott TB28  
 Stewart, William R. WA17  
 Stidham, Jr., Shaler MD26  
 Still, Camille M. TB14  
 Still, Claus SB08  
 Stillman, Randi TA28  
 Stilman, Boris WB19  
 Stoff, Steven TA17  
 Stojkovic, Goran TA21  
 Stojkovic, Mirela SA21  
 Stone, III, George F. TE31  
 Stone, P. MC13  
 Stone, Ryan SC04  
 Stonebraker, Jeffrey S. WC25  
 Stork, Kirk A. TC13, TD13  
 Strassmann, Paul WC30  
 Strate, Oliver WB33  
 Strauss, Todd TD17  
 Street, W. Nick SB07  
 Stubbs, Robert A. MD08, SC06  
 Stuebinger, Andreas SA13  
 Stutzman, Bryan R. MB15  
 Subramanian, Radhika TA13  
 Sudharshan, D. SB14, WA16
- Sugihara, Kokichi SD28  
 Sugumaran, Vijayan SA29  
 Suitoou, Chad SE24  
 Sullivan, James F. MD30, WC30  
 Sullivan, Robert S. TB25  
 Summers, Mike MC20, MD20  
 Sun, Erjiang MC07  
 Sun, Jie MB07  
 Sun, Minghe MD06, SA08  
 Sun, Xiaorong SD06, SE06  
 Sun, Xiaoyun SE12  
 Surrey, Nathan WB14  
 Sushak, Cynthia S. TD24  
 Suzuki, Atsuo SD28  
 Suzuki, Tsutomu SD28  
 Swaminathan, Jayashankar M. TB10  
 Swart, William W. TD11  
 Swersey, Arthur J. MD27  
 Swetits, John J. TA05  
 Sycara, Katia P. MC14  
 Szidarovszky, Ferenc TC26  
 Szwarc, Wlodzimierz SE09  
 Taaffe, Michael R. SE27  
 Tagaras, George WA07  
 Tai, Lawrence S. WB07  
 Takriti, Samer SB05  
 Talalayevsky, Alexander MB33  
 Talavage, Joseph J. SB22  
 Talbert, Gregg S. TD24  
 Talbot, Brian TC19  
 Talle, Eric S. TD27  
 Talluri, Kalyan SC21  
 Tamir, Arie SC28  
 Tan, Jui C. WB08  
 Tan, Margaret MA32  
 Tan, Wei TB08  
 Tandon, Vivek TD05  
 Tang, Christopher S. MB22, SD22, TE29  
 Tansel, Barbaros C. TA08  
 Tardif, Valerie MC23, SE23  
 Tarimcilar, Murat MD31  
 Tarlton, Mark TB28  
 Tarp, Peter SE08  
 Tatikonda, Mohan V. TC16  
 Tavana, Majid WB10  
 Tayi, Giri Kumar MB17, MD17  
 Taylor, B. A. MD12  
 Tayur, Sridhar R. SD17, TA29, TB10  
 Tempelmeier, Horst SE17  
 Teng, Hua-Liang SD20  
 Tengs, Tammy O. TD04  
 Tenhuisen, Matthew L. TB05  
 Teo, C. P. SC05  
 Terlaky, Tamas SD05, SD12  
 Thangiah, Sam R. TE12  
 Therin, Francois J. WC16  
 Thesen, Arne MA23  
 Thienel, Stefan SC08  
 Thomas, L. Joseph TA29  
 Thomasson, Gary TB19  
 Thompson, Edward TC10  
 Thompson, Gary SC29  
 Thompson, Paul MC12, TA32  
 Tibben-Lembke, Ronald Scott MB14  
 Timmermans, Harry WC20
- Tind, Jorgen WA10  
 Tirupati, Devanath TA16, TA23  
 Tobin, Roger L. SC28  
 Tohamy, Noha MA19  
 Toint, Philippe WC07  
 Tokol, Gamze SE27  
 Tollis, Ioannis G. SA13  
 Tolliver, Rick SA30  
 Tompkins, Christopher P. TA28  
 Tong, Xing TA13  
 Topolski, Mark SA31  
 Torres, Marcelo TB07  
 Tortorella, Michael TC08  
 Toulouse, Michel SB06  
 Tovey, Craig MA05, SD13  
 Towns, Mike TE20  
 Trafalis, Theodore B. SD12, WB06  
 Trafton, Gordon MA19  
 Trappen, William F. TA24  
 Traub, Rodney MB08  
 Tretkoff, Carol WA18  
 Triantaphyllou, Evangelos SA34  
 Trick, Michael TE02  
 Trippi, Robert R. SC27  
 Trunkey, Derek WB31  
 Truszkowski, Walter MC13  
 Tsao, H.-S. J. SC18  
 Tsay, Andy MC29  
 Tseng, Paul SA07, SC07  
 Tsoukias, Alexis SB34  
 Tucci, Christopher L. MB16  
 Tuggle, Douglas D. TB25  
 Tuncel, Levent SD05  
 Tushaus, Ulrich SE34  
 Twaalfhoven, Patricia MA04  
 Tyagi, Rajesh SD17  
 Ubhaya, Vasant A. MD05, TA05  
 Ukovich, Walter TC23  
 Ulrich, Karl TA16  
 Unluyurt, Tonguc SE06  
 Upton, Stephan C. TB30  
 Urban, Timothy L. SA27  
 Usanmaz, Gokhan MB13  
 Usanic, Thaddeus W. TE19  
 Uster, Halit MB28  
 Uzumeri, Mustafa V. TA16, TD16  
 Vaideeswaran, Ganesh MC21  
 Vairaktarakis, George MB23, MD23, SD23  
 Vali, Shapoor SC27  
 van Arum, Bart MA04  
 Van der Duyn Schouten, Frank A. SE29  
 van Dijk, Wim MA08  
 Van Dyke, Carl D. MC19  
 Van Kooten, Cornelis TB33  
 Van Oyen, Mark P. SB10  
 van Ryzin, Garrett J. SA26, SB23, SC21, TE10  
 Vance, Pamela SA12, SE21, SE36  
 Vanchieri, Tony SB21  
 Vande Vate, John MA08, MA26  
 Vanthienen, Jan TC21  
 Varaiya, Pravin SD20, TB17  
 Vargas, Vicente A. TE10  
 Vasantharajan, Sriram SD14

