

FINAL PROGRAM

informs *Institute for Operations Research
and the Management Sciences*



Dallas

The Evolving Synergy •
OR/MS and Digital Technology.



www.informs.org/Conf/DAL97/

INFORMS Dallas • Fall October 26-29, 1997

INFORMS DALLAS FALL 1997

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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.

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WELCOME FROM THE GENERAL CHAIR

To the members of INFORMS, guests and other attendees, let me welcome you to Dallas and the great state of Texas. The Dallas '97 meeting starts early on Sunday, October 26, with a full slate of technical sessions and continues through Wednesday noon with nonstop activities. Approximately 470 technical sessions will be held with over 1,600 individual presentations. Twenty tutorials are scheduled, and we are pleased to have George Kozmetsky and Bill Cooper for plenary speakers. The Beale Keynote Address is given by A. H. Christer and the Edelman Keynote address presents the winner of the spring Edelman competition for the practice of OR/MS. Certainly professionals in Operations Research or Management Science, persons interested in the application of the OR/MS methods in practical settings, students hoping to join the profession or individuals just wondering what this field is about will find plenty to do.

Throughout program we have illustrations of the theme of the meeting, "The Evolving Synergy ~OR/MS and Digital Technology". There is no question that our field is growing and thriving right along with explosive developments in digital technology. This is particularly illustrated by the new areas such as telecommunications, but the contributions of computers are no less apparent in the methodology areas such as integer programming.

I am particularly pleased with the balance in the program between the focus of our logo, Applications, Education and Research. We have particularly strong sessions stressing applications in transportation, manufacturing, health, management, telecommunications and the military. One track running through the entire meeting is concerned with education. Training workshops will be held before and during the meeting. We preserve our traditional link to theory through a variety of tracks emphasizing research in methodology.

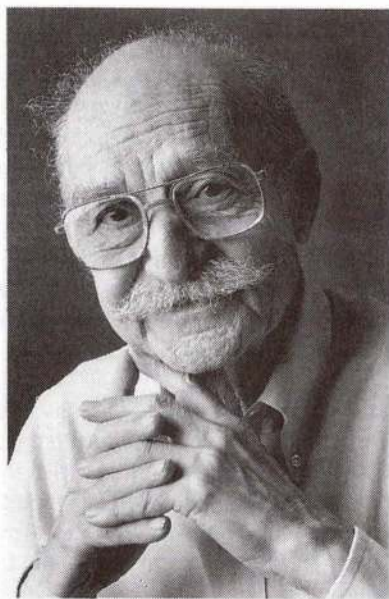
The Hyatt Regency is very attractive and its meeting rooms are large, ensuring that participants will find a pleasant experience in living areas and meeting facilities. In addition to the technical program, there are many opportunities for making and renewing contacts within the profession. Students are especially accommodated with activities hosted by the Student Activities Committee including a room designated for students to gather. We welcome spouses and other guests to the guest program. The Exhibit Area and an Employment Program allow interaction with commercial businesses and potential employers. The General Reception, held in the Union Station adjacent to the hotel, emphasizes a Southwestern and Texas theme through Tex-Mex food, barbecue and a taste of country-western music. Don Walser and his Pure Texas Band provide the entertainment. For those prone to wander away from the hotel, the Dallas area offers many alternative diversions.

For the members of the local committee this is the culmination of two years of effort, and I'm sure that all be relieved at its passing. My thanks to each one of you for your support. Of particular note are the efforts of Jon Bard and Patrick Jaillet in organizing the program, Andy Boyd in recruiting the tutorial speakers and Jeff Kennington, who is handling the Dallas arrangements. Many of you have spoken to our secretary Linda Hallidy, supported by the Mechanical Engineering Department at the University of Texas. She has been the glue holding it all together.

One lasting impression for me is the large number of people involved in the planning and implementation of this meeting. The INFORMS Meetings Committee led by Tom Gulledge provides the policies and carries the collected wisdom associated with more than fifty years of meetings. The INFORMS Rhode Island Office provides invaluable staff support lead by Julie Eldridge and Ginni McGee. The many cluster chairs, session chairs and the invited and contributed paper authors provide the basis for our technical program. In addition we have keynote and plenary speakers, exhibitors, student assistants and meeting staff. This meeting is in fact the culmination of the efforts of approximately 1700 people which comprise the majority of the attendees. Thanks to all of you. If the meeting is a success, it is due to your efforts.

MEETING DEDICATION: ROBERT HERMAN (1914-1997)

We dedicate this meeting to the memory of Robert Herman who died in Austin Texas, on February 13, 1997. Dr. Herman had a long and distinguished career in many diverse areas, but we especially appreciate his contributions to the field of OR. Many of us knew Bob as a thoughtful and caring person, and we will miss him. The Transportation Science Track (Track 11) will hold a tribute to his memory during the MD and ME sessions.



Robert Herman was born August 29, 1914, in New York City. He graduated cum laude and with special honors in physics from the City College of New York in 1935. His graduate work was pursued at Princeton University and, in 1940, he was awarded the MA and PhD degrees in Physics. He left teaching at City College of New York to join the war effort at the Department of Terrestrial Magnetism, the Carnegie Institution of Washington and at the Applied Physics Laboratory of The Johns Hopkins University. He later served as the head of the Chemical Physics Group of the Research Center, assistant to the director and physicist and member of the Principal Staff.

Dr. Herman joined the General Motors Research Laboratories in June 1956. In February 1959, he was appointed Head of the Theoretical Physics

Department and later Head of the Traffic Science Department. He held this position until 1979 when he became General Motors Research Fellow. In September of 1979, Dr. Herman joined the faculty of The University of Texas at Austin as Professor of Physics in the Center for Studies in Statistical Mechanics, and LP Gilvin Professor in Civil Engineering.

Dr. Herman's research covered a wide range of both theoretical and experimental investigations in physics, astrophysics, cosmology, OR, vehicular traffic flow, as well as neurophysiology and musical acoustics. In collaboration with Ralph A. Alpher and George Gamow, he initiated a theory of the origin and relative abundance of the chemical elements in a relativistic "Big Bang" expanding universe. In recognition of this work, Herman & Alpher were awarded the Henry Draper Medal from the National Academy of Sciences in 1993. They also received the John Price Wetherill Gold Medal of The Franklin Institute in 1980 and the New York Academy of Sciences Award in Physical and Mathematical Sciences in 1981.

Dr. Herman was a pioneer in the rapid development of the field of vehicular traffic science. He made significant contributions to the areas of single lane traffic flow and multiple lane traffic flow. With Ilya Prigogine, he developed a Boltzmann-like kinetic theory of multi-lane traffic flow which provides what is perhaps the best description up to this time of this complex traffic situation. He developed a 2-fluid model of town traffic which, coupled with observation, provides a description of vehicular traffic in an overall macroscopic sense. This urban traffic model has been used effectively to determine the quality of traffic and the traffic system in various cities around the world. In 1959, Dr. Herman organized a General Motors

Research Laboratories symposium on the theory of traffic flow, the first international gathering of its kind on this subject. He was involved in the organization of the subsequent symposia held under various auspices around the world. The 10th symposium in this series, "The 10th International Symposium on Transportation and Traffic Theory," was held in his honor at The Massachusetts Institute of Technology in July, 1987.

Dr. Herman was an associate editor of the *Reviews of Modern Physics*; was one of the founders of the Transportation Science Section of ORSA and also became its first chairman as well as the founding editor of its journal, *Transportation Science*. Among many other committees, he served as the Chairman of the Special Task Force on OR and as Chairman of the Special Task Force on Fundamental Research in Transportation.

In 1959, Dr. Herman was co-recipient of the Lanchester Prize in OR for pioneering research on the stability and flow of single-lane traffic. In 1963, he was awarded an honorary medal by the Universite Libre de Bruxelles for his contributions to the advancement of knowledge, and during that same year received the Townsend Harris Medal from the Alumni Association of the City College of New York as a distinguished alumnus and for his scientific contributions.

During 1975, he was honored by being appointed Regents' Lecturer at the University of California, Santa Barbara; and ORSA, during 1976, awarded Dr. Herman the George E. Kimball Medal for distinguished service to the Society and to the profession of OR.

He was elected to the National Academy of Engineering in 1978 for his contributions to the science

of vehicular traffic. In 1979, he was elected a fellow in the mathematical and physical sciences of the American Academy of Arts and Sciences. He served as the President of ORSA (1980-1981).

Dr. Robert Herman presented the Smeed Memorial Lecture, "Characterizing Traffic Conditions in Urban Areas" at University College London, May 12, 1983. He was designated the Philip McCord Morse Memorial Lecturer of the Operations Research Society of America (1989-1991) as well as National Science Council, Republic of China, Lecturer, 1990.

In 1984, he was awarded an Honorary Doctorate in Engineering by the University of Karlsruhe in recognition of his outstanding research in the mathematical foundations and development of the theory of traffic flow. He received the first Lifetime Achievement Award of INFORMS Transportation Science Section for his body of work on vehicular traffic science in 1990. The award was subsequently renamed the Robert Herman Lifetime Achievement Award.

In 1993, he was awarded the John Von Neumann Theory Prize for contributions to the theory of OR/MS by ORSA and TIMS. Also in 1993, he received the Roy W. Crum Distinguished Service Award of the Transportation Research Board for "his pioneering contributions to the field of traffic science".

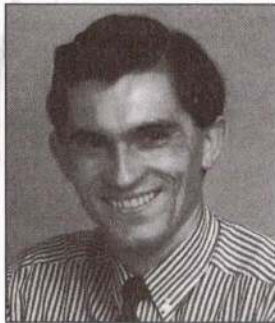
Dr. Herman is the author of a large number of scientific papers in a variety of fields, the editor of several symposium proceedings and the co-author of two books, *High Energy Electron Scattering Tables* (with R. Hofstadter) and *Kinetic Theory of Vehicular Traffic* (with I. Prigogine).

Dallas Local Committee



Front (L to R): Linda Hallidy, Paul Jensen, Elmira Popova
Back (L to R): Betsy Greenberg, Jon Bard, Bruce Colletti, Andy Boyd
Not Pictured: Doug Morrice, Barry Smith

From left to right:
Patrick Jaillet
G.K. Kalyanaram
Jeff Kennington





CITY OF DALLAS

RONALD KIRK
Mayor

Greetings,

On behalf of the citizens of Dallas and my colleagues on the Dallas City Council, it gives me great pleasure to welcome the participants of the Institute of operations Research and the Management Sciences (INFORMS) conference to Dallas. We are excited to be your host city and look forward to making your visit memorable.

Dallas has an especially rich cultural life and a distinctive "can do" spirit. I invite each of you to enjoy our beautiful city and the many places and attractions that offer the best shopping, food and entertainment anywhere. We have a world-class symphony, art museum and many fine theaters and art galleries. Dallas has something for everyone.

I hope that you will discover every reason why Dallas is among the most popular cities in the nation for tourists. I wish you a successful and enjoyable conference and encourage you to visit our city again in the future.

Sincerely,

Ronald Kirk
Mayor

RK/bm



STATE OF TEXAS
OFFICE OF THE GOVERNOR

GEORGE W. BUSH
GOVERNOR

May 16, 1997

Greetings:

Welcome to Dallas and to the Institute for Operations Research and the Management Sciences (INFORMS) conference. This October 26-29, 1997, event is a wonderful opportunity for people to meet, exchange ideas and enhance knowledge.

Expertise in the computer-related fields has become a vital part of our society. By providing a forum to explore "The Evolving Synergy" INFORMS enables professionals to increase student's access to technology, create and implement software applications, and forge new paths in research.

To those of you from out of town, welcome to one of our finest cities. Take time to sample the fine cuisine and entertainment, and enjoy the museums and parks that Dallas has to offer.

Best wishes for a successful conference.



Sincerely,


GEORGE W. BUSH

SCHEDULE OF SPECIAL EVENTS

FRIDAY, OCTOBER 24

CPMS Practice Issues Forum Registration & Reception

ROOM

Cottonbowl

FROM TO

8:00pm 9:30pm

SATURDAY, OCTOBER 25

CPMS Practice Issues Forum

Duncan A/B

8:00am 6:30pm

CPMS Practice Issues Forum Lunch

Parlor 357

12noon 1:00pm

Workshop: OR for the Deregulated Power Industry

Brisbane A/B

1:00pm 5:00pm

INFORMS Board Executive Committee

President's Suite

2:00pm 6:30pm

Conference Registration

Concourse

4:00pm 8:00pm

CPMS Practice Issues Forum Dinner/Reception/Meeting

Latimer A

6:30pm 10:00pm

SUNDAY, OCTOBER 26

Conference Registration

Concourse

7:30am 5:00pm

Workshop: Teaching MS Using Spreadsheets

Brisbane B

8:00am 12noon

INFORMS Board Meeting

Stationmaster

8:00am 6:00pm

Organization Dissertation Award

Dealy

8:00am 6:00pm

INFORMS New Member Welcome & Meeting Orientation

Duncan A

10:30am 12noon

Workshop: Practical Approaches to Simulation Validation

Brisbane B

1:00pm 5:00pm

Railroad SIG Roundtable

Cotton Bowl

1:00pm 5:00pm

Beale Keynote Address - Anthony H. Christer

Reunion E-F

1:15pm 2:15pm

Edelman Keynote Address - SNCF

Reunion G-H

1:15pm 2:15pm

Military Applications Society Council Meeting

Mtgs. Comm. Suite

5:00pm 7:00pm

Organization Dissertation Reception

Reunion E

6:00pm 8:00pm

Roundtable Reception/Dinner

Club Car

6:00pm 8:00pm

MSOM Reception

Regency B

6:15pm 7:15pm

Minority Forum

Colonnade A

6:15pm 7:15pm

Consulting Forum

Colonnade B

6:15pm 7:15pm

Statistics & Quality Section

Colonnade C

6:15pm 7:15pm

Revenue Management Section

Colonnade D

6:15pm 7:15pm

INFORMS Online Meeting/Reception

Duncan A

7:00pm 9:00pm

Forum on Women in OR/MS Reception

Cascade B

7:00pm 9:00pm

Student Reception

Cascade A

7:00pm 9:00pm

Roundtable Meeting

Dealy

8:00pm 11:00pm

MONDAY, OCTOBER 27

INFORMS Board/Editors/Comm. Chair Breakfast

Brisbane B

7:00am 8:00am

Conference Registration

Concourse

7:30am 5:00pm

Roundtable Meeting

Club Car

7:30am 5:00pm

Teacher Program

Dealey

8:00am 5:00pm

Guest Breakfast

Fausto's Oven

8:30am 9:30am

INFORMS Board Meeting

Stationmaster

8:30am 5:00pm

Welcoming Session & Awards

Reunion E-F

10:00am 11:00am

Invited Plenary - George Kozmetsky

Reunion E-F

11:00am 12noon

MSOM Senior Editors Meeting

Regency A

12noon 1:00pm

Roundtable Lunch

Fausto's Oven

12noon 1:00pm

Operations Research: Area Editors' Meeting

Presidents

12noon 1:30pm

Education Committee Meeting

Publications Suite

12:30pm 1:30pm

Section/Society/Fora Officers Meeting & Reception

Club Car

5:15pm 6:45pm

CPMS Isolated Practitioner Workshop

Regency B

6:15pm 7:15pm

INFORMS General Reception

Grand Hall

7:30pm 10:30pm

TUESDAY, OCTOBER 28

Chapter Officers Breakfast

Fowler

7:00am 8:00am

Conference Registration

Concourse

7:30am 5:00pm

TUESDAY, OCTOBER 28 (continued)

Chapter Subcommittee Meeting	Presidents	8:00am	9:00am
CPMS Council Meeting	TBD	8:00am	12noon
Guest Breakfast	Fausto's Oven	8:30am	9:30am
Omega Rho Distinguished Plenary	Reunion E-F	11:30am	12:30pm
Membership Committee Meeting	Duncan A	12noon	2:00pm
Subdivision Committee Meeting	Presidents	12:30pm	3:00pm
INFORMS Business Meeting	Cascade B	7:30pm	8:30pm

WEDNESDAY, OCTOBER 29

Conference Registration	Concourse	7:30am	12noon
Guest Breakfast	Fausto's Oven	8:30am	9:30am

SCHEDULE OF SUBDIVISION BUSINESS MEETINGS

SUNDAY, OCTOBER 26

	ROOM	FROM	TO
College on Information Systems	Duncan B	6:15pm	7:15pm
Section on Location Analysis	Regency C	6:15pm	7:15pm
Section on Logistics	Cotton Bowl	6:15pm	7:15pm
Management Control Systems	Directors	6:15pm	7:15pm
Management of Productivity & Technology	Bryan A	6:15pm	7:15pm
Railroad Applications SIG	Reunion B	6:15pm	7:15pm
Technical Section on Telecommunications	Fowler	6:15pm	7:15pm

MONDAY, OCTOBER 27

ACORD	Brisbane B	12noon	1:00pm
Forum on Women in OR/MS	Duncan A	12noon	1:00pm
Applied Probability Section	Colonnade A	6:15pm	7:15pm
Aviation Applications Section	Reunion E	6:15pm	7:15pm
Computer Science Technical Section	Colonnade H	6:15pm	7:15pm
Decision Analysis Society	Reunion G	6:15pm	7:15pm
Finance Section	Fowler	6:15pm	7:15pm
Group Decision & Negotiation Section	Sanford	6:15pm	7:15pm
Health Applications Section	Latimer A	6:15pm	7:15pm
Manufacturing & Service Operations Management	Regency A	6:15pm	7:15pm
College of Marketing	Directors	6:15pm	7:15pm
Military Applications Society	Reunion F	6:15pm	7:15pm
College on Organization Science	Bryan B	6:15pm	7:15pm
Technology Management	Bryan A	6:15pm	7:15pm
Transportation Science Section	Cascade B	6:15pm	7:15pm

TUESDAY, OCTOBER 28

Accounting, Auditing & Tax Section	Bryan B	6:30pm	7:30pm
College on Artificial Intelligence	Colonnade C	6:30pm	7:30pm
Section on ENRE	Fowler	6:30pm	7:30pm
Forum on Education	Reunion H	6:30pm	7:30pm
Optimization Section	Colonnade F	6:30pm	7:30pm
Public Programs & Processes Section	Latimer A	6:30pm	7:30pm
College on Simulation	Duncan A	6:30pm	7:30pm
Social Science Applications Section	Reunion C	6:30pm	7:30pm

GENERAL INFORMATION

Climate - Dallas has a mild climate in October. Temperatures in the day average in the high 60s and drop to the high 40s overnight. Rainfall is moderate.

Dallas - Dallas is the 8th largest city in the United States. It is a city of contrasts: a little bit of country, a touch of western and a south-of-the-border flavor blended with soaring skyscrapers and neon lights. In 1841, Dallas was a settlement of just 2 log cabins. Today it is the business capital of the Southwest and houses the 3rd largest concentration of corporate headquarters and high-tech companies in the country.

Dallas boasts more restaurants and shopping centers per capita than New York City. The hotel for the meeting is the Hyatt Regency, a very modern building adjacent to an elevated rotating bar and restaurant and the Reunion sports arena. The hotel is located in the heart of downtown's historic West End District where you'll find more than 80 shops and 55 restaurants, street mimes, horse and buggy rides and nightly live musical entertainment. A light rail station is connected to the hotel with transportation throughout the city. Dallas has plentiful arts districts, museums, galleries and a superb symphony center. Sports play a key role in the city's off-hours entertainment. This is home base for the Dallas Cowboys, the Mavericks basketball team, the Texas Rangers baseball team, the Stars hockey team and the Sidekicks soccer team. Within walking distance from the hotel is the Sixth Floor Museum located at the former Texas School Book Depository, the site of the Kennedy assassination. Numerous theme parks, natural parks and lakes provide ample opportunities for relaxation.

E-Mail Centers - So as not to miss the many e-mails that we are all flooded with, e-mail terminals will be set up in the Pullman Room in Union Station to check for messages.

Exhibits - Exhibits will be located in the Colonnade Exhibit Hall. Leading software developers and publishers will showcase the latest software products, technical reference materials and specialized services. Exhibit hours will be:

Sunday	1:00pm	5:00pm
Monday	9:00am	5:00pm
Tuesday	9:00am	5:00pm
Wednesday	9:00am	12noon

Companies interested in exhibiting may contact Cynthia J. Rinaldi at 800-343-0062, ext. 203 or via e-mail at cynthia.rinaldi@informs.org.

Hotel Information - The Hyatt Regency Dallas at Reunion is the official headquarters for the INFORMS Fall Meeting. A block of rooms has been reserved for attendees; conference rates are \$115 single, \$130 double, \$150 triple, \$170 quad. Space is limited and may not be available after **September 23**. Call 800-233-1234 or 214-651-1234 for reservations or fax the reservation form to the hotel at 214-712-7217.

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

Job Placement Service - The INFORMS Job Placement Service, 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 Fall Dallas 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.

Presentation Database - In its efforts to enhance electronic services to its membership, INFORMS is creating a new Web-based database of presentations related to OR/MS. Why waste your beautiful slide shows on a single performance? Why not make them available to the 12,000 INFORMS members who do not attend your presentation? And to many times that number around the world?

There is now an easy way to do this: the INFORMS Database of Presentations in OR/MS. This site is currently being developed by Professor Ramesh Sharda of Oklahoma State University, sharda@ok-state.edu.

If you have presentation-related materials on-line, you can add the URL to the database. If your materials are not already on-line but are in a Web-friendly format - preferably HTML, PowerPoint, Adobe's portable document format (pdf), or postscript -- then INFORMS will host the file for you. And for at least the next year or so, INFORMS will even convert your materials to one of these formats provided that you are a full-time practitioner.

Check out the URL <http://www.informs.org/Presentation/>, and add your presentation to the database.

Professional Lounge - Network and share experiences, ideas and solutions with other professionals - or, just relax. Refreshments will be available. The lounge, in the Colonnade Exhibit Hall, will be open Sunday, 1:00pm - 5:00pm, and Monday and Tuesday, 9:00am - 5:00pm.

Registration -

- **Cancellations & Refunds** - Payments will be refunded **only** if a written cancellation is received in the INFORMS Rhode Island postmarked no later than October 22. Cancellations may also be faxed to 401-274-3189 or emailed to meetings@informs.org and **must** meet this deadline.

- **On-Site Registration** - Meeting registration will be located on the Concourse-Lobby Level during the following hours:

Saturday, 10/25	4:00pm - 8:00pm
Sunday, 10/26	7:30am - 5:00pm
Monday, 10/27	7:30am - 5:00pm
Tuesday, 10/28	7:30am - 5:00pm
Wednesday, 10/29	7:30am - 12noon

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 SESSION CHAIRS AND SPEAKERS, MUST REGISTER AND PAY THE REGISTRATION FEE.**

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

pensive, quicker and easier than on-site registration. Complete the pre-registration form and mail it to INFORMS Dallas, 2 Charles Street, Suite 300, Providence, RI 02904 on or before **October 1**. Fees may be paid by credit card (AMEX, MasterCard or VISA - fax to 401-274-3189) or by check or money order, payable to INFORMS Dallas '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 is firm; all payments postmarked after the October 1 deadline will be charged the full, on-site registration fee.** Registration materials may be picked up in the registration area on the Concourse-Lobby Level.

• Rates

	<u>By 10/1</u>	<u>After 10/1</u>
INFORMS Members	\$180	\$205
Non-Members	\$220	\$245
Student/Retired	\$65	\$65
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 no later than 2 weeks before the meeting.

Transportation - DFW International Airport serves all major carriers and Dallas Love Field serves Southwest Airlines. The Hyatt Regency Dallas (300 Reunion Boulevard) is 23 miles from DFW and taxi fare is approximately \$35. The Hyatt is 7 miles from Love Field and taxi fare is approximately \$12. A Super Shuttle bus is available from both airports for a fare of \$11. From DFW, use the courtesy phone in the baggage claim area to obtain instructions on where to meet bus. From Love Field, make a reservation by calling 1-800-258-3826. After you arrive use the courtesy phone in the baggage claim area to get instructions on where to meet the bus. From Love Field, second person in a party of 2 travels for \$6. If you rent a car at DFW, take the South airport exit, 183 East to Dallas. Highway 183 merges with 35E South. Take the Commerce Street/Reunion Blvd. exit. Next take a right on Houston and a right on Reunion. Valet parking is \$12/day at the Hyatt. DART light rail service is available for those traveling in Dallas. From the North take the Red Line to Union Station and the tunnel to the Hyatt. DART rail fare is \$1.

Travel Arrangements - Get there for less! Call our official travel agency, Conventions in Amer-

ica at 1-800-929-4242, 619-453-3686, FAX 619-453-7976 and ask for **Group #560**, M-F, 6:30am-5:00pm, Pacific Time. You will receive 5%-10% off the lowest applicable fares on **American Airlines**, or the lowest available fare on any carrier. Travel between October 22 - November 1, 1997. All attendees booking through CIA will receive free flight insurance and be entered in their quarterly drawing for domestic travel for 2! Alamo Rent A Car is also offering special rates with unlimited free mileage and bonus frequent flyer miles. To call direct: American, 1-800-433-1790 and ask for Starfile # 3407UC or Alamo, 1-800-732-3232, ID# 269720 GR.

GUEST PROGRAM

Breakfast - A registration fee of \$25 includes a continental breakfast Monday - Wednesday, 8:30 - 9:30am, as well as the General Reception on Monday. Guests may register by using the registration form in this Program. The breakfasts are limited to registered guests only and guests must wear the name badges for admittance.

- **A Special Treat** - Mary Vernon, a painter and a professor of art at the Southern Methodist University, an exhibitor in 7 solo and 30 group exhibitions and a speaker who lectures nationally on art and artists will speak on Tuesday at the breakfast. The topic will be "The Unfathomable Human Body: Is Fashion a Plot to Make Us All Look Bad? Or Is it Something We Have Done to Ourselves?"

Tours

- **History of Dallas, Monday, October 27, \$48**

At 10:00am, the group will be met at the hotel to begin a day of sightseeing in Dallas. Our first stop will be the 6th Floor Exhibit for a look at the event that moved the world, the assassination of President Kennedy. The exhibit depicts JFK's life, legacy and the impact his life and death had on the world. Tour members may also take a brief stroll on the grassy knoll and get a glimpse of where the motorcade traveled. Next, the group will enjoy a delightful lunch at Landry's, located in the West End Historic District. This area is known for its nightlife and offers a variety of restaurants and shops. After lunch, depart for a Dallas city tour, featuring John Neely Bryan's log cabin (the founder of Dallas), Old Red Courthouse, Pioneer Plaza, Dallas City Hall, Dallas Farmers Market, Old City Park, the original Neiman Marcus store,

Arts District, Morton H. Meyerson Symphony Center and more. Estimated return is 4:00pm.

- **Cultural Highlights Tuesday, October 28, \$32**

At 1:00pm, the group will begin an unforgettable afternoon of cultural highlights. Start with a behind the scenes look of the Morton H. Meyerson Symphony Hall (depending on availability) to learn why this world class state-of-the-art facility is known for its acoustics, organ and fine features. Next, visit the Dallas Museum of Art in Dallas' 60-acre downtown Arts District. We will see collections encompassing nearly every culture in human history. The Museum houses important collections of European and American paintings and sculpture, postwar American arts, decorative arts, Asian, pre-Columbian and African art. The Museum also features the Wendy Reves Exhibit. Then, continue on to the African-American Museum in Fair Park to explore the African-American experience through numerous exhibits and displays, historical artifacts, art and folk art, a Texas black women's archive and a black religious center. Estimated return is 5:00pm.

SPECIAL EVENTS

- **CPMS Isolated Practitioner Workshop** - CPMS, The Practice Section of INFORMS, sponsors workshops on topics of interest to isolated practitioners, i.e. Lone Rangers, of OR and MS. The 11th workshop in this series to be held at INFORMS meetings will address timely issues affecting the growing isolated practitioner community. All are welcome to come and participate in this workshop and discussion Monday, October 27, 6:15-7:15pm in Regency B.

Forum on Women in OR/MS

- **Business Meeting & Luncheon** - The Business Meeting & Luncheon will be held at lunchtime, Monday in the Cascade B Room. Everyone interested in issues related to women in OR/MS is invited to attend. Bring a bag lunch and join us 12-1:00pm.

- **Reception** - The Reception for the INFORMS Forum on Women in OR/MS will be held from 7:00-9:00pm on Sunday in the Cascade B Room. This is a good opportunity to meet women researchers and practitioners in OR/MS. Everyone is welcome. The reception is sponsored by The Optimization Center at IBM's T.J. Watson Lab.

General Reception - All participants and their registered guests are invited to attend the INFORMS General Reception on Monday evening, October 27 from 7:30-10:30. The General Reception will be held in the Union Station featuring Tex-Mex food and drink. Don Walser's Pure Texas Band will provide music at the reception from 8:30-10:30pm and we plan to have two-step lessons for members and guests. *For admittance, please present the ticket found in your registration packet.*

Membership Meeting - The INFORMS General Membership Meeting will be on Tuesday, October 28, 7:30-8:30pm in the Cascade B Room. Wine and cheese will be offered and the INFORMS Board Members and Officers will provide the entertainment.

Omega Rho Plenary - The Omega Rho Plenary, "Expanding OR/MS to New Dimensions of Use & Research: From "Ex Ante Planning" to "Ex Post Evaluation & Control" will be presented by William W. Cooper on Tuesday, October 28 in Reunion E-F from 11:30am-12:30pm. Prior to the presentation, Professor Cooper will be inducted as the 26th Honorary Member of Omega Rho.

Practice Issues Forum - CPMS, the Practice Section of INFORMS, announces that its highly regarded Practice Issues Forum will address issues relevant to changing information technology and its impact on management science practice. Ample opportunities will be provided for networking with fellow OR/MS professionals. Attendance will be limited to 30 conferees to ensure a casual and informal atmosphere conducive to personal interactions. Saturday, October 25 from 8:00am-6:30pm in Duncan A/B.

Student Program - The program of the Student Activities Committee addresses the social, professional and academic interests of student attendees. An initiative for students, by students, that complements the efforts INFORMS always makes for student attendees.

The program has 5 parts: a Sunday panel discussion on student chapter concerns; Sunday talks on professional and academic interests, a Sunday evening Student Reception (hosted by INFORMS), a dedicated suite in which students and industry can mingle and social activities to be announced at the meeting. Special sessions of interest to students will be held on Sunday in Track 26.

- SA26 The Importance of Student Chapters in our Community
- SB26 What's Hot in Operations Research
- SD26 Professional Program
- SE26 Academic Program

For further information, contact any Committee member or visit our website at <http://uts.cc.utexas.edu/~bibo>: **Bruce Colletti**, Coordinator, bcolletti@mail.utexas.edu, 512-471-1336; **Astrid Kenyon**, Professional Program, leuba@posse.me.utexas.edu; **Chris Kenyon**, Academic Program, cmkenyon@mail.utexas.edu; **G.V. Ramanan**, Programs Deputy, gvr@mail.utexas.edu; **Sobhi M. Mahmassani** Publicity and Webmaster, bibo@mail.utexas.edu.

Student Reception - Hosted by INFORMS, this reception is open to all student attendees Sunday, October 26, 7:00-9:00pm in the Cascade A Room. Come network with other students (and others who drop by) in a forum that serves free food and drinks. An optimal way to cap off a long day. *For admittance, please present the ticket found in your registration packet.*

Welcoming Session & Awards - The Welcoming Session will feature opening remarks by **Art Geoffrion**, President of INFORMS, and **Paul Jensen**, General Chair of the Dallas meeting. The following awards and prizes will be given: the *George B. Dantzig Dissertation Award*, the *George E. Kimball Medal*, the *Philip McCord Morse Lectureship*, the *Lanchester Prize*, the *INFORMS Prize* and the *INFORMS Expository Writing Award*.

TECHNICAL PROGRAM

INFORMS New Member Welcome and INFORMS Meeting Orientation!

Is this your first INFORMS Meeting? Are you new to INFORMS? We would like to welcome you and help you discover the many benefits of INFORMS, and most importantly, how to get the most out of the INFORMS Meeting in Dallas. We will help you to discover things that are valuable to you at the INFORMS Meeting, e.g., technical information, applications, networking opportunities, social opportunities, job opportunities, etc. and how to find them. 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. We will answer your questions about our 10 journals, about our individual member benefits such as life, disability, and health insurance, credit card, internship programs, and job placement services. We will introduce you 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? We will provide the answers to these questions and more. This workshop will also give you a chance to meet some INFORMS leaders, to learn more about the Institute, and to get answers to all of your questions about the Institute.

Whether you are a new member or an experienced INFORMER, you will learn something new about INFORMS Meetings and the Institute. (It is also a good way to get a discount coupon for many of the Institute's products.) The workshop will be held on Sunday, October 26, 10:30am - 12noon in the Duncan A Room. We look forward to seeing you.

Plant Tours

• Hewlett-Packard, Monday, October 27 - \$15

In December 1995, Hewlett-Packard acquired Convex Computer Corporation, located in Dallas, Texas, to extend its technical computing solutions from the desktop to scalable parallel-processing systems. HP is now the only vendor offering scalable, binary-compatible, technical computing solutions with shared memory and message-passing capabilities, from desk-tops to supercomputers. While touring the Convex Division of HP, you will see a modern manufacturing facility utilizing state-of-the-art manufacturing and material management strategies. Software systems are utilized for product tracking, quality data entry, on-line documentation generation and documentation management. The factory has a modern circuit board assembly process, electro-mechanical assembly and a system configuration and test operation. Minimum material storage is present due to the utilization of demand flow technology in the material and supplier strategies.

• Bell Helicopter Textron, Tuesday, October 28 - \$15

The tour will visit 3 areas: the first part of the tour will be the final assembly line for the Army's OH-58D Kiowa Warrior armed reconnaissance helicopter and the Marines' AH-1W SuperCobra attack helicopter. Here you will see how these helicopters are assembled and the high-tech equipment used. Bell's final assembly line is claimed to be world class. From here you will tour the composite area where parts for the V-22 Osprey tiltrotor aircraft are made, including some radically new computer-driven manufacturing devices. Finally, you will visit Bell's Hall of Heritage where Bell's history is displayed in photos, videos, models and artifacts. The Hall highlights Bell's initial move in vertical flight in the early 1940s.

Teacher Program - The

middle/high school and community college math and science teachers program will be composed of introductory OR and computer application workshops. An introduction to OR/MS will be presented, followed by probability modeling, computer simulations, queueing 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, October 27, 8:00am - 5:00pm in the Dealey Room.

Tutorials

• **AIRLINE - SA2 OR Glue at the FAA: Making Good Decisions That Stick**, *Norm Fujisaki, Federal Aviation Administration, norman.fujisaki@faa.dot.gov*

Analyses conducted in various parts of an enterprise often produce conflicting or disconnected results. This becomes especially true as an organization grows in size. Until a more holistic sense of decision making can be developed, decision makers will continue to make decisions by the seat of their pants. The speaker will share his experiences bringing operations, technology and economic analyses together to forge a cohesive picture for sound business decisions at the FAA.

SB2 Large-Scale Math Programming Computation with Applications in Airlines, *Ellis Johnson, Georgia Institute of Technology, ejohnson@isye.gatech.edu*

The airline industry is currently actively involved in developing and implementing mathematics programming models in planning. Three such problems are considered: crew pairing, fleet assignment, and bid-prices. These problems are currently being solved regularly by major airlines using mixed-integer (for the first two) and non-linear programming (for the third). We discuss size of models, hardware and software being used, and some of the methodology used to overcome computational difficulties. The crew pairing and bid price problem involve solving LPs with many, many columns. Some general approaches to such problems will be given. Large-scale decomposition remains an active area in trying to develop

integrated models. Both modeling and computational issues will be discussed.

SD2 Revenue Management: OR at SABRE, *Barry Smith, SABRE Decision Technologies, barry_smith@sdt.com*

No abstract supplied.

SE2 Real-Time, Mission-Critical Decision Support Systems For Controlling & Managing Airline Operations, *Gang Yu, University of Texas at Austin, yu@uts.cc.utexas.edu*

The field of OR has made tremendous impact in managing and controlling today's airline operations. Accelerated by modern computing technologies, based on improved understanding of the business logic applied in airline industry, enabled by advancement of optimization models and solution techniques, driven by enormous demand from airlines' management for gaining competitive edge in the market, the real-time, mission-critical DSSs for managing and controlling airline operations start to become a reality. This tutorial discusses decision support system applications in airline real time operations.

• **INTEGER PROGRAMMING SA28 Lagrangean Relaxation, Extensions & Applications**, *Monique Guignard-Spielberg, University of Pennsylvania, guignard@dantzig.wharton.upenn.edu*

The goal is to present in a rather concise format what needs to be known in order to design and implement an efficient Lagrangean relaxation in integer programming. The presentation will start with a basic introduction to Lagrangean relaxation for linear integer problems and its geometric interpretation. General

ideas for splitting a problem before applying Lagrangean relaxation will be presented. After a brief review of the important characteristics of the Lagrangean function, we will turn to primal and dual methods for solving relaxation duals: the classic sub-gradient optimization and constraint generation methods and a more recent, hybrid, 2-phase approach.

SB28 Projection & Inverse Projection in Linear Integer Optimization, *Kipp Martin, University of Chicago, kipp.martin@gsb.uchicago.edu*

Projection and inverse projection are 2 very simple, yet unifying, concepts in the theory of linear inequalities. Using projection, we take a system of linear inequalities and replace some variables with additional constraints. Inverse projection, the dual of this process, involves replacing inequalities with variables. We extend the inverse projection concept to the case where some or all of the variables are required to be integer. This process yields extended polyhedral representations in auxiliary variables. We describe 5 methods for generating reformulations with auxiliary variables.

SD28 Computational Issues in Combinatorial Optimization, *Bill Cook, Rice University, cook@marvin.or.uni-bonn.de*

The task of building efficient implementations of combinatorial algorithms presents a number of interesting challenges, distinct from those that arise in the study of the worst case complexity of the algorithms. We present a survey of results in this area, concentrating on network optimization problems, including minimum-weight matchings, maximum flow, minimum cut,

minimum-cost flow, minimum-weight spanning tree and the traveling salesman problem. We will consider exact algorithms, heuristic algorithms and cutting-plane methods. In each case, the target will be the development of implementations that scale up to problem instances having one million or more nodes.

SE28 Heuristics for Discrete Optimization Problems, Jan Karel Lenstra, Eindhoven University of Technology, jkl@win.tue.nl

We review recent theoretical and empirical progress in the development of approximation algorithms for hard scheduling problems. In particular, we discuss the use of LP-relaxations in deriving performance guarantees, a technique for identifying limits of approximability and a variety of neighborhood search approaches for finding reasonable schedules reasonably fast.

MA28 Large-Scale Problem Reformulation, Hanif Sherali, VPI&SU, hanifs@vt.edu

This tutorial describes the theory and the design of algorithms related to the use of the reformulation/linearization/convexification technique. For discrete linear and polynomial programming problems, this technique generates a hierarchy of progressively tighter, higher dimensional, linear programming representations, leading to an explicit characterization of the convex hull of feasible solutions. Several applications that arise in location-allocation, distribution and engineering design contexts have been studied using this approach and the results indicate that this technique can often recover near optimal solutions via a single or a few linear or convex programming relaxations.

• EDUCATION - SA6 Education Tutorial: Teaching Tips for New Teachers, or Just 'cuz You Know It Doesn't Mean You Can Teach It, Ellen Jordan, Tiffin University, ejordan@ccgate.tiffin.edu

This session will be given by experienced professors who have demonstrated excellent teaching ability. They will give practical and useful hints, strategies, methodologies and ways to improve classroom motivation, interest and learning. Evaluation techniques, course structure, group learning and creating interaction will be highlighted. This session is intended to help provide future professors with the tools they need to effectively share what they know.

SB6 Education Tutorial on Marketing Engineering: Market Analysis & Planning in the Information Age, Gary L. Lilien, Pennsylvania State University, G5L@email.psu.edu, Arvind Rangaswamy, Pennsylvania State University, axr15@cac.psu.edu, Vijay Mahajan, University of Texas at Austin, vmahajan@mail.utexas.edu, John D. C. Little, MIT, jlitte@mitvma.mit.edu

Downsized and flatter organizations, exploding volumes of data and rapidly changing market-conditions have combined with powerful new software and personal computers on networks to produce problems and opportunities. The problem is that the traditional marketer's job has been vastly expanded, from one that has historically relied predominantly on intuitive and qualitative skill to one that now has great quantitative demands as well. The opportunity is that the new hardware and software, combined with proper training, can turn conceptual marketers

into marketing engineers who apply the OR/MS approach to marketing problems.

SD6 Education Tutorial: Turning a Dud into a Winner, Tom Grossman, University of Calgary, grossman@mgmt.ucalgary.ca, Erhan Erkut, University of Alberta, erhan.erkut@ualberta.ca, Armann Ingolfsson, University of Alberta, armann.ingolfsson@ualberta.ca

Until recently, our required "Introduction to OM/OR" course was subtitled "Course from Hell taught by Anti-Christ" by the students. In contrast, many of our current students think this is the best course they took so far in the Faculty of Business. We will describe the components of this metamorphosis: extensive use of spreadsheets, demos, labs, electronic communication, cases, games, music, skits, and stupid professor tricks. We believe that many of these catalysts are portable to other institutions.

TD6 Education Tutorial: A Beginners Guide to Using OR/MS Cases in the Classroom, Peter Bell, University of Western Ontario, pbell@ivey.uwo.ca

This tutorial will attempt to help the OR/MS instructor with the teaching of OR/MS cases. Topics will include: What is a "case"? Why use cases in an OR/MS course? Where do I find OR/MS cases? Choosing appropriate cases for your course. Preparing for a case class. Strategies and tactics in the classroom.

ME6 Education Tutorial: Teaching Probabilistic Analysis Samuel S. Chiu, Stanford University, samchiu@leland.stanford.edu

Classes in introductory probability are usually taught topically

oriented. Students are taught the mechanics of probability to manipulate well formulated problems. This tutorial provides a teaching framework to bridge the gap separating mechanics and problem formulation/communication. We will share teaching materials (including software) developed over many years with many iterations of modifications (both radical and fine-tuning).

• **OTHER - SA18 Data Envelopment Analysis: Theory, Methodology & Application, Lawrence Seiford, University of Massachusetts, seiford@ecs.umass.edu, W. W. Cooper, University of Texas, cooperw@mail.utexas.edu**

The power of DEA for analyzing operational processes has been demonstrated by numerous applications including a recent finalist for the Edelman Award. However, in spite of this exposure, the methodology remains unfamiliar to significant portions of the OR/MS community. This tutorial will describe what DEA is conceptually and show why/how to perform an analysis.

TC31 Visualization Techniques for Optimization, Chris Jones, University of Washington, cvj@u.washington.edu

This tutorial presents the current state-of-the-art in using visualization to support all aspects of the modeling process, from model and algorithm development through to final results presentation. Topics covered include animation, virtual reality, sound, hypermedia, among others. The tutorial includes extensive, live examples.

MA19 Electronic Commerce, Andrew Whinston, University of Texas, abw@uts.cc.utexas.edu
The emergence of electronic

commerce as an active commercial area has opened up many new research challenges. This tutorial will outline some of the topics and suggest approaches to their solution. Successful solution will draw upon the fields of computer science for technology and economics to describe the business value. Some examples are in real-time network management, competitive analysis of electronic-based companies and real-time demand estimation for digital products. Tools and techniques, including electronic cash, authentication and security, will be outlined.

MA29 Neural Networks & Linear Programming, Asmin Roy, Arizona State University, asim.roy@asu.edu

Designing and training neural networks using linear programming raises an important set of questions about how the brain actually learns. It also challenges some of the basic notions of learning used to develop algorithms in the neural network field. This tutorial will survey linear programming-based methods to generate neural networks for supervised and unsupervised learning. Robustness and reliability of linear programming-based methods over existing neural network methods will be discussed and an overview of the various applications will be provided.

TB25 Probability Models and Statistical Inference for Software Reliability, Nozer Singpurwalla, George Washington University

We overview the salient developments for modeling and assessing the reliability of computer software. The models that seem to be promising are based on point processes, and inferential issues invariably involve the

Bayesian paradigm with Markov chain Monte Carlo methods. We discuss topics such as optimal testing and classification.

TB7 Set Partitioning, Linear Programming and Combinatorial Optimization in Supply Chain Management, Valerie Tardif, The University of Texas at Austin, vtardif@mail.utexas.edu, David Simchi-Levi, Northwestern University, levi@iems.nwu.edu

A classic and recently popular method for solving many hard combinatorial problems is based on formulating these problems as set-partitioning models. We explain the excellent empirical performance of the set-partitioning technique for a number of problems including vehicle routing, bin-packing and parallel machine scheduling problems. We then apply the set-partitioning method to tactical problems in supply-chain management involving inventory and transportation. In particular, we consider integrating inventory policies and transportation strategies so as to minimize system-wide costs by taking advantage of the shipping cost structure.

SB11 Perspectives and Prospects in Time-Constrained Routing, Marius. M. Solomon, Northeastern University & GERAD, solomon@neu.edu, Jacques Desrosiers, GERAD & Ecole des HEC, Guy Desaulniers, GERAD & Ecole Polytechnique, Francois Soumis, GERAD & Ecole Polytechnique
This tutorial reviews the various modeling and solution methodologies for the vehicle routing problem with time window constraints. On the modeling side, we begin with the classic formulation and continue with a multi-commodity flow formulation for

multiple depots and multiple vehicle type problems. In terms of solution approaches, we present the different branch and bound and mathematical decom-

position methods proposed to solve this problem optimally. Advances in heuristic solutions are also discussed. We then illustrate how to handle issues

such as multiple capacity restrictions or time windows, and different types of synchronization constraints.

Workshops

• OR for the Deregulated Power Industry Saturday, October 25, 1:00-5:00pm

Bob Entriken, Stanford University

The electric power industries of the world are now in an unprecedented period of change. One by one, they are being transformed from cost-conscious, regulated utilities to profit-conscious, competitive corporations. Not only does this constitute an about face in emphasis from the production side to the consumer side of the business, but it presents a wonderful opportunity for the use of OR.

New business problems are being created with each legislative act to deregulate and there is a strong need for OR analysts to fill in the gaps. Further, the particular training and experience of our discipline makes us well equipped to absorb, understand and propagate the wealth of new techniques that will be needed for utility companies to succeed in this new environment. This workshop reviews the latest international developments and explores new areas for research and development that these changes afford us. We will introduce a new set of simple yet demonstrative models that cover the essential aspects of the new business processes arising in our public utilities.

• Teaching Management Science Using Spreadsheets: Making the Transition From the Traditional Approach Sunday, October 26, 8:00am-12noon

Tom Grossman, University of Calgary

The fact that one can do OR in spreadsheets is well-known and is receiving extensive promotion. However, learning how to teach using spreadsheets (and how to do MS well in spreadsheets) is a non-trivial challenge. We discuss both the gains and the losses of teaching in spreadsheets, the pitfalls to be anticipated and managed when making the transition and the differences between a spreadsheet vs. an algebraic representation of OR models. We share lessons learned regarding the needs of students and challenges and opportunities for instructors when teaching with spreadsheets. Numerous examples will be presented. Although focused towards teachers in business schools, this workshop will be of value to anyone interested in learning about performing OR/MS in spreadsheets.

• Practical Approaches to Simulation Validation (aka VV&A) Sunday, October 26, 1:00-5:00pm

Pete Knepell, Logicon RDA

The verification, validation & accreditation (VV&A) of models and simulations is a topic of high interest in the community. Given the intended use of a model or simulation, it is sometimes critical that it is an appropriate representation of reality. For example, DoD directives emphasize the need to build reliable and credible models and simulations, especially when their results are used to make acquisition decisions. While the motivation for VV&A is clear, it is difficult to prescribe a "cook book" set of techniques and procedures – and for good reason: sponsors, developers and users of models and simulations face different problems involving intended use, risk, model detail/complexity/size and the availability of real-world data.

This 3-part workshop will focus on the "how to" of VV&A and is aimed at model managers, developers, evaluators and users faced with the challenges of VV&A. Prior experience with statistics is not needed to understand the session on experimental design. Participants should leave with good ideas on how to approach their VV&A journeys and tools to help along the way.

KEYNOTE & PLENARY ADDRESSES

Beale Keynote Address

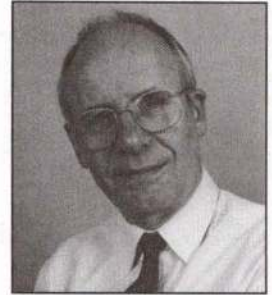
Sunday, October 26, 1:15- 2:15pm

Winner of the Beale Medal awarded by the United Kingdom Operations Research Society

Developments in OR/MS Increasing Both the Science & Impact of Industrial

Maintenance Modeling, A. H. Christer, Univ. of Salford

There is much that OR/MS can do to improve the quality of science within maintenance and thereby, impact upon company objectives. This presentation aims to raise awareness of what is now possible by way of modeling support for maintenance and to address the problems of and the potential for the growth of this awareness among both the maintenance and the OR/MS communities.



Edelman Keynote Address

Sunday, October 26, 1:15- 2:15pm

Winners of the Edelman Award, given for the best example of the practice of OR/MS, selected during the San Diego Spring 1997 INFORMS meeting

Decision Support Scheduling Systems for SNCF (French National Railway), Nejib Ben-Kheder, Josephine Kintanar, William Stripling, SABRE Decision Technology; Cecile Queille, SNCF

The national railroad of France, Soci t  Nationale des Chemins de Fer Fran ais, SNCF, and SABRE Decision Technologies teamed up to address the problem of train capacity allocation in SCNF'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. The implementation of their resulting DSSs is credited with a profit increase of 3-5% reductions in manpower and schedule development time and improvements in planning and scenario evaluation.

Invited Plenary

Monday, October 27, 11:00am-12noon

Synergy for the 21st Century: Between Unstructured Problems & Management

Planning & Controls, George Kozmetsky, Univ. of Texas-Austin

As INFORMS enters the 21st century, more and more the emphasis will need to be on the integration of quantitative methods with advances in digital communication, processing and data mining through integrated managerial and operations decision-making. Paperless processing of data and knowledge in a global context will provide INFORMS members the opportunity to extend their attention into real time controls breakthroughs for both planning and control.

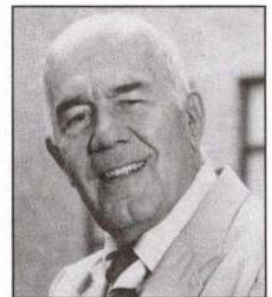


Omega Rho Distinguished Plenary

Tuesday, October 28, 11:30am-12:30pm

OR/MS: Where it's Been. Where It Should be Going? W. W. Cooper, UT Austin

It is argued that movement toward the "control" aspects of management should be effected to expand OR/MS activities beyond their present emphasis on "planning" functions. This will involve increasing the amount of empirical-inferential approaches to research (based on ex-post data) as a way to help bring this about. Examples of such empirical-inferential research activities in OR/MS are supplied by the early work of P.M.S. Blackett and others on high-level policy problems during WW II. Extensions to the control function are evidenced in the work of R. Fetter and others in the development of diagnostic related groups on which the prospective payment systems are based with large and important impacts on the health care delivery systems in the US and other countries. Other examples include the use of OR concepts in the early "turnaround" of Fed Ex from failure to success. New methods will nevertheless be needed to extend and improve available OR/MS approaches. Ways to combine DEA with commonly used statistical methods are described to show how new and old methods may be combined to further enhance their power and ranges. Similar relations of DEA to other OR/MS approaches noted are now being studied, some of which are presently occurring with "fuzzy sets" and "multiple objective programming."



EXHIBITOR/SOFTWARE DEMONSTRATIONS

Several software demonstrations are scheduled on Monday and Tuesday in Track 33. These presentations will show how leading software systems can help you find solutions to complex problems. The demonstrations will be completed by exhibitors showcasing the latest software products, technical reference materials and specialized services. For further details, please refer to the Guide for Products & Services.

Exhibitors

Session	Developer	Product
TA33	ALPHATECH, Inc.*	MagicWand TransCAD
TB33	Applied Decision Analysis, Inc.*	
TC33	Caliper Corporation*	
TB33	COMPASS Modeling Solutions Decisioneering*	Analytica/Crystal Ball
TC33	IBM ILOG, Inc.*	ILOG Solver
MC33	ILOG CPLEX Division	LINDO, LINGO, WHAT'S BEST
MC33	LINDO Systems, Inc.*	
MA33	Ketron Management Science*	MPL On-Line Tutorial
MD33	Maximal Software, Inc. Palisade Corporation	XPRESS-MP
MD33	ROI & Dash Associates* Systems Modeling Tom Sawyer Software*	Graph Layout Toolkit, Graph Editor Toolkit

Session	Publishers	Product
MA33	Baltzer Science Publishers Duxbury Press* Elsevier Science John Wiley & Sons, Inc. Kluwer Academic Publishers McGraw-Hill Sage Publications Springer-Verlag New York, Inc.	INSIGHT

* Indicates software demonstration

Exhibit Hours - Exhibits will be located in the Colonnade Exhibit Hall. Leading software developers and publishers will showcase the latest software products, technical reference materials and specialized services. Exhibit hours will be:

Sunday	1:00pm 5:00pm	Tuesday	9:00am 5:00pm
Monday	9:00am 5:00pm	Wednesday	9:00am 12noon

INVITED CLUSTER CHAIRS

AI & OR Techniques in Project Management Decision Analysis

Adedeji Badiru, Univ. of Oklahoma, Sch. of IE, Norman, OK 73019; badriu@lincoln.ecn.ou.edu

Airline Industry: Tutorials

Andrew Boyd, Texas A&M Univ., Dept. of IE, Coll. Station, TX 77843-3131; boyd@marvin.tamu.edu

Applications

Candace Yano, Univ. of California, Dept. of IE & OR, Berkeley, CA 94720-1735; yano@ieor.berkeley.edu

Combinatorial Optimization

Celso Ribeiro, Catholic Univ. of Rio de Janeiro, Dept. of Comp. Sci., R Marques de Sao Vicente 225, Rio de Janeiro 22453-900; celso@inf.puc-rio.br

DEA & Productivity

Larry Seiford, Univ. of Massachusetts, Dept. of IE/OR, 114 Marston Hall, Amherst, MA 01003-5220; seiford@ecs.umass.edu

Education in OR/MS

Wayne Winston, Indiana Univ., Sch. of Bus., Rm. 570, Bloomington, IN 47405; winston@big.bus.indiana.edu

Electronic Commerce

Jan Stallaert, Univ. of Texas, MS/IS Dept., Austin, TX 78712; stallaert@mail.utexas.edu
Andrew Whinston, Univ. of Texas

Facilities Layout

Benoit Montreuil, Univ. of Laval, SORCIIER Research Ctr., Ste.-Foy, Quebec, Canada G1K 7P4, benoit.montreuil@fsa.ulaval.ca

Flexible Manufacturing

Kathryn Stecke, Univ. of Michigan, Sch. of Bus. Admin., Ann Arbor, MI 48109-1234; kathryn_stecke@ccmail.bus.umich.edu

Forecasting

Kenneth Lawrence, New Jersey Inst. of Tech., Sch. of Mgmt., Newark, NJ 07102; lawrence@tesla.njit.edu

Global Optimization

Christodoulos Floudas, Princeton Univ., Dept. of Chemical Eng., Princeton, NJ 08544-5263; floudas@titan.princeton.edu

Health Care Management

Arnold Reisman, Reisman & Assoc. 1284428 Parkland Drive, Shaker Heights, OH 33122; 102126.1551@compuserve.com

Heuristic Methods in Optimization

J. Wesley Barnes, Univ. of Texas, Dept. of Mech. Eng., OR/IE, Austin TX 78712; wbarnes@mail.utexas.edu

Integer Programming

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Sunday 08:45-10:15**SA01 PANEL: Reality of Implementing DDS-Critical Success Factors Associated with Customers, Data, Hardware, Training, Support**

Cluster: OR/MS Applications
Invited Session

Chair: Richard Ratliff, The SABRE Group, Inc., AA P&YM Support Group, 1 E Kirkwood Blvd., Southlake, TX 76092, richard_ratliffe@sabre.com

1) PANEL: The Reality of Implementing DDS-Critical Success Factors Associated with Customers, Data, Hardware, Training, Support, Etc., Gail S. Hines, Federal Express Corp., Gail Blauer-Jones, Unisys, Sarah F. Davies, First USA Bank, Ellis L. Johnson, GA Inst. of Tech., Angela McBride, American Airlines, Bruce W. Patty, MCGI

Many OR/MS applications fail due to poor appreciation of implementation issues. In this session, successful examples of OR/MS implementation (and reasons) are discussed by a variety of leading industry and academic experts. The presentations and panel discussion should prove valuable to individuals wanting to learn more about OR/MS implementation.

SA02 TUTORIAL: OR Glue at the FAA - Making Good Decisions that Stick

Cluster: Airline Industry Tutorials
Invited Session

Chair: Norm Fujisaki, FAA, ASD-400, 800 Independence Ave., SW, Washington, DC 20591, norman.fujisaki@faa.dot.gov

1) TUTORIAL: OR Glue at the FAA - Making Good Decisions That Stick, Norm Fujisaki, FAA, ASD-400, 800 Independence Ave., SW, Washington, DC 20591, norman.fujisaki@faa.dot.gov

Analyses conducted in various parts of an enterprise often produce conflicting or disconnected results. This becomes especially true as an organization grows in size. Until a more holistic sense of decision making can be developed, DMS will continue to make decisions by the seat of their pants. The speaker will share experiences bringing operations, technology and economic analyses together to forge a cohesive picture for sound business decisions at the FAA.

SA03 The Road to Free Flight

Sponsor: Aviation Applications Section
Sponsored Session

Chair: Steven W. Bradford, Federal Aviation Admin., ASD-130, 800 Independence Ave., Washington, DC 20591, steve.bradford@faa.dot.gov

1) Capacity Analysis of the National Airspace System, Belinda Hargrove, SABRE Decision Tech., 1 E Kirkwood Blvd., MD TSG 7200, Southlake, TX 76092

We discuss a study, conducted from an airline user viewpoint, which evaluated when the current National Airspace System will reach saturation and how long future technologies, free flight, etc., will extend the timeframe of saturation.

2) Dynamic Resectorization for Free Flight, Christopher R. Brinton, Wyndemer, Boulder, CO

The current free flight concept does not address the relationship between the air traffic specialist, airspace sectorization and route and altitude restrictions as used in the ATM system today. To address this, procedures for dynamic resectorization and coordination of aircraft routes for free flight have been proposed and studied.

3) Flexibility as a Measure of Performance Under Free Flight, Stephane Mondoloni, CSSI, Washington, DC

Typical performance metrics used for operational analyses do not capture one of the potentially greatest user benefits of free flight: flexibility of the user to meet schedule. To this end, free flight demand scenarios will be reevaluated from the perspectives of the cost to meet schedule and unrecoverable delay.

4) CDTI Requirements Analysis, Mark Rodgers, FAA, ASD 130, 800 Independence Ave. SW, Washington, DC 20591, William Colligan

Airborne self-resolution of conflicts is one of the free flight concepts of operations proposed. To assess the resultant operational requirements, the spatial temporal density shifts associated with various route structures will be analyzed and the minimum aircraft display requirements characterized for

airlines and airframes along with the procedural requirements for transition of control.

5) Dynamic Density, William Colligan, CSS, Washington, DC, Mark Rodgers

Although still relatively undefined, dynamic density has been identified as one of the operational constraints to free flight. The more mature dynamic density metrics and methodologies will be evaluated from the perspective of the spatial and temporal variance for several different routes reflecting variations of the free flight concept of operations.

SA04 Revolution in Military Affairs

Sponsor: Military Applications Society
Sponsored Session

Chair: Joseph Helman, TASC, Inc., 1101 Wilson Blvd., Ste. 1500, Arlington, VA 22209, jhelman@tasc.com

1) Information Warfare & Force Structure, Joseph Helman, TASC, Inc., 1101 Wilson Blvd., Ste. 1500, Arlington, VA 22209, jhelman@tasc.com

Traditional warfare is being supplemented by technology-based warfare, including information warfare. An attack upon vital national resources is no longer limited to overt, physical destruction of those resources. Substantial and potentially devastating damage can be inflicted without crossing the threshold of violence or even physically crossing international borders.

2) Information Modeling Streamlining, James A. Mosora, TASC, Inc., 1101 Wilson Blvd., Ste. 1500, Arlington, VA 22209, jamosora@tasc.com

Modeling and simulation are essential to the information driven battlefield. Services proliferate model applications and results while OSD wants a minimum number. We examine the risks that may result from either too many or too few models. Comparisons will be made with biological diversity.

3) TMD Attack Operations, Eric Desautels, TASC, Inc., 1101 Wilson Blvd., Ste. 1500, Arlington, VA 22209, esdesautels@tasc.com

Detecting mobile ballistic launchers has been a challenge to military operations since 1944. Mobility of transporter-erector-launchers allows them to operate from dispersed locations. Past weapons were unable to play a decisive role in conflicts. Advances in technology are providing ballistic missiles with a greater role in future conflicts.

4) C4ISR Interoperability & Information for the Warrior, David Dunham, TASC, Inc., 1101 Wilson Blvd., Ste. 1500, Arlington, VA 22209, dhdunham@tasc.com

Without integrating legacy standards and establishing common descriptions of architectures, a seamless stream of C4ISR information to the carrier may remain impossible as an objective for a "system of systems." A mechanism for commonly defining roles and missions and working toward a joint C4ISR architecture is necessary.

SA05 Decision Analysis & Finance

Sponsor: Decision Analysis Society
Sponsored Session

Chair: James E. Smith, Duke Univ., Fuqua Sch. of Bus., Box 90120, Durham, NC 27708-0120, jes9@mail.duke.edu

1) Stochastic Programming Applications in Insurance, John M. Mulvey, Princeton Univ., Dept. of Civil Eng. & OR, E-407 E Quad., Princeton, NJ 08544, mulvey@macbeth.princeton.edu

We develop a strategic planning system for a large insurance company based on multi-stage stochastic programming. The system integrates all major decisions regarding assets (investment choices), liabilities (products, re-insurance) and goals. A temporal objective function takes into account the asymmetric distribution of profit/loss. We demonstrate the approach for a Bermuda re-insurance company.

2) The Role of Portfolio Analysis & Corporate Risk Tolerance in Charting Strategy, Michael R. Walls, CO Sch. of Mines, Dept. of Bus. & Economics, 1500 Illinois St., Golden, CO 80401-2887, mwalls@mines.edu

Managers face a difficult problem in choosing the appropriate portfolio of activities consistent with the firm's strategy and risk appetite. We describe efforts by 1 oil company to measure its financial risk tolerance and utilize it in combination with portfolio optimization to select the appropriate project or business portfolio.

3) Derivatives as a Tool for Improved Decisions, Robert D. Sibolt, Sonat, Inc., PO Box 2563, Birmingham, AL 35202, Gerald L. Sauer

In the real world of financial distress, imperfect information and misaligned management/shareholder risk attitudes, the appropriate use of financial risk management instruments can add significant shareholder value. Sources of value include optimized capital structure, consistent use of market information across company decisions and improved management of real assets.

4) **Estimating Risk-Adjusted Probabilities from Market Data**, *James E. Smith*, Duke Univ., Fuqua Sch. of Bus., Box 90120, Durham, NC 27708-0120, jes9@mail.duke.edu, *Kevin F. McCardle*

In the option pricing theory, the value of a security or project is given by its expected present value, where expectations are calculated using risk-adjusted probabilities. We review and compare alternative approaches for estimating these risk-adjusted probabilities and focus on applications to real oil and gas assets.

SA06 EDUCATION TUTORIAL: Teaching Tips for New Teachers, or Just 'cuz You Know It Doesn't Mean You Can Teach It

Sponsor: Forum on Education
Sponsored Session

Chair: Ellen S. Jordan, Tiffin Univ., 155 Miami St., Tiffin, OH 44883, ejordan@ccgate.tiffin.edu

1) **EDUCATION TUTORIAL: Teaching Tips for New Teachers, or Just 'Cuz You Know it Doesn't Mean You Can Teach it**, *Ronald H. Wright*, Le Moyne Coll., Dept. of Bus. Admin., Syracuse, NY 13214-1399, wright@palm.lemoyne.edu, *Salwa H. Ammar*, *Ruth A. Maurer*, *Ellen S. Jordan*

This session will be given by experienced professors who have demonstrated excellent teaching ability. They will give practical and useful hints, strategies, methodologies and ways to improve classroom motivation, interest and learning. Evaluation techniques, course structure, group learning and creating interaction will be the highlights...

SA07 Supply Chain Management

Sponsor: MSOM
Sponsored Session

Chair: Ravi Anupindi, Northwestern Univ., Kellogg Grad. Sch. of Mgmt., Evanston, IL 60208, anupindi@kaizen.kellogg.nwu.edu

1) **Two-Stage Supply Chain Contracts: A Framework & Analysis**, *Vinayak V. Deshpande*, Univ. of PA, Wharton Sch., 1300 SH-DH, 3620 Locust Walk, Philadelphia, PA 19104, vinayak@wharton.upenn.edu, *Morris A. Cohen*, *Karen L. Donohue*

We model buyer-supplier mechanisms for sharing demand risk and achieving coordination in a supply chain. The model framework is used to analyze alternative supply chain contracts and address issues such as information structure, decision rights and risk sharing. We then analyze tradeoffs for different contracting approaches.

2) **Forecast Revision & Supply Chain Performance**, *Andy A. Tsay*, Santa Clara Univ., Leavey Sch. of Bus., DIS Dept., 500 El Camino Real, Santa Clara, CA 95053

We study the behavior of a decentralized supply chain in which revisions to forecasts of order quantities are allowed within certain bounds. Performance issues considered include inventory patterns, propagation of order variability on moving upstream and end-customer service.

3) **Uncertainty Resolution & Reduction in Postponement for Product Variety**, *Hau L. Lee*, Stanford Univ., Dept. of IEEM, Terman Rm. 352, Stanford, CA 94305, *Seungjin Whang*

Postponement, delaying the point of product differentiation, is widely recognized as an effective and powerful concept in dealing with complexity associated with product variety. We analyze the benefit of postponement coming from waiting for resolution of sales realizations and from improvement in demand forecasting based on recent sales data.

4) **Inventory Pooling with Claims: A Duopoly Model**, *Ravi Anupindi*, Northwestern Univ., Kellogg Grad. Sch. of Mgmt., Evanston, IL 60208, anupindi@kaizen.kellogg.nwu.edu, *Eitan Zemel*, *Yehuda Bassok*

We present a game-theoretic model for a distribution system, a critical feature of which is the concept of "claims," i.e., every piece of inventory is owned by an individual who has rights to its use. For the duopoly setting, we show the existence and uniqueness of the Nash equilibrium and discuss comparative statics under various allocation mechanisms for profits and revenues.

SA08 Cellular Manufacturing

Contributed Session

Chair: Bhaba R. Sarker, LA State Univ., Dept. of IE, Baton Rouge, LA 70803-6409, bsarker@unix1.sncc.lsu.edu

1) **Locating Machine Cells with Bottleneck Machines**, *Bhaba R. Sarker*, LA State Univ., Dept. of IE, Baton Rouge, LA 70803-6409, bsarker@unix1.sncc.lsu.edu, *Shaojun Wang*, *Avinash M. Waikar*

The machine location problem is formulated as a linear integer programming problem which is an equivalent version of the quadratic assignment problem. Because of the complexity in solving large instances, a heuristic is developed. A numerical example with extensive computational test results is shown to satisfactory level.

2) **Grouping Efficiency & Efficacy in Group Technology**, *Muslema Khan*, LA State Univ., Dept. of IE, Baton Rouge, LA 70803, mtalakkd@unix1.sncc.lsu.edu, *Bhaba R. Sarker*

Several measures of grouping efficiency and efficacy are explained and exploited to classify these measures for grouping of parts and machines in CMSs. An average measure along with a new measure is developed to measure the relative strengths of the existing measures of grouping efficiency and efficacy over a given set of instances.

3) **Measure of Similarity/Dissimilarity Measures in Cellular Manufacturing**, *Khan M. Saiful Islam*, LA State Univ., Dept. of IE, Baton Rouge, LA 70803, kislam@unix1.sncc.lsu.edu, *Bhaba R. Sarker*

Both similarity and dissimilarity measures are sometimes confusing and misleading as to their purpose and rightful use in cellular manufacturing. A measure is developed to measure the relative strengths of these measures of judging the similarity and dissimilarity of parts and machines. An illustrative example is provided.

4) **Effect of Alternative Cell Locations & Material Transporters in the Design of Manufacturing Cells**, *Rasaratnam Logendran*, OR State Univ., 118 Covell Hall, Dept. of IME, Corvallis, OR 97331-2407, logendrr@ccmail.orst.edu, *Yunan*

We present a model and a solution algorithm to investigate the effect of cell locations and material transporters in the formation of manufacturing cells. A tandem configuration for AGVs is assumed and the first-come-first-served principle is applied for moving parts between I/O location and a cell or between 2 cells.

SA09 Flexible Manufacturing I

Cluster: Flexible Manufacturing
Invited Session

Chair: Kathryn E. Stecke, Univ. of MI, Sch. of Bus. Admin., Ann Arbor, MI 48109-1234, kathryn_stecke@ccmail.bus.umich.edu

1) **Switching Dispatching Rules in a Flexible Manufacturing Cell**, *Amiya K. Chakravarty*, Tulane Univ., Freeman Sch. of Bus., New Orleans, LA 70118-5669, amiyac@office.sob.tulane.edu

The choice of dispatching rules in real time is modeled using a modified version of DEA as a pattern recognition tool. The model is shown to be very effective in choosing a mix of dispatching rules, varying the mix with system objectives and outperforming existing shop floor control strategies.

2) **Scheduling of Golf Club Head Injection Processes**, *Denny Hong-Mo Yeh*, Univ. of Toronto, Fac. of Mgmt., 105 St. George St., Toronto, Ontario, M5S 3E6, Canada, yeh@fmgmt.mgmt.utoronto.ca, *Suresh P. Sethi*, *Chelliah Sriskandarajah*

Scheduling of golf club heads involves parallel machines, negligible setups and orders for club heads by sets; all items in an order must be completed before delivery. Using GAs, we minimize the sum of earliness penalties for items and tardiness penalties for orders.

3) **Scheduling Jobs in FMS Cells with Multiple Resources**, *Eugeniusz Toczyłowski*, Warsaw Univ. of Tech., Nowowiejska 15/19, Warszawa, 00-665, Poland, toczyłowski@ia.pw.edu.pl

The profit-based operational scheduling in a class of FMS is considered. In the model, each set of identical durable FMS resources, machines, cutting tools, etc., is aggregated and considered as a single composite resource called M-processor. The detailed scheduling approach is based on construction and analysis of the network of events with precedence relations imposed by limited capacities of M-processors...

SA10 Traffic Flow Theory

Sponsor: Transportation Science Section
Sponsored Session

Chair: R. Jayakrishnan, Univ. of CA, Dept. of Civil & Environ. Eng., Irvine, CA 92717, rjayakri@uci.edu

1) Driver Memory: Motorist Selection & Retention of Individualized Headways in Highway Traffic, Michael J. Cassidy, Univ. of CA, Dept. of Civil & Environ. Eng., 109 McLaughlin Hall, Berkeley, CA 94720, cassidy@euler.berkeley.edu, **John R. Windover**

We demonstrate that drivers have different personalities in that they follow vehicles at different headways and drivers retain their personalities in that each driver tends to maintain his headway over space, and in some instances, drivers return to their headways after being forced by a traffic disturbance to alter them temporarily.

2) Particle Hopping Models & Traffic Flow Theory, Kai Nagel, Los Alamos Ntl. Lab., TSA-DO/SA MS 997, Los Alamos, NM 87545, kai@lanl.gov

Particle hopping models are jerky, coarse-grained representations of particle movement. Surprisingly, one can prove fluid-dynamical limits for these models. For 2 of the best-known particle hopping models, the fluid-dynamical limits turn out to be versions of the Lighthill-Whitham equation for traffic flow. Extensions towards more realism are possible.

3) Modeling Hysteresis in Traffic Flow, H. Michael Zhang, Univ. of IA, Dept. of Civil & Environ. Eng., Public Policy Ctr. 210 S Quad, Iowa City, IA 52242, mhzhang@icaen.uiowa.edu

The hysteresis phenomena in traffic flow has been known to transportation researchers for decades, yet no theory to date has been able to model such phenomena. We will make a first attempt to deduce traffic hysteresis from a traffic theory. We will show that the predictions of the theory have accorded well with certain empirical observations and provide an explanation for those theoretical predictions that do not fit empirical results...

SA11 Routing

Sponsor: Transportation Science Section

Sponsored Session

Chair: Michel Gendreau, Univ. de Montreal, CRT/DIRO, CP 6128, Succ. Centre-ville, Montreal, Quebec, H3C 3J7, Canada, michelg@crt.umontreal.ca

1) A Routing Heuristic for the Pickup & Delivery Traveling Salesman Problem, Jacques Renaud, Univ. du Quebec, Ctre. SORCIER, 2600 Blvd. Laurier, CP 10700, Sainte-Foy, Quebec, GIV 4V9, Canada, jrenaud@telu.quebec.ca, **Fayez F. Boctor, Jamal Ouenniche**

We deal with a variant of the TSP with 2 types of customers: pickup customers and delivery customers. Each pickup customer is associated with one delivery customer who must be visited after the pickup customer. First, we show how to adapt some classic traveling salesman heuristics then propose a new and efficient composite heuristic. Results based on a new set of test problems show that the proposed heuristic outperforms all the heuristics tested.

2) An Exact Algorithm for the Multi-Constrained & Multi-Depot Vehicle Routing Problem, Luis Contesse B., P. Univ. Catolica de Chile, Dept. de Ing. Ind. y de Sis., Casilla 306, Correo 22, Santiago, Chile, lcontesse@ing.puc.cl, **Juan Carlos Munoz A**

We discuss an algorithm which solves to optimality the multi-depot VRP with hard time windows for a fleet of vehicles with different capacities and other network constraints using a partial column generation approach within the B&B method. Some preliminary practical applications are exhibited.

3) Arc Routing with Time Windows & Split Deliveries, Michel Gendreau, Univ. de Montreal, CRT/DIRO, CP 6128, Succ. Centre-ville, Montreal, Quebec, H3C 3J7, Canada, michelg@crt.umontreal.ca, **Pierre Dejax, Moshe Dror, Cyrille Gueguen**

We examine capacitated arc routing problems with time windows on directed, undirected and mixed graphs and transformations of these arc routing problems into a node routing setting. Problems with and without split deliveries are solved using a column generation methodology applied to the node routing images of the transformed arc routing problems.

SA13 Managing Information Flows in the Product Development Process

Cluster: New Product Development

Invited Session

Chair: Christoph Loch, INSEAD, Blvd. de Constance, Fontainebleau, 77305, France, loch@insead.fr

1) Managing Uncertain Information in a Large Development Project, Christoph Loch, INSEAD, Blvd. de Constance,

Fontainebleau, 77305, France, loch@insead.fr, **Christian Terwiesch**

Engineering changes consume much time and money in product development. This field study at a major automotive company tracks engineering changes and the uncertain information at their source, caused by technology and market changes, project management (overlapping of interdependent activities) and information sharing discipline. We draw lessons for managing uncertain information in a project.

2) Influence of Proximity, Authority, Interdependence & Identity on the Spread of Innovation in Multinational Corporations, David McKendrick, Univ. of CA, San Diego, CA, **Michael T. Pich, Suzanne Stout**

We examine organizational characteristics, including proximity, authority, interdependence and identity relations, that influence the degree to which numerous product, process and administrative innovations are shared among dispersed work groups within 3 multinational corporations in the telecommunications industry. We present a model of the process underlying the spread of new technologies within multinational firms.

3) The Role of Scientific Networks in International Scientific Research, Arnoud De Meyer, INSEAD, Blvd. de Constance, Fontainebleau, 77305, France, meyer@insead.fr

Scientific research is stimulated by collaboration and communication. One can observe an increase, recently, in the number of international collaborative research projects. The aim of this study is to understand the factors that encourage the emergence as well as the productivity of international networks of researchers, and in particular how information flows enable the rapid mobilization of these networks for the definition and execution of international research projects. The research is based on a large scale survey of 2 scientific communities in Europe...

SA14 PANEL: Technology Transfer & the Military

Cluster: Technology Transfer

Invited Session

Chair: Steve Guilfoos, AFMC TTO/TTR, 4375 Chidlaw Dr., Ste. 6, WPAFB, OH 45433-5006, guilfoos@techmail.wpafb.af.mil

1) PANEL: Technology Transfer & the Military, Lance Davis, Kathryn Drew, James Wanko, Tim Sharp

The DoD has developed many innovative management processes which enable their share of "tech-knowledge" with the public and private sectors. We focus on the technology transfer process in the Army, Navy and Air Force. We discuss our use of the WWW, leveraging our limited resources, organizing in a down-sized environment and how we reduce the traditional bureaucracy to bring technologies to the American taxpayer. Along the way, we demonstrate our successes in helping the public and private sectors...

SA15 Perspectives on Knowledge Transfer

Cluster: Technology Management

Invited Session

Chair: Gabriel Szulanski, Univ. of PA, Wharton School, 2000 SH-DH, Philadelphia, PA 19104-6370, szulanski@wharton.upenn.edu

1) Transactive Memory as a Mechanism to Facilitate Knowledge Transfer, Linda Argote, Carnegie Mellon Univ., Grad. Sch. of Ind. Admin., Pittsburgh, PA 15213, argote+@andrew.cmu.edu, **Richard K. Moreland**

We develop the concept of transactive memory as a mechanism to transfer knowledge over time in work groups. Transactive memory includes knowledge of who knows what, of whom to trust and of how to coordinate. Results of 2 laboratory experiments that demonstrate the beneficial effects of transactive memory on group performance are presented.

2) Network as Knowledge, Bruce Kogut, Univ. of PA, Wharton Sch., 2000 SH-DH, Philadelphia, PA 19104, kogut@wharton.upenn.edu

We discuss how knowledge is organized in a network from the perspective of its emergent properties and also from the perspective of design. The ideas are analyzed through comparative case histories of the electrical equipment and auto supply networks.

3) Replication of Strategy, Sidney Winter, Univ. of PA, Wharton Sch., 2000 SH-DH, Philadelphia, PA 19104, winter@wharton.upenn.edu, **Gabriel Szulanski**

Internal knowledge transfer is an increasingly familiar method of appropriating additional returns from existing knowledge. We examine the basic strength of the replication strategy, the costs and the hazards involved, and the strategic choices that need to be confronted.

4) **Appropriability & the Challenge of Scope: Banc One Routinizes Replication**, *Gabriel Szulanski*, Univ. of PA, Wharton School, 2000 SH-DH, Philadelphia, PA 19104-6370, szulanski@wharton.upenn.edu

The appropriation of rents from superior knowledge hinges, to some extent, on the organizational capability to replicate effectively patterns of action that underlie success. We report the findings of an in-depth field study of Banc One's capability to replicate superior practices and supporting systems in the banks it acquires.

SA16 PANEL: Dissertation Proposal Competition Awards

Sponsor: College on Organization Science
Sponsored Session

Chair: Jacqueline Meszaros, Univ. of WA, Bothell 2201 26th Ave. SE, Bothell, WA 98021-4900, mwszaros@u.washington.edu

1) **PANEL: Dissertation Proposal Competition Awards**

No abstract supplied.

SA17 AIDS Modeling I

Sponsor: Health Applications Section
Sponsored Session

Chair: Edward H. Kaplan, Yale Univ., Sch. of Mgmt., Dept. of Medicine, New Haven, CT 06520-8200, edward.kaplan@yale.edu

1) **Modeling the HIV/AIDS Epidemic via Life Tables**, *Giuseppe Schinaia*, Univ. of Rome La Sapienza, Dept. of Geoecon. & Stats., Via Castro Laurenziano 9, Rome, 00161, Italy, scchinaia@scec.eco.uniroma1.it, *Gianpaolo S. Tomba*

This simulation model of the HIV/AIDS epidemic uses life tables estimated from cohort studies conducted on seropositive and AIDS-diagnosed individuals. It allows for non-Markov staging of HIV progression to AIDS; age at diagnosis and first opportunistic infection observed are used as covariates to estimate the sojourn time in each compartment.

2) **Couples-Based Surveillance of STDs using Social Network & Transmission System Analyses**, *James S. Koopman*, Univ. of MI, Dept. of Epidemiology, 109 Observatory St., Ann Arbor, MI 48102-2029, jkoopman@sph.umich.edu

Current STD surveillance methods cannot define the importance for infection transmission dynamics of couples-based partnerships in different subgroups/social settings and cannot monitor the fraction of infections detected and treated in different subgroups/social settings. Partner and partnership characteristics on partners who cannot be located provide crucial information relevant to these issues...

3) **Implicit Valuation of a Blood Exclusion Decision**, *Edward H. Kaplan*, Yale Univ., Sch. of Mgmt., Dept. of Medicine, New Haven, CT 06520-8200, edward.kaplan@yale.edu, *Harold Pollack*

We examine Israel's decision to exclude blood donations from Ethiopian immigrants. We report a model for determining the probability that an antibody negative donation is potentially infectious and estimate this risk for Ethiopian and non-Ethiopian Israelis using the best available data. Considering the mix of the 2 donor pools, we estimate the expected reduction in infectious donations due to exclusion...

SA18 TUTORIAL: Data Envelopment Analysis - Theory, Methodology & Application

Cluster: DEA & Productivity
Invited Session

Chair: Lawrence M. Seiford, Univ. of MA, Dept. of IE/OR, 114 Marston Hall, Amherst, MA 01003-5220, seiford@ecs.umass.edu

1) **TUTORIAL: Data Envelopment Analysis - Theory, Methodology & Application**, *Lawrence M. Seiford*, Univ. of MA, Dept. of IE/OR, 114 Marston Hall, Amherst, MA 01003-5220, seiford@ecs.umass.edu, *William W. Cooper*

The power of DEA for analyzing operational processes has been demonstrated by numerous applications including a recent finalist for the Edelman Award. However, in spite of this exposure, the methodology remains unfamiliar to significant portions of the OR/MS community. This tutorial will describe what DEA is conceptually and show why/how to perform an analysis...

SA20 Telecommunication Network Design

Sponsor: College on Information Systems
Sponsored Session

Chair: Varadharajan Sridhar, OH Univ., Sch. of Comm. Systems Mgmt., 197 RTVC, 9 S College St., Athens, OH 45701-2979, sridhar@ouvaxa.cats.ohio.edu

1) **LAN/SMDS Interconnection Network Design**, *June S. Park*, Univ. of IA, Dept. of MS, Iowa City, IA 52242-1000, jpark@scout-po.biz.uiowa.edu, *Larry J. LeBlanc*, *Alina Chircu*, *Byugha Lim*

We construct a capacitated network design model to minimize the cost of interconnecting remote LANs using a combination of the SMDS connection less service and point-to-point leased digital links. Actual structures of the tariff rates are used which are rather complex. Clustering and SA algorithms are developed.

2) **Design of ATM-Based Backbone Networks with Multiple Fiber Optic Links**, *Indranil Bose*, Purdue Univ., Krannert Grad. Sch. of Mgmt., W Lafayette, IN 47906, bosei@vm.cc.purdue.edu, *Kemal Altinkemer*

The flow assignment problem in ATM-based backbone networks with parallel links and multiple service classes having various delay requirements is studied. Queuing analysis and MIP-based heuristics are used to determine an "efficient frontier" that allows users to decide on the cost-delay tradeoff in backbone network design.

3) **Campus Network Design**, *June S. Park*, Univ. of IA, Dept. of MS, Iowa City, IA 52242-1000, jpark@scout-po.biz.uiowa.edu, *Yinyu Ye*, *Lihua Zhu*

We construct capacitated network design models to minimize the cost of interconnecting LANs distributed in a campus area using repeaters, LAN switches, routers and high-speed backbones. Interesting subproblems and adequate solution strategies are discussed.

4) **Interconnection of LANs Using an ATM Backbone**, *Frederick Kaefer*, IN Univ., Dept. of Op. & Dec. Tech., 10th & Fee Ln, Bloomington, IN 47405-1701, fkaefer@indiana.edu

When ATM is used in the backbone, high speed access to shared resources is enabled. Furthermore, ATM is scalable and has quality of service guarantees that support voice and video applications. We develop mathematical models for designing a campus network that uses an ATM backbone for interconnecting LANs.

5) **Optimal Migration of Legacy LANs to Gigabit Ethernet**, *Hans Kruse*, OH Univ., Sch. of Comm. Systems Mgmt., 197 RTVC, 9 S College St., Athens, OH 45701-2979, kruse@ouvaxa.cats.ohio.edu

With the developments of Gigabit Ethernet products and specifications, organizations will soon begin migrating their legacy and ATM LANs to a Gigabit Ethernet-based backbone architecture. Models and solution procedures which minimize the cost of such migration strategies subject to architectural and capacity constraints are addressed.