- Vaughn, Fernando SA24  
 Vazsonyi, Andrew SE25, TA25  
 Veatch, Michael H. TA09  
 Vecchietti, Aldo SB08  
 Vedder, James N. TD27  
 Veeramani, Raj TD23, TE21  
 Veiga, G. MD15  
 Veinott, Jr., Arthur F. MC26  
 Veloso, Manuela M. TC12, TD12  
 Venkatadri, Uday MC14  
 Ventura, Jose A. TD09  
 Vepsalainen, Ari SB27, SD29, SE14, WB08  
 Verroen, Erik J. MA04  
 Verter, Vedat TA23, TD22  
 Vertinsky, Ilan TB33  
 Vicente, Luis N. WA06  
 Vickers, Jr., Ross MB31  
 Vikas, Shree TC08  
 Villalobos, J. Rene TD31  
 Villani, James MB04  
 Villeneuve, Daniel SD08, TA21  
 Vincke, Philippe G. H. SB34  
 Viniotis, Ioannis SB32  
 Visco, Eugene P. SB30  
 Viswanathan, S. MA29  
 Vlahos, Kiriakos SB24  
 Voelk, Michael TC22  
 Vohra, Rakesh MB15, SC05  
 Von Winterfeldt, Detlof TA04  
 Voss, Chris WB22  
 Voss, Stefan MD06  
 Votry-Kundich, Ken TC22  
 Vovor, Tsevi MC08, TD15  
 Wakeel, Mohammed Al MD22, TE09  
 Wakim, Nagi MD13  
 Waldron, Henry E. SC28  
 Walker, Alan MA13  
 Walker, Warren E. MA04  
 Wallace, William A. SC04, SD16, SE13  
 Waller, Steve TC20  
 Walls, Michael R. WC24  
 Walsh, Kenneth R. MB17, WA32  
 Walter, Joe WA10  
 Wan, Yat-Wah TA09  
 Wang, Chia-Li TD07  
 Wang, H. F. SE05  
 Wang, Jin-Yuan TA21  
 Wang, Kung-Jeng TD23  
 Wang, P. Patrick TD07  
 Wang, Pyng SD06  
 Wang, Tzyh-Jong MA23  
 Wang, Xiaopei TB06  
 Wang, Yashan TD29  
 Wang, Yu-Ming MC17  
 Wang, Yunzeng TC10  
 Wang, Zhongxian TA19, WD24  
 Wapman, Kenneth J. TB09  
 Warburton, Art R. SC24  
 Ward, Joseph D. MD05  
 Wardell, Whit TC20  
 Wardi, Yorai SD15  
 Ware, Keith SD08  
 Warme, David M. TA08  
 Warners, J. P. SD12  
 Wasil, Edward A. SC12  
 Wassermann, Ruth A. SB17  
 Watanabe, Yu MA32  
 Watson, Edward F. MD17  
 Watts, Diana L. SD29  
 Weatherford, Larry R. SC21  
 Webb, G. Kent WC08  
 Weber, Elke U. SC34  
 Wedley, William C. SD34, TB05  
 Wee, Liang Chee TB34  
 Wegener, Bernd F. TB31  
 Weglarz, Jan SC09  
 Wei, Guo SD09  
 Weidow, David MC13, MD13  
 Weinhardt, Christof WB21  
 Weintraub, Alexander J. SC23  
 Weintraub, Andres F. MC08, SE08  
 Weisband, Suzanne TE34  
 Weiss, Gideon MB26  
 Welch, Steve MA08, MC08  
 Wen, Chieh-Hua WB20  
 Wen, Daling WA17  
 Wen, U. P. SE05  
 Weng, Michael X. TD09  
 Weng, Z. Kevin SE22  
 Werner, Frank MB09  
 Wesolowsky, George O. MA28  
 Wessaely, Roland TC06  
 Westbrook, Jeffery TE15  
 Westerlund, Tapio SB08  
 Wets, G. TC21  
 Wey, Wann-Ming TB20  
 White, III, Chelsea C. MB14, SE14  
 White, Lawrence J. SC32  
 White, Michael MD21  
 White, Tom SB31  
 Whitler, Jason E. WB27  
 Whitman, Peter C. TC17  
 Wholey, Douglas R. TA28, TC28  
 Wiecek, Margaret M. TB05, WA10  
 Wieland, Fred MD21  
 Wiener, Peter MC21  