SA21 Theoretical Foundations of MMT I

Cluster: Management of Medical Technology
Invited Session

Chair: Ori Heller, Univ. of PA, Snider Ctr., Wharton Sch., 402 Vance Hall, 3733 Spruce St, Philadelphia, PA 19104, oheller@sec1.wharton.upenn.edu

1) **Theoretical Foundations of MMT: An Overview**, *Ori Heller*, Univ. of PA, Snider Ctr., Wharton Sch., 402 Vance Hall, 3733 Spruce St, Philadelphia, PA 19104, oheller@sec1.wharton.upenn.edu, *Eliezer Geisler*

The objectives of the meeting on "Theoretical Foundations of MMT" are described, followed by an overview of the MMT intellectual space as a disciplinary area. We also provide an update on the activities within MMT, including our book series and the forthcoming dedicated Journal of MMT. Finally, we describe the academic background of MMT in schools of business and medicine.

2) **Management of Medical Technology as a Field of Knowledge**, *Ori Heller*, Univ. of PA, Snider Ctr., Wharton Sch., 402 Vance Hall, 3733 Spruce St, Philadelphia, PA 19104, oheller@sec1.wharton.upenn.edu, *Eliezer Geisler*

We portray the theoretical foundations of MMT as a field of knowledge by utilizing a schematic approach similar to the periodic table of the elements. We trace the underlying disciplines and sub-fields of knowledge that compose MMT, and project the sub-areas of research and academic investigation which are involved in the rapidly developing discipline of MMT. Examples from

recent studies and cases are provided.

3) Management of Medical Technology: From Theory to Practice, David Walker, Valley Children's Hospital, 3151 North Millbrook, Fresno, CA 93726, firstbreath@earthlink.net, **Ori Heller, Eliezer Geisler**

We describe one case of the application of the theoretical foundations of MMT in an instance of a teaching hospital. We explain the role that the stakeholders of MMT in the hospital play in the technical, clinical and managerial components of the MMT process.

SA23 Logistics & Supply Chain Management I Contributed Session

Chair: Rachel Yang, Univ. of IL, 350 Commerce West, Champaign, IL 61820, ryang@uiuc.edu

1) Benchmarking Competitiveness of Supply Chains: An Empirical Study, Rohit Bhatnagar, Nanyang Tech. Univ., Nanyang Bus. Sch., B2A-26 Sch. of Acct. & Bus., Singapore, 639798, Singapore, arbhatnagar@ntu.edu.sg

We focus on 2 important issues relating to global supply chains: supply chain performance measures and impact of location on competitiveness of the supply chain. We will present results from a study conducted in Singapore which covered approximately 1000 multinational companies with sites in the Asia-Pacific region.

2) Measurement of Logistical Effectiveness in Retail Supply Chains, Yasemin Aksoy, Tulane Univ., Freeman Sch. of Bus., New Orleans, LA 70018, yaksoy@office.sob.tulane.edu

A multi-attribute evaluation model is applied to measure the effectiveness of logistic efforts in retail supply chains. Initial model design was achieved through collaboration with Saks Fifth Avenue managers who are in charge of the company's logistic activities.

3) Plant Missions in Global Manufacturing Networks: An Exploratory Study of the Color Picture Tube Industry, Anil Khurana, Boston Univ., Sch. of Mgmt., 595 Commonwealth Ave., Boston, MA 02215, akhurana@bu.edu, **Brian Talbot**

We explore plant missions in a global organization. We find that plants in the same business unit adopt different missions, possibly because of the emergence of global manufacturing networks. We suggest a framework for global manufacturing linking the notions of plant mission, inter-plant knowledge sharing and centers of excellence.

4) The Implication of Market Specific Stock-to-Parallel Imports, Poh-Kim Tay, Univ. of IL, Dept. of Bus. Admin., Champaign, IL 61820, ptay@uiuc.edu, **Rachel Yang**

Automobile and electronics companies have considered using parts postponement and market specific stock as product design strategies to cut inventory in their global supply chains. We examine another benefit of the planned product variety in the global marketplace: to control unauthorized product flows and reduce parallel imports.

SA25 Bayesian Diagnostics, Assessing Compatibility, Model Selection & Computation

Cluster: Statistics & Reliability
Invited Session

Chair: Dongchu Sun, Univ. of MO, 222 Math Sci. Bldg., Dept. of Stats., Columbia, MO 65211, dsun@stat.missouri.edu

1) Bayesian Methods for the Accelerated Failure Time Model, Wesley Johnson, Univ. of CA, Div. of Stats., Davis, CA 95616, wjohnson@ucdavis.edu, **Edward J. Bedrick, Ronald Christensen**

We discuss a new method of specifying prior distributions for the parameters of accelerated failure time models. We further provide a discussion and illustration of Bayesian inferences, diagnostics, model choice and sensitivity analysis for these models.

2) Empirical Bayes Decision Criteria for Assessing Compatibility with Quantitative Nuclear Power Reactor Safety Goals, Harry F. Martz, Los Alamos National Lab., Group TSA-1, MS F600, Los Alamos, NM 87545, harry@hypatia.lanl.gov

Nonparametric empirical Bayes decision criteria are developed for use in deciding whether a nuclear power reactor is compatible with a specified numerical safety goal. The method is illustrated using the data from the probabilistic risk assessments performed on all US commercial nuclear power plants under the NRC's individual plant examination program.

3) Bayesian Estimation Techniques Accounting for Uncertainty in the Selection of a Model, Andrew A. Neath, Southern IL Univ.,

Dept. of Math & Stats., Edwardsville, IL 62026, aneath@siue.edu

In searching for an appropriate statistical model, an investigator is often guided towards certain parametric families. Of course, the choice of a parametric family is at best an approximation. We consider some methods for quantifying the uncertainty associated with the choice of a parametric family.

4) Optimal Stopping & Bayesian Computations in Reliability Growth Tests, Refik Soyer, George Washington Univ., Dept. of MS, Monroe Hall 403, Washington, DC 20052, soyer@gwis2.circ.gwu.edu, **Thomas Mazzuchi**

We address the problem of determining when to terminate the testing/modification process and release a system in reliability growth tests. We present a Bayesian decision theoretic approach by formulating the system release problem as a sequential decision problem. We show optimality of 1-stage look ahead stopping rules and discuss computational issues.

SA26 PANEL: The Importance of Student Chapters in Our Community

Cluster: Student Affairs
Invited Session

Chair: Valerie Tardif, Univ. of TX, Grad. Program in OR/IE, Austin, TX 78712-1063, vtardif@mail.utexas.edu

1) PANEL: The Importance of Student Chapters in our Community, John R. Birge, Univ. of MI, jrbirge@umich.edu, **Kim Y. Woodson**, NC State Univ., **Martha A. Centeno**, FL Intl. Univ., **Karla L. Hoffman**, George Mason Univ., **Valerie Tardif**, Univ. of TX

Student chapters are a wonderful way to assemble people that share a common interest, unite students and faculty, promote learning and understanding of our field and provide an escape from work through social activities. INFORMS recognizes and encourages all the different purposes that student chapters serve in the lives of OR/MS students. We discuss ways to help student chapters achieve even more success.

SA27 Intelligent Heuristics in Logistics

Cluster: Interface Between OR & AI
Invited Session

Chair: Dilek Tuzun, Lehigh Univ., Dept. of IMSE, Mohler Lab., 200 W Packer Ave., Bethlehem, PA 18015, dit2@lehigh.edu

1) Characterizing Upstream Demands in Manufacturing Supply Chains, S. David Wu, Lehigh Univ., Mfg. Logistics Inst., 200 W Packer Ave., Mohler Lab., Bethlehem, PA 18015, sdwl@lehigh.edu, **Mary J. Meixell**

We propose an analytical model which characterizes lead time and demand variations in a manufacturing supply chain. The model is motivated by the practice in automotive industry where upstream production releases change on a frequent basis. The model provides a means to characterizing upstream demand variations considering manufacturing lead time and operational policies.

2) Heuristics for Stochastic Job Shop Scheduling, Robert H. Storer, Lehigh Univ., Dept. of IMSE, Mohler Lab., Bethlehem, PA 18015, rhs2@lehigh.edu, **Jaime M. Bustos**

Two approaches to job shop scheduling with stochastic processing times are considered: (1) find a robust sequence apriori and stick to it and (2) apply non-myopic dispatch procedures where at each scheduling decision point we determine which operation to dispatch by (heuristically) solving (various) scheduling problems over the remaining operations.

3) An Improved Two-Phase Tabu Search Heuristic for the Location Routing Problem, Dilek Tuzun, Lehigh Univ., Dept. of IMSE, Mohler Lab., 200 W Packer Ave., Bethlehem, PA 18015, dit2@lehigh.edu, **Laura I. Burke**

There are many distribution systems where it is necessary to integrate decisions of selection of distribution centers and vehicle routing. The LRP, which combines these 2 decisions, is NP-hard. We present an improved 2 phase heuristic for the LRP and report recent results on the performance of this heuristic.

SA28 TUTORIAL: Lagrangean Relaxation, Extensions & Applications

Cluster: Integer Programming Tutorials
Invited Session

Chair: Monique Guignard-Spielberg, Univ. of PA, Dept. of Decision Sci., Wharton Sch., 1320 SH-DH, Philadelphia, PA 19104-6366, guignard@dantzig.wharton.upenn.edu

1) TUTORIAL: Lagrangean Relaxation, Extensions & Applications, Monique Guignard-Spielberg, Univ. of PA, Dept. of Decision Sci., Wharton Sch., 1320 SH-DH, Philadelphia, PA 19104-6366, guignard@dantzig.wharton.upenn.edu

Our goal is to present in a concise format what needs to be known in order to design and implement an efficient Lagrangean relaxation in IP. We also describe a few successful applications. We will start with a basic introduction to Lagrangean relaxation for LIPs and its geometric interpretation. General ideas for splitting a problem before applying Lagrangean relaxation will be presented. We also discuss the integer linearization principle...

SA29 Nonlinear Programming Theory & Application

Cluster: Nonlinear Programming

Invited Session

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

1) Computing Global Solutions of Nonconvex NLPs, Nick Sahinidis, Univ. of IL, Dept. of Mech. & IE, Urbana, IL 61801, nikos@uiuc.edu

In the context of B&B algorithms for nonconvex NLPs we develop: a) range contraction techniques aimed at strengthening lower bounds; b) finite, as opposed to the typical convergent, branching schemes; c) a general purpose computational system. Extensive computational results are presented for several classes of structured NLPs.

2) A Mean-Variance Model for Route Guidance in Advanced Traveler Information, Suvrajeet Sen, Univ. of AZ, SIE Dept., Eng. Bldg., PO Box 210020, Tucson, AZ 857210020, sen.sie.arizona.edu, Rekha S. Pillai, Shirish Joshi, Ajay K. Rathi

We formulate a route planning model as a quadratic 0-1 integer program with network structure. The quadratic form models the mean and variance associated with a path. By utilizing the structure of the problem we devise an algorithm in which the 0-1 QP is solved by using a continuous relaxation followed by an enumeration of some selected paths.

3) New Bounding Schemes & a Global Algorithm for the Pipe Network Design Problem, Rajiv Tolani, SABRE Decision Tech., PO Box 619615, DFW Airport, TX 75261-9615, Hanif Sherali

We describe a global optimization algorithm for the water distribution pipe network design problem. A new lower bounding scheme is developed that exploits the convex-concave structure of the underlying nonconvex constraint functions. Computational results on solving some standard problems to global optimality for the 1st time are presented.

SA30 Heuristics for Vehicle Routing & Transportation Problems I

Cluster: Heuristic Methods in Optimization

Invited Session

Chair: Daniele Vigo, Univ. of Bologna, DEIS, Viale Risorgimento 2, Bologna, 40136, Italy, dvigo@deis.unibo.it

1) Arc Routing & Scheduling Problem with Vehicle/Site Dependencies, John Sniezek, Univ. of MD, Coll. of Bus. Mgmt., College Park, MD 20742, Lawrence D. Bodin, Michael O. Ball

In residential sanitation with vehicles of varying sizes and capacities, some streets that require service can only be serviced by a subset of the vehicle types - complicating the partitioning of the required streets into routes. Two heuristic algorithms for solving this problem are described and computational experience presented.

2) A Neural Network Solution to the Generalized Orienteering Problem, Bruce L. Golden, Univ. of Maryland, Van Munching Hall, Coll. of Bus. & Mgmt., College Park, MD 20742, Qiwen Wang, Xiaoyun Sun

We attack a generalization of the orienteering problem in which each point has a score with respect to several attributes and the objective function is nonlinear. We present a neural network solution procedure. The results indicate that neural networks can be used to solve certain combinatorial optimization problems effectively.

3) ADART: Autonomous Dial-a-Ride Transit, James B. Orlin, MIT, Rm. E53-357, Sloan Sch. of Mgmt., Cambridge, MA 02139, jorlin@mit.edu, Ravindra K. Ahuja, Robert B. Dial, Matthew Jaro

We investigate routing and scheduling algorithms for a modernized version of the many-to-few dial-a-ride transportation, ADART. ADART employs fully automated order-entry and dispatching systems that reside on board the vehicles. We describe decentralized routing and scheduling algorithms for ADART.

4) A Granular Tabu Search Algorithm for Routing Problems, Daniele Vigo, Univ. of Bologna, DEIS, Viale Risorgimento 2, Bologna, 40136, Italy, dvigo@deis.unibo.it, Paolo Toth

We propose a TS heuristic using an effective intensification/diversification tool based on the use of restricted (granular) neighborhoods which do not contain the moves involving arcs which are not likely to belong to good, feasible solutions. The use of granular neighborhoods with other features of the TS approach is studied and tested on constrained routing problems.

5) Solving Vehicle Routing Problems with Side Constraints Using Constraint Programming, Bruno De Backer, ILOG, 9 rue de Verdun BP85, Gentilly Cedex, 94253, France, debacker@ilog.fr, Vincent Furnon

Standard mathematical models for VRPs do not easily take into account important side constraints such as complex time windows, precedence constraints or multiple capacities. We present a new approach for modeling and solving routing problems, implemented using ILOG Solver, and results on problems ranging from TSPs to complex VRPs.

SA31 Boolean Combinatorics & Optimization

Cluster: Combinatorial Optimization

Invited Session

Chair: Peter L. Hammer, Rutgers Univ., RUTCOR, PO Box 5062, New Brunswick, NJ 08903-5062, hammer@rutcor.rutgers.edu

1) Boolean Function Lattices, Cor Bioch, Erasmus Univ. Rotterdam, Dept. of Comp. Sci. FEW H4-27, PO Box 1738, Rotterdam, 3000 DR, The Netherlands, bioch@few.eur.nl

We study the relationship between Boolean function lattices and more general intersection structures of Boolean functions on a set X , such as the hypercube, with the monoid of quasi-orderings on X . This naturally leads to the study of monotonicity operators of Boolean functions. We also show the relationship with modal logic.

2) Functional Dependencies in Horn Theories, Alexander Kogan, Rutgers Univ., RUTCOR, PO Box 5062, New Brunswick, NJ 08903, kogan@rutcor.rutgers.edu, Toshihide Ibaraki, Kazuhisa Makino

Functional dependencies are commonly used in relational database design to express integrity constraints. The most popular way of representing knowledge in AI is by means of a Horn theory. For any given Horn theory, we study the structure of the set of functional dependencies, prove that it is quasi-acyclic and provide polynomial algorithms for the recognition of whether a functional dependency holds...

3) Convexity in Logical Analysis of Data - LAD, Peter L. Hammer, Rutgers Univ., RUTCOR, PO Box 5062, New Brunswick, NJ 08903-5062, hammer@rutcor.rutgers.edu, Oya Ekin, Alexander Kogan

We present a polynomial solution to the important LAD problem of constructing a convex Boolean function which agrees with a given set of observations. This solution uses a complete combinatorial and algebraic characterization of convex functions that implies the uniqueness of their prime disjunctive normal form representation.

SA32 Heuristic Approaches to Integer Network Problems

Sponsor: CSTS

Sponsored Session

Chair: Richard S. Barr, SMU, Dept. of Comp. Sci. & Eng., Dallas, TX 75275-0122, barr@seas.smu.edu

1) Alternative Metaheuristic Approaches to the Multi-Resource Generalized Assignment Problem, Mohammad M. Amini, Univ. of Memphis, Fogelman Coll., Memphis, TN 38152, mamini@cc.memphis.edu, Bahram Alidaee, Michael J. Racer

We present alternative metaheuristics to solve the MRGAP. These metaheuristics include TS, the search space smoothing technique, the noising method and a new hybrid metaheuristic, the dynamic search space smoothing method. Computational results are discussed.

2) Interval-Pivoting Algorithms for the Interval-Flow Transportation Problem, Aruna Apte, SMU, Dept. of Comp. Sci. & Eng., Dallas, TX 75275, aapte@seas.smu.edu, Richard S. Barr

The interval-flow version of the transportation model requires that arc flows be either 0 or within a specified range. We present interval-pivoting adjacent-extreme-point heuristics that employ a nonstandard basis definition and TS to find near-optimal solutions to large instances of these MIPs in seconds.

3) Destabilizing Target Systems: Probabilistic Network

Optimization Models & Efficient Algorithms, Richard S. Barr, SMU, Dept. of Comp. Sci. & Eng., Dallas, TX 75275-0122, barr@seas.smu.edu, **Gregg Jernigan**

Target systems analysis evaluates the interconnected nature of targets in making recommendations to achieve strategic objectives. We present a probabilistic target systems analysis network model and alternative heuristic algorithms for the nonlinear-integer optimization problem of selecting the minimum-cost target set required to meet system-level functional damage goals.

Sunday 10:30-12:00

SB01 PANEL: Impact of Emerging Digital Technologies in OR/MS Applications

Cluster: OR/MS Applications
Invited Session

Chair: Edward E. Rothberg, Silicon Graphics Computer Systems, 2011 N Shoreline Blvd., Bldg. 71-580, Mountain View, CA 94043, rothberg@sgi.com

1) **PANEL: The Impact of Emerging Digital Technologies of OR/MS Applications, E. Andrew Boyd,** TX A&M Univ., boyd@marvin.tamu.edu, **Harlan P. Crowder,** IBM Consulting Group, **Roy Marsten,** Cutting Edge Optimization, **YanJun Zhang,** SMU

One of the most important tools of the OR practitioner is the digital computer. Computing power has increased dramatically in the last few decades and most likely will continue this ascent into the future. More powerful tools generally allow more challenging problems to be solved. This panel discusses areas where advances in computing have made previously intractable OR problems tractable, where they have made advances in other OR technologies possible...

SB02 TUTORIAL: Large-Scale Math Programming Computation with Applications in Airlines

Cluster: Airline Industry Tutorials
Invited Session

Chair: Ellis L. Johnson, GA Inst. of Tech., Sch. of ISyE, 765 Ferst Dr., Atlanta, GA 30332-0205, ejohnson@isye.gatech.edu

1) **TUTORIAL: Large-Scale Math Programming Computation with Applications in Airlines, Ellis L. Johnson,** GA Inst. of Tech., Sch. of ISyE, 765 Ferst Dr., Atlanta, GA 30332-0205, ejohnson@isye.gatech.edu

The airline industry is currently actively involved in developing and implementing mathematics programming models in planning. Three such problems are considered: crew pairing, fleet assignment and bid-prices. These problems are currently being solved regularly by major airlines using mixed-integer (for the first 2) and NLP (for the 3rd). We discuss size of models, hardware and software being used and some of the methodology used to overcome computational difficulties...

SB03 Free Flight - Implications for the Carriers

Sponsor: Aviation Applications Section
Sponsored Session

Chair: Stephanie B. Fraser, US Airways, Inc., 2345 Crystal Dr., DCA/H700, Arlington, VA 22227, stephanie.fraser@usairways.com

1) **American Airlines' Perspective on Free Flight, Earl Wolfe,** American Airlines, MD 853, PO Box 619617, DFW Airport, TX 75261-9617, earl_wolfe@amrcorp.com

An American Airlines representative will discuss why they support free flight and the urgency of fielding DSSs in the near term to provide a bridge between today's system and the mature free flight system.

2) **Operational Impacts of Collaborative Decision Making, Mike Baker,** Southwest Airlines

CDM will make more efficient use of airline and airspace resources through information exchange. This process will result in millions of dollars in savings from improved (GDP) National Ground Delay Programs.

3) **Collaborative Decision Making Benefits Analysis: Metrics & Preliminary Results, Rose Y. Hsu,** American Airlines, PO Box 619616, DFW Airport, TX 75261-9616, rose_hsu@amrcorp.com

Some preliminary work has been completed to investigate the value of the CDM process. These preliminary results not only provide insight to the forecasting accuracy of CDM but also define the frame of CDM benefit analyses.

4) **The SkySource Concept: Facilitating Collaborative Air**

Traffic Management, Gerard Eldering, The MITRE Corp., 1820 Dolley Madison Blvd., McLean, VA 22102-3481, eldering@mitre.org, **Andrew R. Lacher**

Collaborative air traffic management requires an information exchange mechanism that provides for information security and protection of proprietary data. The Skysource concept, developed by ARINC and MITRE, creates an information exchange mechanism through private-public partnership that addresses critical business and organizational issues.

SB04 Joint Warfare Systems I

Sponsor: Military Applications Society
Sponsored Session

Chair: Jeffrey R. Cares, JWARS Office, Crystal Square 4, Ste. 100, 1745 Jefferson Davis Highway, Arlington, VA 22202, caresj@paesmtmp.pae.osd.mil

1) **Land Warfare Representations in the Joint Warfare System, Terry W. Prosser,** JWARS Office, Crystal Square 4, Ste. 100, 1475 Jefferson Davis Hwy, Arlington, VA 22202, prossert@paesmtmp.pae.osd.mil

The JWARS is a Deputy Secretary of Defense-directed initiative to develop a defense planning model to meet OSD, Joint Staff, CINC and service requirements. The JWARS Office has produced a working prototype and begun development of a production version. Land warfare is the primary focus of JWARS.

2) **Representation of Maritime Operations in JWARS, Jeffrey R. Cares,** JWARS Office, Crystal Square 4, Ste. 100, 1745 Jefferson Davis Hwy, Arlington, VA 22202, caresj@paesmtmp.pae.osd.mil, **Barry Justice**

The representation in JWARS of Navy and Marine Corps contribution to expeditionary warfare, power projection ashore, littoral warfare and regional sea control have a profound impact on force structure and planning decisions. JWARS will support this type of analysis with a representation of maritime forces.

3) **Air Warfare in JWARS, John O. Yanaros,** JWARS Office, Crystal Square 4, Ste. 100, 1745 Jefferson Davis Hwy, Arlington, VA 22202, yanarosj@paesmtmp.pae.osd.mil

JWARS is required to address operational plans development and assessment as well as force structure sufficiency now and in acquisition outyears and analysis of alternatives. Through a C4ISR baseline, innovative operational concepts and alternative organizations may be investigated. Potential legacy models and functionalities will also be discussed.

4) **Space Systems in JWARS, John O. Yanaros,** JWARS Office, Crystal Square 4, Ste. 100, 1745 Jefferson Davis Hwy, Arlington, VA 22202, yanarosj@paesmtmp.pae.osd.mil

Space contributions to JWARS focuses on space support and enhancement missions within the scope of development scenarios. Space control, application and attack will follow in the development of JWARS.

5) **Intelligence Fusion in the JWARS Prototype, Terry W. Prosser,** JWARS Office, Crystal Square 4, Ste. 100, 1475 Jefferson Davis Hwy, Arlington, VA 22202, prossert@paesmtmp.pae.osd.mil

A central development objective of JWARS is the representation of perceived battlespace truth. Perception of enemy activities and how that perception feeds the command and control decision process was a fundamental focus of the JWARS prototype. Synthetic forces use perception to affect decisions in the prototype.

SB05 Copulas in Decision Analysis

Sponsor: Decision Analysis Society
Sponsored Session

Chair: Robert Clemen, Duke Univ., Fuqua Sch. of Bus., Durham, NC 27708-0120, clemen@mail.duke.edu

1) **Copulas in Decision Analysis: A Tutorial, Robert Clemen,** Duke Univ., Fuqua Sch. of Bus., Durham, NC 27708-0120, clemen@mail.duke.edu

Copulas provide a way of modeling uncertainty that differs from the typical factorization of a joint distribution into marginal and conditional. We present mathematical properties of copulas, discuss copula families that are useful for decision and risk analysis, give simple examples and describe methods for assessing required dependence parameters (correlations).

2) **Three Methods for Assessing Subjective Correlations: An Experimental Investigation, Gregory W. Fischer,** Duke Univ., Fuqua Sch. of Bus., Durham, NC 27708-0120, fischer@mail.duke.edu

edu, *Robert Clemen, Robert L. Winkler*

We investigate 3 methods for assessing subjective correlations among a set of variables: direct assessments of rank-order correlations, assessments of probability of concordance and conditional estimates of fractile x given fractile Y . We evaluate methods in terms of internal consistency and correspondence with empirical estimates of correlation among variables.

SB06 EDUCATION TUTORIAL: Marketing Engineering - Market Analysis & Planning in the Information Age

Sponsor: Forum on Education

Sponsored Session

Chair: Gary L. Lilien, PA State Univ., 402 Bus. Admin. Bldg., College Park, PA 16802, gl5@email.psu.edu

Co-Chair: Arvind Rangaswamy

1) EDUCATION TUTORIAL: Marketing Engineering - Market Analysis & Planning in the Information Age, *Vijay Mahajan*, Univ. of TX, Grad. Sch. of Bus., Dept. of Mktg., Austin, TX 78712-1176, vmahajan@mail.utexas.edu, *John D. C. Little*

Downsized and flatter organizations, exploding volumes of data and rapidly changing market-conditions have combined with powerful new software and PCs on networks to produce problems and opportunities. The problem is that the traditional marketer's job has been vastly expanded, from one that has historically relied predominantly on intuitive and qualitative skill to one that now has great quantitative demands as well...

SB07 Category Management

Sponsor: MSOM

Sponsored Session

Chair: Ravi Anupindi, Northwestern Univ., Kellogg Grad. Sch. of Mgmt., Evanston, IL 60208, anupindi@kaizen.kellogg.nwu.edu

1) Structural Properties of Retail Assortments, *Garrett J. van Ryzin*, Columbia Univ., Grad. Sch. of Bus., 412 Uris Hall, New York, NY 10027, gjv1@columbia.edu, *Siddharth Mahajan*

We study some structural properties of retail assortments of substitutable items. These properties lead to a better understanding of what factors determine the optimal breadth and depth of merchandise assortments.

2) Towards a More Complete Store-Level Promotional Model, *Robert C. Blattberg*, Northwestern Univ., Kellogg Grad. Sch. of Mgmt., Dept. of Mktg., Evanston, IL 60208, *Richard A. Briesch*

We use store-level data and separate consumer response into brand switching, stockpiling and category expansion effects for 2 different product categories. It is shown that the use of store-level data for estimation may yield very different answers than individual-level data. The managerial implications of our findings are then derived and discussed.

3) Models for Managing Variety on the Retail Shelf, *Ravi Anupindi*, Northwestern Univ., Kellogg Grad. Sch. of Mgmt., Evanston, IL 60208, anupindi@kaizen.kellogg.nwu.edu, *Maqbool Dada*, *Sachin Gupta*

We study the assortment and stocking problems on the retail shelf. A key feature is that customers are willing usually to substitute items when their "most preferred" item is either not in the assortment or out of stock. We present models for consumer demand and for assortment and stocking decisions.

SB08 Managing Information -Intensive Firms

Sponsor: MSOM

Sponsored Session

Chair: Uday M. Apte, SMU, Cox School of Bus., Dallas, TX 75275-0333, uapte@mail.cox.smu.edu

1) An Architecture for Information Intensive Services: The Case Manager Approach, *Cynthia M. Beath*, SMU, Cox Sch. of Business, Dallas, TX 75275-0333, cbeath@mail.cox.smu.edu, *Uday M. Apte*

We propose an IT and organizational architecture that dramatically can improve information intensive processes that support a case, a bundle of service deliverables for a single customer. The case manager approach entails work processes carried out by a single empowered and informed individual who completes an entire case.

2) Staffing & Capacity in Technical Publishing, *Uday S. Karmarkar*, UCLA, Anderson Sch. of Mgmt., 110 Westwood Plaza, Box 951481, Los Angeles, CA 90095-1481, uday.karmarkar@anderson.ucla.edu

The flow of work to a service department is often quite variable. As a result, the time taken to complete the work also varies. A model to set staffing levels to meet target lead times under varying loads is formulated and applied to a case example in technical publishing.

3) Towards a Definition of Knowledge Work, *Ulrike Shultze*, Case Western Reserve Univ., 10900 Euclid Ave., Cleveland, OH 44106-7235, uxs5@po.cwru.edu

Understanding knowledge work is important to information intensive firms. Even though there are numerous theories of organizational learning and knowledge management, there are few definitions of knowledge work. Reviewing knowledge-based theories of the firm and labor process theory, we develop a definition of knowledge work.

4) Knowledge Management in Information-Intensive Firms: A Framework, *Uday M. Apte*, SMU, Cox School of Bus., Dallas, TX 75275-0333, uapte@mail.cox.smu.edu, *Richard O. Mason*

We discuss and characterize the challenges of knowledge management in information-intensive firms and propose a theoretical framework. The framework provides a method for separating the knowledge component of activities from other components to facilitate its management.

SB09 Flexible Manufacturing II

Cluster: Flexible Manufacturing

Invited Session

Chair: Kathryn E. Stecke, Univ. of MI, Sch. of Bus. Admin., Ann Arbor, MI 48109-1234, kathryn_stecke@ccmail.bus.umich.edu

1) FMS Applications in Hungary: Some Case Studies, *Koty Lapid*, Hungarian Academy, PO Box 3317, Beer Sheva, Israel, kolap@magnet.hu

We investigate whether the flexibility of manufacturing systems plays an important role in Hungarian companies' business strategies. In cases where FMS played a role and indeed was applied, we analyze what kind of flexibility has been reached.

2) Evaluating the Throughput of FMSs With Limited Buffers, *Ulrich A. Tezloff*, MIT, OR Ctr., 77 Massachusetts Ave., Cambridge, MA 02139-4307

New closed form expressions in order to evaluate the throughput of FMSs with limited local buffers are presented. They are based on the product from formulation of closed queueing networks of the Jackson type.

3) A Robust Simulation Approach for New Manufacturing Technology Adoption, *Stephen R. Lawrence*, Univ. of CO, Coll. of Bus., CB 419, Boulder, CO 80303-0419, stephen.lawrence@colorado.edu, *George E. Monahan*, *Timothy L. Smunt*

We develop and test a methodology to assist managers in making decisions regarding manufacturing technology adoption and timing, TAT. We adapt concepts from the evolving robust optimization literature to the TAT problem using an approach we call robust simulation. Specifically, we extend a TAT problem first introduced in Monahan & Smunt (1989)...

SB10 Traffic Measurement & Estimation Algorithms

Sponsor: Transportation Science Section

Sponsored Session

Chair: Reinhart Kuhne, Steierwald Schonharting & Partner GmbH, Hessbrühlstr. 21c, Stuttgart, 70565, Germany, ssp@ssp-s.cemil.compuserve.com

1) Automated Travel Time Measurement Using Vehicle Lengths From Loop Detector Speed Traps, *Benjamin Coifman*, Univ. of CA, Inst. of Transport. Studies, 109 McLaughlin Hall, Berkeley, CA 94720, zephyr@eecs.berkeley.edu

We investigate the feasibility of vehicle reidentification from vehicle lengths measured over a large separation (approximately 1 mile) using existing loop detector infrastructure. Results show that it is possible to reidentify vehicles using noisy, non-unique vehicle length measurements and hence, measure travel time directly without additional detector hardware.

2) A Real-Time Origin Destination Matrix Estimation Framework Using True Section Densities, *Carlos Sun*, Univ. of CA, Dept. of Civil & Environ. Eng., Inst. of Transport. Studies, Irvine, CA 92697, sun@translab.its.uci.edu, *R. Jayakrishnan*, *Wei K. Tsai*

We propose a complete framework for real-time OD matrix estimation that is implementable with current traffic control technology. The first part is concerned with the derivation of true densities in a traffic information and control environment; the second is concerned with the usage of such densities in

a real-time OD matrix estimation framework. The proposed framework incorporates current information...

3) Real-Time Estimation of Time Dependent O-D Flows Using Kalman Filter with Polynomial Expression of State Variables, Ying Kang, Univ. of TX, Dept. of Civil Eng. & MSIS, ECJ 6.204, Austin, TX 78712-1076, yingkang@mail.utexas.edu, Hani S. Mahmassani

A polynomial expression is used to represent the time varying characteristics of OD flows. The parameters of these polynomials are estimated as state variables by Kalman filter, consistent with results of a DTA algorithm. Numerical results are presented.

4) Design of a Traveller Information System Based on Section-Related Traffic Data Detection, Reinhart Kuhne, Steierwald Schonharting & Partner GmbH, Hessbruhlstr. 21c, Stuttgart, 70565, Germany, ssp@ssp-s.ccmil.compuserve.com

Section-related traffic data such as travel time or traverse cruising speed can be derived from correlating detuning curves as feature sequences of adjacent inductive loops detectors. Tracing vehicles and platoons through consecutive segments yield gross travel time which can be disseminated for individual and collective route guidance systems.

SB11 TUTORIAL: Perspectives & Prospects in Time Constrained Routing

Sponsor: Transportation Science Section
Sponsored Session

Chair: Marius M. Solomon, Northeastern Univ., MS Dept., 360 Huntington Ave., Boston, MA 02115, solomon@neu.edu

1) TUTORIAL: Perspectives & Prospects in Time Constrained Routing, Jacques Desrosiers, GERAD & HEC, 5255 Decelles, Montreal, PQ H3T 1V6, Canada, Guy Desaulniers, Marius M. Solomon, Francois Soumis

This tutorial reviews the various modeling and solution methodologies for the VRP with time window constraints. On the modeling side, we begin with the classic formulation and continue with a multi-commodity flow formulation for multiple depots and multiple vehicle type problems. This leads to a discussion of modeling tasks as nodes or arcs of the underlying network...

SB13 Empirical Studies of Product Development

Cluster: New Product Development
Invited Session

Chair: Robert P. Smith, Univ. of WA, Dept. of IE, Box 352650, Seattle, WA 98195, smith@ieng.washington.edu

1) Technology Brokering & Innovation: Evidence from a Product Design Firm, Andy Hargadon, Stanford Univ., Dept. of IE/EM, Stanford, CA 94305, hargo@leland.stanford.edu

This paper blends network and organizational memory perspectives in a model of technology brokering that explains how certain organizations routinely develop innovative products. These firms act as technology brokers between industries to introduce existing solutions where they were previously unknown, creating new products that are original combinations of existing knowledge.

2) Managing Product Development in Turbulent Environments, Alan MacCormack, Harvard Bus. School, Morgan Hall T17, Boston, MA 02163, amaccormack@bhs.edu, Marco Iansiti

Existing models of product development emphasize avoiding unnecessary change and uncertainty; they portray a structured process with clear goals and milestones. When technologies and markets are predictable this process works well. We highlight a new product development model for turbulent environments drawing upon studies of several high technology industries.

3) Product Development Project Uncertainty & Project Outcomes, Mohan V. Tatikonda, Univ. of NC, Kenan-Flagler Bus. Sch., CB 3490, Carroll Hall, Chapel Hill, NC 27599-3490, tatikonm.bsacd1@mhs.unc.edu

This paper characterizes technology novelty and project complexity as central contributors to task uncertainty in product development projects. Task uncertainty relationships with project outcomes and organizational approaches which moderate these relationships are investigated via a large-sample survey study of completed product development projects.

4) Choosing Ambiguity Content in Engineering Design Problem Framing, Robert P. Smith, Univ. of WA, Dept. of IE, Box 352650, Seattle, WA 98195, smith@ieng.washington.edu

There is a distinction between technical problem solving under conditions of high and low ambiguity. The engineer has explicit choice over these conditions for many design problems. This paper describes the constraints on and effects of

this important problem framing choice based on extended observation of 3 engineering design projects.

SB14 Technology Transfer & NASA

Cluster: Technology Transfer
Invited Session

Chair: Joseph S. Heyman, NASA Langley Research Ctr., 11 Langley Blvd., MS 118, Hampton, VA 23681, joe_heyman@gmgate.larc.nasa.gov

1) NASA's Industrial Technology Transfer Benefits, Sally Little, NASA, Marshall Sp Flight Ctr.

NASA's Technology Transfer Program has a renewed focus on US commercial industry. Industry benefits from technologies developed for the civilian space program. The Industrial Assistance and Space Act Programs are 2 government-industry agreements that assist in US industry's ability to compete in the global marketplace.

2) NASA's Intellectual Property Fuels Technology Transfer with Industry

NASA's intellectual property is the foundation on which some US companies are building their future. Licenses give industry competitive advantages in high-technology products, while partnerships with NASA bring benefits to both the industry and NASA. Examples of recent successes as well as opportunities for future licenses are discussed.

3) (Re)Inventing Government-Industry R&D Collaboration, Bruce J. Holmes, NASA Langley Research Ctr., 11 Langley Blvd., Hampton, VA 23681

SB15 Strategic Dimensions of Technology Integration

Cluster: Technology Management
Invited Session

Chair: W. Clayton Hubner, Jr., Coll. of William & Mary, Sch. of Bus. Admin., PO Box 8795, Williamsburg, VA 23187-8795, wchubn@dogwood.tyler.wm.edu

1) Strategic Dimensions of Technical Flexibility, Mariann Jelinek, Coll. of William & Mary, 313 Burns Ln, Williamsburg, VA 23185-3908, mxjeli@facstaff.wm.edu, W. Clayton Hubner, Jr.

We address various dimensions of technological flexibility in organizations linking the concept to the literatures of manufacturing, strategy and organizational cognition. A grounded theory of strategic agility is proposed, uniting technology flexibility and transfer potential with organizational and human dimensions.

2) International Transfers of Manufacturing Process Technology: An Empirically-Based Plant-Level Model, W. Clayton Hubner, Jr., Coll. of William & Mary, Sch. of Bus. Admin., PO Box 8795, Williamsburg, VA 23187-8795, wchubn@dogwood.tyler.wm.edu

Plant-level transfers of process technology enable firms to leverage technology investments by using the knowledge and skill base in 1 facility as a pattern for technological development in another. Such transfers are rarely easy, and the extant literature provides little direct insight regarding the process or key factors for success associated with it. We present survey results from a multi-phase, multi-method study of international plant level technology transfer and propose an empirically-based model.

3) Technology Transfer at US Army Construction Engineering Lab: A DEA Study, Marilyn T. Lucas, Univ. of IL, 350 Commerce West, 1206 S 6th St., Champaign, IL 61820, mlucas@commerce.cba.uiuc.edu, Rachel Yang

The role of communications within technology transfer activities is studied using a DEA model. Data and cases are collected and analyzed at the US Army CERL. The efficiency measurements developed and the contributing factors examined have broad implications for transferring military technologies to civil use.

4) Strategic Reconfiguration of Agile Electronics Enterprises, Maheswaran Rajasekharan, TX A&M Univ., Dept. of IE, College Station, TX 77843-3131, m0r4732@acs.tamu.edu, Brett Peters

Uncertainty in product demands and mix for electronic products mandates the need for a strategic planning framework that considers dynamic reconfiguration of agile enterprises. We present an agile enterprise reconfiguration model that considers both subcontracting and in-house production. Both the model and an efficient solution methodology are discussed.

SB16 Strategy & Institutional Theory

Sponsor: College on Organization Science
Sponsored Session

Chair: Havagreeva Rao, Emory Univ., Gozuieta Sch. of Bus., Atlanta, GA 30322, havagreeva.rao@embus.emory.edu

1) Management Fashion: An Institutional-Theory Perspective on Business Schools' Competitive Environment, Eric Abrahamson, Columbia Univ., Grad. Sch. of Bus., 720 Uris Hall, New York, NY 10027

Business schools belong to a business-knowledge-producing community including other culture-producing industries, i.e., business book publishing, periodicals, consulting, etc., that compete to advance/impart cutting edge business information/knowledge. I present research on this community's functioning because business schools' long-term survival depends on their strategic positioning within this community.

2) Institutions, Organization & the Emergence of US/European Electronic Information Services, Marc Ventresca, Northwestern Univ., Kellogg Grad. Sch. of Mgmt., 2001 Sheridan Rd., Evanston, IL 60208-2001

Institutional arrangements and jurisdictional struggles among state and other actors provide mechanisms by which new industries form and take on structure and meaning. I combine archival and interview data on the formative moments of the US/European electronic data services with an analysis of public/commercial sector producer dynamics.

3) By Invitation Only: Status, Privilege & the Social Structure of Tournaments, Marvin Washington, Northwestern Univ., Kellogg Grad. Sch. of Mgmt., 2001 Sheridan Rd., Evanston, IL 60208-2001, **Edward Zajac**

We examine how status differences arise, i.e., past history, positive association, negative association, etc., and the privileges implied by such differences. Using extensive data from intercollegiate athletics, we find that status is a significant predictor of whether a college is invited to participate in post-season tournaments, irrespective of performance.

4) The Legitimacy of Strategic Alliances: An Institutional Perspective, Tina Dacin, TX A&M Univ., College Station, TX 77843-4221, tdacin@sigma.tamu.edu, **Christine Oliver**

Strategic alliances serve an important legitimating function that significantly influence firm success. We advance a theoretical framework which identifies 6 types of alliance legitimacy and corresponding firm advantages. We develop propositions explaining when alliance-based legitimacy is likely to contribute to firm success.

5) How Shall this Organization Be Named? Embedding Organizational Identity within Institutional Fields, Mary Ann Glynn, Emory Univ., Gozuieta Sch. of Bus., Atlanta, GA 30322, **Rikki Abzug**

We examine how choice of organizational name is affected by institutional forces in 3 studies: a historical study of naming patterns, an archival study of institutional, environmental, organizational and agency effects and a survey on name legitimacy. We found that organizations negotiate a reputational strategy of being similar but different than other firms in their institutional field.

SB17 AIDS Modeling II

Sponsor: Health Applications Section
Sponsored Session

Chair: Lawrence M. Wein, MIT, Sloan Sch. of Mgmt., Rm. E53-343, Cambridge, MA 02139, lwein@mit.edu

1) Resource Allocation for HIV Control, Margaret L. Brandeau, Stanford Univ., IE/EM Dept., Stanford, CA 94305-4024, brandeau@stanford.edu, **Gregory Zaric**

We discuss models to determine optimal resource allocation for control of the HIV epidemic. We investigate how the optimal resource allocation changes as a function of population size, growth of the epidemic in each population and effectiveness of interventions (measured by changes in behavior as a function of resources expended).

2) Mathematical Considerations of Antiretroviral Therapy Aimed at HIV-1 Eradication or Maintenance of Low Viral Loads, Rebecca D'Amato, MIT, OR Ctr., Cambridge, MA 02139, **Lawrence M. Wein, Alan Perelson**

We construct and analyze a mathematical model that tracks the dynamics of cells and virus, under a combination regime of reverse transcriptase and protease inhibitors. We investigate factors that influence the success or failure of powerful regimens to eradicate HIV-1 or to maintain viral loads at low levels.

3) The Effects of Buprenorphine Treatment on Reducing Drug

Abuse & the Spread of HIV, Gregory Zaric, Stanford Univ., Dept. of IE/EM, Stanford, CA 94305-4024, zaric@leland.stanford.edu, **Paul G. Barnett**

Burperorphine, a newly developed alternative to methadone, can be used for combating opiate addiction. This study considers the effectiveness of buprenorphine in reducing illicit drug use, preventing HIV infection and mortality and increasing quality-adjusted years of survival. We use an epidemic model combined with economic analysis.

SB18 Resource Sharing in DEA

Cluster: DEA & Productivity

Invited Session

Chair: Wade D. Cook, York Univ., Schulich Sch. of Bus., 4700 Keele St., North York, Ontario, M3J 1P3, Canada, wcook@bus.yorku.ca

1) Equitable Allocation of Shared Costs in DEA, Wade D. Cook, York Univ., Schulich Sch. of Bus., 4700 Keele St., North York, Ontario, M3J 1P3, Canada, wcook@bus.yorku.ca, **Moshe Kress**

In many applications of DEA there is a common cost or resource shared by all DMUs. The advertising expense for a product sold by all branches would be an example. We present a DEA-based approach for allocating that resource across the DMUs in an equitable way.

2) Separating Sales & Service Efficiencies in Bank Branches, Moez Hababou, York Univ., Schulich Sch. of Bus., 4700 Keele St., North York, Ontario, M3J 1P3, Canada

Bank branch personnel perform a variety of transactions, some of which are service related, while others pertain to sales. The apportionment of their time between these 2 functions, however, is not readily available as data at the branch level. We look at methods for extracting efficiency measures for each function.

3) Efficiency vs. Effectiveness in Organizational Performance, Hans Tuenter, York Univ., Schulich Sch. of Bus., 4700 Keele St., North York, Ontario, M3J 1P3, Canada, htuent@bus.yorku.ca

DEA has been used in many studies to evaluate bank branch performance. We look at efficiency (at the DMU level) vs. effectiveness (at a higher level in the hierarchy) in the transformation of resources into outputs at the branch level.

SB19 INFORMS New Member Welcome & INFORMS Meeting Orientation

Invited Session

Chair: Julia J. Pet-Edwards, Univ. of Central FL, Dept. of IE & Mgmt. Systems, PO Box 162450, Orlando, FL 32816-2450, edwards@iems.engr.ucf.edu

Co-Chair: Robert L. Armacost

1) INFORMS New Member Welcome & INFORMS Meeting Orientation

This workshop explores the benefits of INFORMS membership, identifies how members can become more involved in INFORMS and provides guidance for finding your way around the INFORMS meeting. This will be most beneficial for new members and first time meeting attendees. Refreshments provided.

SB20 Database, Advertising & Economic Issues in Electronic Commerce I

Sponsor: College on Information Systems
Sponsored Session

Chair: Sury Ravindran, Univ. of TX, Dec. Sciences, Sch. of Mgmt., 2601 N. Floyd Rd., Richardson, TX 75080, suryan@utdallas.edu

1) An Architecture for Real-Time Monitoring in Electronic Commerce, Prabhudev Konana, Univ. of TX, MSIS Dept., Grad. Sch. of Bus., Austin, TX 78712, pkonana@cism.bus.utexas.edu, **John Durett, Aloysius Mok, G. Liu**

Many electronic commerce applications require monitoring of timing constraints and user defined rules. We provide an architecture for monitoring conformance of such constraints in the WWW environment using Java programming language and database technology. We show how such an architecture can be used successfully for electronic commerce in financial markets.

2) Organizing & Managing Digital Products Companies, Anitesh Barua, Univ. of TX, Ctr. for Res. on Elect. Comm., MSIS Dept., Grad. Sch. of Bus., Austin, TX 78712, barua@mail.utexas.edu, **Ramnath Chellappa, Andrew B. Whinston**

Digital products companies face special challenges in efficiently providing mass

customized products. We develop an integrated approach to organizing and managing their value chain processes based on business value complementarity notions. This involves making complementary choices of technologies, strategies, processes and incentives to exploit the unique characteristics of digital products.

3) Consumer Behavior in On-Line Advertising Environments, Patrali Chatterjee, Vanderbilt Univ., Owen Grad. Sch. of Mgmt., Nashville, TN 37203, chattep@ctrvax.vanderbilt.edu

Advertising sponsorships have emerged as a dominant business model for generating revenues in the Web medium on the Internet. We illustrate how clickstream data obtained from server access logs can be used to segment consumers based on navigation behavior and track consumer response to advertising content on the Web.

4) Digital Libraries: A New Organizational Form for Information Trading, Byungtae Lee, Univ. of AZ, Eller Sch. of Mgmt., McClelland Hall 430, Tucson, AZ 85721, blee@bpa.arizona.edu

Digital libraries (an emerging organizational form) facilitate information trading by combining features of existing alternatives such as bookstore and traditional libraries. Using an industrial organization-based approach, I draw boundaries among these alternatives and explain how they evolve when challenged by alternatives, thus deriving insights into the future of e-commerce.

SB21 Theoretical Foundations of MMT II

Cluster: Management of Medical Technology

Invited Session

Chair: Bahador Ghahramani, Univ. of MO, 225 Eng. Mgmt. Bldg., Sch. of Eng., Rolla, MO 65401-0249, ghahrama@shuttle.cc.umn.edu

1) A Systems Engineering Approach to Total Quality Management in the Health Care Industry, Bahador Ghahramani, Univ. of MO, 225 Eng. Mgmt. Bldg., Sch. of Eng., Rolla, MO 65401-0249, ghahrama@shuttle.cc.umn.edu

We present SE applications in the health care industry using the TQM techniques. TQM is a managerial technique and philosophy that encourages synergy and teamwork by all members of the organization to continuously improve how well care delivery meets patient expectations and provides the highest standard of service. In practice, a health care industry organization that adopts TQM and implements SE principles will regularly benchmark its care delivery operations...

2) Creating a Market Place for New Technological Solutions, Sirkku Kivisaari, VTT, PO Box 1002, 02044 VTT, Finland, sirkku.kivisaari@vtt.fi

New markets with great business potential are emerging, e.g., preventive health care, home health care and telemedicine. Technology providers entering these fields need to integrate technological development with market construction. This study provides a framework for analysis and development of these markets.

3) An Assessment of Consumer and Physician Valuations of Direct-to-Consumer Advertising of Prescription Products, Fusun Gonul, Carnegie Mellon Univ., Grad. Sch. of Bus., Pittsburgh, PA 15213-3890, fg0k@andrew.cmu.edu

We examine both consumers and physicians with micro-level surveys in order to glean insights on the valuation of DTC advertising and on its interaction with other forms of promotion such as detailing by sales representatives.

SB23 Logistics & Supply Chain Management II

Contributed Session

Chair: Linda Nozick, Cornell Univ., Sch. of Civil & Environ. Eng., Hollister Hall, Ithaca, NY 14853-3501, lkn3@cornell.edu

1) A Heuristic Algorithm for Vehicle Routing Problems with Backhauls, Suk-Chul Rim, Ajou Univ., Dept. of IE, Suwon, 442-749, Korea, scrim@madang.ajou.ac.kr, **Nae-Heon Kim, Byung-Do Min**

For the VRP with backhauls, we propose a heuristic in which the vehicle may visit the nodes with more pickup before finishing the visit of nodes with more delivery, but visits each node exactly once. Computational tests show significant improvement in total travel distance over the existing algorithms.

2) A Genetic Algorithm for a Competitive Location Problem on a Network, In-Chan Choi, Korea Univ., Dept. of IE, 1 5-Ka Anamdong, Sungbuk-ku, Seoul, 136, Korea, ichoi@kucn.korea.ac.kr, **Seong-in Kim, Dae-ho Hwang**

We present a new binary IP formulation of a competitive location problem originally considered by Dobson & Karmarkar. Based on the formulation, we develop a GA which utilized penalty functions and modified elitism. Computational results are reported.

3) International Supply Chain Logistics for Achieving Service Quality, Donna L. Retzlaff-Roberts, Univ. of Memphis, Fogelman Coll., Memphis, TN 38152, retzlaff@cc.memphis.edu, **Mohammad M. Amini**

We present a case study involving a European-based company to determine the most cost effective supply chain logistics for achieving a 6-hour service commitment to customers within the continental US.

4) Linking Facility Location & Inventory Analysis, Linda Nozick, Cornell Univ., Sch. of Civil & Environ. Eng., Hollister Hall, Ithaca, NY 14853-3501, lkn3@cornell.edu, **Mark A. Turnquist**

Inventory costs are an important element of facility locations decisions in distribution systems. We will discuss how costs resulting from an inventory policy of (S-I,S) at the distribution centers, each of which services a number of unique outlets, can be integrated within a fixed charge facility location model.

SB25 Adaptive Markov Decision Models in Reliability

Cluster: Statistics & Reliability

Invited Session

Chair: Apostolos N. Burnetas, Case Western Reserve Univ., Dept. of OR, 10900 Euclid Ave., Cleveland, OH 44106-7235, atb4@po.cwru.edu

1) Inspection Policies for Highly Reliable Systems, Stephen J. Herschkorn, Rutgers Univ., Fac. of Mgmt. & RUTCOR, New Brunswick, NJ 08903, herschko@rutcor.rutgers.edu, **Michael Katehakis**

We consider a system with known structure and highly reliable components. We discuss issues related to the problem of developing optimal policies for combined inspection and maintenance of such systems.

2) Optimal Maintenance Policies Under Incomplete Information, Michael Katehakis, Rutgers Univ., Fac. of Mgmt. & RUTCOR, New Brunswick, NJ 08903, mnk@rci.rutgers.edu, **Apostolos N. Burnetas**

We consider the maintenance/replacement problem of a single machine with unknown failure characteristics. We develop an adaptive maintenance policy which has optimal properties with respect to the rate of increase of the finite horizon costs under easily verifiable recurrence conditions.

3) Sequential Inspection Under Capacity Constraints, Shaohui Zheng, HKUST, Dept. of ISMT, Clear Water Bay, Kowloon, Hong Kong, **David D. Yao**

We study the inspection process in multi-stage batch manufacturing with capacity limits. The rate of defectives are assumed to be random variables with known distribution. We establish the optimal of a policy characterized by a sequence of thresholds with randomization at no more than 2 threshold values.

4) Queues with Unreliable Servers & Incomplete Information, Apostolos N. Burnetas, Case Western Reserve Univ., Dept. of OR, 10900 Euclid Ave., Cleveland, OH 44106-7235, atb4@po.cwru.edu, **Gia-Shie Liu**

We consider the group replacement problem for the servers of an M/M/c queueing system under incomplete information on system characteristics. We present the structure of optimal replacement that do or do not depend on the number of customers in the system, and discuss cost comparisons between the 2 cases.

SB26 What's Hot in Operations Research

Cluster: Student Affairs

Invited Session

Chair: Paul A. Jensen, Univ. of TX, Dept. of Mech. Eng., Austin, TX 78712, pjensen@mail.utexas.edu

1) Stochastic Optimization: The Present & Future in Operations Research, John R. Birge, Univ. of MI, Dept. of IOE, 1205 Beal Ave., Ann Arbor, MI 48109-2117, jrbirge@umich.edu

OR models invariably involve some uncertainty and a desire to achieve a best result. Today, many realistic problems combining stochastic elements with optimization are solvable. We describe application areas such as manufacturing, planning, finance and transportation and focus on major unresolved issues and one view of future evolution.

2) Bayesian Methods & Operations Research, John G. Wilson, Univ. of TX, Dept. of IE/OR, ETC 5.128, Austin, TX 78712-1063,

John_wilson@mail.mba.wfu.edu

Bayesian methodology has become important in theoretical statistics and many applied fields. This is partially due to computational methods making it easy to model real problems which are otherwise mathematically intractable. However, Bayesian methods have had slow acceptance in OR. A brief survey on the OR applications and opportunities of Bayesian approaches will be presented.

3) **Operations Research in Finance**, *Patrick Jaillet*, Univ. of TX, Dept. of MSIS, Austin, TX 78712-1175, jaillet@athena.bus.utexas.edu

Quantitative approaches in finance linked to OR and other mathematical disciplines are fast growing areas which offer opportunities to graduating students with a variety of backgrounds.

SB27 Neural Networks & Tabu Search in Operations Research

Cluster: **Interface Between OR & AI**
Invited Session

Chair: **Michael Magent**, Air Products & Chemicals, Inc., Decision Sciences - A6224, 7201 Hamilton Blvd., Allentown, PA 18195-1501

1) **Metamodeling with Neural Networks - Some Examples**, *Seth Flanders*, National Inst. of Justice, Dept. of Justice, 633 Indiana Ave. NW Rm. 303, Washington, DC 20531, flanders@ojp.usdoj.gov

While neural networks are known to be universal function approximators, they also can be thought of as a class of metamodels or models of models. Examples from several different fields such as engineering, OR and criminology are presented.

2) **A Tabu Search Variant of the K-Means Clustering Algorithm**, *Shivakumar Viathyanathan*, IBM Almaden Res. Ctr., 650 Harry Rd., San Jose, CA 95120-6099

We examine empirically the performance of a tabu search based variant of the popular k-means algorithm. We define a simple move that enables the batch version of the k-means algorithm to search beyond points of local optimality. Initial experiments and results indicate the usefulness of tabu search in the context of clustering algorithms and suggest further study.

3) **Improved Tabu Neural Network (ITANN) for the Traveling Salesman Problem**, *Michael Magent*, Air Products & Chemicals, Inc., Decision Sciences - A6224, 7201 Hamilton Blvd., Allentown, PA 18195-1501

ITANN, a combination of tabu search and neural networks, uses principles from OR and neural networks in an efficient neural network simulation algorithm. Results for the TSP show ITANN outperforms previous variants of the Hopfield-Tank neural model in terms of speed and solution quality.

SB28 TUTORIAL: Projection & Inverse Projection in Linear Integer Optimization

Cluster: **Integer Programming Tutorials**
Invited Session

Chair: **Kipp Martin**, Univ. of Chicago, Grad. School of Bus., 1101 E 58th St., Chicago, IL 60637, kipp.martin@gsb.uchicago.edu

1) **TUTORIAL: Projection & Inverse Projection in Linear Integer Optimization**, *Kipp Martin*, Univ. of Chicago, Grad. School of Bus., 1101 E 58th St., Chicago, IL 60637, kipp.martin@gsb.uchicago.edu

Projection and inverse projection are 2 very simple, yet unifying, concepts in the theory of linear inequalities. Using projection we take a system of linear inequalities and replace some variables with additional constraints. Inverse projection, the dual of this process, involves replacing inequalities with variables. We extend the inverse projection concept to the case where some or all of the variables are required to be integer...

SB29 Theory of Error Bounds with Applications

Cluster: **Nonlinear Programming**
Invited Session

Chair: **Zhi-Quan Luo**, McMaster Univ., Dept. of Elect. & Comp. Eng., Comm. Res. Lab., Rm. 225, Hamilton, Ontario, L8S 4K1, Canada, luozq@ssc.vax.cis.mcmaster.ca

1) **On the Extension of Frank-Wolfe Theorem to the Quadratically Constrained Quadratic Program**, *Shuzhong Zhang*, Erasmus Univer. Rotterdam, Econometric Inst., PO Box 1738,

Rotterdam, 3000 DR, The Netherlands, zhang@few.eur.nl, **Zhi-Quan Luo**

We study the continuity of the feasible set defined by convex quadratic inequalities and show that if a convex quadratic function is bounded below over such set then its infimum is always attained. We also present some results on the nonconvex case.

2) **New Characterizations of the Existence of an Error Bound for a Convex Inequality System**, *Sien Deng*, Northern IL Univ., Dept. of Math., DeKalb, IL 60625, deng@math.niu.edu

We discuss various new characterizations of the existence of a global/local error bound for a convex inequality system as well as their applications.

3) **Global Error Bounds & Metric Regularity in Optimization**, *Wu Li*, Old Dominion Univ., Dept. of Math. & Stats., Norfolk, VA 23529, wuli@math.odu.edu

Metric regularity can be considered as a special form of local error bounds. However, under certain conditions metric regularity is equivalent to global error bounds. We establish a relation between weak Slater condition and an estimate of the distance from a point to the intersection of finitely many convex sets.

SB30 Heuristics for Vehicle Routing & Transportation Problems II

Cluster: **Heuristic Methods in Optimization**
Invited Session

Chair: **Daniele Vigo**, Univ. of Bologna, DEIS, Viale Risorgimento 2, Bologna, 40136, Italy, dvigo@deis.unibo.it

1) **Itinerary-Based Airline Fleet Assignment**, *Timothy S. Kniker*, MIT, OR Center, 77 Mass Ave., Rm. E40-130, Cambridge, MA 02139, *Cynthia Barnhart*, *Brian Rexing*, *Ahmad Jarrah*, *Nirup Krishnamurthy*

Current models of the fleet assignment process do not accurately capture the network effects associated with multi-leg passenger itineraries. We will present a next generation fleet assignment model that incorporates passenger flows and describe some ways this new model can be solved.

2) **Scheduling Deliveries for Vehicles with Multiple Compartments**, *Emmanuel Chajakis*, Computer Command & Control Co., 2300 Chestnut St., Ste. 230, Philadelphia, PA 19103, chajakis@cccc.com, *Monique Guignard-Spielberg*

Deliveries to convenience stores consist of frozen, refrigerated and ambient temperature items. Because of their small sizes they are transported in different compartments of the same truck. We propose optimization models for scheduling deliveries and test them both on real and randomly generated data.

3) **Models & Heuristic Algorithms for Low Demand Transportation Systems**, *Federico Malucelli*, Univ. di Perugia, Inst. di Elettronica, Via G Duranti 1/A-1, Perugia, 06131, Italy, maluc@istel.ing.unipg.it, *Maddalena Nonato*, *Stefano Pallottino*

A circular line with a number of compulsory stops is considered. Between each pair of consecutive stops, detours may occur to satisfy additional service associated with optional stops. Mathematical models and heuristic approaches are proposed for the off-line case and extended to multiple intersecting lines and on-line demands.

4) **A New Approach to Inventory Routing Problems**, *Ann Campbell*, GA Inst. of Tech., Sch. of ISyE, Atlanta, GA 30332-0205, ann@isye.gatech.edu, *Lloyd W. Clarke*, *Martin W. Savelsbergh*

Inventory routing concerns distribution situations in which a shipper controls the inventory of his customers. The shipper exploits the flexibility to coordinate the delivery process and reduce his distribution costs. We present a new approach to solving inventory routing problems based on integer programming techniques.

5) **Heuristic Algorithms for the Traveling Salesman Problem with Pickup & Delivery**, *Daniele Vigo*, Univ. of Bologna, DEIS, Viale Risorgimento 2, Bologna, 40136, Italy, dvigo@deis.unibo.it, *Michel Gendreau*, *Gilbert Laporte*

We consider the TSPPD where each customer is associated with 2 quantities of goods to be collected and delivered, respectively. The vehicle capacity must not be exceeded and tour length must be minimized. We describe different heuristics for TSPPD and analyze their average and worst-case performance.

SB31 Boolean Functions & Applications

Cluster: **Combinatorial Optimization**
Invited Session

Chair: Peter L. Hammer, Rutgers Univ., RUTCOR, PO Box 5062, New Brunswick, NJ 08903-5062, hammer@rutcor.rutgers.edu

1) **Sequential Testing of Boolean Functions**, *Endre Boros*, Rutgers Univ., RUTCOR, PO Box 5062, New Brunswick, NJ 08903-5062, boros@rutcor.rutgers.edu, *Tonguc Unluayurt*

Sequential diagnosis of multicomponent systems is a frequently arising problem. We give algorithms for finding the most cost effective diagnosis procedure for various system functions, as well as present some examples showing that reasonably sounding heuristics can fail badly.

2) **On Some Combinatorial Problems in Telecommunication Networks**, *Michel Minoux*, Univ. P. et M. Curie-CNRS, MASI Inst. Blaise Pascal, 4 place Jussieu, Paris, F-75252, France, michel.minoux@masi.ibp.fr

We focus on minimum cost multicommodity flow problems with step-increasing (discontinuous) cost functions, for which a large-scale LP relaxation is proposed and frequency assignment problems in large-scale radio link networks. Conclusions from a wide comparative study of heuristics (the European "CALMA" project) are discussed.

3) **Underground Nuclear Explosion Identification of Logical Analysis of Data**, *Peter L. Hammer*, Rutgers Univ., RUTCOR, PO Box 5062, New Brunswick, NJ 08903-5062, hammer@rutcor.rutgers.edu, *Endre Boros*, *Slava Brover*, *Alexander Kogan*, *Ilya Muchnik*

We present a pilot study aimed at distinguishing seismological signals produced by earthquakes (EQ) and by underground nuclear explosions (UNE). Eighty-two seismic events, 45 UNEs and 37 EQs, were analyzed by LAD and "theory" consisting of only 2 patterns was built, achieving 100% distinction between the 2 types of events.

SB32 Modeling Environments for Combinatorial Optimization

Sponsor: CSTS

Sponsored Session

Chair: Collette R. Coullard, Northwestern Univ., 2225 N Campus Dr., Evanston, IL 60208-3119, coullard@iems.nwu.edu

Co-Chair: Jonathan H. Owen

Sunday 13:15-14:15

SC37 BEALE KEYNOTE: Developments in OR/MS Increasing Both the Science & Impact of Industrial Maintenance Modeling

Invited Session

Chair: Elmira Popova, Univ. of TX, OR/IE Group, Dept. of Mech. Eng., ETC 5.120, Austin, TX 78712, elmira@mail.utexas.edu

1) **BEALE KEYNOTE: Developments in OR/MS Increasing Both the Science & Impact of Industrial Maintenance Modeling**, *Tony Christer*, Univ. of Salford, Dept. of Comp. & Math. Sci., Manchester, M5 4WT, UK, a.h.christer@cms.salford.ac.uk

There is much that OR/MS can do to improve the quality of science within maintenance and thereby, impact upon company objectives. This presentation aims to raise awareness of what is now possible by way of modeling support for maintenance and to address the problems of and the potential for the growth of this awareness among both the maintenance and the OR/MS communities.

SC38 EDELMAN KEYNOTE: Decision Support Scheduling Systems for SNCF

Invited Session

Chair: Stephen Strauss, AT&T Labs., 379 Campus Dr., Rm. 2B-208, Somerset, NJ 08873, sastrauss@attmail.com

1) **EDELMAN KEYNOTE: Decision Support Scheduling Systems for SNCF**, *Nejib Ben-Kheder*, SABRE Decision Tech., PO Box 619616, Ft. Worth, TX 75261, *Josephine Kintanar*, *Cecile Queille*, *William K. Stripling*

The national railroad of France, SNCF, 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. The implementation of their resulting DSSs is credited with an overall profit increase of 3-5%, reductions in manpower and schedule development

time and improvements in planning and scenario evaluation.

Sunday 14:45-16:15

SD01 OR/MS Applications in the Energy Sector

Cluster: OR/MS Applications

Invited Session

Chair: Steve Kretsch, SABRE Decision Tech., 4255 Amon Carter Blvd., Ft. Worth, TX 76155, steve_kretsch@sdt.com

1) **Optimizing Logistical Operations in a Field Measurement Operations Problem**, *Douglas J. Morrice*, Univ. of TX, MSIS Dept., CBA 5.202, Austin, TX 78712-1175, morrice@mail.utexas.edu, *Astrid Kenyon*

We consider a field measurement operations problem in which signals are sent from several locations and received at several other locations. We discuss a number of optimization problems including a design and operations problem, a VRP, a locations problem and an equipment fuel purchasing problem.

2) **Optimized End to End Supply Chain Planning**, *Nestor Resurreccion*, Aspen Technology, Inc., PIMS Group, 3050 Post Oak Blvd., Ste. 530, Houston, TX 77056, *Robert McGinnis*, *Basil L. Joffe*, *Michael Grupa*, *Lewis Haupt*

We discuss new strategies in optimizing the entire supply chain network and its impact on company profitability. We look at all aspects of an optimized multi-period environment where costs and revenue potentials from raw material acquisition, transportation, warehousing, exchange of products to end customer profitability are analyzed.

3) **OR Applications in a Deregulated Environment**, *Steve Kretsch*, SABRE Decision Tech., 4255 Amon Carter Blvd., Ft. Worth, TX 76155, steve_kretsch@sdt.com, *Madhu Anne*

Economics of interstate gas pipelines has changed dramatically with the unbundling of gas supply and transmission. Pipelines no longer can rely on long-term firm contracts to cover costs and gain reasonable returns. New models in the area of forecasting and optimization will help pipelines increase profitability in a deregulated environment.

SD02 TUTORIAL: Revenue Management, OR at SABRE

Cluster: Airline Industry Tutorials

Invited Session

Chair: Barry C. Smith, The SABRE Group, Inc., Research Group, 1 E Kirkwood Blvd. MD 7390 TSG, Southlake, TX 76092, barry_smith@sdt.com

1) **TUTORIAL: Revenue Management - OR at SABRE**, *Barry C. Smith*, The SABRE Group, Inc., Research Group, 1 E Kirkwood Blvd. MD 7390 TSG, Southlake, TX 76092, barry_smith@sdt.com

No abstract supplied.

SD03 Airspace Models

Sponsor: Aviation Applications Section

Sponsored Session

Chair: Fran Melone, Federal Aviation Admin., OR & Analysis, ASD-430, Washington, DC 20591, fran.melone@faa.dot.gov

1) **Airspace Modeling in the Federal Aviation Administration**, *Robert B. Rovinsky*, Federal Aviation Admin., ASD-410, 800 Independence Ave. SW, Washington, DC 20591, robert.rovinsky@faa.dot.gov

The US navigable airspace, managed today by the FAA, is an extremely valuable but little understood public asset. The agency is beginning to move from relying on manual methods and outdated modeling and analysis tools. We describe these efforts and some opportunities for interesting OR work.

2) **TAAM 3 - The New Scenario-Based Object-Oriented Airport & Airspace Simulation Model**, *Alexander Klein*, The Preston Group, 11350 Random Hills Rd., Ste. 880, Fairfax, VA 22030

TAAM 3 features state-of-the-art object-oriented design incorporating 3 levels of modeling: 1 150 scenarios written as open-text C-like executable scripts, a powerful rulebase engine and C++ methods inside objects, e.g., for aircraft navigation. Objects include controllers, crews, aircraft, FMSs, centers, airport towers, runways, etc. Challenges in designing TAAM as a truly open system as well as current and potential model applications are discussed.

3) **National Airspace Resource Investment Model - NARIM**, *Mark Rodgers*, FAA, ASD 130, 800 Independence Ave. SW,

Washington, DC 20591

The FAA and NASA are developing analysis tools to apply to both agencies' investment decision making. We describe how these tools, the National Airspace Resource Investment Model, will allow NASA and the FAA to examine new concepts of operations in the National Airspace System.

4) Latest Developments in the SIMMOD Airspace Model & Its Use, Dave Winer

SIMMOD is a detailed airspace model originally modeled by the FAA. Mr. Winer will discuss some of SIMMOD's latest developments and applications.

SD04 Joint Warfare Systems II

Sponsor: Military Applications Society
Sponsored Session

Chair: Jeffrey R. Cares, JWARS Office, Crystal Square 4, Ste. 100, 1745 Jefferson Davis Highway, Arlington, VA 22202, caresj@paesmp.pae.osd.mil

1) Decision Analysis in JWARS, Charles Leake, JWARS Office, Crystal Square 4, Ste. 100, 1745 Jefferson Davis Hwy, Arlington, VA 22202, cleake@paesmp.pae.osd.mil

More than any other representations contained in JWARS, the representation of operational level decision making will have a profound impact of force structure, procurement and planning policies. This brief provides an overview of analyses JWARS will support and the methods by which JWARS will represent decisions.

2) JWARS MOEs & MOPs: Analytical Building Blocks, Jeffrey R. Cares, JWARS Office, Crystal Square 4, Ste. 100, 1745 Jefferson Davis Hwy, Arlington, VA 22202, caresj@paesmp.pae.osd.mil

Many older generation models were developed from a list of functional requirements which included MOEs and MOPs only after the model functions and operations were built. Conversely, the JWARS project is taking an approach designed to build an analytical tool.

3) JWARS Software Development Process, Terry W. Prosser, JWARS Office, Crystal Square 4, Ste. 100, 1475 Jefferson Davis Hwy, Arlington, VA 22202, prossert@paesmp.pae.osd.mil

JWARS is a large-scale object-oriented software engineering project. The software development process must address a large and complex mission space within a changing doctrinal and technological environment. In order to meet these development objectives, the JWARS Office adopted a spiral-based software engineering approach.

4) Implicit Searches in Combat Models, Jeffrey R. Cares, JWARS Office, Crystal Square 4, Ste. 100, 1745 Jefferson Davis Hwy, Arlington, VA 22202, caresj@paesmp.pae.osd.mil

Since JWARS will require many thousands of interactions between hundreds of objects while the users will require fast run times, the JWARS Office is very interested in alternative, computationally efficient algorithms. The JWARS development team devised a new method of representing the classic military OR problem: searches at sea.

SD05 Copula Applications in Decision & Risk Analysis

Sponsor: Decision Analysis Society
Sponsored Session

Chair: Robert Clemen, Duke Univ., Fuqua Sch. of Bus., Durham, NC 27708-0120, clemen@mail.duke.edu

1) Why Laplace was Wrong: Using Copulas to Bounds Convolutions When Marginals Are Known Imprecisely, Scott Ferson, Applied Biomathematics, 100 N Country Rd., Setauket, NY 11733, ramos@gramercy.ios.com

Williamson's algorithms that compute bounds on the distributions of arithmetic operations on random numbers when only their marginal distributions are known also work when the marginal can only be bounded. Therefore, they constitute a probability bound analysis that renders obsolete the maximum entropy criteria for selection of input distributions.

2) Applications of Copulas in Actuarial Science, Emiliano Valdez, Univ. of WI, Sch. of Bus., 975 University Ave., Madison, WI 53706, evaldez@bus.wisc.edu, Edward Frees

Dependence among random variables can be modeled by using a copula to specify the joint distribution. We explore how copulas are used in actuarial science to examine dependence among competing risks, mortality in paired individuals, the ordering of risks and insurance company losses and expenses.

3) Using Decision Analytic & Bayesian Methods to Determine Optimal Cancer Screening Policies, Chris Lacke, NC State Univ., NCCR PO Box 29538, Cotton Bldg., Raleigh, NC 27626-0538,

chris_lacke@mail.ehnr.state.nc.us

Deterministic cost-effectiveness studies have been used to develop cancer screening plans. We use the multivariate normal copula to combine expert opinions into probability distributions in a colorectal cancer screening program. The optimal invasive procedure is determined using utility analysis.

SD06 EDUCATION TUTORIAL: Turning a Dud into a Winner

Sponsor: 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) EDUCATION TUTORIAL: Turning a Dud into a Winner, Erhan Erkut, Univ. of Alberta, Fac. of Bus., Edmonton, Alberta, T6G 2R6, Canada, erhan.erkut@ualberta.ca, Armann Ingolfsson, Thomas A. Grossman

Until recently, our required "Intro. to OM/OR" course was subtitled, "Course from Hell Taught by Anti-Christ" by the students. In contrast, many of our current students think this is the best course they've taken so far in the Faculty of Business. We describe the components of the metamorphosis: extensive use of spreadsheets, demos, labs, electronic communication, cases, games, music, skits and stupid professor tricks...

SD07 Emergent Approaches to Production Line Management

Sponsor: MSOM
Sponsored Session

Chair: David C. Juran, Columbia Bus. Sch., New York, NY 10027, david.juran@snet.net

Co-Chair: John McClain

1) Order Release Times in a Transient Stochastic Production Environment, Mark Spearman, GA Inst. of Tech., Sch. of ISyE, Atlanta, GA 30332, mark.spearman@isye.gatech.edu

We consider a production line operating with existing WIP, stochastic production times and due dates. We determine a set of MRP lead times that consider both capacity and the stochastic nature of the production system using infinitesimal perturbation analysis and the stochastic counterpart method.

2) Modeling of Low-Inventory Lines & Worker Behavior, Kenneth L. Schultz, Cornell Univ., Johnson Grad. Sch. of Mgmt., 109 Malott Hall, Ithaca, NY 14853, schultz@johnson.cornell.edu

Previous research on serial production lines has used assumptions about processing time distributions. Recent research has shown how some of these assumptions can lead to misleading results. We compare modeling and experimental results to gain insight into the effects of these assumptions.

3) Experience & Expertise in Partnerships: An Application to Venture Investing, Philip C. Anderson, Dartmouth Coll., Tuck Sch. of Bus. Admin., 100 Tuck Hall, Hanover, NH 03755-9001, philip.c.anderson@dartmouth.edu

Research in worksharing in industrial settings has examined production systems where worker tasks are not uniquely assigned. We extend the logic of worksharing to complex, abstract, white-collar tasks where tacit knowledge is critical. An empirical study of venture capital partnerships examines overlap in the partners' areas of expertise.

4) Personality & Performance in Production Systems, David C. Juran, Columbia Bus. Sch., New York, NY 10027, david.juran@snet.net

In a serial worksharing laboratory experiment, both productivity and quality are found to depend on worker personality, age and experience. The relationships are quite strong, with explanatory power ranging from 30%-80%. The profile of an "ideal worker" is strikingly different for upstream and downstream positions in the line.

SD08 Planning for Producer & Consumer Flexibility

Sponsor: MSOM
Sponsored Session

Chair: Anantaram Balakrishnan, PA State Univ., Smeal Coll. of Bus. Admin., 303 Beam Bldg., University Park, PA 16802-1913, anantb@psu.edu

1) Modular Product Lines with Configuration Flexibility, Michael Pangburn, PA State Univ., 303 Beam Bldg., University Park, PA 16802, mikepangburn@psu.edu

We consider a product line including a set of substitutable modules and analyze the impact of modular flexibility on product-line design decisions. Modular flexibility permits consumers to interchange individual modules, thus impacting consumers' optimal purchase choices. Both manufacturing costs and the solutions to consumers' stochastic discrete-choice problems are module-set dependent.

2) Determining the Value of Flexibility in Production Systems: An Application to Semiconductor Manufacturing, Terry P. Harrison, PA State Univ., Dept. of MSIS, 303 BAB, University Park, PA 16802, hbx@psu.edu, Elena Katok

The value of flexibility comes from its ability to partially insulate a system against uncertainty. We present a general joint simulation-optimization algorithm that determines the value of flexibility and aids in selecting the level of investment in flexibility. We apply this algorithm to realistic-sized problems in semiconductor manufacturing.

3) Manufacturing Planning in a Flexible Demand Environment: An Application to Specialty Steel Manufacturing, Anantaram Balakrishnan, PA State Univ., Smeal Coll. of Bus. Admin., 303 Beam Bldg., University Park, PA 16802-1913, anantb@psu.edu, Joseph Geunes

We address process and production planning for a specialty steel manufacturer whose customers provide some flexibility in product characteristics. We model the problem as a revenue-maximizing MIP with an interesting embedded packing subproblem using "expandable" items, propose some valid inequalities to strengthen the formulation and discuss computational results.

4) Efficient Configuration of Multi-Plant Networks: A Strategic Framework & Insights from Analytical Models, Shailesh Kulkarni, Univ. of Cincinnati, Dept. of QAOM, Cincinnati, OH 45221-0130, kulkarsh@ucbeh.san.uc.edu, Michael J. Magazine, Amit Raturi

We discuss alternate plant configurations and charters for firms operating with multi-plant networks. We develop a framework for understanding the issues and tradeoffs at a strategic level. We also develop simple analytical models to represent various configurations and develop a set of performance criteria. We feel that the framework and models provide insights into efficient configuration of multi-plant networks.

SD09 Performance Analysis of Semiconductor Manufacturing Systems

Cluster: OR Applications in Semiconductor Manufacturing
Invited Session

Chair: Phuoc Tran-Gia, Univ. of Wuerzburg, Inst. of Computer Science, Am Hubland, Wuerzburg, 97074, Germany, trangia@informatik.uni-wuerzburg.de

1) On Cycle Times & Interdeparture Times in Semiconductor Manufacturing, Manfred Mittler, IBM Germany, Sckickardstr.30, Boeblingen, 71034, Germany, mittler@vnet.ibm.com, Notker Gerlich, Alexander K. Schoemig, Oliver Rose

We investigate the distributions of cycle times and interdeparture times in 2 semiconductor manufacturing systems. The results were obtained by means of simulation. The findings show the normal distribution is, in these cases, a very good approximation of the cycle time distribution. Furthermore, we show that the distribution of interdeparture times can sometimes be approximated by the exponential distribution.

2) Managing & Measuring the Performance of Inventory in Semiconductor Manufacturing, Gerry Feigin, IBM Corp., TJ Watson Res. Ctr., PO Box 218, Yorktown Heights, NY 10598

A number of factors make effective management of inventory (both WIP and finished goods) especially challenging in semiconductor manufacturing. These include long cycle times, high risk of obsolescence, short product lifetimes, large product variety and volatile demand. We discuss why standard inventory management and measurement techniques are not sufficient in this environment and present directions for research in this area.

3) Toward Understanding the Capacity of Wafer Fabs & Other Reentrant Manufacturing Systems, Jim Dai, GA Inst. of Tech., Sch. of ISyE, Atlanta, GA 30332-0205, John J. Hasenbein, John Vande Vate

The extreme complexity of semiconductor manufacturing operations arises in large part from the complex reentrant nature of material flows. It is common that machine utilizations or wafer outs fall below planned levels, while WIP piles up at nonbottleneck processes and bottleneck processes sit idle. We study the queuing network model and the fluid model of the semiconductor system. We show that "virtual bottlenecks" can constrain the throughputs of these systems...

4) Discrete-Time Analysis of Batch Servers with Two Job

Classes, Alexander K. Schoemig, Univ. of Wuerzburg, SIEMENS AG, Bereich Halbleiter HL MS PR, Wuerzburg, 97074, Germany

Production processes where several jobs are loaded into a single machine and processed simultaneously are common in semiconductor manufacturing. These machines are called batch servers. We extend previous studies of batch servers considering 2 job classes. For solving optimization problems the discrete-time analysis technique is used. The intent of this paper is to demonstrate the feasibility of discrete-time analysis technique for OR in manufacturing.

SD10 Freeway/Arterial Traffic Control

Sponsor: Transportation Science Section

Sponsored Session

Chair: H. Michael Zhang, Univ. of IA, Dept. of Civil & Environ. Eng., Public Policy Ctr. 210 S Quad, Iowa City, IA 52242, mhzhang@icaen.uiowa.edu

1) A New Formulation of System Optimal Assignment for Traffic Corridors, H. Michael Zhang, Univ. of IA, Dept. of Civil & Environ. Eng., Public Policy Ctr. 210 S Quad, Iowa City, IA 52242, mhzhang@icaen.uiowa.edu

We present a dynamic assignment model for traffic corridors comprised of freeways and arterial streets. Our formulation unifies the treatment of freeway and arterial traffic dynamics, considers explicit queueing at intersections and, to some degree, traffic signal operations. Rather than modeling waiting vehicles as point queues, we consider the physical length of the queue that further allows the consideration of queue spillbacks.

2) The MILOS Integrated Freeway-Surface Street Control Strategy, Douglas M. Gettman, Univ. of AZ, Dept. of SIE, Bldg. 20, Rm. 111, Tucson, AZ 85721, K. Larry Head, Pitu B. Mirchandani

MILOS is an integrated strategy for coordinated wide-area control of a freeway and surface street corridor. The MILOS strategy is based on a multi-objective formulation that trades off area-wide ramp metering considerations with local surface street congestion to improve corridor traffic conditions.

3) An Optimization Algorithm for Freeway Traffic Control, H. Michael Zhang, Univ. of IA, Dept. of Civil & Environ. Eng., Public Policy Ctr. 210 S Quad, Iowa City, IA 52242, mhzhang@icaen.uiowa.edu

Freeway ramp metering has often been formulated as an optimal control problem and standard optimization algorithms are routinely used to solve it off-line. Because nonlinear optimal control problems having dynamic state constraints are often difficult to solve numerically, most of the current optimal ramp control formulations simplify the constraints to have only control variables in them (control-only constraints)...

SD11 Methods for Problem Representation in Routing & Scheduling I

Sponsor: Transportation Science Section

Sponsored Session

Chair: Warren B. Powell, Princeton Univ., Program in Stats. & OR, Dept. of Civil Eng., Princeton, NJ 08544, powell@princeton.edu

1) Data Sets for Vehicle Routing & Crew Scheduling Problems, Jacques Desrosiers, GERAD & HEC, 5255 Decelles, Montreal, PQ H3T 1V6, Canada, Guy Desaulniers, Francois Soumis, Marius M. Solomon

We will describe some data sets on various routing and scheduling problems that are available at GERAD. These include data for VRPTW, m-TSPTW, MDVSP and airline crew pairing.

2) Data for Network Design Problems, Teodor Gabriel Crainic, Univ. de Montreal, CRT, CP 6128, Succ. Centre-Ville, Montreal, Quebec, H3C 3J7, Canada, theo@crt.umontreal.ca, Bernard Gendron, Michel Gendreau

We describe an architecture for representing network design problems which can be used as a basis for designing datasets for storing a library of problems. We discuss recent computational work and propose a general strategy for testing and comparing algorithms for network design.

3) Evaluation of Operational Strategies for Dynamic Fleet Management, Amelia C. Regan, Univ. of TX, Dept. of Civil Eng., ECT Hall 6.2, Austin, TX 78703, acregan@translab.its.uci.edu

A simulation architecture used to compare operational strategies including load acceptance, assignment and reassignment strategies for dynamic carrier fleet management is described and suggestions are proposed for the cooperative development of a more general architecture for evaluating a wider range of dynamic fleet management problems.

SD13 Issues in the Management of New Product VarietyCluster: **New Product Development**

Invited Session

Chair: **Kamalini Ramdas**, Univ. of VA, Darden Grad. Sch. of Bus., Charlottesville, VA 22906, ramdash@arden.gbus.virginia.edu1) **Variety & Supply Chain Configuration**, *Taylor Randall*, Univ. of PA, Wharton Sch. 3620 Locust Walk, OPIM Dept., 300 SH-DH, Philadelphia, PA 19104-6366, *Marshall Fisher*, *Karl Ulrich*

Using the US bicycle industry as a research context, we compare and contrast the ability of different supply chain configurations to bring variety to consumers. Specifically, we examine the different supply chain, production system and product line strategies used in the industry and investigate the impact of these strategies on various aspects of firm performance.