 Wijeratne, Ajith B. MA19  
 Wilcox, Steven P. SA31  
 Wilhelm, Wilbert E. TA08  
 Wilkinson, Jeffery TE31  
 Wilkinson, Mickey WB29  
 Willemain, Thomas R. MD25, TA27, TB25  
 Willems, Rene F. W. M. TB31  
 Willems, Sean SA26  
 Williams, Greg A. TB14  
 Williams, Ruth J. MB26  
 Williamson, Jeff TD31  
 Willis, J. MC13  
 Willoughby, Keith TE29  
 Willoughby, Roy TB31  
 Wilson, James R. MA27  
 Wilson, Sandra D. SD26  
 Windover, John R. TA20  
 Wingrove, Earl MB04  
 Winkler, Robert L. MD24  
 Witt, Stephen F. TE11  
 Wolf, Alan-Scheller SD26  
 Wollsieffer, Burris D. TD08  
 Wolstenholme, Eric MD28  
 Womer, Keith SC30  
 Wong, C. L. MA06  
 Wong, K. N. SD05  
 Wong, Richard T. SD32, SE32  
 Wood, Brian MD21  
 Wood, Michael J. WB07  
 Woodruff, David L. MA06  
 Woods, Jimmie D. SC27  
 Woroch, Glenn SC32  
 Wortman, Martin A. SA23  
 Wright, Lauren TC34  
 Wright, Lillian C. SB14  
 Wright, Ronald H. TE25  
 Wright, Russell W. SB14, WA16  
 Wrobel, Sandra TE24  
 Wu, Dongjun TB17  
 Wu, Felix TB17  
 Wu, Soon Yi MA05  
 Wu, Y. J. TC19  
 Wurgaft, Hernan TD08  
 Wusterbarth, Arlene R. SC30  
 Xia, Cathy MD09  
 Xiao, Baichun SE29  
 Xu, Jiefeng MB32, TA32  
 Xu, Jiyang MB12  
 Xu, Susan H. MB23, TD29  
 Xuereb, Jean-Marc WA16  
 Yaghubian, Arman R. SC23  
 Yakura, Elaine K. MC16  
 Yale, Karla MA12  
 Yan, David MC13  
 Yan, Dicky TE15  
 Yan, Houmin SB15  
 Yang, Rachel SA22, SB14  
 Yang, Shitao MD14  
 Yang, Ya MD09  
 Yano, Candace Arai SD14, TA29  
 Yao, David D. SA26, TD29  
 Yarrow, Leslie-Ann MA15  
 Yazgan, H. Resit TE09  
 Yen, Jin-Ru MB33  
 Yeomans, J. Scott TD09  
 Yeung, Y. C. MA06  
 Yilmaz, Mustafa R. TE19  
 Yim, Samuel WB29  
 Yoon, Moon-Gil MC32  
 Yoshimoto, Kazuho K. SC25  
 Yoshizaki, Hugo MB17  
 Young, Kevin SE31  
 Youssou, Gningue MD07  
 Yu, Gang SD09, TD18  
 Yu, Steven TA23  
 Zahedi, Fatemeh Mariam MC17, WA21  
 Zajic, Tim SE24  
 Zamora, Juan M. MC33  
 Zaric, Gregory TE04  
 Zemel, Eitan MC29  
 Zeng, Amy Z. SB29  
 Zeng, Dajun MC14, SC17  
 Zenios, Stavros A. SA04  
 Zenios, Stefanos A. TD04  
 Zhang, Alex TD29  
 Zhang, Hongtao SB15  
 Zhang, Mei MA14  
 Zhang, Rachel Q. MD29, TC29  
 Zhang, Shuren TD22  
 Zhang, Weiming MD29  
 Zhang, Z. G. WB33  
 Zhao, Wen TB21  
 Zhao, Yiqiang Q. TA07  
 Zheng, Shaohui TD29  
 Zheng, Ting MA22  
 Zheng, Yu-Sheng SC22, TB21, TC10  
 Zhou, Chao MB20  
 Zhu, Dan MD14  
 Zilbovicius, Mauro SA17  
 Ziliaskopoulos, Athanasios MB20, MC20, MD20, SE20, TC20  
 Zimniak, Arkadiusz SE09  
 Zipkin, Paul H. MD29, SC10, SD22, TC29  
 Zitron, R. WB33  
 Zobel, Christopher W. TA27  
 Zoghby, Jeriad M. TA09  
 Zozom, Jr., Andrew SC23  
 Zuckerman, Ilene TA28  
 Zuddas, Paola MB05