2) **A Cross-Functional Approach to Evaluating Line Extensions for Assembled Products**, *Kamalini Ramdas*, Univ. of VA, Darden Grad. Sch. of Bus., Charlottesville, VA 22906, ramdash@arden.gbus.virginia.edu, *Mohanbir Sawhney*

Manufacturers of assembled products typically introduce some totally new products and some line extensions annually. Sharing of physical or augmenting features may cut product development, manufacturing and distribution costs, but can increase cannibalization. We estimate the market and cost impact of new product variety, and model new product decision making.

3) **Customer Response to Changes in Number of SKUs**, *Teck H. Ho*, UCLA, Anderson Sch., 110 Westwood Plaza, Box 951481, Los Angeles, CA 90095-1481, teho@anderson.ucla.edu, *Juin K. Chong*, *Christopher S. Tang*

Using panel data from 540 households, we study how customers react to line extensions and trimmings. We provide clues on customer switching behavior and determine the relative performance of surviving, new and trimmed SKUs in several frequently bought product categories.

4) **Managing Product Variety: Operations & Product Design Perspectives**, *Jayashankar M. Swaminathan*, Univ. of CA, Haas Sch. of Business, Berkeley, CA 94720, *Therani N. Madhusudan*, *Sridhar R. Tayur*

With an ever increasing number of new product types being offered by manufacturers, it has become essential to design products that would enable effective operations. The inability to combine engineering and operational models makes it a difficult task to develop and analyze such models. We present an integrated model for designing product lines to enable efficient operations. Our approach consists of a generative design phase for a product line which is coupled with an evaluation phase based on operational models...

SD14 Technology Transfer & NISTCluster: **Technology Transfer**

Invited Session

Chair: **Albert Jones**, NIST, Bldg. 220, Rm. A127, Gaithersburg, MD 20899-001, jonesa@cme.nist.gov1) **Applications of AI-Based Scheduling to a Systems Company**, *Luis Rabelo*, OH Univ., Rm. 294, Stocken Ctr., Dept. of IMSE, Athens, OH 45701, rabelo@chargers.ent.ohiou.edu, *Pisamai Wongsavenwate*

A real-time, hybrid scheduler developed with researchers at NIST has been improved by using evolutionary programming concepts. Issues related to the implementation of this hybrid scheduler at an industrial company are discussed. Emphasis is given to the knowledge acquisition and modeling process required for the development of this scheduler.

2) **Integration of Shop Floor Data with Real-Time Scheduling**, *Albert Jones*, NIST, Bldg. 220, Rm. A127, Gaithersburg, MD 20899-001, jonesa@cme.nist.gov, *Frank Riddick*

One key to implementing any real-time scheduler is the requirement to use up-to-date shop floor data whenever the schedule is updated. Work at NIST to develop a generic interface between scheduling and shop floor data collection is presented. Also, efforts to modify commercial schedulers to use this interface are discussed.

3) **Simulation of Loading Dock Layout**, *Simon Frechette*, NIST, Bldg. 220, Rm. A127, Gaithersburg, MD 20899, simon.frechette@nist.gov

Forecasted increases in production volume often lead to increases in the flow of raw materials and finished goods through a factory. Modifications often are proposed to the shipping and receiving facilities to address this problem. Simulation often is used to evaluate such modifications. A case study from 1 manufacturing facility is discussed.

SD15 Issues in Product Development & DesignCluster: **Technology Management**

Invited Session

Chair: **Morgan Lee Swink**, IN Univ., Op. & Dec. Tech. Dept., Grad. Sch. of Bus., Bloomington, IN 47405, mswink@indiana.edu1) **Strategies for Managing Radical Change in Core Businesses & Product Lines**, *Susan Walsh Sanderson*, RPI, Sch. of Mgmt., Troy, NY 12180, *Robert Davis*

Radical shifts in technologies, competition or the loss of key customers may threaten a company's ability to survive. We examine the strategies of 2 companies, HADCO and Galileo Electro-Optics, in altering their core technologies and product lines. We develop a model of radical change in core businesses and product lines.

2) **Theoretical & Empirical Study of Design Focus**, *Debashish N. Mallick*, Boston Coll., Carroll Sch. of Mgmt., Chestnut Hill, MA 02167, mallickd@bc.edu

The concept of design focus is based on the premise that the task homogeneity includes faster learning and effective and efficient utilization of design resources. We study 40 product development projects to examine the concept of design focus as a strategic alternative for gaining competitive advantage.

3) **Methods for Accelerating New Product Development: Which Are Most Effective?**, *Morgan Lee Swink*, IN Univ., Op. & Dec. Tech. Dept., Grad. Sch. of Bus., Bloomington, IN 47405, mswink@indiana.edu

Different product development projects often involve different challenges, priorities and goals. The uses and impacts of various methods and tools for accelerating new product development, given differences in project size, scope, complexity and desired outcomes, are examined. Survey data from over 100 different development projects are analyzed in order to establish the relative merits of different acceleration methods in various product development contexts.

4) **Managing the Fuzzy Front-End of New Product Development**, *Anil Khurana*, Boston Univ., Sch. of Mgmt., 595 Commonwealth Ave., Boston, MA 02215, akhurana@bu.edu, *Stephen Rosenthal*

Enhanced capabilities for concurrent engineering, rapid prototyping and supplier partnerships help reduce new product development times. Yet, it is decisions in the "front end" of new product development that dictate this success. We discuss our empirical results (based on a systematic examination of the front-end) on this subject.

SD16 Strategy & EconomicsSponsor: **College on Organization Science**

Sponsored Session

Chair: **Brian Silverman**, Univ. of Toronto, Rotman Fac. of Mgmt., 105 St. George St., Toronto, Ontario, M5S 3E6, Canada, silverman@mgmt.utoronto.ca1) **Privatizing the Intellectual Commons: Universities & the Commercialization of Biotechnology**, *Nicholas Argyres*, Univ. of Southern CA, Marshall Sch. of Bus., Los Angeles, CA 90089-1421, nargyres@sba.usc.edu, *Julia Porter Liebeskind*

We analyze universities' attempts to adapt their policies and organizational structures to commercialize biotechnology research. We argue that these attempts have been hampered by universities' social-contractual commitment to sustain an "intellectual commons" and by organizational standards supporting this commitment. This has led to the generation of new organizational forms.

2) **Accounting for Endogeneity when Assessing Strategy Performance: Does Entry Mode Choice Affect FDI Survival?**, *J. Myles Shaver*, NYU, Stern Sch. of Bus., 44 W 4th St., New York, NY 10012, mshaver@stern.nyu.edu

Firms choose strategies based on their attributes and industry conditions; therefore, strategy choice is endogenous and self-selected. By examining foreign direct investment survival, I demonstrate how empirical models that fail to account for endogenous choice and regress performance measures on strategy choice variables are misspecified and their conclusions incorrect.

3) **An Empirical Framework for Testing Theories About Complementarity in Organizational Design**, *Susan Athey*, MIT, Dept. of Economics, 50 Memorial Dr., Cambridge, MA 02142, athey@mit.edu, *Scott Siern*

We analyze empirical strategies for evaluating the performance effects of organizational design and the factors which determine their adoption. We characterize an econometric procedure to identify complementarity between organizational practices which accounts for the presence of unobserved heterogeneity; with simulated data, this procedure performs significantly better

than alternatives.

4) Strategy & Structure: The Choice of Driver Employment Relation in the Interstate For-Hire Trucking Industry, Jack Nickerson, Washington Univ., Olin Sch. of Bus., 1 Brookings Dr., St. Louis, MO 63130, nickerson@wuolin.wustl.edu, **Brian Silverman**

We integrate Porter's competitive strategy and Williamson's transaction cost economics frameworks to explain heterogeneity of organizational form. We argue that firms adopt economizing organizational forms conditional upon the strategic position they pursue and vice versa. We find support for this positioning-economizing framework through empirical analysis of the trucking industry.

SD17 Economic & Efficiency Models of Health Care

Sponsor: Health Applications Section

Sponsored Session

Chair: Yasar A. Ozcan, VA Commonwealth Univ., 1008 E Clay St., Rm. 230, PO Box 98023, Richmond, VA 23298-0203, ozcan@gems.vcu.edu

1) Determining the Cost of Providing Services for Severely At-Risk Medicaid Managed Care Children, Terrie Reeves, TX Woman's Univ., Coll. of Health Sci., Dept. of Health Care Admin., Houston, TX 77030, **Stuart A. Capper, Robert J. Tosatto, Angie S. Francis**

CHIP, a public/private provider for severely at-risk children, wanted to submit a bid to a Medicaid-managed care provider. However, cost and time per procedure was unknown because service was provided per visit. We describe a matrix algebra-based analysis which allowed us to derive cost per procedure from their existing visit and payroll data.

2) Determinants of Specialty Hospital's Efficiency, C. Christopher Lee, Central WA Univ., Dept. of Bus. Admin., 400 E 8th Av, Ellensburg, WA 98926-7485, leec@cwu.edu, **Ik-Whan G. Kwon, Hongjae Jeong**

We will attempt to find determinants of specialty hospitals' efficiency. First, the DEA model will generate efficiency scores from the sample of specialty hospitals. Then, the logistic regression analysis will report statistically significant factors affecting the efficiency. This study will fill the gap in the efficiency study literature that lacks research on specialty hospitals.

3) Forecasting Demand for Open Heart Surgery: Politics & "Science", David Zalkind, George Washington Univ., Dept. of MS, Monroe 401A, Washington, DC 20052

We present 3 rounds of forecasting demand for open heart surgery over more than a decade in the context of certificate of need applications. The interplay of politics and "science" will be discussed.

SD18 Resampling & Simulation Methods for DEA

Cluster: DEA & Productivity

Invited Session

Chair: Paul Wilson, Univ. of TX, Dept. of Economics, Austin, TX 78712, wilson@mundo.eco.utexas.edu

1) Stochastic Frontier Distance Functions & DEA with Resampling: A Comparison Using Hazardous Waste Treatment Data, Robert L. Boggs, Univ. of NC, Gen. Admin. Planning Div., Chapel Hill, NC 27599, bob_boggs@unc.edu, **Vaishali Mangain**

Until recently, SPFA could be used in multi-input/multi-output environments only by invoking a cost or revenue function. DEA could determine a frontier without using prices, but assumed no measurement error for input and output quantities. Recent advances in stochastic distance functions allow researchers to estimate a multi-output function when price data are unavailable...

2) Nonparametric Tests of Returns to Scale Using DEA, Paul Wilson, Univ. of TX, Dept. of Economics, Austin, TX 78712, wilson@mundo.eco.utexas.edu, **Leopold Simar**

We discuss various statistics for testing hypotheses regarding returns to scale in the context of nonparametric models of technical efficiency. We also present bootstrap estimation procedures which yield appropriate critical values for the test statistics. Evidence on the true sizes of the various proposed tests is obtained from Monte Carlo experiments.

3) A General Methodology for Bootstrapping in Nonparametric Frontier Models, Leopold Simar, Inst. of Stats./CORE, 20 voie du Roman Payss, Louvain-la-Neuve, B-1348, Belgium, simar@stat.ucl.ac.be, **Paul Wilson**

The DEA method has been extensively used in the literature to provide measures of the technical efficiency of firms. These measures allow rankings of

firms according to their performance. The underlying frontier model is nonparametric since no particular functional form is assumed for the frontier model. Since the observations result from some data generating process, statistical properties of the estimated efficiency measures have to be derived...

4) Some Characteristics of Stochastic Efficiency, Hiroshi Morita, Kobe University, Dept. of Comp. & Systems Eng., Kobe, 657, Japan, morita@seg.kobepu.ac.jp, **Lawrence M. Seiford**

This study is an efficiency analysis of data with stochastic noise. Because of the stochasticity of input/output data, the efficiency score is also stochastic. We analyze selected characteristics of stochastic efficiency, such as the probability of being efficient, the expectation of efficiency and/or a specified percentile of efficiency.

SD19 PANEL: George B. Dantzig Dissertation Award

Sponsored Session

Chair: David Simchi-Levi, Northwestern Univ., 2225 North Campus Dr., Dept. of IE/MS, Evanston, IL 60208-3119, levi@iems.nwu.edu

1) George B. Dantzig Dissertation Award

The George B. Dantzig Dissertation Award was established by INFORMS to promote greater interaction between academia and industry by encouraging research relevant to practice in any area of OR and MS. Finalists will present their work and highlight the contribution of their research.

SD20 Database, Advertising & Economic Issues in Electronic Commerce II

Sponsor: College on Information Systems

Sponsored Session

Chair: Young Ryu, Univ. of TX, Dec. Sci., Sch. of Mgmt., 2601 N Floyd Rd., Richardson, TX 75080, ryoung@utdallas.edu

1) Digital Libraries: A New Organizational Form for Information Trading, Byungtae Lee, Univ. of AZ, Eller Sch. of Mgmt., McClelland Hall 430, Tucson, AZ 85721, blee@bpa.arizona.edu

Digital libraries (an emerging organizational form) facilitate information trading by combining features of existing alternatives such as bookstore and traditional libraries. Using an industrial organization-based approach, I draw boundaries among these alternatives and explain how they evolve when challenged by alternatives, thus deriving insights into the future of e-commerce.

2) Ethical/Legal Issues on the Internet, Sue Conger, SMU, Cox Sch. of Bus., Dallas, TX 75275, sconger@aol.com

The internet, in addition to growing 35% yearly in number of US users, has spawned numerous legal issues, including copyright and citation protections as well as trademarked and registered words, phrases and ideas. Current legal ruling and pending litigation relating to these issues are discussed.

3) Networked Organization Partner Selection Strategies, Sury Ravindran, Univ. of TX, Dec. Sciences, Sch. of Mgmt., 2601 N. Floyd Rd., Richardson, TX 75080, suryan@utdallas.edu

Electronic computer networks have brought organizations interested in electronic commerce the mixed blessing of vast amounts of data which sometimes overwhelm their information processing capability. We discuss the advantages and disadvantages of compensatory and non-compensatory choice models of networked organizational partner selection.

SD21 Theoretical Foundations of MMT III

Cluster: Management of Medical Technology

Invited Session

Chair: Luis G. Vargas, Univ. of Pittsburgh, Katz. Grad. Sch. of Bus., Pittsburgh, PA 15260

1) Capacity Planning of Surgical Suite Utilization: A Minimal Cost Analysis Model, Luis G. Vargas, Univ. of Pittsburgh, Katz. Grad. Sch. of Bus., Pittsburgh, PA 15260, **Jerrold H. May, W.E. Spangler, David Strum**

Classic definitions of operating suite utilization do not reflect accurate use of resources. Separating this measure into under and over utilization measures and applying the model to 6 years of data from a large teaching hospital showed that potential savings are such that correctly measuring utilization could be financially rewarding.

2) Medical Information & the Internet: Managing Disclosure & Privacy Effectively, Urs E. Gattiker, The Aarhus Sch. of Bus., Dept. of Org. & Mgmt., Haslegaardsvej 10, Aarhus V, DK-8210,

Denmark, internet_research_program@bigfoot.com

Cognitive development theory and the domains of morality are used to address social and organizational aspects of privacy and security of medical data. Data from the Internet Research Program indicate that gender, age and community size can influence people's moral tolerance about privacy while cross-national differences exist. Implications for researchers and decision-makers are outlined.

3) A Project-Based Approach to Education & Assistance for Medical Entrepreneurs, Myron Weber, Univ. of Calgary, 2500 University Dr. NW, Calgary, Alberta, T2N 1N4, Canada, James J. Chrisman, James O'Grady, Vance Gough

The University of Calgary is renowned for its project-based entrepreneurial education and assistance programs. We examine whether projects are an effective educational and assistance tool for MMT and discuss the contingencies that influence the design of effective education and assistance programs for medical entrepreneurs.

SD23 Logistics & Supply Chain Management III

Contributed Session

Chair: Leftheris Iakovou, Univ. of Miami, Dept. of IEN, PO Box 248294, Coral Gables, FL 33124, lefteris@eng.miami.edu

1) An Integrated Model for Fleet Planning & Revenue Management, Leftheris Iakovou, Univ. of Miami, Dept. of IEN, PO Box 248294, Coral Gables, FL 33124, lefteris@eng.miami.edu, Chi Ip

In traditional revenue management, pricing and inventory control decisions are based on the assumptions that the supply of the perishable assets is static and the lifetime of the underlying assets is infinite. We propose an integrated model that captures the dynamic nature of the supply and the finiteness of the lifetime of certain assets.

2) Managing Perishable Product Inventories, Susan M. Hesse, Northwestern Univ., 2225 N Campus Dr., Evanston, IL 60208, hesse@iems.nwu.edu, Mark S. Daskin, Collette R. Coullard

We consider issues relating to the production, distribution and management of perishable product inventories. Per unit costs are charged against product outdates and shortages, while transportation costs are charged against each retailer shipment. Human platelet management motivates the study, which aims to improve regional blood center policies.

3) Managing Cost-Service-Level Tradeoffs in Supply Chains with Common Parts, Ajay Mishra, Univ. of Pittsburgh, Katz Grad. Sch. of Bus., Pittsburgh, PA 15260, mishra+@pitt.edu, Prakash Mirchandani

We consider a supply chain meeting multiple product demand at a retailer. We study the effects of parts commonality on inventory policies in such situations and explore their relationship to end-item service levels.

4) Intelligent Electronic Catalogs, Alex Bangash, Lucent Technologies, 101 Crawfords Corner Rd., Rm. 2L-518, Holmdel, NJ 07733, bangash@hoexch.ho.lucent.com, Ramesh Bollapragada

Electronic catalogs and virtual storefronts are changing commerce and retailing. These also have a profound impact on distribution, logistics and inventory management. We describe methodologies for using OR-based methods for electronic commerce enabled supply chain management.

SD24 Finance

Contributed Session

Chair: Jayaram K. Sankaran, Univ. of Auckland, MSIS Dept., Private Bag 92019, Auckland, New Zealand, j.sankaran@auckland.ac.nz

1) Optimal Selection of Small Portfolios, Jayaram K. Sankaran, Univ. of Auckland, MSIS Dept., Private Bag 92019, Auckland, New Zealand, j.sankaran@auckland.ac.nz, K. Chandrasekhar

We discuss algorithms for selecting portfolios that are optimal among those that contain at most a given number of securities. Two criteria are considered: maximizing the ratio of average excess return to standard deviation and maximizing the correlation of portfolio return with that of a given market index.

2) Assiomatic Finance Theory in a Stochastic Environment, Raimondo Manca, Univ. di Chieti, Dip. di Scienze, Viale Pindaro 42, Pescara, 65127, Italy, rmanca@sci.unich.it

Assiomatic finance exchange theory is fully defined in a deterministic environment. We present an attempt to construct an assiomatic theory in a stochastic environment. The problem should be faced using non-homogeneous semi-Markov processes, that, in a natural way, permit to follow the time evolution of a dated sum.

3) Using Financial Statements in the Valuation of a Firm, Anibal C. Irarrazabal, Catholic Univ. of Chile, Vicuna MacKenna 4860, Santiago, Chile, airarraz@ing.puc.cl

Analysis of different approaches to valuation: discounted flow models and accounting-based valuation techniques. Four important public corporations are valued using their financial statements. The key to successfully investing and managing a firm lies in understanding not only what the value is but the sources of the value.

4) The Ex Situ Oil Market vs. the Market for Assets Holding in Situ Oil Projects, John Lohrenz, LA Tech. University, Dept. of Chem. Eng., PO Box 10348, Ruston, LA 71272-0046, jl@engr.latech.edu, Wanara Oliveira

Is there correlation between ex situ market oil prices and market values of assets holding in situ oil? Option theory methods for in situ oil projects based on ex situ oil price market behavior presume such a correlation. Yet some, admittedly preliminary, studies of market data challenge such presumptions.

5) Optimal Managerial Incentive Contracts, Mergers & the Size of the Firm, Diane Reyniers, London Sch. of Econ., Houghton St, London, WC2A 2AE, UK, d.j.reyniers@lse.ac.uk

According to the risk reduction version of the managerial utility hypothesis of conglomerate mergers, managers diversify their firm's operations at shareholder's expense. We examine a reconciliation of this hypothesis with profit maximization in which shareholders adjust managerial incentive contracts after merger. With optimal readjustment, shareholders benefit from diversification and managers receive higher expected compensation...

SD25 Markov Chain Monte Carlo in Complex Problems

Cluster: Statistics & Reliability

Invited Session

Chair: Siddhartha Chib, Washington Univ., Olin Sch. of Bus., 1 Brookings Dr., CB 1133, St. Louis, MO 63130, chib@simon.wustl.edu

1) Bayesian Analysis & Computation for Correlated Ordinal Data Models, Ming-Hui Chen, Worcester Polytech. Inst., Dept. of Math Sci., 100 Institute Rd., Worcester, MA 01609, mhchen@wpi.edu, Dipak Dey

Hierarchical generalized linear models using scale mixtures of multivariate normal link functions are proposed. Model comparisons and diagnostics are considered. Various efficient simulation-based computational algorithms are further developed and a real data example is used to illustrate the proposed methodologies.

2) On Efficient Parametrizations for Simulation-Based Fitting of Generalized Linear Mixed Effects Models, Alan Gelfand, Univ. of CT, Dept. of Stats., Storrs, CT 06269-3120, alan@merlot.stat.uconn.edu

Markov chain Monte Carlo methods are widely used in the fitting of generalized linear mixed effects models. Many practical issues arise. We focus on choice of parametrization. With regard to Markov chain Monte Carlo model fitting in selecting a parametrization, concern is partly with simplifying the sampling but primarily with expediting convergence...

3) Solving Influence Diagrams by Markov Chain Monte Carlo Simulation, Peter Mueller, Duke Univ., Box 90251, Inst. of Stats & Dec. Sci., Durham, NC 27708-0251, pm@stat.duke.edu

We consider an approach to expected utility maximization based on Markov chain Monte Carlo simulation. We define an artificial probability model $h(a, x)$ on the product space of alternatives and states. By simulating from $h(a, x)$ we solve the original optimization problem. The approach is related to SA methods.

4) Estimation & Comparison of Models with Multiple Change Points, Siddhartha Chib, Washington Univ., Olin Sch. of Bus., 1 Brookings Dr., CB 1133, St. Louis, MO 63130, chib@simon.wustl.edu

A new Bayesian approach is developed for models with multiple change points. This approach relies on a hidden Markov representation of the change point model. Computation is based on Markov chain Monte Carlo methods. Also, techniques for finding Bayes factors are developed and illustrated in examples.

SD26 Professional Program

Cluster: Student Affairs

Invited Session

Chair: Astrid Kenyon, Univ. of TX, Dept. of Mech. Eng., Austin, TX 78712

1) Keeping the "Up" in Start-Up, Vijay Mehrotra, Onward Inc., 888 Villa St., Ste 210, Mountain View, CA 94041, vijay@onward-

net.com

The Silicon Valley images of start-up companies and high technology entrepreneurs quickly are becoming part of our mythology. I speak about my own experiences in starting and growing a consulting firm, using a lot of what I have learned in life and in school.

2) Working at Big Blue...(or Any Other BIG Color Company), Charley Kelly, Jasper Enterprises, 6905 Jester Blvd., Austin, TX 78750, jasper57@aol.com

Working in a large company has advantages and disadvantages. Some techniques and personality types fit better into larger groupings, but most corporations have accommodated all types. We share our perceptions and experiences of 34 years with IBM and 5 years as a private consultant.

3) Working for a Governmental or Quasi-Governmental Agency, Harvey R. Mitchell, Federal Reserve Bank of Dallas, Op. Analysis Dept., 2200 N Pearl St., Dallas, TX 75201, harvey.mitchell@dal.frb.org

We address the uses of OR methods at the Federal Reserve, and discuss the skills that are valued in the various analyses performed. One specific example shows how simulation was used to assist the bank on an equipment purchase decision.

SD27 Computational Intelligence & Operations Research

Cluster: Interface Between OR & AI

Invited Session

Chair: Alice E. Smith, Univ. of Pittsburgh, Dept. of IE, 1031 Benedum Hall, Pittsburgh, PA 15261, aesmith@engrng.pitt.edu

1) Error Detection Within an Automated Machine Calibration Inspection System, John Huffman, Boeing Corp., 303 East Grail, Wichita, KS 67207, Janet M. Twomey

This paper describes a process for interpreting machine calibration data by applying computational intelligence techniques, specifically, neural networks for pattern fitting and fuzzy logic rules for error cause association. An application for detecting cutting machine calibration and calibration test errors is presented, but this approach can be used for many inspection tasks.

2) A Methodology for Maximizing the Revenue of Corporate Training Schedules, Bryan A. Norman, Univ. of Pittsburgh, 1048 Benedum Hall, Pittsburgh, PA 15261, banorman@engrng.pitt.edu

We consider the problem of scheduling corporate training courses subject to instructor and room constraints with the objective of maximizing total profit. The problem can be viewed as a variation of an academic timetabling problem. Heuristic methodologies are developed and their cost effectiveness is demonstrated on test problems.

3) Scheduling Courses Using Integrated Artificial Intelligence & OR Tools, Robert Allen Kilmer, Army War Coll., 176 B Lee Rd., West Point, NY 10996, George Hluck

We examine the approach used at the US Army War College to schedule and assign students to course electives. A GA places courses into time periods. A linear program assigns students to courses to maximize satisfaction of student preferences. The combined approach produces very good results.

4) Self-Tuning Adaptive Penalty Function for Genetic Algorithms, David Coit, Rutgers Univ.

Many penalty functions require parameter and scaling factor tuning. A general adaptive penalty technique is presented which uses feedback obtained during GA search. All penalty function parameters are self-tuning. The effectiveness of this method is illustrated on the series-parallel redundancy allocation problem.

5) An Evolutionary Neighborhood Search Technique for Combinatorial Optimization Problems, Cenk Tunasar, SABRE Decision Tech., Dallas, TX, Jayant Rajgopal

A parallel neighborhood search technique is presented where the search progresses with a population of candidate solutions that expand around better ones. The algorithm is a hybrid of modern search techniques like GA, simulated annealing and tabu search. Several applications are demonstrated by highlighting the competitiveness and the robustness of the algorithm.

SD28 TUTORIAL: Computational Issues in Combinatorial Optimization

Cluster: Integer Programming Tutorials

Invited Session

Chair: Bill Cook, Rice Univ., Comp. & Applied Math., PO Box 1892, Houston, TX 77251-1892, cook@marvin.or.uni-bonn.de

1) TUTORIAL: Computational Issues in Combinatorial Optimization, Bill Cook, Rice Univ., Comp. & Applied Math., PO Box 1892, Houston, TX 77251-1892, cook@marvin.or.uni-bonn.de

The task of building efficient implementations of combinatorial algorithms presents a number of interesting challenges, distinct from those that arise in the study of the worst case complexity of the algorithms. We present a survey of results in this area, concentrating on network optimization problems, including minimum-weight matchings, maximum flow, minimum cut, minimum-cost flow, minimum-weight spanning tree and the TSP...

SD29 Interior Point Methods for Nonlinear Programming

Cluster: Nonlinear Programming

Invited Session

Chair: Yuying Li, Cornell Univ., Comp. Sci. Dept., Upson Hall, Ithaca, NY 14853, yuyubg@cs.cornell.edu

1) Stabilizing the SQP Algorithm in the Presence of Dependent Constraints, Stephen J. Wright, Argonne Nat. Lab., MCS Division, Argonne, IL 60439, wwwright@mcs.anl.gov

The standard local analysis of the SQP algorithm for NLP assumes that the active constraint gradients are linearly independent at the solution. We describe a slightly modified SQP algorithm in which superlinear convergence is attainable without this assumption. The algorithm and its analysis are strongly motivated by primal-dual interior-point methods.

2) Inexact Reflective Newton Methods for Large-Scale Optimization Subject to Bound Constraints, Mary Ann Branch, The MathWorks, Inc., 24 Prime Park Way, Natick, MA 01760-1500, branch@mathworks.com

We describe an extension of the reflective Newton method for optimizing large scale NLPs with simple bound constraints. The main issue is efficiently choosing a step, using a combination of subspace trust region and "inexact" Newton ideas, that preserves the method's properties. We give experimental evidence supporting the large-scale extension.

3) Dealing with Indefiniteness in an Interior Method for General Nonlinear Programming, David M. Gay, Bell Labs/Lucent Tech., 600 Mountain Ave., Murray Hill, NJ 07974-0636, dmg@bell-labs.com, Michael Overton, Margaret Wright

Primal-dual path-following methods can work well for minimizing nonlinear objectives subject to general nonlinear constraints (equalities and inequalities), but must sometimes deal with negative curvature to avoid saddle points and local maxima. We discuss some modified-Cholesky schemes and report experience with a MATLAB implementation.

4) Interior Point Methods for Large-Scale Nonlinear Programming, Jorge Nocedal, Northwestern Univ., EECS Dept., Evanston, IL 60208, nocedal@venuc.ece.nwu.edu, Richard Byrd, Mary Beth Hribard

We describe a robust and efficient interior point method for solving large nonlinear optimization problems with nonlinear equality and inequality constraints. It combines ideas of sequential quadratic programming and interior point methods in a way that allows for direct use of 2nd derivatives.

5) A Trust Region & Affine Scaling Method for Nonlinear Minimization with Linear Constraints, Yuying Li, Cornell Univ., Comp. Sci. Dept., Upson Hall, Ithaca, NY 14853, yuyubg@cs.cornell.edu, Thomas F. Coleman

A trust region idea is combined with an affine scaling Newton method for minimizing a nonlinear function with linear inequality constraints. We describe the proposed method and a reflection technique which is particularly useful in this context. Explicit sufficient decrease conditions and preliminary computation results are presented also.

SD30 Search Heuristics for Complex Systems

Cluster: Heuristic Methods in Optimization

Invited Session

Chair: Manuel Laguna, Univ. of CO, CB 419, Boulder, CO 80309, manuel.laguna@colorado.edu

1) Scheduling Jobs on Parallel Machines with Tooling, Personnel & Time Constraints, Rafael Moras, St. Mary's Univ., One Camino Santa Maria, San Antonio, TX 78228-8534, enrafael@stmarytx.edu, Bill Mason

Heuristic algorithms are developed for a problem scheduling problem originally found at Bausch & Lomb, San Antonio, Texas. The problem involves resource availability constraints including personnel (setup operators), tooling (edging cams), products (processing left and right lenses concurrently) and time (production deadlines).

2) Robust Pipe Network Design Optimization Using Genetic Algorithms, Istvan Lippai, Univ. of CO, Civil, Environ. & Archit. Eng., Box 421, Boulder, CO 80309-0421, lippai@spot.colorado.edu, James P. Heaney

An application of GAs for pipe network optimization is presented. GAs have shown promise in providing improved links between analysis and design. We show how analysis and design of a water distribution network can be done using a spreadsheet and a commercially available spreadsheet add-in called Evolver.

3) Combining Risk Analysis & Optimization with Scatter Search, James P. Kelly, Univ. of CO, College of Bus. & Admin., Boulder, CO 80309, james.kelly@colorado.edu, Manuel Laguna

We describe the implementation of a scatter search procedure that seeks to optimize a simulation model associated with a risk analysis problem. In this context, the objective function evaluation consists of a Crystal Ball simulation. Crystal Ball is a forecasting and risk analysis software for electronic spreadsheets.

SD31 Binary Optimization

Cluster: Combinatorial Optimization

Invited Session

Chair: Peter L. Hammer, Rutgers Univ., RUTCOR, PO Box 5062, New Brunswick, NJ 08903-5062, hammer@rutcor.rutgers.edu

1) A Variable Redefinition Strategy for Linear & 0-1 Programs, Paul T. Hadavass, Clemson Univ., Dept. of Math. Sci., Clemson, SC 29634, Warren P. Adams

We present a variable redefinition strategy for efficiently solving a class of specially structured LP problems. The method is directly applicable to families of well-studied 0-1 LPs, as well as to various 0-1 quadratic and polynomial programs. Included here is the vertex packing problem and relatives.

2) Facets of the Quadratic 0-1 Knapsack Polytope, David Rader, Rose-Hulman Inst. of Tech., Dept. of Math., Terre Haute, IN 47803, rader@rutcor.rutgers.edu

We characterize several classes of facets for the quadratic 0-1 knapsack polytope. For each class, we derive bounds on all coefficients. We also look at certain complexity questions related to these facets. These results generalize results for the linear knapsack polytope which have been obtained over the past 20 years.

3) Maximizing the Product of Two Linear Functions in 0-1 Variables, David Rader, Rose-Hulman Inst. of Tech., Dept. of Math., Terre Haute, IN 47803, rader@rutcor.rutgers.edu, Peter L. Hammer, Pierre Hansen, Panos Pardalos

We study the maximization of the product of 2 linear pseudo-Boolean functions. We first give low-order polynomial algorithms for the solution of the continuous relaxation, then describe penalties used to fix variables in the discrete problem. Extensive computational tests demonstrate the effectiveness of these results.

SD32 Interaction of Analytic Information Systems & Decision Technologies

Sponsor: CSTS

Sponsored Session

Chair: Gautam Mitra, Brunel Univ., Dept. of Math. & Stats., Uxbridge, Middlesex, UB8 3PH, UK, mastgmm@brunel.ac.uk

1) Putting the A in On-Line Analytical Processing, Sam Savage, Stanford Univ., Dept. of EES & OR, 417 Terman Eng. Ctr., Stanford, CA 94305-4023, savage@leland.stanford.edu

OLAP represents a powerful new way to explore data but can hardly be called an analytical tool by OR standards. By embedding forecasting, optimization, simulation and other OR techniques in this multi-dimensional data rich environment, it will earn the right to the A in its acronym. We illustrate the natural coupling between data modeling, symbolic modeling and the "what-if" analysis phases of a DSS.

2) The Interaction of Information & Decision Technologies: On-Line Analytical Processing & Modeling, Nikitas-Spiros Koutsoukis, Brunel Univ., Dept. of Math. & Stats., Uxbridge, Middlesex, UB8 3PH, UK, mapgnsk@brunel.ac.uk, Gautam Mitra, Shirley de Jonk

OLAP captures the structure of real world data in the form of multidimensional tables. Information held by data warehouses, manipulated and presented through multidimensional views provide invaluable support for the decision maker. We illustrate the natural coupling between data modeling, symbolic modeling, what-if analysis phases of a DSS.

3) Data & Modeling Systems for Integrated Supply Chain

Management, J. Shapiro, MIT, E53-363, 30 Wadsworth St., Cambridge, MA 02139, jshapiro@mit.edu

A rapidly growing number of companies are seeking to sustain and improve their competitive advantage by the implementation and application of data and modeling systems to integrated supply chain management. We review these developments by discussing top-down vs. bottom-up approaches to system design and implementation and links between enterprise resource planning and supply chain analysis by optimization models...

4) Knowledge Networks for Decision Support, Ramesh Sharda, OK State Univ., Coll. of Bus. Admin., Stillwater, OK 74078-0555, sharda@okstate.edu

The problem of providing the appropriate form, style and content of information to members of a group without overloading them remains a challenge. Knowledge networks may provide the framework for solving this problem. We will review the problem, proposed solutions and the role of OR techniques in developing knowledge networks.

Sunday 16:30-18:00

SE01 OR/MS Applications in Manufacturing

Cluster: OR/MS Applications

Invited Session

Chair: Narayan Venkatasubramanian, i2 Technologies, 909 E Las Colinas Blvd., Irving, TX 75039

1) Practical Issues in Supply Chain Management, Scott W. Hadley, Numetrix Ltd., 655 Bay St., Ste. 1200, Toronto, Ontario, M5G 2K4, Canada

A large number of issues/opportunities exist surrounding practical applications of supply chain management tools, for instance, addressing soft constraints (representational and algorithmic), communication/justification of the decision process, visualization and parallelism. This talk motivates the need for academic activity in these and other areas of supply chain management.

2) On Solving Supply Chain Planning Problems with Hybrid AI/OR Approaches, Monte Zweben, Red Pepper Software/People Soft, 1810 Gateway Dr., Ste. 150, San Mateo, CA 94114, zweben@pepper.com

Supply chain planning problems address conflicting objectives (such as maximizing on-time performance vs. minimizing supply chain inventory) subject to overly constrained material and resources. OR approaches quickly generate solutions to capacity-feasible, single criteria (cost), high-level planning problems. AI approaches, on the other hand, are effective in solving real-world scheduling problems which are often over-contained and guided by multiple, conflicting criteria...

3) Challenges in Supply Chain Planning & Scheduling, James M. Crawford, Jr., i2 Technologies, 1603 LBJ Freeway, Ste. 780, Dallas, TX 75234

Supply chain planning is a hot area commercially, but hereto has received relatively little academic attention. Hundreds of 1000s of orders are not unusual, making these problems orders of magnitude larger than most job-shop or other academic scheduling problems. Further, optimized planning often involves solving several interacting linear and discrete subproblems.

4) Logistics Partnerships with Suppliers, Ramakrishna Desiraju, Philips Labs., 345 Scarborough Rd., Industrial Dynamics Group, Briarcliff Manor, NY 10510

We present the blue-print of a DSS that aids in the identification of appropriate logistics partnerships. These partnerships are determined on the 3 basic dimensions that correspond to material, information and cash flows. These dimensions are replenishment policy, information exchange and financial arrangement. Based on the suppliers and component characteristics, the DSS recommends the most appropriate of the 3 choices on each of these 3 dimensions. We present a high level description of the methodology used in the DSS to arrive at the recommendations.

SE02 TUTORIAL: Real-Time, Mission-Critical Decision Support Systems for Controlling & Managing Airline Operations

Cluster: Airline Industry Tutorials

Invited Session

Chair: Gang Yu, Univ. of TX, Dept. of MSIS, Grad. Sch. of Bus., CBA 5.202, Austin, TX 78712, yu@uts.cc.utexas.edu

1) TUTORIAL: Real-Time, Mission-Critical Decision Support Systems for Controlling & Managing Airline Operations, Gang

Yu, Univ. of TX, Dept. of MSIS, Grad. Sch. of Bus., CBA 5.202, Austin, TX 78712, yu@uts.cc.utexas.edu

The field of OR has found its tremens impact in managing and controlling today's airline operations. Accelerated by modern computing technologies, based on improved understanding of the business logic applied in airline industry, enabled by advancement of optimization models and solution techniques, driven by enormous demand from airlines management for gaining competitive edge in the market, the real-time, mission-critical DSS for managing and controlling airlines' operations start to become a reality...

SE03 Operation Analysis & Performance Monitoring

Sponsor: Aviation Applications Section
Sponsored Session

Chair: Rose Y. Hsu, American Airlines, PO Box 619616, DFW Airport, TX 75261-9616, rose_hsu@amrcorp.com

SE04 Future Air & Space Combat

Sponsor: Military Applications Society
Sponsored Session

Chair: Robert S. Renfro, II, US Air Force, HQ NAIC/TAAE, 4180 Watson Way, WPAFB, OH 45433, rrenfro@webtv.net, rsr44@naic.wpafb.af.mil

1) **Cultural, Training & Individual Biases Effects on Air Combat**, Robert S. Renfro, II, US Air Force, HQ NAIC/TAAE, 4180 Watson Way, WPAFB, OH 45433, rrenfro@webtv.net, rsr44@naic.wpafb.af.mil

In air combat, there are many uncertainties that a pilot must examine when making decisions. The decision process undertaken by a pilot is based on his culture, training and individual preferences. These preferences are often influenced by factors which can be modeled and predicted.

2) **Mission Area Planning: A Value Focused Thinking Approach**, David Taylor, Sp Warfare Ctr., 12557 Kent Rd., King George, VA 22485, vmidave@aol.com

The decision analyzed development or acquisition of space assets that provide maximum operational contribution to the warfighter. The disparity in the functions performed by each of these assets requires a value model of the utility of each asset to be able to examine the tradeoffs among disparate systems.

3) **The High Level Architecture & You**, Robert S. Renfro, II, US Air Force, HQ NAIC/TAAE, 4180 Watson Way, WPAFB, OH 45433, rrenfro@webtv.net, rsr44@naic.wpafb.af.mil

DoD models and simulations are moving rapidly toward compliance with the HLA. The work of NAIC/TAEI and others involved with the WPAFB HLA working group impacts the way future air combat simulations will operate. There are still many obstacles to tackle before reaching the HLA vision.

SE05 New Findings in Behavioral Decision Research: Implications for Decision Analysis

Sponsor: Decision Analysis Society
Sponsored Session

Chair: George Wu, Harvard Bus. Sch., Dept. of Managerial Econ., Morgan 133, Boston, MA 02163, gwu@hbs.edu

1) **Dominance Violations & Event Splitting in Decision Making Under Uncertainty**, George Wu, Harvard Bus. Sch., Dept. of Managerial Econ., Morgan 133, Boston, MA 02163, gwu@hbs.edu, Richard Gonzalez

We find systematic violations of stochastic dominance that arise when an event outcome pair "x if A or B" is split and made strictly worse, "x if A" and "x-y if B." We demonstrate the effect for both choice and matching tasks. These effects are explained by subadditivity of probability judgments.

2) **Implicit & Explicit Subadditivity in Judgment & Choice Under Uncertainty**, Craig Fox, Duke Univ., Fuqua Sch. of Bus., Box 90120, Durham, NC 27708, cfox@mail.duke.edu

We examine 2 rationality violations observed in judgment and choice under uncertainty: explicit subadditivity, the sum of judged probabilities exceeds the judged probability of the union of events, and implicit subadditivity, the judged probability of an event increases when described in terms of the disjunction of constituent events.

3) **Inconsistent Judgments of Complementary Events**, Yuval Rottensteich, Univ. of Chicago, Grad. Sch. of Bus., 1101 E 58th St., Chicago, IL 60637, David V. Budescu, Ido Erev, Adele Diederich

The judged probabilities of 2 mutually exclusive and exhaustive hypotheses should sum to one. We find, however, that in many cases, such sums actually

fall below one. We also find that despite being systematically too low, judged probabilities are context-independent. Thus, although they are worryingly non-additive, judged probabilities do show a remarkable coherence.

SE06 Innovative Teaching with Spreadsheets

Sponsor: Forum on Education
Sponsored Session

Chair: Sam Savage, Stanford Univ., Dept. of EES & OR, 417 Terman Eng. Ctr., Stanford, CA 94305-4023, savage@leland.stanford.edu

1) **Innovative Nonlinear Programming Models**, Cliff T. Ragsdale, VA Polytech. Inst. & State Univ., Dept. of MS & Info., Blacksburg, VA 24061-0235, cragdsal@mail.vt.edu

Spreadsheet solvers make it possible to go beyond the linear boundaries of the past and cover new and interesting NLP problems in introductory OR/MS courses. This presentation will introduce several innovative examples for problems in logistics, finance, project selection and DA.

2) **Toward a Collection of Excel Add-ins for OR/IE**, Paul A. Jensen, Univ. of TX, Dept. of Mech. Eng., Austin, TX 78712, pjensen@mail.utexas.edu

We describe add-in collections programmed by students during a graduate course. As well as reviewing the content of the new add-ins, we will discuss issues associated with teaching the course.

3) **Deiteration: From Iterative to Instantaneous**, Sam Savage, Stanford Univ., Dept. of EES & OR, 417 Terman Eng. Ctr., Stanford, CA 94305-4023, savage@leland.stanford.edu

The incredible speed of today's computers allows procedures once considered iterative to be performed instantaneously. This can impact rich new insights into non-intuitive phenomena. Some examples include the Blitzogram (an instantaneous histogram) and the Stochastitron (an animated instantaneous convolution).

SE07 Evaluating Production Schedules

Sponsor: MSOM

Sponsored Session

Chair: Brenda Dietrich, IBM, TJ Watson Research Ctr., PO Box 218, Yorktown Heights, NY 10598, dietric@watson.ibm.com

1) **Multi-Criteria Master Production Scheduling**, Robin Lougee-Heimer, IBM, TJ Watson Research Ctr., Rte. 134, Yorktown Heights, NY 10598, rlh@watson.ibm.com, Pinar Keskinocak, Seshashayee Murthy

Master production schedulers have the job of determining the specific configurations, quantities and dates of production that their company will undertake to satisfy customer demand. The determination is inherently multi-criteria as planners trade off such competing and incommensurate objectives as minimizing inventory and maximizing customer satisfaction. We present the multi-criteria production planning problem and our solution approach.

2) **You Don't Have to Be in the Dark Anymore**, Ping Zhang, Syracuse Univ., Sch. of Info. Studies, Syracuse, NY 13244, pzhang@mailbox.syr.edu

Visualization of production planning data for decision making support is nearly nonexistent. A manufacturing production planning visualization system is prototyped and empirically tested. Hundreds of products and thousands of components and many other factors can be visualized to provide planners with production planning insight.

3) **An Agent-Based Multi-Objective Load Planning System**, John Rachlin, IBM, TJ Watson Research Ctr., Rte. 134, Yorktown Heights, NY 10598, rachlin@watson.ibm.com, R. Akkiraju, Seshashayee Murthy

In manufacturing environments, load planners face a number of competing objectives to try to determine how best to deliver products to customers. While satisfying a wide range of vehicle loading constraints, planners must also consider cost in the context of a manufacturing process. We discuss the application of this new load planning methodology to applications in the paper and steel industry.

4) **Application of Fuzzy Due-Date Bargainer in Manufacturing**, Yen-Hung Chen, NC State Univ., OR Program, PO Box 5144, Raleigh, NC 27659-7913, ychen1@eos.ncsu.edu

A methodology of due-date assignment and production planning was developed for make-to-order manufacturing systems. Customer due-date and production capacity are considered to be fuzzy numbers. The customer who requires an

earlier due-date can trade off purchase price and delivery date. We discuss the application of technology in manufacturing, as well as recent research progress.

SE08 Product Variety & Store Choice

Sponsor: MSOM

Sponsored Session

Chair: Teck H. Ho, UCLA, Anderson Sch., 110 Westwood Plaza, Box 951481, Los Angeles, CA 90095-1481, teho@anderson.ucla.edu

Co-Chair: Christopher S. Tang

1) **Product Deleting Decisions for Packaged Goods Products**, Peter Fader, Univ. of PA, The Wharton Sch., SH-DH, 3620 Locust Walk, Mktg. Sch., Philadelphia, PA 19104-6371, pete@marketing.wharton.upenn.edu, Edward J. Fox, Bruce G. S. Hardie, Michael Wisniewski

We examine the critical decision of which product(s) to delete from a product line. We consider both strategic approaches (i.e., the development of optimal product assortments as the basis for deletion decisions) as well as tactical approaches (i.e., incremental decisions about item-by-item line pruning). We explore these 2 approaches from the differing perspectives of manufacturers and retailers.

2) **Product Variety Management: A State-of-the-Art Review**, Juin K. Chong, UCLA, Anderson Sch., 110 Westwood Plaza, Box 951481, Los Angeles, CA 90095-1481, Teck H. Ho, Christopher S. Tang

Does more stock keeping units mean higher market share? Based on multi-category shopping data from 500 households over a 2-year period, we show that more stock keeping units mean higher market share in 70% of the product categories. We explain why there isn't such a positive relationship in the remaining product categories.

3) **Determining Where to Shop: Basket Size, Fixed & Variable Shopping Costs**, David Bell, UCLA, Anderson Sch. of Mgmt., 110 Westwood Plaza, Los Angeles, CA 90095-1481, david.bell@anderson.ucla.edu, Teck H. Ho, Christopher S. Tang

We use multicategory data to investigate the relationship between consumer shopping costs and store selection. By including a variable cost which is proportional to the shopping basket size, our results are a striking counterpoint to conventional wisdom which suggests that location is the primary driver of a store.

SE09 Modeling of Semiconductor Manufacturing at Texas Instruments

Cluster: OR Applications in Semiconductor Manufacturing
Invited Session

Chair: Darius Rohan, Texas Instruments, Inc., 13353 Floyd Rd., Dallas, TX 75248, darius@dragon.mtc.ti.com

1) **An Overview of Modeling of Semiconductor Manufacturing at Texas Instruments**, Darius Rohan, Texas Instruments, Inc., 13353 Floyd Rd., Dallas, TX 75248, darius@dragon.mtc.ti.com

This presentation provides a brief overview of the various modeling activities at Texas Instruments.

2) **Methodology of Determining Optimal Cluster Equipment Configuration**, Jani D. Jasadireja, Texas Instruments, Inc., 13353 Floyd Rd., Dallas, TX 75248

In the semiconductor wafer fabrication process, clustering has become 1 of the most popular ways of integrating different processes in the same equipment. In a cluster equipment, several process chambers of the same or different process capability are integrated into 1 equipment. Consequently, the analysis of this type of manufacturing system may not be as straight forward and intuitive anymore. This paper demonstrates the application of simulation to determine the optimal multichamber cluster equipment...

3) **Selecting Product Portfolios: A Problem Formulation for the SC Industry**, Lori Jones, Texas Instruments, Inc., 13353 Floyd Rd., Dallas, TX 75248

The semiconductor market is a rapidly changing, highly competitive environment. Managing product portfolio is essential to the success of semiconductor companies. This presentation is a survey of optimization techniques applied towards portfolio selection and management. Research was conducted both within and outside the semiconductor market. Lastly, a sample problem formulation which comprehends market demand, available capacity, price elasticity, etc., is presented.

4) **World Wide Equipment Productivity Teaming at Texas Instruments**, Bob Schlueter, Texas Instruments, Inc., 13353 Floyd

Rd., Dallas, TX 75248, Mark Gorman

We outline the process for equipment productivity teaming across multiple sites at Texas Instruments. We discuss the benefits gained and potential pitfalls from world wide teams addressing specific equipment sets.

SE10 Network Traffic Control Algorithms

Sponsor: Transportation Science Section
Sponsored Session

Chair: K. Larry Head, Univ. of AZ, Dept. of SIE, Tucson, AZ 85750

1) **Performance Studies of a Network Traffic Control Algorithm with Analytically Embedded Traffic Flow Models**, Wann-Ming Wey, Univ. of CA, Dept. of Civil & Environ. Eng., Inst. of Transport. Studies, Irvine, CA 92697, wwey@translab.its.uci.edu, R. Jayakrishnan

We present a complete optimal formulation of a network traffic control scheme with embedded traffic flow models (platoon dispersion) in the form of arc-flows in a time-expanded network. The integer-linear network-programming formulation is solved using a modified network simplex and B&B scheme. The results of comparing the solutions to other network signal optimization schemes and actuated controls are discussed.

2) **Time-Dependent Route Guidance & Traffic Signal Coordination in Congested Traffic Networks**, Akmal S. Abdelfatah, Univ. of TX, Dept. of Civil Eng., ECJ 6.2, Austin, TX 78712, akmal@mail.utexas.edu, Hani S. Mahmassani

Given time-dependent demand, we seek a combined solution of the dynamic traffic assignment and the signal control (signal settings and coordination) which minimizes the total travel time in the network. A mathematical formulation and solution algorithm are given and numerical results discussed.

3) **Computational Improvements for Real-Time Implementation of the Controlled Optimization of Phases Traffic Signal Control Strategy**, K. Larry Head, Univ. of AZ, Dept. of SIE, Tucson, AZ 85750, Pitu B. Mirchandani, Steven G. Shelby

Several computational improvements in the COP strategy will be discussed. These improvements address the trade-off between computational complexity of the DP approach and the level of detail contained in the traffic model that are critical to real-time implementation.

SE11 Methods for Problem Representation in Routing & Scheduling II

Sponsor: Transportation Science Section
Sponsored Session

Chair: Warren B. Powell, Princeton Univ., Program in Stats. & OR, Dept. of Civil Eng., Princeton, NJ 08544, powell@princeton.edu

1) **A Policy Evaluation Architecture for the Inventory Routing Problem**, Anton J. Kleywegt, GA Inst. of Tech., Sch. of ISyE, Atlanta, GA 30332-0205, anton.kleywegt@isye.gatech.edu, Martin W. Savelsbergh, Lloyd W. Clarke, Ann Campbell

Standard data sets are often used in the evaluation of algorithms for solving static and deterministic optimization problems. Evaluating control strategies for dynamic and stochastic systems requires more than just data sets. We propose a simulation architecture with real-world data to compare policies for the inventory routing problem.

2) **A Testing Architecture for Airline Optimization Problems**, Pamela H. Vance, Auburn Univ., Dept. of ISE, Auburn, AL 36849-5346, Andrew J. Schaefer, Alper Atamturk, George L. Nemhauser, Ellis L. Johnson, Diego Klabjan, Anton J. Kleywegt

We present data sets for representing several deterministic airline optimization problems, including daily crew scheduling, weekly exceptions crew scheduling, long-haul crew scheduling and fleet assignment and routing. We show how to use the online OAG as a source of problem data sets. We also consider a simulation-based architecture for evaluating policies for the stochastic daily crew scheduling problem.

3) **An Object Architecture for Dynamic Resource Scheduling Problems**, Warren B. Powell, Princeton Univ., Program in Stats. & OR, Dept. of Civil Eng., Princeton, NJ 08544, powell@princeton.edu, Gregory A. Godfrey, Joel A. Shapiro

We present an object architecture for representing dynamic resource scheduling problems that arise in vehicle routing and fleet management. We describe how to store problems, present a set of test datasets and describe a methodology for testing and comparing algorithms.

SE12 Large-Scale Supply Chains

Cluster: Supply Chain Operations
Invited Session

Chair: Ton G. de Kok, Eindhoven Univ. of Tech., PO Box 513, Eindhoven, 5600 MB, The Netherlands, a.g.d.kok@tn.tue.nl

1) Multi-Echelon Inventory Control in Divergent Systems with Differentiated Shipping Frequencies, M. C. van der Heijden, Univ. of Twente, Fac. of Tech. & Mgmt., Dept. of OR/Logistics, BB413, Enschede, 7500 AD, The Netherlands, m.c.vanderheijden@sms.utwente.nl

We consider inventory control in a 2-echelon divergent network, consisting of a central warehouse and multiple (non-identical) retailers. We assume that the depot review period is a multiple of the retailer review period. We determine control policies that satisfy fill rate constraints.

2) On Obtaining Optimal Solutions for Multi-Echelon Inventory Systems with Service-Level Constraints, Geert-Jan van Houtum, Univ. of Twente, WB/POM, Enschede, 7500 AE, The Netherlands, g.j.j.a.n.vanhoutum@wb.utwente.nl

Finding optimal replenishment strategies for multi-echelon inventory systems in general is hard. However, for a few systems where penalty costs are introduced in order to obtain a sufficiently high level of service, the solution is known and can be computed efficiently. We show how to exploit this for systems with strict service-level constraints.

3) Cost-Optimal Control Policies for N-Echelon Divergent Networks, E. B. Diks, Eindhoven Univ. of Tech., Dept. of Math. & Comp. Sci., PO Box 513, Eindhoven, 5600 MB, The Netherlands, diks@win.tue.nl, **Ton G. de Kok**

Consider a divergent periodic review multi-echelon inventory system (e.g. a distribution system or production system) with constant lead times. We consider linear penalty and holding costs incurred at the end of each period. The objective is to minimize the expected holding and penalty costs per period.

4) Control Policies for General N-Echelon Assembly Networks, Ton G. de Kok, Eindhoven Univ. of Tech., PO Box 513, Eindhoven, 5600 MB, The Netherlands, a.g.d.kok@tn.tue.nl, **J. Visschers**

We consider a multiple end-product/multiple component network with possibly intermediate subassemblies. Demand for end-products as well as independent demand for subassemblies and components is assumed to be stationary and i.i.d. in subsequent periods. Our objective is to determine cost-effective echelon order-up-to-levels for all items.

SE13 Models & Methods for Concurrent Engineering

Cluster: New Product Development
Invited Session

Chair: Jeffrey Liker, Univ. of MI, Dept. of IOE, Ann Arbor, MI 48109-2117

1) Core Principles of Product Development at Toyota & Chrysler, Durward K. Sobek, II, Univ. of MI, Dept. of IOE, Ann Arbor, MI 48190

Toyota and Chrysler are frequently benchmarked models of concurrent engineering. Both are highly successful by many conventional measures of concurrent engineering effectiveness (e.g., lead time, product cost, customer acceptance). This research finds some common principles, but also some very divergent approaches to product development across these best-practice examples.

2) The Dual Roles of Physical Modeling in Concurrent Engineering, Warren Smith, 6 Holton Circle, Londonderry, NH 03035

We examine 2 mutually contradictory roles played by physical models as a method for learning about technologies during product development. The use of models for "parametric experimentation" as compared to "conceptual experimentation" is distinguished. A study based on 58 problem-solving cases shows each is most effective under different previous knowledge conditions.

3) Interactive Learning Modules for Training in Concurrent Engineering, Susan Walsh Sanderson, RPI, Sch. of Mgmt., Troy, NY 12180

This presentation describes a multimedia tool that conveys to engineers and managers the interrelationship among design, manufacturing and marketing of new products. In working through decisions required in product development, the user assumes the role of product designer, manufacturing engineer and marketing expert to address tradeoffs in product development performance.

4) A Methodology for Reengineering for Product-Process Integration, Jeffrey Liker, Univ. of MI, Dept. of IOE, Ann Arbor,

MI 48109-2117

This presentation will provide an overview of a methodology for redesigning the design process to effectively integrate product and process engineering. The methodology emphasizes integration across the organization's core design tasks, formal organization structure, human resource systems and design technologies.

SE14 Financial Engineering

Sponsor: Financial Services Section
Sponsored Session

Chair: John R. Birge, Univ. of MI, Dept. of IOE, 1205 Beal Ave., Ann Arbor, MI 48109-2117, jrbirge@umich.edu

1) Optimization in Financial Engineering, Ilan Adler, Univ. of CA, Dept. of IEOR, 4183 Etcheverry, Berkeley, CA 94720-1777, adler@ieor.berkeley.edu

No abstract supplied.

2) Continuity Corrections for Discrete Path-Dependent Options, Paul Glasserman, Columbia Univ., 403 Uris Hall, Business Sch., New York, NY 10027, pglasser@research.gsb.columbia.edu

We develop correction terms for pricing discretely monitored path-dependent options using formulas for their continuous counterparts. The correction terms can be interpreted as shifting a barrier, a strike or an extreme price. We also develop lattice methods for accurate pricing of both the discrete and continuous versions. The lattice methods themselves use analogous correction terms to dramatically improve convergence to the accurate price.

3) Physical Models in Financial Engineering, Vadim Linetsky, Univ. of MI, IOE Dept., Ann Arbor, MI 48109, linetsky@engin.umich.edu

No abstract supplied.

4) Issues in Robust Modeling for Two-Stage Systems, Shabbir Ahmed, Univ. of IL, Dept. of Mech. & IE, Urbana, IL 61801, saahmed1@uiuc.edu, **Alan J. King, Samer Takriti**

In 2-stage systems, decision makers can adjust initial decisions after new information has been received. We demonstrate that "robust" modeling paradigms based on single-stage concepts, such as robust optimization, are subject to serious errors. Returning to first principles, we explore a valid class of second-moment approximations for 2-stage systems.

SE15 Management of Risk in Complex Systems

Cluster: Technology Management
Invited Session

Chair: John R. Harrald, George Washington Univ., Dept. of Eng. Mgmt., Gelman Library Rm. 632, Washington, DC 20052, harrald@seas.gwu.edu

1) Risk Perception, Risk Communication & Risk Management in Prince William Sound, Alaska, John R. Harrald, George Washington Univ., Dept. of Eng. Mgmt., Gelman Library Rm. 632, Washington, DC 20052, harrald@seas.gwu.edu

The recently completed risk assessment of marine oil transportation in Prince William Sound (the site of the EXXON Valdez disaster) required reaching consensus with multiple stakeholders, each with strongly held perceptions of risk and desirable risk reduction measures. The risk assessment and risk communications methods used to achieve this consensus are described.

2) Risk-Based Bidding in Project Management, Rene van Dorp, George Washington Univ., Dept. of OR, Staughton Hall, 707 22nd St., Washington, DC 20052, doropjr@seas.gwu.edu, **Michael R. Duffey**

When bidding on large, fixed price contracts engineers must become risk analysts. Over estimate risk and you don't get the contract, underestimate and you could go bankrupt. A risk assessment methodology that is integrated with project planning and project management is developed.

3) The Critical Task of Aviation Risk Assessment: Capturing & Structuring Human Error, Mohammed Berenji

No abstract supplied.

SE16 Strategy & Networks

Sponsor: College on Organization Science
Sponsored Session

Chair: Ranjay Gulati, Northwestern Univ., Kellogg Grad. Sch. of Mgmt., 2001 Sheridan Rd., Evanston, IL 60208-2011, r-gulati@nwu.edu

1) The Network Structure of Reputation, Ron Burt, Univ. of

Chicago, Grad. Sch. of Business, 1101 E 58th St., Chicago, IL 60637, ron.burt@gsb.uchicago.edu

I use network and performance data on several hundred bank officers to show how network context affects reputation. I trace the stability of an officer's reputation, bonus compensation and the probability of an officer leaving the firm to the network context in which the officer's reputation is formed.

2) Collaborative Strategies Among Competitive Firms, Quintus Jett, Stanford Univ., Dept. of IE, Stanford, CA 94305-4024, quintus@leland.stanford.edu, **Kathleen M. Eisenhardt**

This hypothesis-testing study applies a game-theoretic approach to firm strategies in the computer industry. Its purpose is to develop a topology of collaborative strategies for these competitive firms and test which are most effective.

3) Network Organizations: Trust-Based Exchanges of Tacit Resources, Peter S. Ring, Loyola Marymount Univ., Dept. of Mgmt., 7101 E 80th St., Los Angeles, CA 90045, peter_smith_ring@smtp1.insead.fr

Relying on transactions cost economics and the so-called resource based theory of the firm, I provide an explanation of how resilient trust is developed and relied upon in network contexts to govern the exchange of value adding resources. The arguments are grounded in longitudinal case studies of inter-firm collaborations.

4) Strategy & Network Formation, Gordon Walker, SMU, Cox Sch. of Bus., Dallas, TX 75275-0333, gwalker@mail.cox.smu.edu

Firm strategies are lodged in a network of interfirm relationships. As investments in these relationships increase and the relationships endure, the network acquires a structure that evolves over time. We examine how firm strategy and network structure interact over time using a variety of network formation models and data.

5) Different Strokes for Different Folks: An Empirical Assessment of Contingent Network Effects on Firm Performance, Ranjay Gulati, Northwestern Univ., Kellogg Grad. Sch. of Mgmt., 2001 Sheridan Rd., Evanston, IL 60208-2011, r-gulati@nwu.edu, **Stephen Shortell, James Westphal**

We explain how interorganizational networks can affect organizational performance by providing firms access to "organizational capital" embedded in the design of networks. Access to such capital is contingent on the specific network design. Hypotheses are tested with survey and archival data in a sample of more than 2,700 hospitals.

SE17 Quality & Productivity in Post-Acute & Long-Term Care

Sponsor: Health Applications Section
Sponsored Session

Chair: Sandra Potthoff, Univ. of MN, Carlson Sch. of Mgmt., 420 Delaware St. SE, Box 97, Minneapolis, MN 55455, pott001@tcc.umn.edu

1) Using Resident Assessment Data to Measure Quality of Long-Term Care, Francois Sainfort, Univ. of WI, IE Dept. Ctr. for Health Res., 1513 University Ave., Madison, WI 53706, sainfort@ie.engr.wisc.edu

We address the issue of whether and how one can use resident assessment data to estimate the level of quality of care delivered in a nursing facility. Resident assessment data from 4 states are used to investigate alternative ways of aggregating such information. Conceptual and methodological difficulties are discussed.

2) Best Practices in Home Health Care Case Management, Laura Kochevar, Univ. of MN, Environ. & Occupational Health, Sch. of Public Health, Minneapolis, MN 55455, laurak.kochevar-2@tc.umn.edu, **Paul E. Johnson, Kingshuk K. Sinha, Sandra Potthoff**

Influences on efficacy of home health care for patients with congestive heart failure were investigated using a 3-phase methodology: case management efficacy was described using archival data and DEA; survey data were used to compare managers with high efficacy cases to managers with low efficacy cases; and managers' performance on experimental cases were used to validate best practice components.

3) Factors Affecting Hospital Length of Stay for Medicare, Sandra Potthoff, Univ. of MN, Carlson Sch. of Mgmt., 420 Delaware St. SE, Box 97, Minneapolis, MN 55455, pott001@tcc.umn.edu

This study merged several large national sets to investigate the relationship of hospital, patient and post-acute care market characteristics to Medicare patients'

hospital length of stay. Data from 9 states (1 from each census region) across 7 DRGs were investigated.

4) Physician Profiling: Past, Present & Future, H. David Sherman, Northeastern Univ., Coll. of Bus. Admin., 404 Hayden Hall, Boston, MA 02115, hsherman@lynx.neu.edu

Physician profiling has become an accepted process to manage quality and economic performance. Diverse methods have been developed for profiling, exhibiting wide variation in sensitivity to health care service objectives. These methods suggest a new profiling model for more comprehensive effective measurement and management of cost and quality of physician services.

SE18 Performance Measurement with DEA

Cluster: DEA & Productivity
Invited Session

Chair: Robert G. Dyson, Univ. of Warwick, Warwick Bus. Sch., OR & Systems Group, Coventry, CV4 7AL, UK, r.g.dyson@warwick.ac.uk

1) Measurement Issues in DEA, Estelle Shale, Univ. of Warwick, Warwick Business Sch., Coventry, CV4 7AL, UK, **Robert G. Dyson**

Problems associated with data measurement in DEA have received little exposure in the literature relative to their potential impact on the efficiency evaluations. In a continuing investigation into the management of a branded chain of pub restaurants 2 such issues have arisen, variable isotonicity and the inclusion of qualitative indices in the input/output set. These problems and approaches to their resolution are discussed.

2) Evaluating USAF Medical Treatment Facilities with DEA, Lawrence M. Seiford, Univ. of MA, Dept. of IE/OR, 114 Marston Hall, Amherst, MA 01003-5220, seiford@ecs.umass.edu, **Richard S. Barr, Christoph Hofbeck**

We examine 83 USAF MTF over a period of 4 years. Identification of best practice across USAF bases and MTF cost centers provides managerial information for improvement. A window analysis identifies trends and patterns in efficiency scores of individual MTFs.

3) Sensitivity Analysis of DEA Measures, Joe Zhu, Univ. of MA, Dept. of MIE, 219 ELAB, Amherst, MA 01003, jzhu@ecs.umass.edu, **Lawrence M. Seiford**

Necessary and sufficient conditions are derived to yield the entire (largest) stability region for maintaining efficiency in DEA. In our framework, data are allowed to vary simultaneously for all DMUs across different subsets of inputs and outputs. The sensitivity analysis procedure can be accomplished by a series of LPs.

4) Multi-Method Branch Performance Measurement of a Portuguese Bank, Robert G. Dyson, Univ. of Warwick, Warwick Bus. Sch., OR & Systems Group, Coventry, CV4 7AL, UK, r.g.dyson@warwick.ac.uk, **Ana Santos**

The performance of the branches of a Portuguese bank has been measured using the multiple measurement methods including DEA and other approaches. The approaches are used jointly to address a range of issues arising at both branch and corporate levels. The research explores the advantages of a multi-method approach.

SE19 PANEL: Mentoring - How To Get It & How To Do It

Sponsor: Women in OR/MS Forum
Sponsored Session

Chair: Donna C. Llewellyn, GA Inst. of Tech., Sch. of ISyE, Atlanta, GA 30332-0205, donna.llewellyn@isye.gatech.edu

1) PANEL: Mentoring - How to Get It & How to Do It

This will be a panel discussion on the topic of mentoring. Representatives will discuss and answer questions on mentoring of students, faculty and industry professionals. The issues will be addressed both from the standpoint of how to be a better mentor and how to receive better mentoring.

SE20 Integration Technology, Implications & Justifications

Sponsor: College on Information Systems
Sponsored Session

Chair: Reza Barkhi, Univ. of MA, MIS Dept., Coll. of Mgmt., 1 University Ave., Lowell, MA 01854, barkhir@woods.uml.edu

1) **From an Organization with Networks to a Networked Organization**, *Efrem Mallach*, Univ. of MA, Coll. of Mgmt., 1 University Ave., Lowell, MA 01824, mallache@woods.uml.edu, *Dorothy J. Eastman*

In a fully networked organization, the nature of information sharing changes. Information flow becomes unpredictable and information loses traceability to its originator. We study the barriers to networked organizations, the implications for organizational behavior patterns, for information quality and for the required supporting technology.

2) **Mapping Business Processes into SAP for Organizational Integration**, *Kimberly Queenan*, Stream Intl., kqueenan@stream.com, *Reza Barkhi*

Implementation of SAP requires business processes to be defined precisely and compiled tightly. We propose a framework that may help establish and structure business processes so that they facilitate implementation in SAP. We explore the mapping of business process definitions in to SAP modules using data flow diagrams via decomposition and leveling. In this framework, convergence and harmonization are discussed.

3) **Managing Investments in Robotics or Other Technology**, *Thomas Klammer*, Univ. of North TX, Dept. of Acct., Denton, TX 76205, klammer@cobaf.unt.edu

Problems frequently arise in managing investments in robotics or other technology. Project sponsors (the technical staff) often do not communicate with the evaluators (the financial staff). Disconnects between top management and the technical and financial staffs can create adversarial relationships. We summarize ways to reduce these types of problems.

4) **Information-Based Technology Investment Decisions**, *Norma C. Powell*, Univ. of MA, Lowell, MA 01844, powelln@woods.uml.edu, *Reza Barkhi*

Companies make investment decisions in order to increase the value of the firm. The investment decision impacts the value of the firm in 1 of 2 basic ways: an increase in the revenue stream or a decrease in costs. Traditional investment justification models may not apply to information-based technologies. The reason may be due to an inadequate understanding and measurement of cost-benefit for information-based technologies....

SE21 Theoretical Foundations of MMT IV

Cluster: Management of Medical Technology
Invited Session

Chair: Chandru R. Chandrasekar, Univ. of Dundee, Dept. of Accountancy & Finance, 16 Greystane Rd., Invergowrie, Dundee, DD2 5JQ, Scotland, chandru@mcmail.com

1) **Strategic Management of Innovation Risk in the Bio-Pharmaceutical Industry: A UK Perspective**, *Chandru R. Chandrasekar*, Univ. of Dundee, Dept. of Accountancy & Finance, 16 Greystane Rd., Invergowrie, Dundee, DD2 5JQ, Scotland, chandru@mcmail.com, *W. A. Nixon, D. M. Power, A. A. Lonie*

We explore the implications of the literature on the strategic management of innovation risk of the bio-pharmaceutical industry in the UK. The need for an integrated approach combining financial, technical and competitive strategies is highlighted to align the interests of managers and all stakeholders and to promote sustainable innovation.

2) **Who Cares Wins: Controlled Trials to Cash-Flows**, *Chandru R. Chandrasekar*, Univ. of Dundee, Dept. of Accountancy & Finance, 16 Greystane Rd., Invergowrie, Dundee, DD2 5JQ, Scotland, chandru@mcmail.com, *S. R. Murali, Mahendra Raj*

Critical evaluation of the costs and consequences of implant use are clear signals for reform of the innovation process in the orthopedic implant industry. A theoretical model developed in this paper translates the benefits of academic credibility and the avoidance of "ethical distress" into favorable cash-flows and enhanced value creation.

3) **Provision for Revision: Implant Failure & Financial Engineering**, *Chandru R. Chandrasekar*, Univ. of Dundee, Dept. of Accountancy & Finance, 16 Greystane Rd., Invergowrie, Dundee, DD2 5JQ, Scotland, chandru@mcmail.com, *S. R. Murali, Mahendra Raj*

Who pays for failed implants? Inherent risks impose a significant burden on the incentive to innovate and the tolerance of failure. We propose a market-based model for a financial engineering solution to promote liquidity in risk-sharing and convergence of corporate and public interests in the development of medical technology.

SE23 Logistics & Supply Chain Management VI Contributed Session

Chair: Carlos Vidal, GA Inst. of Tech., 1602 Brook View Ave., Doraville, GA 30340-3835, carlos77@isye.gatech.edu

1) **An International Production-Distribution Model with Transfer Pricing & Transportation Cost Allocation**, *Carlos Vidal*, GA Inst. of Tech., 1602 Brook View Ave., Doraville, GA 30340-3835, carlos77@isye.gatech.edu, *Marc Goetschalckx*

We present a tactical production-distribution model for the optimization of a global supply chain that considers transfer prices and allocation of transportation costs as decision variables. The resulting problem is non-linear. We analyze its LP relaxation and other techniques for solving the original problem. Preliminary computational results are presented.

2) **Multiple Sourcing: Determining Suppliers & Order Policy**, *Pandu R. Tadikamalla*, Univ. of Pittsburgh, Katz Grad. Sch. of Bus., Pittsburgh, PA 15260, pandu@vms.cis.pitt.edu, *Ajay Mishra*

Splitting a replenishment order between 2 or more suppliers can lead to several benefits including safety stock reduction and lower cycle inventory costs. We study the problem of selecting from a set of nonidentical suppliers and deciding the order policy to minimize costs subject to service-level constraints.

3) **The Interaction of Location & Inventory in Distribution Systems**, *Steven J. Erlebacher*, WA Univ., Olin Sch. of Bus., 1 Brookings Dr., CB 1133, St. Louis, MO 63130-4899, erlebacher@wuolin.wustl.edu, *Russell D. Meller*

How does one design a distribution system with multiple distribution centers (DCs) when the DCs will service multiple customers? We model the interaction between DC location and inventory decisions considering fixed, transportation, inventory and ordering costs in the presence of random demand.

SE24 Economics

Contributed Session

Chair: Ben S. Wang, Stanford Univ., Dept. of OR, PO Box 2502, Stanford, CA 94309, wangsp@stanford.edu

1) **Computation of Economic Dynamics with Shape-Preserving Splines**, *Ben S. Wang*, Stanford Univ., Dept. of OR, PO Box 2502, Stanford, CA 94309, wangsp@stanford.edu

We present a shape-preserving algorithm to preserve the shape feature, monotonicity and concavity, of optimal value function of dynamic economic problems while solving by value iteration. Error analysis is given along with convergence results. Numerical examples in economic growth and pension savings allocation are provided.

2) **On the Emergence of Valuation Patterns**, *Bernhard F. Borges*, Max Planck Inst. for Psych. Res., Ctr. Adaptive Behavior, Leopoldstrasse 24, Munich, 80802, Germany, borges@mpipf-muenchen.mpg.de

We report the results of investigations of preference formation as an endogenous, adaptive process. GAs were employed to model maximizing agents in risky environments favoring survival of the fittest. Our results indicate that adaptive agents respond with reference-dependent valuation patterns reminiscent of those obtained in work with humans.

3) **A Disequilibrium Facility Location Model**, *Tan Miller*, Warner-Lambert, 201 Tabor Rd., Morris Plains, NJ 07950, *Terry L. Friesz, Roger Tobin*

We explore the coupling of recently developed spatial price disequilibrium models with a location model of a firm making location, production and distribution decisions. We examine the question of whether the locating firm can exploit, in the short- and medium-run, the price disequilibrating effects of its entry.

4) **An Economic Analysis of Resource Allocation in Computer Networks**, *Rex Eugene Pereira*, Univ. of TX, PO Box 4969, Austin, TX 78765-4969, pereira@mail.utexas.edu

We analyze the market for provision of Internet connectivity services in order to determine optimal pricing strategies for Internet service providers and to analyze policies which will maximize the net social welfare. I present a model which captures the current market conditions in the Internet service provider market. The presentation raises the level of analysis well above that of conventional congestion models.

SE25 Recent Developments in Bayesian Modeling: Model Choice & Diagnostics

Cluster: Statistics & Reliability
Invited Session

Chair: Peter Mueller, Duke Univ., Box 90251, Inst. of Stats & Dec. Sci., Durham, NC 27708-0251, pm@stat.duke.edu

1) Does Particulate Matter Particularly Matter?, Merlise Clyde, Duke Univ., Inst. of Stats. & Dec. Sci., 210A Old Chemistry, Durham, NC 27708-0251, clyde@stat.duke.edu, **Heather Desimone-Sasinowska**

Whether particulate matter, PM10, is associated with mortality is an important issue, as the PA considers standards and policy. Results depend heavily on the choice of covariates. We use Bayesian model averaging to assess the effect of PM10 on mortality, taking into account model uncertainty.

2) Bayesian Predictive Simultaneous Variable & Transformation Selection in the Linear Model, Jennifer Hoeting, CO State Univ., Dept. of Stat., Fort Collins, CO 80526, jah@stat.colostate.edu, **Joseph Ibrahim**

We propose 2 variable and transformation selection procedures for predictors in linear models. The simultaneous procedure avoids the problem that the selected model depends upon the order in which variable and transformation selection are performed. The stepwise procedure is useful for analyses with many predictors. Software is available from Statlib.

3) Case Influence Analysis in Bayesian Inference, Eric Bradlow, Univ. of PA, Wharton Sch., Ste. 1400 SH-DH, 3620 Locust Walk, Philadelphia, PA 1914, ebradlow@wharton.upenn.edu, **Alan Zaslavsky**

We demonstrate how case influence analysis, commonly used in regression, can be applied to complex Bayesian hierarchical models. The procedure (a reweighting approach) is particularly useful when inference is obtained via Markov chain Monte Carlo (i.e. computationally expensive). Application of the method to a 1993 DuPont Corporation opinion survey is presented in detail.

SE26 Academic Program

Cluster: Student Affairs

Invited Session

Chair: Chris Kenyon

1) Publishing in Operations Research

To succeed in academia, it is necessary to publish results and studies. An editor discusses the criteria used to select papers for peer review and what editors look for in submissions, together with indications on how to present work for maximum impact.

2) Routes to a Faculty Position

Before or after obtaining a Ph.D., the search for a faculty position has to be started. A successful professor speaks about actually going through the steps of search, interview and obtaining a position. Also covered are the subsequent years that lead to tenure.

3) Profiting From DALLAS97, Bruce Colletti, Univ. of TX, Dept. of Mech. Eng., Austin, TX 78712, bcolletti@mail.utexas.edu, **Astrid Kenyon, Chris Kenyon**

Information overload is the chief hazard at an INFORMS meeting. One also must frequently choose between interesting but simultaneously scheduled presentations. This short talk suggests ways that may help students get the most out of the many opportunities afforded at the meeting.

SE27 Generic Memory-Based Heuristic Search

Sponsor: College on Artificial Intelligence

Sponsored Session

Chair: Erick Rolland, Univ. of CA, Anderson Grad. Sch. of Mgmt., Riverside, CA 92521-0203, erik.rolland@ucr.edu

1) Enhanced Memory Adjusting Heuristics for Audit Scheduling, Ray Patterson, Univ. of TX, Sch. of Mgmt., PO Box 830688, MS J043, Richardson, TX 75083-0688, **Erick Rolland, Bajis M. Dodin**

We propose a generic memory adjusting heuristic for solving a complex version of the audit scheduling problem. Computational results are presented and compared to prior solution approaches.

2) Hybrid TS-GA Heuristics, Chris Huntley, Univ. of CA, Anderson Grad. Sch. of Mgmt., Riverside, CA 92521, **Erick Rolland**

Based on a recent successful application of GA to the well-known capital budgeting problem, we present memory-based enhancements to basic GA functionality. We provide an in-depth empirical analysis of our computational experiences with our proposed approach.

3) New Meta-Heuristics for the Capacitated Minimum Spanning Tree, Erick Rolland, Univ. of CA, Anderson Grad. Sch. of Mgmt.,

Riverside, CA 92521-0203, erik.rolland@ucr.edu, **Ray Patterson**

We present a new meta-heuristic for the CMST. We investigate the use of the state-of-the-art heuristics combined with memory functions and present computational results from our experiments.

SE28 TUTORIAL: Heuristics for Discrete Optimization Problems

Cluster: Integer Programming Tutorials

Invited Session

Chair: Jan Karel Lenstra, Eindhoven Univ. of Tech., Dept. of Math. & Comp. Sci., PO Box 513, Eindhoven, 5600 MB, The Netherlands, jkl@win.tue.nl

1) TUTORIAL: Heuristics for Discrete Optimization Problems, Jan Karel Lenstra, Eindhoven Univ. of Tech., Dept. of Math. & Comp. Sci., PO Box 513, Eindhoven, 5600 MB, The Netherlands, jkl@win.tue.nl

We review recent theoretical and empirical progress in the development of approximation algorithms for hard scheduling problems. In particular, we discuss the use of LP-relaxations in deriving performance guarantees, a technique for identifying limits of approximability and a variety of neighborhood search approaches for finding reasonable schedules reasonably fast.

SE29 Nonlinear Programming Algorithms & Applications

Cluster: Nonlinear Programming

Invited Session

Chair: Leon S. Lasdon, Univ. of TX, MSIS Dept., Coll. of Bus. Admin., Austin, TX 78712-1175, lasdon@mail.utexas.edu

1) Toward Evaluating the Quality of Least-Cost Steady State Flows in Natural Gas Pipelines, E. Andrew Boyd, TX A&M Univ., Dept. of IE, College Station, TX 77843-3131, boyd@marvin.tamu.edu

Issues in developing lower bounds for general least cost steady state flows in natural gas pipelines are discussed. Computational results are presented.

2) Nonlinear Optimization by Sequential Large-Scale Approximation, Marco Lavoie, Carleton Univ., Systems & Computer Eng., 1125 Colonel By Dr., Ottawa, Ontario, K1S 5B6, Canada, lavoie@sce.carleton.ca, **John W. Chinneck**

Typical sequential approximation methods use only 1 or a few points to approximate the objective and constraints at each iteration. We propose a new approach which uses numerous sample points to establish better function approximates. Other feature: better handling of equalities, guarantees of convex subproblems. Preliminary empirical results are given.

3) Solving Large NLPs in GAMS Using SLP/GRG, Allan D. Waren, Cleveland State Univ., Computer Sci. Dept., 2121 Euclid Ave., Cleveland, OH 44115, waren@babbage.cba.csuohio.edu, **Walter O. Rom, Leon S. Lasdon**

SLP/GRG is an algorithm for solving large, sparse NLPs, which combines SLP and GRG features. The current implementation, using IBM's OSL to solve the LP subproblems, has been linked to GAMS. Results of solving problems with up to a few 1000 variables and constraints are presented.

4) Averaging with Well-Behaved Maps for Solving Fixed Points & Variational Inequalities, Thomas L. Magnanti, MIT, OR Center, Rm. E40-147, 1 Amherst St., Cambridge, MA 02139-4307, magnanti@mit.edu, **Georgia Perakis, Marina Epelman**

We examine a general averaging framework for solving fixed points. The key idea is to consider averaging with maps that are "well" behaved and counteract the "bad" properties of the fixed point map. Our framework considers averaging with well-behaved maps such as nonexpansive (including the identity) and contractive maps.

SE30 Tabu Search for Difficult Scheduling & Routing Problems

Cluster: Heuristic Methods in Optimization

Invited Session

Chair: John B. Chambers, Univ. of TX, PO Box 26486, Austin, TX 78755, jbc@cs.utexas.edu

1) Further Developments in Applying Tabu Search to the General Vehicle Routing Problem with Time Windows, J. Wesley Barnes, Univ. of TX, Grad. Program in OR/IE, Dept. of Mech. Eng., Austin, TX 78712, wbarnes@mail.utexas.edu, **William Nanry,**

William Carlton

We discuss recent developments, both theoretical and applied, in our ongoing research into multi VRPs with time windows. We include consideration of new search neighborhoods, technological precedence considerations and implementation issues in using these methods at a Defense Logistics agency depot.

2) New Tabu Search Results for the Flexible Job Shop Scheduling Problem, John B. Chambers, Univ. of TX, PO Box 26486, Austin, TX 78755, jbc@cs.utexas.edu, J. Wesley Barnes

We discuss recent investigations into the development of a revised adaptive approach for the TS solution of flexible job shop scheduling problems. We extend our previous experience with dynamic mechanisms characterized by memory intervals derived from studies of underlying classic job shop models.

SE31 Network Design I

Cluster: Combinatorial Optimization
Invited Session

Chair: Bernard Gendron, Univ. de Montreal, CRT, CP 6128, Succ. Centre-ville, Montreal, Quebec, H3C 3J7, Canada, bernard@crt.umontreal.ca

1) Computational Experiments with Survivable Network Design Problems, Daniel Bienstock, Columbia Univ., Dept. of IE/OR, New York, NY 10027, dano@ieor.columbia.edu, Gabriella Muratore

We consider network design problems where we must route demands and install capacities so that the failure of a single node still permits a certain percentage of each demand to be routed. We present a mixed integer formulation of problems of this type and discuss computational experience.

2) Approximating the Network Loading Problem, Rafael Epstein, MIT, OR Ctr., Bldg. E40, Cambridge, MA 02139, repstein@mit.edu, Thomas L. Magnanti

Given facilities of different capacities, we seek a minimum cost network design with sufficient capacity to meet prescribed demands. The design can install many facilities of any type on each edge. We examine data, i.e., cost, demand, number of commodities, etc., and dependent performance assessments of approximation techniques for this network loading problem.

3) An Entropy-Based Approach to Fixed-Charge Network Flow Problems, Ismail Chabini, MIT, Dept. of Civil & Environ. Eng., 77 Mass. Ave., Rm. 1-263, Cambridge, MA 02139, chabini@mit.edu, Bernard Gendron

We present a new approach for solving fixed-charge network flow problems based on relaxation and the addition of entropy-type functions to take into account the bounds on the variables. The resulting relaxation is easy to solve and provides a new class of heuristics. Experimental results are presented and analyzed.