# DAILY PLANNER

SUNDAY	MONDAY	TUESDAY	WEDNESDAY
Session SA 8:00 - 9:30	Session MA 8:00 - 9:30	Session TA 8:00 - 9:30	Session WA 8:00 - 9:30
Break 9:30 - 10:00	Break 9:30 - 10:00	Break 9:30 - 10:00	Break 9:30 - 10:00
Session SB 10:00 - 11:30	Welcoming Session 10:00 - 11:00  Plenary Session 11:00 - 12:00	Keynote/TB 10:00 - 11:30	Session WB 10:00 - 11:30
		Edelman Award Presentation 11:30 - 12:00	
Lunch 11:30 - 1:00	Lunch 12:00 - 1:00	Lunch 11:30 - 1:00	Lunch 11:30 - 1:00
Session SC 1:00 - 2:30	Session MB 1:00 - 2:30	Session TC 1:00 - 2:30	Session WC 1:00 - 2:30
Break 2:30 - 2:45	Break 2:30 - 2:45	Break 2:30 - 2:45	Break 2:30 - 2:45
Session SD 2:45 - 4:15	Session MC 2:45 - 4:15	Session TD 2:45 - 4:15	Session WD 2:45 - 4:15
Break 4:15 - 4:30	Break 4:15 - 4:30	Break 4:15 - 4:30	Break 4:15 - 4:30
Session SE 4:30 - 6:00	Session MD 4:30 - 6:00	Session TE 4:30 - 6:00	

## AMPL: A Modeling Language for Mathematical Programming

Whether you are ready to try or ready to change, here are 6 ways we are ready to help:

### 1. BROWSE COMPASS MODELING SOLUTIONS'

**WEB SITE:** [www.modeling.com](http://www.modeling.com) to get a description of the AMPL language, information on the Windows version, AMPL Plus, and on AMPL-related solvers available through Compass. The site also describes the AMPL technical support and software maintenance services we provide.

### 2. BROWSE THE AMPL WEB

**SITE:** [www.ampl.com/ampl](http://www.ampl.com/ampl) for a wide range of information about AMPL, AMPL-related solvers, features, explanations, sample problems, and many more instructive aspects and descriptions of the AMPL language and its use.

### 3. CONTACT COMPASS

**DIRECTLY**, by e-mail at [info@modeling.com](mailto:info@modeling.com), by fax at 702/322-3030, or by phone at 702/322-7600. If you can't browse our web sites, we will mail you product information. If you're interested in using math programming languages for model

development, maintenance and enhancement, we'll also be happy to discuss the issues and problems. Also, we often can review models sent to us through FTP on the Internet.

### 4. BUY THE BOOK: "AMPL: A MATHEMATICAL PROGRAMMING LANGUAGE"

by Fourer, Gay and Kernighan (ISBN 0-534-50983-5). The \$70.95 price includes the book, the Student Editions of AMPL for DOS and AMPL Plus for Windows (with CPLEX, GRG2, MINOS and XLSOL), and a user guide. Use the web site for orders: [www.duxbury.com](http://www.duxbury.com) or contact Duxbury Press, an imprint of Brooks Cole Publishing, an ITP Company. Compass also offers extra copies of the AMPL Plus Student Edition software for classroom and laboratory use. Please contact Compass for details.