4) Tabu Search for Broadband Network Design Problems, Bernard Gendron, Univ. de Montreal, CRT, CP 6128, Succ. Centre-ville, Montreal, Quebec, H3C 3J7, Canada, bernard@crt.umontreal.ca, Charles Fleurent, Jean-Yves Potvin, S. Raghavan, Patrick Soriano

We study a class of problems that arise when designing so-called broadband telecommunications networks. We present modeling alternatives for these problems and present solution methodologies based on TS. Experimental results will be presented and analyzed.

SE32 Recent Developments in Logical Analysis of Data Methods & Applications

Sponsor: CSTS

Sponsored Session

Chair: Salvador Nieto Sanchez, LA State Univ., 3128 CEBA Bldg., Baton Rouge, LA 70803-6409, snieto@lsuvm.sncc.lsu.edu

1) A Branch & Bound Approach for Inferring a Boolean Function from Complete & Incomplete Examples, Jennifer Austin, LA State Univ., Dept. of IE, 3128 CEBA, Baton Rouge, LA 70803, jrodri@unix1.sncc.lsu.edu, Evangelos Triantaphyllou

We present a new B&B algorithm for inferring a Boolean function from examples. Examples are positive, negative or unclassifiable. The new B&B approach utilizes the limited information in the unclassifiable examples, thus improving the inference process. We present some theoretical and empirical results and some other related problems.

2) A Fast Guided Learning Approach for Inferring Monotone Boolean Function from Positive & Negative Examples, Lu Jieping,

LA State Univ., Dept. of IE, 3128 CEBA Bldg., Baton Rouge, LA 70803, jlu@unix1.sncc.lsu.edu, *Evangelos Triantaphyllou*

We use the concepts of Hansel chains and binary search in inferring a monotone Boolean function by using membership queries. An extensive empirical study suggests that the proposed approach is considerably more effective than an old one which uses only Hansel chains. We also present ways to solve large scale problems.

3) Classification of Text Documents by Using a Machine Learning Approach, Evangelos Triantaphyllou, LA State Univ., Dept. of IE, 3128 CEBA, Baton Rouge, LA 70803-6409, ietrian@lsuvm.sncc.lsu.edu, Salvador Nieto Sanchez

Each document is first analyzed in terms of sequences of lexical terms. Next, a classification approach based on discrete optimization and mathematical logic is applied. Sample documents are used to extract a set of logical rules which in turn are used for new classifications. Some empirical results with interesting implications are discussed.

Monday 08:00-09:30**MA01 OR/MS Applications in Passenger Rail**

Cluster: OR/MS Applications

Invited Session

Chair: B. N. Srikar, Amtrak, 400 N Capitol, Washington, DC 20001, tjo@bellcore.com

1) Market Driven Decision Making in Passenger Railroads, Sushant Jain, SABRE Decision Technologies, PO Box 619616, Ft. Worth, TX 75261, suhant_jain@sabre.com, Nihal J. Mehta

In order to increase their revenues, improve market share and reduce their costs, railroads have to move from constraint-driven decision making to market-driven decision making. The marketing process starts with long term product positioning, medium term planning and pricing to end with short term yield management and scheduling. OR techniques can be used at every step to ensure consistency and added value throughout the process...

2) Approaches to Yield Management in Railroad Applications: A Survey, Edwin R. Kraft, Amtrak, 400 N Capitol, Washington, DC 20001, B. N. Srikar

We survey the research and implementation of revenue management of yield management techniques as applied in airlines, passenger rail, freight rail and trucking applications. We explore the relationship between the analytical approach, marketing characteristics, operating environment and transportation network topology.

3) Evaluation of Revenue Management Strategies & Policies, B. N. Srikar, Amtrak, 400 N Capitol, Washington, DC 20001, tjo@bellcore.com

This paper describes the basic model that has been developed to simulate the revenue management system controls to evaluate the strategies and policies that affect the system operation. The leg class control and market limit control optimal authorizations along with hierarchical bucket nesting and the reservations behavior modeled for departure day simulation. The expected revenue generated for alternate revenue management policies is estimated from the Monte Carlo simulation.

4) Integrated Decision Support for Passenger Railways, Tom Shelton, SABRE Decision Tech., 4255 Amon Carter Blvd., Ft. Worth, TX 76155

Passenger railways like most large corporations are faced with making both strategic and tactical decisions. Typical strategic decisions for railways include fleet planning, pricing structure, marketing programs and long term inventory control levels. Tactical decisions include such areas as competitive pricing, yield management and short term equipment redeployment. More often than necessary, decision making for strategic and tactical purposes is flawed and contradictory...

MA02 Applications in Services

Cluster: Applications

Invited Session

Chair: Patrick T. Harker, Univ. of PA, OPIM Dept., 1300 SH-DH, Wharton Sch., 3620 Locust Walk, Philadelphia, PA 19104-6315, harker@wharton.upenn.edu

1) Intermediation & Competition in Information-Based Services, Uday S. Karmarkar, UCLA, Anderson Sch. of Mgmt., 110 Westwood Plaza, Box 951481, Los Angeles, CA 90095-1481, uday.karmarkar@anderson.ucla.edu, Charles J. Corbett

Substantial changes are occurring in information-based service industries such as financial services, publishing, education and even retailing. We analyze

intermediation and competition in this environment with reference to examples from pure information services, banking and publishing. Modeling approaches for technology choice, service (information) design and pricing are described.

2) Queues in Which Servers Learn & Burn-Out, Noah Gans, Univ. of PA, Dept. of OPIM, The Wharton Sch., Philadelphia, PA 19104-6366, gans@opim.wharton.upenn.edu

Traditional queueing models assume that while processing times are random, the distribution of processing times remains the same from one service to the next. We investigate what happens when the processing time distribution depends on the server's previous experience.

3) Managing College Admissions: Hitting the Enrollment Target by Dynamic Control, Yi He, Univ. of Toronto, Fac. of Mgmt., 105 St. George St., Toronto, Ontario, M5S 3E6, Canada, yihe@fmgmt.mgmt.utoronto.ca, **Oded Berman, Dmitry Krass**

We consider the problem of managing admissions to a college program. There is an enrollment target with penalties for positive and negative deviations. In each period, a decision must be made of how many new offers to issue. We develop structural results and an efficient algorithm for the problem.

4) Creating High-Performance Financial Institutions, Frances X. Frei, Univ. of Rochester, Simon Sch. of Bus., 3-345 Carol Simon Hall, Rochester, NY 14627, frei@mail.ssb.rochester.edu, **Patrick T. Harker**

We summarize the Wharton/Sloan banking study, with particular emphasis on the use of DEA and other methodologies to ascertain the drivers of cost, profit and quality efficiency in the industry. A brief discussion of future financial services-related applications areas will also be discussed.

MA03 Flight Planning

Sponsor: Aviation Applications Section

Sponsored Session

Chair: Cindy Peters, SABRE Decision Tech., 1 E Kirkwood Blvd., MD TSG 7385, Southlake, TX 76092, cindy_peters@sdt.com

1) Efficient Decomposition of Large-Scale Integrated Planning Models, Timothy L. Jacobs, The SABRE Group, Inc., 1 E Kirkwood Blvd., Southlake, TX 76092, **Barry C. Smith, Ellis L. Johnson**

Many integrated planning problems can be posed as large-scale multicommodity flow problems in which the links have limited capacities. Industrial examples include the efficient operation of communication systems, transshipment problems and airline networks. Many of these can be broken into manageable subproblems using standard decomposition methods. We present an application of Bender's decomposition for efficiently solving large-scale nonlinear multicommodity flow problems...

2) Non-Stationary Queueing Models for Estimating Take-Off Delays at an Airport, B. Venkatesh Rao, SABRE Tech. Solutions, 1 E Kirkwood Blvd., MD 7390, Southlake, TX 76092

Airline schedule development process involves preparing and modifying many drafts before a final version is released. We are concerned about estimating take-off and landing queueing delays at an airport for a schedule draft. Delay estimates are useful in assessing changes in block-times when schedule structure changes and can be used to identify the schedule drafts which decrease the queueing delays of aircraft during take-off and landing.

MA04 Defense Enterprise Planning & Management

Sponsor: Military Applications Society

Sponsored Session

Chair: Lynne M. Sullivan, DISA (D2), Skyline #5, Ste. 9127, Falls Church, VA 22041-3205, sulliv11@ncr.disa.mil

1) Defense Enterprise Planning & Management, Lynne M. Sullivan, DISA (D2), Skyline #5, Ste. 9127, Falls Church, VA 22041-3205, sulliv11@ncr.disa.mil

We provide an overview of DEPM. DEPM provides a management structure for process management within public sector organizations. DEPM includes strategic planning, performance measurement, management by processes and process-aligned information systems.

2) Strategic Planning & Performance Measurement for the DoD, Larry Kelly, CALIBRE Systems, Inc., 5111 Leesburg Pike, Ste. 514, Falls Church, VA 22041, lkelly@calibresys.com, **David L. Olson**

We demonstrate how DoD planning objectives were aligned and linked with DoD cross-functions. We also demonstrate how performance measures were defined for each link. This linking is necessary for compliance with the GPRA of 1993.

3) Cross-Functional Process Alignment, Thomas R. Gullede, Jr., George Mason Univer., Inst. of Public Policy, MS 2E4, Fairfax, VA 22030-4444, gullede@gmu.edu, **Rainer Sommer**

We demonstrate the modeling methodology that was used to document DoD cross-functional processes. We present several organizational views, including a function view that models the performance measurement links and a control view that models the cross-functional extended event-driven process chain. This presentation uses a modern automated IS planning methodology.

MA05 Predicted vs. Experienced Utility

Sponsor: Decision Analysis Society

Sponsored Session

Chair: David Schkade, Univ. of TX, Dept. of Mgmt., CBA 4.202, Austin, TX 78712, schkade@mail.utexas.edu

1) Errors in Predicting Future Tastes & Feelings, David Schkade, Univ. of TX, Dept. of Mgmt., CBA 4.202, Austin, TX 78712, schkade@mail.utexas.edu

All decisions involve predictions of future tastes or feelings. The accuracy of these predictions is essential to good decision making. Recent research suggests that these predictions are often inaccurate or biased, because the factors that determine how an experience feels are different than those that determine the prediction.

2) Combining Experiences Over Time: Effects of Duration, Intensity Changes & Online Measurements on Retrospective Evaluations of Pain, Dan Ariely, Duke Univ., Fuqua Sch. of Bus., Durham, NC 27708-0120, ariely@mail.duke.edu, **Gal Zauberman**

Overall evaluations are abstracted from on-going experience and play an important role in future decisions. We look at the rules by which the on-going experiences combine to give an overall evaluation. This is done in the context of sounds, pain and the stock market.

3) Predicted vs. Experienced Utility: Implications for Decision Analysis, Robert Clemen, Duke Univ., Fuqua Sch. of Bus., Durham, NC 27708-0120, clemen@mail.duke.edu

The distinction between predicted and experienced utility has important implications for DA, especially for how we think about and test the effectiveness of prescriptive procedures. We address fundamental, empirical and practical issues that stem from the predicted/experienced utility distinction.

MA06 Integrating Consulting & Teaching for OR Faculty: How & Why

Sponsor: Forum on Education

Sponsored Session

Chair: Ronald H. Wright, Le Moyne Coll., Dept. of Bus. Admin., Syracuse, NY 13214-1399, wright@palm.lemoyne.edu

Co-Chair: Salwa H. Ammar

1) Using Real World Experiences to Jump Start Your Research & Teaching, Steven A. Melnyk, MI State Univ., Dept. Mktg. & Supply Chain Mgt, 1183 Teakwood Cir., Haslett, MI 48840

Traditionally, OM research has centered on a thorough knowledge of the current literature. This approach, while effective, leads to incremental improvements. We examine another approach to identify new and interesting research areas by working with firms, either in class projects, joint studies or consulting.

2) Faculty Consulting in Rapidly Changing Engineering Technologies, Sencer Yeralan, Univ. of FL, Dept. of ISE, 303 Weil Hall, Gainesville, FL 32611

In the presence of rapid technological advances, faculty consulting may be the primary means of engineering faculty to remain effective in teaching and research. Based on personal experiences in the computer industries, we discuss cases where consulting work helped research, especially in systems modeling and in the formulation of objectives.

3) Consulting for Academic Causes

Consulting is neither a deviant nor an opportunistic engagement for an academic. Consulting motivates, exhilarates and reinforces the academic spirit. It becomes a strategic alliance between university and industry. An alliance that contributes to generation, implementation and dissemination of knowledge through research, publishing and teaching.

4) The Interactions Between Academic Teaching & Faculty Consulting, Ronald H. Wright, Le Moyne Coll., Dept. of Bus. Admin., Syracuse, NY 13214-1399, wright@palm.lemoyne.edu, **Salwa H. Ammar**

We will provide arguments aimed at dispelling the myth that consulting and classroom teaching are competing and conflicting functions. We will provide evidence, based on our experience, of the direct benefits of consulting in the classroom. We will also argue that teaching skills are necessary for success in consulting.

MA07 Production & Inventory Planning

Sponsor: MSOM

Sponsored Session

Chair: Rachel Q. Zhang, Univ. of MI, 1205 Beal Ave., Dept. of IOE, Ann Arbor, MI 48109-2117, rzhang@engin.umich.edu

1) **Strategic Semiconductor Capacity Planning**, *Sergio Chayet*, Northwestern Univ., Dept. of IE/MS, Evanston, IL 60208, sergio@dual.iems.nwu.edu, *Wallace J. Hopp*

Designing a new wafer fab involves both sizing the facility and selecting the equipment under conditions of substantial demand and technological uncertainty. We develop a sequential optimization model for supporting this decision process and use it to gain insight into the key decision variables and tradeoffs.

2) **Rationing Policies for Multiple-Priority Customers**, *Roman Kapuscinski*, Univ. of MI, Bus. School, Ann Arbor, MI 48109, roman.kapuscinski@cmail.bus.umich.edu

Consider a capacitated production-inventory system with multiple customer priorities. For the single-product case with general distribution of demand, the structure of the optimal policy is shown in both finite and infinite horizon cases. Properties of the optimal policy for multiple products are derived. Computational results illustrate sensitivity of the optimal policy.

3) **Multi-Product Kanban Systems**, *John A. Buzacott*, York University, Schulich Sch. of Bus., North York, Ontario, M3J 1P3, Canada, jbzacot@bus.yorku.ca, *Bruno Baynat*, *Yves P. Dallery*

A number of products share common facilities with production release controlled using kanbans. However, kanban control can be implemented in different ways, depending on the emphasis placed on controlling total inventory vs. product specific inventory. Using stochastic models, we illustrate the difference between these approaches.

4) **Optimal Inventory Policies for Systems with Two Demand Sources**, *Rachel Q. Zhang*, Univ. of MI, 1205 Beal Ave., Dept. of IOE, Ann Arbor, MI 48109-2117, rzhang@engin.umich.edu, *Matthew J. Sobel*

We consider a periodic review inventory system with demand arriving simultaneously from a deterministic source and a random source. The deterministic demand has to be satisfied immediately while the random demand is filled only if there is stock available to do so. We prove that a modified (s,S) policy is optimal under general conditions.

MA08 Strategic Considerations in Supply Chain Management & Product-Process Related Choices

Sponsor: MSOM

Sponsored Session

Chair: Kyle D. Chen, Stanford Univ., 2250 Latham St., Apt. 10, Mountain View, CA 94040, kyle.chen@stanford.edu

1) **Strategy of Cost Allocations for Internal Commerce in Manufacturing Organizations: An Operations Management Perspective**, *Kyle D. Chen*, Stanford Univ., 2250 Latham St., Apt. 10, Mountain View, CA 94040, kyle.chen@stanford.edu, *Ram Akella*

We consider a decentralized organization structure and formulate a cost allocation model for internal commerce. Using multi-echelon inventory models, we describe the network of organizational entities as an internal supply chain. We analyze the interactions of these entities using both a cost center approach and a profit center approach.

2) **Practical Issues & Pragmatic Approaches for Internal Commerce in Supply Chain Management**, *Marius Holtan*, Stanford Univ., EES & OR Dept., Stanford, CA 94305, marius@leland.stanford.edu, *Kyle D. Chen*, *Giri Giridharan*, *Ram Akella*

We consider actual practices of cost allocation in a multi-billion dollar industry. We approach aligning goals of sub-divisions and different functional areas and consider the adequacy or inadequacy of simple coordination rules such as transfer pricing.

3) **Make vs. Buy Decisions Incorporating Delivery, Quality & Opportunity Costs of Technology Loss**, *Marius Holtan*, Stanford

Univ., EES & OR Dept., Stanford, CA 94305, marius@leland.stanford.edu, *Kyle D. Chen*, *Giri Giridharan*, *Ram Akella*

A high technology company continuously develops new and improved products. It continuously has to decide whether to outsource production of components in its new products or make the components in-house. Apart from a cost perspective, these decisions impact the company's competitive edge and the development of key manufacturing skills as well as the space of future technological opportunities. We consider these strategic trade-offs in making make vs. buy decisions that incorporate quality and supplier reliability costs.

4) **Strategic Pruning of Products & Processes in Supply Chain Management**, *Marius Holtan*, Stanford Univ., EES & OR Dept., Stanford, CA 94305, marius@leland.stanford.edu, *Ram Akella*

As new generations of semiconductor equipment are developed, semiconductor manufacturers continuously develop new products and production processes. In a limited capacity environment with excess demand, keeping the system ready for possible future demand of high profit products may be better than clogging up the system with certain low profit products. We present a model of the production and pruning process, together with outsourcing, for effective supply chain management in a semiconductor company.

MA09 Modeling & Analysis of Semiconductor Manufacturing I

Cluster: OR Applications in Semiconductor Manufacturing

Invited Session

Chair: Sean McNunn, Dallas Semiconductor, 4401 S Beltwood Parkway, Dallas, TX, sean.mcunn@dalsemi.com

1) **Semiconductor Metric Goals & Fab Improvements: The Danger of Inappropriate Measurement Tools**, *Linda Sattler*, Texas Instruments, 4505 Normandy #3, Dallas, TX 75205

When employees are measured and rewarded on certain goals, an inappropriate measurement tool can cause demotivation and costly compromises. This talk outlines some of the current problems with the standard metrics used in semiconductor fabs (throughput, yield, etc.) and describes a queueing curve approach that is being used at Texas Instruments for more appropriate goal setting.

2) **Alternative Methods for Shop Floor Control in Wafer Fabrication**, *Dick Hildenbrand*, Texas Instruments, Inc., 13353 Floyd Rd., Dallas, TX 75248

Discussion includes high-level architecture of a state-of-the-art CIM system under development that embeds IE- and OR-based methods to maximize throughput while minimizing cycle time. Specific topics highlighted are a CPM-based scheduling methodology and a rules hierarchy to select heuristically the best lot for a machine or vice-versa. If time permits, WIP management (an advanced form of a Kanban system) and throughput management sub-systems may be covered.

3) **Comparison of Static & Dynamic Modeling of Semiconductor Manufacturing**, *Duy Nguyen*, Dallas Semiconductor, 4401 S Beltwood Parkway, Dallas, TX, duy.nguyen@misnts1.dalsemi.com, *Derek Rutherford*

Capacity modeling is done typically in semiconductor manufacturing 1 of 2 ways. The 1st is using a static model such as a spreadsheet. Second is a dynamic model such as simulation. A comparison of these 2 modeling techniques shows how they complement and contrast each other.

4) **Using a Relational Database to Integrate Simulation Data**, *Adam Warner*, Dallas Semiconductor, Inc., 4401 S Beltwood Parkway, Dallas, TX, adam.warner@dalsemi.com

Generally, the most difficult task in developing an ongoing simulation model of a complex manufacturing environment is collecting and refreshing the data. A relational database can be used to automate the gap between the manufacturing data sources and the input files needed for the simulation model, greatly easing model maintainability.

MA10 Dynamic Traffic Assignment I: Network Stochasticity

Sponsor: Transportation Science Section

Sponsored Session

Chair: Hani S. Mahmassani, Univ. of TX, Dept. of Civil Eng., ECJ 6.204, Austin, TX 78712, masmah@mail.texas.edu

1) **A Priori Least Expected Time Paths in Stochastic, Time-Varying Networks**, *Elise D. Miller-Hooks*, Univ. of TX, Dept. of Civil Eng., ECJ 6.2, Austin, TX 78758, leeroy@uts.cc.utexas.edu, *Hani S. Mahmassani*

Travel times in congested transportation networks are time-varying and

uncertain quantities. Two procedures are presented: the first determines the a priori least expected time paths in stochastic, time-varying networks; the second determines a lower bound on the expected time of these paths and illustrates the trade-offs between information and computational complexity.

2) **The Optimal Dynamic Network Toll Problem**, *Terry L. Friesz*, George Mason Univ., Systems Eng. Dept., 4400 University Dr., Fairfax, VA 22030-4444, tfriesz@gmu.edu

We show how appropriate disequilibrium dynamics can be employed to formulate the problem of setting optimal dynamic network tolls which are asymptotically stable and consistent with classic static user equilibrium. We discuss the qualitative properties of this optimal control problem and suggest numerical solution techniques.

3) **Performance Robustness of an a Priori DTA Solution Methodology Under Stochastic On-Line O-D Demands**, *Srinivas Peeta*, Purdue Univ., Sch. of Civil Eng., W Lafayette, IN 47907-1284, *Chao Zhou*

Simulation experiments are conducted to investigate the robustness of an a priori optimization-based solution methodology for the on-line stochastic DTA problem in which the time-dependent OD demands are assumed to be random variables with known distributions. Results indicate that the a priori solution is more robust than the traditional mean OD matrix-based solution. Robustness under incidents and incorrectly assumed distributions is investigated.

MA11 Fleet Management & Routing

Sponsor: Transportation Science Section

Sponsored Session

Chair: Jacques Renaud, Univ. du Quebec, Ctre. SORCIER, 2600 Blvd. Laurier, CP 10700, Sainte-Foy, Quebec, GIV 4V9, Canada, jrenaud@teluq.quebec.ca

1) **Solving Real-World Routing Problems by Using GIS & Optimization Techniques**, *Don Weigel*, ESRI Inc., Dept. 4200, 380 New York St., Redlands, CA 92373, dweigel@esri.com, *Buyang Cao*

We discuss how to combine GIS and state-of-the-art optimization techniques to solve large-scale routing problems representing home delivery and technical dispatch problems effectively. We describe the development of applications systems incorporating GIS and optimization techniques. Results obtained by real deployed systems are presented which indicate the synergism between GIS and OR.

2) **A Sweep-Based Algorithm for the Vehicle Fleet Mix Problem**, *Jacques Renaud*, Univ. du Quebec, Ctre. SORCIER, 2600 Blvd. Laurier, CP 10700, Sainte-Foy, Quebec, GIV 4V9, Canada, jrenaud@teluq.quebec.ca, *Fayez F. Boctor*

We consider the fleet size and composition problem. First we show how to adapt the improved petal heuristic to solve this problem then evaluate the performance of the resulting heuristic. For this evaluation, we use a set of benchmark problems. Results show that the proposed heuristic produces good solutions - sometimes even better solutions than those produced by a TS heuristic proposed earlier by other researchers.

3) **A Paradigm for Benchmarking Lean Operations in the US Airline Industry**, *Dennis F. X. Mathaisel*, Babson Coll., Babson Hall, Dept. of Math., Babson Park, MA 02157, dfxm@mit.edu, *Clare L. Comm*

US airlines are implementing lean principles and practices in their flight operations and maintenance centers. The goals of these practices are to reduce costs, improve quality and better respond to customer needs. We develop a model for benchmarking an industry's lean practices.

MA12 Management of Supply Chains

Cluster: Supply Chain Operations

Invited Session

Chair: Ricardo Ernst, Georgetown Univ., Sch. of Bus., 37th & O St. NW, G-4 Old North, Washington, DC 20057, ernstr@gunet.georgetown.edu

1) **A Survey of New Results on the Bullwhip Effect**, *Frank Chen*, Northwestern Univ., Dept. of IE/MS, 2225 N Campus Dr., Evanston, IL 60208, *Jennifer K. Ryan*, *David Simchi-Levi*

The increase in demand variability as one moves up a supply chain, a phenomenon popularly known as the bullwhip effect, has been observed across a wide range of industries. We review recent results which quantify this effect. We demonstrate the impact of different forecasting techniques, lead time and information on the bullwhip effect.

2) **Sales vs. Demand: How Does it Affect Your Supply Chain Decisions?**, *Manuel Baganha*, Univ. Nova de Lisboa, Dept. Gestao,

Marques de Fronteira 20, Lisboa, 1000, Portugal, mcb@feunl.fe.unl.pt, *Ricardo Ernst*

Through IT many companies have on-line access to point of sale data. Point of sale data captures sales information not demand. In fact, sales information can be misleading because it misrepresents actual demand, lost sales and substitution demand information. Most inventory models require demand information. We address the issue and quantify the impact of using sales instead of demand information.

3) **Addressing Product Line Design Issues via Inventory Models with Substitution Effects**, *Ricardo Ernst*, Georgetown Univ., Sch. of Bus., 37th & O St. NW, G-4 Old North, Washington, DC 20057, ernstr@gunet.georgetown.edu, *Panos Kouvelis*

Product line design involves the selection of product models to be offered to various market segments by a firm. We suggest the creative use of inventory models with substitution effects explicitly accounted as a way to structure relevant issues for the product line design problem. Sensitivity analysis of the model provides interesting insights for the problem.

4) **Process Innovation, Product Differentiation & Channel Structure**, *Sudheer Gupta*, McGill Univ., 1001 Sherbrook St. W, Montreal, Quebec, H3A 1G5, Canada, gupta@management.mcgill.ca, *Richard J. Loulou*

We study design of distribution channel structure in competitive markets where manufacturers produce differentiated products and invest in cost reducing process innovation. Conditions on various equilibria are derived and results indicate a strategic incentive for the manufacturers in keeping their production and distribution costs high.

MA13 Dew Product Development Process Perspectives

Cluster: New Product Development

Invited Session

Chair: Steven Eppinger, MIT, Sloan Sch. of Mgmt., E53-347, Cambridge, MA 02139, eppinger@mit.edu

1) **Managing Experimentation & Learning in the Design of New Products & Processes**, *Stefan Thomke*, Harvard Business Sch., Soldiers Field, Morgan Hall T63, Boston, MA 02163, sthomke@hbs.edu

Experimentation is a fundamental innovation activity and accounts for a significant part of total innovation cost and time. I will show that a given experiment can be conducted in different "modes" (e.g. computer simulation and rapid prototyping) and that users find it economical to switch between these modes to reduce total design cost and time.

2) **The Role of Structured Flexibility in New Product Development**, *Viswanathan Krishnan*, Univ. of TX, Coll. of Bus. Admin., CBA 4.202, Austin, TX 78712, krishnan@mail.utexas.edu

Highly dynamic environments in many industries require that development processes be flexible, which makes the development project hard to manage. A new approach is presented that combines the benefits of structure and flexibility in a product development process. Structured flexibility is illustrated with a model and industrial examples.

3) **Information Queues in Managing Product Development Project Coordination**, *David N. Ford*, Univ. of Bergen, Dept. of Info. Science, Bergen, N-5020, Norway, david.ford@ifi.uib.no

Development concurrence and product complexity increase the need for effective coordination of product development projects. Traditional approaches use project performance information such as expected cycle time to manage coordination. A dynamic simulation model is used to investigate using project integration as well as performance to manage project coordination.

4) **An Empirical Study of Integration Mechanisms in Dispersed Product Development Teams**, *Steven Eppinger*, MIT, Sloan Sch. of Mgmt., E53-347, Cambridge, MA 02139, eppinger@mit.edu, *Manuel E. Sosa*

Interaction and collaboration among members of geographically dispersed product development teams is an important problem in current organizations. We investigate the effectiveness of available integration mechanisms in various development situations. Our methodology determines the integration needs of a project and maps these to the capabilities of the available tools.

MA14 Estimating Implied Probability Distributions from Option Prices

Sponsor: Financial Services Section

Sponsored Session

Chair: Stewart Mayhew, Purdue Univ., Krannert Sch. of Mgmt., 1310 Krannert Bldg., West Lafayette, IN 47907-1310, mayhew@mgmt.purdue.edu

1) Implied Volatility Functions: Empirical Tests, Bernard Dumas, Duke Univ., Fuqua Sch. of Bus., 134 Towerview Dr., Durham, NC 27708, **Jeff Fleming, Robert E. Whaley**

We examine the out-of-sample performance of the valuation methodology proposed by Derman & Kans (1994) and Rubinstein (1994). Their methods fit an implied deterministic volatility function using traded option prices. We evaluate the reliability of this approach by examining its predictive and hedging performance using S&P 500 options.

2) Constructing Binomial Trees From Multiple Probability Distributions, Gregory Brown, Univ. of Texas, Coll. of Bus. Admin., Austin, TX 78712, trout@utxsvs.cc.utexas.edu, **Klaus B. Toft**

We use options with all available expiration dates to identify a binomial asset price process. Unlike Dehman & Kani (1994), we do not assume that option prices with all possible expiration dates exist. Instead, we solve the problem by imposing economic restrictions similar in nature to those of Rubinstein (1994).

3) Pricing S & P 500 Index Options Using a Hilbert Space Basis, Peter Abken, Federal Reserve Bank of Atlanta, 104 Marietta St. NW, Atlanta, GA 30303, peter.abken@atl.frb.org, **Dilip B. Madan, Sailesh Rammamurti**

We extend the approach of Madan & Milne (1994) for pricing contingent claims as elements of a separable Hilbert space. We develop restrictions on the prices of Hermite polynomial risks that allow all option maturity classes to be used in estimation.

MA15 Multicriteria Decision Making Involving Risk & Uncertainty

Cluster: Technology Management
Invited Session

Chair: Margaret F. Shipley, Univ. of Houston, Coll. of Bus., 1 Main St., Houston, TX 77002, shipley@dt.uh.edu

1) A Cross-Cultural Comparison of Decision Making Styles, Michael K. Badawy, VA Tech., Pamplin Coll. of Bus., 7054 Haycock Rd., Falls Church, VA 22043

We explore decision-making styles in an international context. Based on empirical data it provides a cross-cultural comparison of managerial styles, focusing on the US, Europe and Japan. Implications for MOT are discussed.

2) Deciding Which IT or RD Projects to Fund, Jeffrey L. Ringuet, Boston Coll., Op. & Strategic Mgmt. Dept., Fulton Hall, 140 Comm. Ave., Chestnut Hill, MA 02167, jeffrey.ringuet@bc.edu, **Stephen C. Graves, Charles E. Downing**

The problem of choosing which IT or R&D project to fund is complicated. We present a decision methodology that is based on Monte Carlo simulation and random sampling. Our preliminary results suggest that this solution procedure works well and allows for more general modeling of the problem.

3) Multicriteria Analysis of Product Development Decisions, John F. Hebert, Univ. of Akron, Dept. of Mgmt., Akron, OH 44325-4801, jhebert@uakron.edu, **Richard F. Deckro**

We explore the tradeoffs confronting product developers as they attempt to maximize market share by: 1) shortening the product development cycle (getting their product to market more quickly) and 2) increasing product quality (which usually implies being more deliberate during the product development cycle).

4) A Fuzzy Database Approach for Structuring a Diverse Team to Meet Multiple Goals, Margaret F. Shipley, Univ. of Houston, Coll. of Bus., 1 Main St., Houston, TX 77002, shipley@dt.uh.edu, **Andre de Korvin, Forrest F. Aven**

A fuzzy database methodology is presented that allows the decision maker to select persons with diverse characteristics in order to accomplish working relationship goals. These goals include commitment to the team, style of decision making and satisfaction. The diversity characteristics include gender, race/ethnicity and age.

MA16 Strategy & Technology

Sponsor: College on Organization Science
Sponsored Session

Chair: Raghu Garud, NYU, Stern Sch. of Bus., Tisch Hall, Mgmt. Dept., 40 W 4th St., New York, NY 10012, rgarud@stern.nyu.edu

1) Developing Technology as a Strategic Competence, Deborah J. Dougherty, McGill Univ., Fac. of Mgmt., 1001 Sherbrooke St. W,

Montreal, Quebec, H3A 1G5, Canada, doughert@management.mcgill.ca

We find that innovative organizations treat technology as competencies, while others treat technology as commodities or components. These strategic roles arise from relationships between technology and product developments, opportunity assessments and firm identity. We outline these relationships and how they can change to make technology a strategic competence.

2) Keeping Pace with Technology: An Ecology of Innovation, Michael W. Lawless, Duke Univ., Fuqua Sch. of Bus., Durham, NC 27708-0120, lawless@mail.duke.edu

I propose that new technology is presented to a market through historical vertical-market relationships that influence rivals' adoption patterns. Additionally, interdependence among rivals affects their technology-pacing and entry-order strategies for innovations. Propositions for conduct and performance are evaluated in the context of the US microcomputer market.

3) Competing on the Internet: How Few Exemplar Firms are Rewriting the Rules of Competition, Suresh B. Kotha, Univ. of WA, Sch. of Bus. Admin., Box 353200, Seattle, WA 98195, skotha@u.washington.edu, **Anil Nair**

Several technological innovations have made the Internet a viable setting for business transactions. A proliferation of firms has sought opportunities offered by the emergent medium. Research identifying successful business models to compete on the Internet is yet to emerge. We use a case study approach to identify how some exemplar firms are succeeding in this technology-driven medium.

4) Linking Mechanisms & Transient Advantages in Network Industries, Raghu Garud, NYU, Stern Sch. of Bus., Tisch Hall, Mgmt. Dept., 40 W 4th St., New York, NY 10012, rgarud@stern.nyu.edu, **Sanjay Jain, Corey Phelps**

Linking mechanisms are ways by which firms in network industries connect with each other to create technological systems. These ties result in the sharing of proprietary knowledge. Under these conditions, firms innovate continually to create transient advantages. We explicate these notions by examining strategic interactions in the Web browser market.

MA17 Use of Expectations in Analysis of Quality of Care Data

Sponsor: Health Applications Section
Sponsored Session

Chair: Farrokh Alemi, Cleveland State Univ., Health Admin. Program, 2121 Euclid, Rm. 352, Cleveland, OH 44115, f.alemi@popmail.csuohio.edu

1) Risk Adjusted Control Charts: A Tutorial, Walter O. Rom, Cleveland State Univ., Dept. of Op. Mgmt., 2121 Euclid, Cleveland, OH 44115, ro239@vmcms.csuohio.edu, **Farrokh Alemi**

Control charts are important tools for TQM and continuous improvement. In health care, in contrast to some manufacturing situations, the input to processes has wide variation. The most significant input to health care processes is the patients, condition and admission. There is wide variation among the severity of illness of patients on admission; therefore, traditional assumptions of control charts are not met...

2) Using Gap Analysis to Assess Patient Satisfaction & to Improve Perceived Quality of Care: A Tutorial, Thomas Whipple, Cleveland State Univ., Dept. of Mktg., Cleveland, OH 44115, t.whipple@popmail.csuohio.edu

Measuring service quality of health services is demonstrated by utilizing the disconfirmation paradigm. It maintains that satisfaction is related to the size and direction of the disconfirmation experience and that disconfirmation is related to the patient's initial expectations (formed from past experience), word-of-mouth and advertising. Service quality evaluations result from a comparison of patient expectations with actual service performance...

3) Quality Transformation with In-House & Contracted Employees: Cultural Expectations, Mary Hrivnak, Cleveland State Univ., Mgmt. & Labor Dept., Cleveland, OH 44115, m.hrivnak@csuohio.edu, **Debra Griest**

Regular and contracted employees bring different expectations to work that affect the use of TQM. Presenters rely on their work with NASA to report on the cultural differences among these 2 sets of employees and the impact of these differences on the success of TQM.

MA18 DEA Applications in Health Care

Cluster: DEA & Productivity
Invited Session

Chair: Vivian Valdmanis, Univ. of OK, Dept. Health Admin. & Policy, Oklahoma City, OK 73190, vvaldman@rex.re.uokhsc.edu

1) Profit, Productivity & Quality: A Directional Distance Function Approach, R. Fare, Southern IL Univ., Dept. of Economics, Carbondale, IL 62901

Efforts to link Shephard distance functions and efficiency to productivity have proved to be surprisingly difficult, due to the fact that there is no natural duality between the Shephard input and output distance function and profit function. We show that a generalization of the Shephard type distance functions, the directional distance function, is dual to the profit function. This allows us to derive a measure of profit efficiency...

2) Causes of Output-Based Inefficiency in Hospitals, G. Ferrier, Univ. of AR, Dept. of Economics, 402 BADM, Fayetteville, AR 72701-1201, Vivian Valdmanis

In an earlier work we analyzed input based efficiency and assessed which correlates were significant in defining deviations from efficient practice. In this work we analyze output-based efficiency DEA model in order to assess how hospitals are optimizing the levels of outputs given inputs. This is relevant given the rapidly changing market in hospital services, particularly managed care and reforms in Medicare and Medicaid interested in cost-control...

3) Comparing Teaching & Non-Teaching Hospitals, S. Grosskopf, Southern IL Univ., Dept. of Economics, Carbondale, IL 62901-4515, Vivian Valdmanis

Our past works have included analyzing teaching hospitals among themselves and comparing frontiers of teaching and non-teaching hospitals. We synthesize our findings and present new results on the differences between these hospital types. We use the input based DEA model as well as distance approach in order to determine congestion, relative efficiency between teaching and non-teaching hospital frontiers...

MA19 TUTORIAL: Electronic Commerce

Cluster: Electronic Commerce

Invited Session

Chair: Andrew B. Whinston, Univ. of TX, MSIS Dept., Coll. of Bus. Admin., Austin, TX 78712-1175, abw@uts.cc.utexas.edu

1) TUTORIAL: Electronic Commerce, Andrew B. Whinston, Univ. of TX, MSIS Dept., Coll. of Bus. Admin., Austin, TX 78712-1175, abw@uts.cc.utexas.edu

The emergence of electronic commerce as an active commercial area has opened up many new research challenges. We outline some of the topics and suggest approaches to their solution. Successful solution will draw upon the fields of computer science for technology and economics to describe the business value. Some examples are in real-time network management, competitive analysis of electronic based companies and real-time demand estimation for digital products...

MA20 Research Directions in Accounting Information Systems

Sponsor: College on Information Systems

Sponsored Session

Chair: Robert A. Nehmer, Berry College, Campbell Sch. of Bus., PO Box 5024, Mt. Berry, GA 30149-5024, mehmer@berry.edu

1) Social Constructs & AIS Research, Jesse Dillard, Univ. of NM, Anderson Sch. of Mgmt., 1924 Las Lomas, Albuquerque, NM 87131, dillard@unm.edu

The application of sociology in AIS research is needed in order to better understand AISs in action. Four organizational sociology research paradigms are discussed: functionalism, interpretism, anti and non. The AIS research using the alternative paradigms is reviewed. The AIS field must broaden its perspective of what constitutes legitimate research and encourage the application of alternative paradigms.

2) Misleading Graphs: Effects on Decision Making, Vairam Arunachalam, Univ. of MO, Sch. of Accountancy, 319 Middlebush Hall, Columbia, MO 65211, acctva@showme.missouri.edu

Graphs are widely used in annual reports to supplement financial information presented in tabular format. Research has shown that annual reports contain graphs that are misleading in the sense that they portray a magnitude of changes in the graphs either over or understating the numerical magnitude of change in the underlying variables. Little is known about the effects of such misleading graphics on decision making...

3) Logical Modeling of Embedded Audit Functions, Robert A.

Nehmer, Berry College, Campbell Sch. of Bus., PO Box 5024, Mt. Berry, GA 30149-5024, mehmer@berry.edu

Logical models of accounting systems have appeared infrequently in the literature, yet their descriptive and predictive power is quite formidable. We present the initial results of adding a practical functionality and embedded audit routines to logical models of accounting systems. This extends the use of such models to auditing practice.

MA21 Theoretical Foundations of MMT V

Cluster: Management of Medical Technology

Invited Session

Chair: Rias J. van Wyk, Univ. of Cape Town, Grad. Sch. of Bus., rias.j.van-wyk-1@tc.umn.edu

1) Medical Technology: A Macro Map, Rias J. van Wyk, Univ. of Cape Town, Grad. Sch. of Bus., rias.j.van-wyk-1@tc.umn.edu

We offer a conceptual contribution to the theory of MMT and propose a classification of medical technologies based on 4 main categories: prostheses, procedures, products and processes. These 4 Ps are broken down further. The macro map helps analysts to explore long-term trends in landscape of medical technology.

2) Constraint-Driven Management of Medical Technology in Developing Countries, Mladen Poluta, Groote Schuur Hospital - UTC Medical School, Dept. of Biomedical Eng., Observatory 7925, South Africa

A new approach to MMT in developing countries is proposed. This holistic, systems-based method addresses the political, economic, technological and socio-cultural realities of many developing countries, with a focus on the particular constraints of the sub-Saharan region in Africa.

3) Information Technology as a Vehicle for Change in How Medicine is Practiced, Bryan Bergeron, Massachusetts General Hosp., Med. Info. Lab., Fruit St., Dept. Anesthesia/Critical Care, Boston, MA 02114, bergeron@hstbme.mit.edu

Medicine is under extreme pressure to evolve from a relatively closed practice to a system based on metrics that are repeatable and open to inspection. IT takes a central role in this evolution, simultaneously empowering clinicians and making them more accountable to the public, the government and their patients.

MA23 Logistics & Supply Chain Management V

Contributed Session

Chair: Awi Federgrun, Columbia Univ., Grad. Sch. of Bus., 419 Uris Hall, New York, NY 10027, afedergr@research.gsb.columbia.edu

1) Time & Quantity Policy for Consolidated Shipments, Sila Cetinkaya, TX A&M Univ., IE Dept., College Station, TX 77843-3131, sila@watmims.uwaterloo.ca, James H. Bookbinder

In a time and quantity policy, goods must be dispatched by time T but may be dispatched sooner if a sufficiently large load Q is available. Renewal theory is employed to compute the optimal (T,Q) pair under conditions realistic for transportation by truck.

2) Multi-Location Combined Pricing & Inventory Control Models, Aliza Heching, Columbia Univ., 419 Uris Hall, GSB, 116th & Broadway, New York, NY 10027, ars9@columbia.edu, Awi Federgrun

We address the simultaneous determination of pricing and inventory strategies for a multi-retailer system under coordinated replenishments with leadtimes. We develop analytical approximations and close-to-optimal strategies of simple structure, both for finite and infinite horizon models.

3) A Neuro-Dynamic Programming Approach to Retailer Inventory Management, Benjamin Van Roy, MIT/Unica Tech., 77 Massachusetts Ave., Rm. 35-307, Cambridge, MA 02139, bvr@mit.edu, Dimitri P. Bertsekas, Yuchun Lee, John N. Tsitsiklis

We present a model of 2-echelon retailer inventory systems and cast the problem of generating optimal control strategies into the framework of DP. We formulate 2 specific case studies, for which the underlying DP problems involve 33 and 46 state variables, respectively. To address these complex problems, we apply approximate DP algorithms...