### 5. ATTEND A TWO-DAY

**AMPL SEMINAR**, offered by Compass on May 19-20 in Washington, D.C., and September

22-23 in San Francisco. The fee is \$875 for the first company registrant and \$775 for additional registrants. Educational discounts are available. Laptops are required or may be provided at an additional charge. A knowledge of math programming and modeling is highly desirable. Additional information is available on the Compass web site at [www.modeling.com/g-events.htm](http://www.modeling.com/g-events.htm). Contact Melodee Heeger at Compass for registration.

### 6. ATTEND THE ADVANCED AMPL TUTORIAL

with AMPL developers Professor Robert Fourer and Dr. David Gay, also hosted by Compass on Sunday evening, May 4, during the INFORMS Conference. Designed for those familiar with AMPL, or with another math programming language, the complimentary session will cover AMPL's new features and syntax, as well as the advanced modeling techniques it makes possible. Registration is required. Please contact Melodee Heeger at Compass.

## COME VISIT US AT BOOTH A2

*AMPL: complete, powerful, flexible, efficient...a better solution to generate or improve large and/or complex models...with Compass support. And there's no better time to start.*



PHONE 702/322-7600

FACSIMILE 702/322-3030

E-MAIL [info@modeling.com](mailto:info@modeling.com)

WEB [www.modeling.com](http://www.modeling.com)

Compass Modeling Solutions Inc. • 1005 Terminal Way, Suite 100 • Reno, NV 89502

**Pointing The Way To Better Solutions**

## INFORMS San Diego - Master Track Schedule

	8-9:30	10-11:30	1-2:30	2:45-4:15	4:30-6	8-9:30	1-2:30	2:45-4:15	4:30-6	8-9:30	10-11:30	1-2:30	2:45-4:15	4:30-6	8-9:30	10-11:30	1-2:30	2:45-4:15		
	SA	SB	SC	SD	SE	MA	MB	MC	MD	TA	TB	TC	TD	TE	WA	WB	WC	WD		
1-San Diego	N/A		IS&T Conference							Keynot										
2-Golden West	N/A		IS&T Conference							C.S.		Computer Science								
3-California	Job Placement Center																			
4-Helix	Data Env Anal		Public Programs							Public Sector										
5-Council	Linear Programming												P.M.		Soc Sci Apps					
6-Chamber	Combinatorial Optimization										I. P.		Global Optimization							
7-Cabinet	Non-linear Programming										Queuing Systems			Quality			NLP			
8-Forum	Integer Programming										Business Applications				BPR					
9-Senate	IS&T		Scheduling							Machine Scheduling										
10-Committee	Production Scheduling				Stochastic Programming				Supply Chain				Multi Criteria							
11-Sheffield	Edelman Competition				Roundtable				Tourism											
12-Padre	Computer Science																			
13-Sierra	Computer Science																			
14-De Anza	NPD		Material		Plng		Logistics				Environment				Forecas					
15-Mesa	OrgThry		Production Control			DynPgm		Network Flows												
16-Adobe	Technology Management																			
17-El Camino	Operations Management				Information Systems				Energy				Econ							
18-Sunrise	TUTORIALS																			
19-Sunset	IS&T		RASIG Round Table			RASIG			Optimization			Group Decision		Prod	Tut					
20-Stratford	Transportation																			
21-Esquire	Aviation								Transportation		Artificial Intelligence									
22-Dover	Flex Mfg.		Manufacturing						Global Manufacturing											
23-Towne	Manufacturing & Service Management										Flex Manufacturing Systems				DA					
24-Friars	Decision Analysis																			
25-Hampton	Education																			
26-Windsor North	Applied Probability																			
27-Parliament	Marketing		Simulation						Stoch		Strategic Planning				Telecomm					
28-Executive	Location Analysis							Health												
29-Congress	Service Management				Inventory Management														Mil Apps	
30-Garden North	Military Applications																			
31-Garden South	Military Applications																			
32-Le Pavillon	Telecommunications																			
33-WindsorSouth	Workshops				OR Applications				Forestry				Reliability							
34-Del Mar	Choice Engineering								NSF		Management Information Systems									
36-Le Sommet			New Members		Women															
37-Pavillon Lounge	Nicholson																			

The Welcoming Session (WS35), 10:00-11:00am, and Plenary Session (MP35), 11:00am-12:00 noon, are scheduled for Monday in the Town and Country Room