4) An Inventory Problem with Transportation Costs & Constraints, Katherine Pryor, Univ. of MI, 2175 Lakeview Dr., # 103, Ypsilanti, MI 48198, kpryor@engin.umich.edu, Chelsea C. White, III

Currently, many manufacturing companies want to capture interdependent components of the supply chain in a single mathematical model in order to find a "better" global solution. This research involves modeling the inventory and

transportation components together by modifying the traditional inventory problem to account for transportation costs and constraints.

MA24 Advertising & Promotions

Contributed Session

Chair: Ping Wang, James Madison Univ., Dept. of Info. & Dec. Sci., Harrisonburg, VA 22807, wangpx@jmu.edu

1) **A Synthesized Approach to Market Response Modeling**, *Ping Wang*, James Madison Univ., Dept. of Info. & Dec. Sci., Harrisonburg, VA 22807, wangpx@jmu.edu, *Momiao Xiong*

To profit from direct market promotions, it becomes more and more important that marketers effectively analyze their test mailing results and develop reliable market response models. Synthesized models are proposed to identify the characteristics of potential profitable buyers. These models draw strength from traditional regression-based response models and newly ANN models...

2) **Advertising Effect, Influence of Inflation & Competitive Advertising Strategies Under the Lanchester Model of Combat**, *Qinan Wang*, Nanyang Tech. Univ., Nanyang Bus. Sch., S3-B2A-36, Singapore, 639798, Singapore, aqnwang@ntuvas.ntu.ac.sg

We present an empirical study of the advertising effect, the effect of inflation on the response model and the competitive advertising strategies under the Lanchester model of combat. It is shown that the advertising effect cannot be generally modeled by the square root function and current advertising expenditures fit the model better...

3) **Cointegration, Causality & Persistence: Some New Evidence Between Advertising & the Macro-Economy**, *Francisco Ferna Ramos*, Univ. of Porto, Fac. of Econ., Rua Dr. Roberto Frias, Asprela, 4200, Portugal, framos@fep.up.pt

I reinvestigate the relationship between advertising and various macroeconomic variables. The analysis is based on the recently developed cointegration and causality techniques. The results fail to show evidence of any relationship between advertising activity and the level of national income, disposable income and unemployment...

4) **Efficient Scheduling of On-Air Promotions on Network Television**, *Srinivas Bollapragada*, General Electric R&D Ctr., PO Box 8, Schenectady, NY 12301, bollapragada@crd.ge.com

Television networks use a fraction of their air time for scheduling promotions to increase the ratings (viewership) of their shows. Promotions of different lengths and types are scheduled to target various demographic groups depending on the contents of the shows. We present a math programming algorithm to efficiently schedule on-air promotions.

MA25 Reliability Modeling & Bayesian Analysis

Cluster: Statistics & Reliability

Invited Session

Chair: Refik Soyer, George Washington Univ., Dept. of MS, Monroe Hall 403, Washington, DC 20052, soyer@gwis2.circ.gwu.edu

1) **Bayesian Analysis for Competing Risk Models**, *Dongchu Sun*, Univ. of MO, 222 Math Sci. Bldg., Dept. of Stats., Columbia, MO 65211, dsun@stat.missouri.edu

A class of poly-Weibull or poly-lognormal distributions is introduced. This distribution typically arises when the data is the minimum of several Weibull or lognormal failure times from competing risks. Bayesian approach is proposed when the cause of a failure is unknown. Various simulation procedures using Markov chain Monte Carlo methods are presented.

2) **A General Bayesian Model for Accelerated Life Testing**, *Rene van Dorp*, George Washington Univ., Dept. of OR, Staughton Hall, 707 22nd St., Washington, DC 20052, doropjr@seas.gwu.edu, *Thomas Mazzuchi*

We present a flexible methodology for analyzing accelerated life testing data. The model handles continuous and interval data for a wide variety of testing scenarios including fixed stress, progressive and profile step stress and sequential testing. In addition, the model can combine information obtained from different scenarios.

3) **Reliability Applications of Maximum Entropy Dirichlet Procedure**, *Ehsan S. Soofi*, Univ. of WI, Sch. of Bus. Admin., PO Box 742, Milwaukee, WI 53201, esoofi@ccsd.uwm.edu, *Thomas Mazzuchi*, *Refik Soyer*

The MED generates prior and posterior distributions of an information index which are used for assessing suitability of a model for data. The MED procedure also produces prior and posterior distributions for the parameters of each model. We present the MED algorithm and demonstrate the procedure to

reliability applications.

4) **Bayesian Computations for Accelerated Life Tests**, *Refik Soyer*, George Washington Univ., Dept. of MS, Monroe Hall 403, Washington, DC 20052, soyer@gwis2.circ.gwu.edu, *Alaattin Erkanli*

We present a Bayesian approach for inference from accelerated life tests. Our approach is based on Markov chain Monte Carlo methods. We consider various forms of acceleration functions and illustrate how posterior and predictive analyses can be done efficiently using Markov chain Monte Carlo methods for various life models.

5) **A Bayesian Perspective on a General Age Replacement Policy**, *Ulku Gurler*, Bilkent Univ., Dept. of IE, Ankara, 06533, Turkey, ulku@bilkent.edu.tr, *Savas Dayanik*

MA26 Performance of Queuing Networks

Sponsor: Applied Probability Section

Sponsored Session

Chair: Shane Henderson, Univ. of MI, Dept. of IOE, 1205 Beal Ave., Ann Arbor, MI 48109-2117, shane.henderson@umich.edu

1) **Capacity Realization in Reentrant Lines**, *Sunil Kumar*, Stanford Univ., Grad. Sch. of Bus., Stanford, CA 94305, skumar@leland.stanford.edu, *Samuel C. Wood*

We study bottleneck utilization in realistic reentrant line models of semiconductor fabs operating under closed loop release policies. We present scenarios in which operating policies cause poor bottleneck utilization and discuss the relevant mechanisms. We also present an algorithm for identifying policies which cause poor bottleneck utilization.

2) **A Convergent Version of Value Iteration for the Synthesis of Optimal Scheduling Policies for Discrete-Stochastic Queuing Networks**, *Rong-Rong Chen*, Univ. of IL, Coordinated Science Lab., 1308 W Main St., Urbana, IL 61801, r-chen1@students.uiuc.edu, *Sean Meyn*

The synthesis problem is addressed for the average cost optimal control of multiclass queuing networks using value iteration. It is argued that a natural choice for the initial value function is the value function for an associated deterministic fluid control problem. We show that the algorithm is convergent in this case and numerical studies are presented to show that this choice may lead to fast convergence to an optimal policy.

3) **Perfect & Imperfect Simulation of the Stationary Measures of Markov Chains**, *Richard Tweedie*, CO State Univ., Dept. of Stats., 102A Statistics Bldg., Ft. Collins, CO 80523-1877, tweedie@stat.colostate.edu

We describe algorithms for simulating random samples from the invariant measures of stochastically ordered Markov chains. Vertical and horizontal backwards coupling algorithms are introduced; convergence properties of these algorithms and their approximations are discussed. Results are applied to study the limiting distribution of a storage model with finite capacity and a reentrant queuing network.

4) **Performance Evaluation of Non-Markovian Multi-Class Queuing Networks**, *Shane Henderson*, Univ. of MI, Dept. of IOE, 1205 Beal Ave., Ann Arbor, MI 48109-2117, shane.henderson@umich.edu

Mathematical programming methods have been developed to bound the performance of multiclass queuing networks when the inter-arrival and service time distributions are exponential. We demonstrate an extension of these methods to more general distributions. Bounds are established through a combination of simulation & LP.

MA27 Theory & Applications of Genetic Algorithms

Sponsor: College on Artificial Intelligence

Sponsored Session

Chair: Gary J. Koehler, Univ. of FL, Dept. of Dec. & Info Sci., BUS 351 Coll. of Bus. Admin., Gainesville, FL 32611, koehler@dale.cbalufl.edu

1) **System Identification & Curve Fitting with a Genetic Algorithm Hierarchy**, *Alice E. Smith*, Univ. of Pittsburgh, Dept. of IE, 1031 Benedum Hall, Pittsburgh, PA 15261, aesmith@engr.pitt.edu, *Mehmet Gulsen*

A hierarchical GA for systems identification and curve fitting problems is presented. Closed form functions are selected by the primary GA module, then coefficients are optimized by a subordinate GA module. The hierarchical approach is demonstrated on non-linear regression, time series and systems

identification problems from the literature.

2) Theory & Application of Genetic Algorithms, Siddhartha Bhattacharyya, Southern IL Univ., Dept. of Mgmt., Rehn Hall, Carbondale, IL 62901, sidb@siu.edu, **Marvin D. Trout**

Formal theory provides an extension of schema analysis of bit-string GAs to arbitrary representations and suggests principles for effective search. We investigate the form-theoretic design of operators for genetic search over discrete probability spaces and highlight its application to a non-trivial decision task.

3) Computing Expected Waiting Times for Genetic Algorithm Markov Chains, Jackie Rees, Univ. of FL, Dec. & IS Dept., Gainesville, FL 32611, **Gary J. Koehler**

An exact model of GA behavior exists for a wide variety of GA operators. The finite population form of this model yields a Markov chain whose transition matrix is very large. Special computational methods are needed to compute factors such as waiting times. We discuss several such approaches with results.

MA28 TUTORIAL: Large-Scale Problem Reformulation

Cluster: Integer Programming Tutorials

Invited Session

Chair: Hanif Sherahli, VA Polytech. Inst. & State Univ., Dept. of ISE, Blacksburg, VA 24061-0118, hanifs@vt.edu

1) TUTORIAL: Large-Scale Problem Reformulation, Hanif Sherahli, VA Polytech. Inst. & State Univ., Dept. of ISE, Blacksburg, VA 24061-0118, hanifs@vt.edu

We describe the theory and design of algorithms related to the use of the reformulation-linearization/convexification technique for solving discrete and continuous nonconvex programming problems. For discrete linear and polynomial programming problems, this generates a hierarchy of progressively tighter, higher dimensional, LP representations, leading to an explicit characterization of the convex hull of feasible solutions...

MA29 TUTORIAL: Neural Networks & Linear Programming

Cluster: Tutorials

Invited Session

Chair: Asim Roy, AZ State Univ., Dept. of DIS, Tempe, AZ 85287, asim.roy@asu.edu

1) TUTORIAL: Neural Networks & Linear Programming, Asim Roy, AZ State Univ., Dept. of DIS, Tempe, AZ 85287, asim.roy@asu.edu

MA30 PANEL: The Future of Vehicle Routing Research

Cluster: Heuristic Methods in Optimization

Invited Session

Chair: Bruce L. Golden, Univ. of Maryland, Van Munching Hall, Coll. of Bus. & Mgmt., College Park, MD 20742

1) PANEL: The Future of Vehicle Routing Research, Bruce L. Golden, Univ. of Maryland, **Michel Gendreau**, Univ. de Montreal, **James P. Kelly**, Univ. of CO, **Robert A. Russell**, Univ. of Tulsa

Recently, a variety of metaheuristics have been used by researchers to solve VRPs. For the most part, high-quality solutions have been obtained, but the algorithms are often slow and involve many parameters. We examine where we are and where we ought to go from here.

MA31 Network Design II

Cluster: Combinatorial Optimization

Invited Session

Chair: Teodor Gabriel Crainic, Univ. de Montreal, CRT, CP 6128, Succ. Centre-Ville, Montreal, Quebec, H3C 3J7, Canada, theo@crt.umontreal.ca

1) Dynamic Service Network Design, Warren B. Powell, Princeton Univ., Program in Stats. & OR, Dept. of Civil Eng., Princeton, NJ 08544, powell@princeton.edu, **Hugo P. Simao**

We consider the problem of dynamically dispatching a truck over a link under stochastic, time-varying demands. A dynamic programming approximation is proposed. Small problems can be solved optimally for comparison and the technique is scalable to large-scale networks.

2) Network Design for Express Shipment Delivery, Cynthia Barnhart, MIT, Ctr. for Transport. Studies, Rm. 1-229, Cambridge, MA 02139, cbarnhar@mit.edu, **Niranjana Krishnan**, **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 movement and shipment flows. We develop an interactive decomposition approach to solve real applications of the express shipment network design problem. These applications involve billions of decision variables and hundreds of thousands of constraints...

3) Parallel Branch & Bound for Multicommodity Capacitated Network Design, Bernard Gendron, Univ. de Montreal, CRT, CP 6128, Succ. Centre-ville, Montreal, Quebec, H3C 3J7, Canada, bernard@crt.umontreal.ca, **Benoit Bourbeau**, **Teodor Gabriel Crainic**, **Antonio Frangioni**

We present parallel B&B algorithms for multicommodity capacitated network design problems. The bounding procedures are based on Lagrangean relaxation and state-of-the-art nondifferentiable optimization techniques. Several variants of parallelizations are introduced and compared based on experimental results on clusters of workstations.

4) Global Memories, Parallel Tabu Search & Network Design, Teodor Gabriel Crainic, Univ. de Montreal, CRT, CP 6128, Succ. Centre-Ville, Montreal, Quebec, H3C 3J7, Canada, theo@crt.umontreal.ca, **Michel Toulouse**, **Michel Gendreau**

We explore various ways to recreate global memories in a cooperative parallel TS scheme. Relevant issues concern the information to use and its impact on the individual search threads. Experiments with a fixed cost, capacitated multicommodity network design problem are discussed.

MA32 Case Studied I: Developing End-User Applications Using Optimization Modeling

Sponsor: CSTS

Sponsored Session

Chair: Bjarni Kristjansson, Maximal Software Inc., 2111 Wilson Blvd., Ste. 700, Arlington, VA 22201, bjarnik@site.gmu.edu

MA33 Software Demonstrations I

Sponsor: CSTS

Sponsored Session

Chair: Bjarni Kristjansson, Maximal Software Inc., 2111 Wilson Blvd., Ste. 700, Arlington, VA 22201, bjarnik@site.gmu.edu

1) INSIGHT Software, Sam Savage, Stanford Univ., Dept. of EES & OR, 417 Terman Eng. Ctr., Stanford, CA 94305-4023, savage@leland.stanford.edu

2) MPL On-Line Tutorial, Bjarni Kristjansson, Maximal Software Inc., 2111 Wilson Blvd., Ste. 700, Arlington, VA 22201, bjarnik@site.gmu.edu

Monday 11:00-12:00

MP37 PLENARY: Synergy for the 21st Century: Between Unstructured Problems & Management Planning & Controls

Invited Session

Chair: Patrick Jaillet, Univ. of TX, Dept. of MSIS, 2815 San Gabriel, Austin TX 78705-3596, jaillet@athena.bus.utexas.edu

1) PLENARY: Synergy for the 21st Century: Between Unstructured Problems & Management Planning and Controls, George Kozmetsky, Univ of Texas, 2815 San Gabriel, Austin TX 78705-0245

As INFORMS enters the 21st Century, more and more the emphasis will need to be on the integration of quantitative methods with advances in digital communication, processing and data mining through integrated managerial and operations decision-making. Paperless processing of data and knowledge in a global context will provide INFORMS members the opportunity to extend their attention into real time controls breakthroughs for both planning and control.

Monday 13:00-14:30**MC01 Logistics & Automotive Support at Norfolk Southern Corporation**

Sponsor: Railroad Applications SIG
Sponsored Session

Chair: Marc S. Meketon, US Airways, Inc., OR Crystal Park
4-DCA/H700, 2345 Crystal Dr., Arlington, VA 22227,
marc_meketon@usairways.com

1) Logistics at Norfolk Southern, Robert Lucas, Norfolk Southern Corp., Roanoke, VA, David Lawson

We will describe the activities of the logistics unit at Norfolk Southern that supports automotive customers.

2) Computer Simulation of Norfolk Southern Automobile Mixing Centers at Kansas City, Fostoria & Shelbyville, Darin A. England, Norfolk Southern Corp., 125 Spring Ave. NW, Atlanta, GA 30303, Erick D. Wikum

Norfolk Southern's 1997 capital budget includes nearly \$200 million for the construction of facilities to support a 12-year, multi-billion dollar automobile distribution contract. We describe and demonstrate the AutoMod model we have developed to simulate 3 of these facilities and present results from our simulation studies.

3) Computer Simulation of Norfolk Southern Automobile Mixing Center at Chicago, Xingang Cheng, Norfolk Southern Corp., 125 Spring St. SW, MS 110, Atlanta, GA 30303, Ajith B. Wijeratne

Norfolk Southern's 1997 capital budget includes nearly \$200 million for the construction of facilities to support a 12-year, multi-billion dollar automobile distribution contract. We describe and demonstrate the AutoMod model we have developed to simulate the Chicago facility and present results from our simulation studies.

MC02 Applications in Telecommunications

Cluster: Applications
Invited Session

Chair: Leonard L. Lu, AT&T Labs., 101 Crawford Corner Rd.,
Room 3K324, Holmdel, NJ 07733, llul@qpc2.ho.att.com

1) Tributary Networks Using Stacked Rings, John G. Klineciewicz, AT&T Labs., 101 Crawford Corner Rd., Rm. 3L-301, Holmdel, NJ 07733-3030, jgk@qpc2.ho.att.com, Hanan Luss, Dicky Yan

We describe an algorithm to design tributary networks based on so-called "stacked" self-healing rings in which several SHRs can be routed around the same topology. The methodology integrates techniques for designing the topology, assigning nodes to SHRs and balancing traffic in a way that is computationally efficient.

2) Transient Behavior of Queuing Systems with Correlated Traffic, Lalita Kulkarni, BNR Inc., 2201 Lakeside Blvd., Richardson, TX 75082-4399, lalita@bnr.ca, Sanqi Li

We present the time-dependent solutions of various stochastic processes associated with a finite quasi-birth-death queueing system. These include the transient queueing solutions, the departure and loss intensity processes and certain cumulative measures. We study the effect of arrival process correlation on the transient queueing system.

3) An Optimization Problem in Wireless Transport Network Design, Yufei Wang, Lucent Tech., 101 Crawford Corner Rd., Rm. 3J-322, Holmdel, NJ 07733, ywang@lucent.com

A wireless transport network connects cell sites to a switch. Most service providers use the simple star topology without traffic concentration/multiplexing to take advantage of economies of scale. We propose a solution approach for this network synthesis problem to minimize total cost under a given traffic and transport technology.

4) Designing Backhaul Networks for PCS Networks Using Genetic Algorithms, Tony Cox, Cox Associates, 503 Franklin St., Denver, CO 80218, tcoxdenver@aol.com, Lawrence Davis, Leonard L. Lu, David Orvosh, Xiaorong Sun

We introduce a GA for designing networks for carrying PCS traffic. The approach selects a least-cost subset of network nodes as hubs, assigns other nodes to these hubs and chooses types of links to connect the nodes and hubs based on capacities and costs of each link type.

MC03 What's Happening in Aviation OR?

Sponsor: Aviation Applications Section
Sponsored Session

Chair: Robert B. Rovinsky, Federal Aviation Admin., ASD-410,
800 Independence Ave. SW, Washington, DC 20591,
robert.rovinsky@faa.dot.gov

1) What's Happening in Aviation OR?

This is an opportunity to discuss what is happening throughout the aviation OR world. Come prepared to speak about major problems and opportunities to apply OR as well as issues confronting you, your work group and the entire profession.

MC04 Tracking & Forecasting Defense Contractor Overhead Costs

Sponsor: Military Applications Society
Sponsored Session

Chair: Stephen J. Balut, Institute for Defense Analysis, 1801 N
Beauregard St., Alexandria, VA 22311, sbalut@ida.org

1) Historical Trends in Aerospace Contractors' Overhead Costs, Alec Salerno, Inst. for Defense Analysis, 1801 N Beauregard St., Alexandria, VA 22311, asalerno@ida.org, John J. Cloos

As defense budgets decline and procurement programs are reduced, there has been increasing interest in understanding contractor overhead costs. We present historical trends in the direct and indirect costs of 4 DoD aerospace contractors. Costs have been aggregated and normalized to provide a non-proprietary description of past cost experiences.

2) A Dynamic Model of Defense Aerospace Contractor Overhead Costs, Thomas P. Frazier, Institute for Defense Analysis, 1801 N Beauregard St., Alexandria, VA 22311, tfrazier@ida.org

We present a dynamic model of DoD contractor overhead costs. The model is used to predict how overhead costs change as business in the contractors plants change. The model is a variant of the partial adjustment dynamic model first proposed by Nerlove and was constructed using time-series cost data.

3) A Dynamic Model Defense Shipbuilders Overhead Costs, Thomas P. Frazier, Institute for Defense Analysis, 1801 N Beauregard St., Alexandria, VA 22311, tfrazier@ida.org

We present an extension of the dynamic model developed to estimate DoD aerospace contractor overhead costs. The model predicts how overhead costs change as business in the shipbuilder yards change. The model was constructed using time-series data from shipyards engaged in construction and repair of US Navy ships.

MC05 Decision Analysis Arcade

Sponsor: Decision Analysis Society
Sponsored Session

Chair: Dana R. Clyman, Univ. of VA, Darden Grad. Sch. Bus.
Admin., PO Box 6550, Charlottesville, VA 22906-6550,
dana@virginia.edu

1) Myopic Utility: A Framework for Asset Dependent Decision Making, Frederick B. Buoni, FL Inst. of Tech., 150 West Univ. Blvd., Coll. of Eng., Melbourne, FL 32901, Paulo A. Dasilva

Subjective expected utility theory provides for a global utility function. We present a framework based on subjective expected utility which reflects the changes in preference with changes in a decision making asset. An example of this myopic utility theory is discussed.

2) History-Remembering Utility Rollback for Stochastic Tree Models, Gordon B. Hazen, Northwestern Univ., IE/MS Dept., Evanston, IL 60208-3119, hazen@iems.nuw.edu, Jayavel Sounderpandian

The simplest model for utility rollback over stochastic trees is Markovian utility, which has constant risk attitude and remembers only the most recent state visited. We show that Markovian utility can be extended to remember an arbitrary state history. We illustrate the technique on 1 or more medical decision models.

3) Strategy Decision Modeling of the Corporate Portfolio of Business in the Spreadsheet, Samuel E. Bodily, Univ. of VA, Darden Grad. Sch., PO Box 6550, Charlottesville, VA 22906-6550

To adequately model project decisions in a spreadsheet can be difficult. Strategic decisions generally involve larger, more comprehensive models. Corporate portfolio models that combine multiple business units into a corporate portfolio complicate the task even further. These challenges and some ideas on

how to cope with them will be presented.

4) Modeling Concern for Equity by Aggregating Preference Intensities, Charles M. Harvey, Univ. of Houston, Dept. of Dec. & IS, Houston, TX 77204-6282, charvey@uh.edu

A model due to John Harsanyi provides for the aggregation of utility functions for individuals or parties into a utility function for society. We conjecture why this model is not used in DA and we construct a parallel model based on preference that directly represents concern for equity.

MC06 VBA in OR/MS Education

Cluster: Education in OR/MS
Invited Session

Chair: Chris Albright, IN Univ., Sch. of Business, Decision Tech. Dept., Bloomington, IN 47405, albright@indiana.edu

1) What is Visual Basic for Applications & Why Should You Care?, Cliff T. Ragsdale, VA Polytech. Inst. & State Univ., Dept. of MS & Info., Blacksburg, VA 24061-0235, cragsdal@mail.vt.edu

VBA is the macro language used in the Microsoft Office suite of applications. As a subset of the VB programming language, VBA offers far more programming power than the keystroke-based macro languages of yesteryear. However, it is also quite a bit more difficult to learn. This will be a mini-tutorial on how VBA works within the context of the object model for Excel. The strategy for integrating VBA within curriculum changes in the MS&IT major at Virginia Tech will also be outlined.

2) Decision Support System Prototyping with Visual Basic for Applications, Robert F. Easley, Univ. of Notre Dame, Mgmt. Dept., Coll. of Bus. Admin., Notre Dame, IN 46556-0399, reasley@darwin.helios.nd.edu

VBA is an effective tool for implementing various MS models in DSS prototypes. Students with programming experience can quickly learn enough VBA, especially by taking advantage of macro recording, to implement DSS prototypes in class assignments and projects. This reinforces student understanding of the correct and appropriate use of the underlying decision models. I will present typical assignments and student projects...

3) Developing Visual Basic for Applications Around Spreadsheet Models, Chris Albright, IN Univ., Sch. of Business, Decision Tech. Dept., Bloomington, IN 47405, albright@indiana.edu

Students in my course plan to be systems analysts and programmers, not management scientists. They are likely to be building DSS for others, and these might be built around mathematical models. Therefore, I teach mathematical modeling via Excel spreadsheets, but also show how to use VBA to embed a model in an overall application with a front end and back end. The front end enables users to input data to the model using dialog boxes or other means...

4) The Secret of Creating Great Visual Basic for Applications in Excel Fast, Sam Savage, Stanford Univ., Dept. of EES & OR, 417 Terman Eng. Ctr., Stanford, CA 94305-4023, savage@leland.stanford.edu

It's simple. Just assign it as a homework problem to your students, most of whom know a lot more about computers than you do. Of course you can't publish their results without paying them, but think of what you can learn by reading their code! Some fine examples will be demonstrated.

MC07 Stochastic Models of Supply Chains

Sponsor: MSOM

Sponsored Session

Chair: Lawrence M. Wein, MIT, Sloan Sch. of Mgmt., Rm. E53-343, Cambridge, MA 02139, lwein@mit.edu

1) Reducing International Risk Through Quantity Contracts, Alan A. Scheller-Wolf, Carnegie Mellon Univ., Grad. Sch. of Ind. Admin., 5000 Forbes Ave., Pittsburgh, PA 15217, Sridhar R. Tayur

Quantity contracts can dampen variations in income caused by exchange rate fluctuations. After establishing optimal policies for a 2-echelon model, we investigate the effects of increasing minimum order quantity, increasing supplier capacity and the use of different currencies in the presence of different lead times, pass throughs and exchange rate movements.

2) Capacity Reservation for Supply Flexibility in a Semiconductor Supply Chain, Alex Brown, Stanford Univ., Dept. of IEEM, Stanford, CA 94305-4024, Hau L. Lee

Integrated circuits manufacturers often rely on subcontract foundries for wafer fabrication. For such companies, the reservation of future capacity at subcontractors is critical to assure supply. Ideally, the firms need flexible commitments to reduce financial and supply risks. We analyze flexible

long-term capacity reservation agreements using the concept of a capacity option as a payment mechanism for supply flexibility.

3) Inventory Levels in Assemble-to-Order Systems, Paul Glasserman, Columbia Univ., 403 Uris Hall, Business Sch., New York, NY 10027, pglasser@research.gsb.columbia.edu, Yashan Wang

We consider the problem of setting optimal target inventory levels in an assemble-to-order system in which multiple components are assembled into various finished goods. Replenishment of component inventories follows a base-stock policy constrained by variable production times. We minimize inventory holding costs subject to a service-level constraint.

4) Traffic Analysis of Production-Inventory Systems with Complex Demand & Forecasting Processes, L. Beril Toktay, MIT, OR Ctr., Cambridge, MA 02139-4262, Lawrence M. Wein

We perform a heavy traffic analysis of a multi-product, single-machine production/inventory system, where demand is modeled according to the Martingale model of forecast evolution developed by Heath & Jackson (1994) and Graves et al. (1986, 1994). We derive optimal base stockpolicies and corresponding costs under a variety of demand processes and forecasting scenarios.

MC08 Yield Management, Inspection & Semiconductor Competitiveness

Sponsor: MSOM

Sponsored Session

Chair: Ram Akella, Stanford Univ., Dept. of Eng. Econ. Syst. & OR, Stanford, CA 94305, akella@leland.stanford.edu

1) Integration Process Control & Base-Line Defect Level Reduction in Semiconductor Fabrication Lines, Kyle D. Chen, Stanford Univ., 2250 Latham St., Apt. 10, Mountain View, CA 94040, kyle.chen@stanford.edu, Ram Akella

We integrate in-line monitoring, defect review & classification and root cause analysis into a comprehensive methodology to achieve process control and base-line defect level reduction simultaneously in semiconductor fabrication lines. As part of the yield learning strategy, we explore different policies of allocating inspection and review capacities.

2) Integrated Inspection & Review Sampling for Yield Learning: I, Eric Wang, Stanford Univ., EES & OR Dept., Stanford, CA 94305, ericwang@leland.stanford.edu, Ram Akella

In-line inspection to monitor defect excursions as surrogates for end of line yield excursions recently has emerged as a powerful new approach. However, this then necessitates review sampling of defects on a wafer to estimate defect populations of different types on a wafer. We describe a combined inspection-review sampling approach to achieve effective yield improvement at a specified stage of a semiconductor fabrication facility and the significant gains that result.

3) Integrated Inspection & Review Sampling for Yield Learning: II, Chih-Hung Lin, Stanford Univ., EES & OR Dept., Stanford, CA 94305, linch@leland.stanford.edu, Ram Akella

In the 1st part of this work, we described integrated inspection-review sampling approaches at a single stage of a semiconductor fabrication line (fab) to achieve yield learning. In the 2nd part, we 1st compare several different schemes for review sampling that fabs use and others that we have developed. We indicate the conditions under which each of these is effective. We also describe fab-wide approaches.

4) Adaptive Wafer Inspection Sampling for Semiconductor Fabrication Lines, William Kuo, Univ. of CA, Dept. of IE/OR, Berkeley, CA 94720, wykuo@cimsim.ieor.berkeley.edu, Ram Akella, J. George Shanthikumar

We describe a novel and effective approach for adaptive inspection sampling in semiconductor fabrication lines (fabs). The approach explicitly models the machine failures/excursions that we are attempting to monitor at the various stages. We describe an efficient adaptive sampling approach for allocating inspection capacity among multiple stages of the line.

MC09 Modeling & Analysis of Semiconductor Manufacturing II

Cluster: OR Applications in Semiconductor Manufacturing
Invited Session

Chair: John W. Fowler, AZ State Univ., Dept. of IMSE, Tempe, AZ 85287-5906, john.fowler@asu.edu

1) Matching Factory Lots to Customer Orders, Kraig Knutson, AZ State Univ., Dept. of IMSE, Tempe, AZ 85287-5906, kraig

knutson@asu.edu, *Karl Kempf, John W. Fowler*

Present methods of matching factory lots to customer orders result in inefficient factory loading, increased cycle time and in excess finished goods inventory. Using simulation and design of experiments methods, we study how various sizes of lots and orders and matching policies affect plant profitability. Plant profitability is measured in excess finished goods inventory and on-time delivery of orders.

2) Simulation Evaluation of Reticle Management in Photolithography, Matt Hickie, Motorola - MOS 12, 1300 N Alma School Rd., Chandler, AZ 85224, matt_hickie@chdqm2.sps.mot.com, *John W. Fowler*

Photolithography performance is not only dependent upon the stepper being available, but also upon the availability of reticles. We present the strategic, tactical and operational aspects of reticle management. Strategically, decisions must be made to purchase extra reticles. Tactically, reticle storage and dispersion among the equipment is analyzed. Operationally, what material to run on which piece of equipment is considered.

3) Operator-Machine-Lot Interference Analysis in Semiconductor Manufacturing, Doron Meyersdorf, TEFEN USA, 1065 E Hillsdale Blvd., Ste. 400, Foster City, CA 94404-1615, doron@tefen.com, *Ori Biron, Ertunga C. Ozelkan*

A staffing model based on M/M/S/K queueing theory is developed to analyze the OML interference in semiconductor manufacturing processes. The model allows one to predict the impact of changes in layout, work methods, capacity, volume and product mixture on the staffing requirements and area performance. Unlike classical approaches, in which the machines are treated as customers, here wafer lots are taken as the designated customers to be serviced. The results show that the OML model is superior...

4) Test Wafer Opportunities for Cost Reduction, Doron Meyersdorf, TEFEN USA, 1065 E Hillsdale Blvd., Ste. 400, Foster City, CA 94404-1615, doron@tefen.com, *Ertunga C. Ozelkan*

After defining the problems associated with TWs and TW management, a LP-based TW-controller is developed to obtain optimal TW decision policies. The model provides management with vital information on how many TWs to be purchased, downgraded, repolished, reused and/or reworked at each level of semiconductor production process in each time period.

MC10 Developments in Urban Travel Forecasting Methods

Sponsor: Transportation Science Section

Sponsored Session

Chair: David E. Boyce, Univ. of IL, Dept. of Civil & Materials Eng, 842 W Taylor St., Chicago, IL 60607, dboyce@uic.edu

1) Methods for Analyzing the Demand for Toll Highways, Michael Florian, Univ. of Montreal, CRT/DIRO, PO Box 6128, Sta. Centreville, Montreal, Quebec, H3C 3J7, Canada, mike@crt.umontreal.ca

Various methods for analyzing the demand and network flows for toll highways have been developed and used over the past few years. We review the main methods used and their implementation by using multiclass network equilibrium assignments.

2) Combined Travel Choice Models: A Real World Application, David E. Boyce, Univ. of IL, Dept. of Civil & Materials Eng, 842 W Taylor St., Chicago, IL 60607, dboyce@uic.edu, *Kenneth Compere, Maya Tatineni*

A combined OD, mode, route and time-of-day choice model was implemented for the Chicago region and used to evaluate alternative proposals in a highway controversy. The lessons learned and implications for future modeling strategies are examined.

MC11 Dynamic Vehicle Dispatching

Sponsor: Transportation Science Section

Sponsored Session

Chair: Amelia C. Regan, Univ. of TX, Dept. of Civil Eng., ECT Hall 6.2, Austin, TX 78703, acregan@translab.its.uci.edu

1) Dynamic Vehicle Dispatching: Optimal Heavy Traffic Performance & Practical Policies, Noah Gans, Univ. of PA, Dept. of OPIM, The Wharton Sch., Philadelphia, PA 19104-6366, gans@opim.wharton.upenn.edu, *Garrett J. van Ryzin*

We analyze a general model of dynamic vehicle dispatching which seeks to capture the nature of congestion in a broad class of logistics systems. Our analysis suggests an effective heuristic which uses a few simple principles to control congestions, principles which can be easily incorporated within classic,

static routing algorithms.

2) Diversion Issues in Real-Time Dispatching, Michel Gendreau, Univ. de Montreal, CRT/DIRO, CP 6128, Succ. Centre-ville, Montreal, Quebec, H3C 3J7, Canada, michelg@crt.umontreal.ca, *Soumia Ichoua, Jean-Yves Potvin*

In real-time settings, diversion occurs when a vehicle is rerouted from its current planned destination towards the location of a new request. We examine various issues that must be addressed if diversion is allowed in a real-time dispatching system.

3) Operational Strategies for Dynamic Dispatching of Carrier Fleet Operations, Amelia C. Regan, Univ. of TX, Dept. of Civil Eng., ECT Hall 6.2, Austin, TX 78703, acregan@translab.its.uci.edu, *Hani S. Mahmassani*

We examine the performance of several real-time operational strategies under varying levels of demand, including load acceptance and assignment heuristics, some of which allow en-route diversion and load reassignment. The effects of congestion on the ability of these strategies to provide efficient service to time-sensitive operations are discussed.

MC12 Topics in Supply Chain Management

Cluster: Supply Chain Operations

Invited Session

Chair: Panos Kouvelis, Washington Univ., Olin Sch. of Bus., CB 1133, 1 Brookings Dr., St. Louis, MO 63130

1) How a Strong Position in the Supply Chain Can Decrease Costs via Coordinated Quantity Discounts, Charles L. Munson, Washington Univ., Olin Sch. of Bus., St. Louis, MO 63130, *Meir J. Rosenblatt*

We suggest a method for a company to create an integrated plan that dictates order and production quantities throughout a 3-firm channel. We show that incorporating quantity discounts into both ends of the supply chain can decrease significantly costs compared to concentrating only on the lower end.

2) Flexible & Risk Sharing Sourcing Contracts in Volatile Price Environments, Panos Kouvelis, Washington Univ., Olin Sch. of Bus., CB 1133, 1 Brookings Dr., St. Louis, MO 63130, *Chung-Lun Li*

We consider the problem when a firm has to purchase a fixed amount of a material from a single supplier in order to satisfy a deterministic demand at a given time. We consider 2 different types of supply contracts. An inflexible contract requires the firm to specify at time 0 exactly how many units and when those units will be purchased. A flexible contract requires the firm to specify at time 0 exactly how many units it will purchase, but it does not require the firm to specify when those units will be purchased...

3) Supply Contracts with Order Adjustments & Penalties: Policies & Implications, Joseph Milner, Washington Univ., Olin Sch. of Bus., 1 Brookings Dr., CB 1133, St. Louis, MO 63130, *Meir J. Rosenblatt*

We model long term supply contracts where buyers are permitted penalized order adjustments to committed quantities. We analyze optimal buyer behavior and demonstrate the effect of potential cost savings to supplier behavior. We investigate when such contract offers, in conjunction with price discounts, may be beneficial to both parties.

MC13 New Developments in Integrated Product

Development: Industrial & Academic Perspectives

Cluster: New Product Development

Invited Session

Chair: Michael J. Shaw, Univ. of IL, 2151 Beckman Inst., 405 North Mathews, Urbana, IL 61801, m-shaw2@uiuc.edu

1) Sense & Response Enterprise Systems: A Simulation Perspective, William F. Fulkerson, Deere & Co., Computer Info. Systems, Moline, IL 61265-8098, wf28155@deere.com

An adaptive enterprise must respond to forces such as mass customization, communication technology and the workplace revolution, driving change in the marketplace. A methodology for corporate governance that enables an adaptive response to this environment is presented and the issues in moving from a build-and-sell to sense-and-respond enterprise are presented.

2) Manufacturing Cost Modeling for Product Design, Angela Locascio, Motorola, Corp. Mfg. Research Ctr., 1301 E Algonquin Rd., Rm. 1014, Schaumburg, IL 61096

Methodology is developed and implemented to improve our product design process. An activity based costing methodology is utilized to quantify ambiguous manufacturing costs. This system allows designers and manufacturing engineers to improve manufacturability and provides a better way

to assess the cost impact of design decisions.

3) **From Knowledge to Competence to Competitive Advantage**, *Russell W. Wright*, Univ. of IL, Dept. of Bus. Admin., 2406 Branch Rd., Champaign, IL 61821

This paper looks at how knowledge evolves over time and proposes research questions regarding the influence of knowledge on new product strategies in successive product generations. I use data from the DRAM and microprocessor segments of the US semiconductor industry to perform an event history analysis to investigate the research questions.

4) **Mass Customization: What it Means for Product Line Proliferation & Consolidation**, *Rachel Yang*, Univ. of IL, 350 Commerce West, Champaign, IL 61820, ryang@uiuc.edu

In the age of mass customization many consumer products experience product proliferation but consumer herd behavior and fashion cycles still exist, leading to product consolidation. A firm's position in product line proliferation and consolidation is examined from aspects of product development cost, manufacturing technology, consumer preference and market structure.

MC14 GARCH Models

Sponsor: Financial Services Section

Sponsored Session

Chair: Jin-Chuan Duan, Hong Kong Univ. of Sci. & Tech., Dept. of Fin., Clear Water Bay, Kowloon, Hong Kong, jcduan@usthk.ust.hk

1) **Answering the Critics: Yes, ARCH Models Do Provide Good Volatility Forecasts**, *Torben G. Andersen*, Northwestern Univ., Dept of Fin., 2001 Sheridan Rd, Kellogg Grad. Sch. of Bus., Evanston, IL 60208, t-andersen@nwu.edu, *Tim Bollerslev*

Volatility permeates modern finance. Accurate forecasts of volatility are therefore critical for empirical asset pricing. By standard forecast criteria, ARCH models seemingly provide poor forecasts. We demonstrate, in contrast, that ARCH models yield surprisingly accurate interday variance forecasts for the notion of (latent) volatility that is relevant for financial applications.

2) **The Impact of News on Foreign Exchange Rates: Evidence from High Frequency Data**, *Thomas McCurdy*, Univ. of Toronto, Fac. of Mgmt., 105 St. George St., Toronto, Ont., M5S 3E6, Canada, tmcurdy@chass.utoronto.ca, *Dirk Eddelbutel*

We investigate the impact of the frequency of general and currency-specific news headlines on de-seasonalized intraday DEM-USD exchange rate changes. More news is associated with a (marginal) decrease in volatility. The result accords with market participants' explanations for observed volatility clustering.

3) **Pricing Options Under Generalized GARCH & Stochastic Volatility Processes**, *Peter Ritzchen*, Case Western Reserve Univ., WSOM, 10900 Euclid Ave., Cleveland, OH 44106-7235, phr@pyrite.som.cwru.edu, *Rob Trevor*

We develop an efficient lattice algorithm for pricing European and American options under GARCH processes. This algorithm is extended to price options under almost all existing GARCH specifications as well as under a very large family of bivariate diffusions in which volatility follows its own, perhaps correlated, process.

4) **American Option Pricing Under GARCH by a Markov Chain Approximation**, *Jin-Chuan Duan*, Hong Kong Univ. of Sci. & Tech., Dept. of Fin., Clear Water Bay, Kowloon, Hong Kong, jcduan@usthk.ust.hk, *Jean-Guy Simonato*

We propose a numerical method for valuing American options under GARCH. The method is based on approximating the asset price process by the finite-state, time-homogeneous Markov chain. The transition probability matrix is typically sparse and this feature can be used to increase the dimension of the Markov chain to obtain better numerical results.

MC15 Emerging Issues in Management & Technology

Cluster: Technology Management

Invited Session

Chair: Nan Muir Bodensteiner, Univ. of Houston, Box 234, 2700 Bay Area Blvd., Houston, TX 77058, muir@cl.uh.edu

1) **Building Student Retention in a MOT Program**, *William T. Flannery*, Univ. of TX, Div. of Mgmt. & Mktg., 6900 N Loop 1604 West, San Antonio, TX 78249-0634, flannery@lonestar.utsa.edu, *Woodie Spivey*, *Richard Howe*

We provide an overview of the considerations given to building a M.S. in MOT program that focuses on program quality and regional needs while emphasizing student retention in the program. We include program content, delivery

methodologies and distance learning.

2) **Integrating a Master of Science in Information Systems Program with a Master of Science in MOT Program**, *Glenn B. Dietrich*, Univ. of TX, Div. of Acct. & IS, 900 N Loop 1604 West, San Antonio, TX 78249-0632, dietrich@lonestar.utsa.edu, *William T. Flannery*

Graduate programs in IS and MOT have the potential of overlapping objectives and courses to the extent that they compete for the same student. We discuss the development of 2 complementary programs (i.e., an MS in IS and an MS in MOT) with complementary objectives and course offerings.

3) **Linking MOT Programs to Commercial Activities via Student Projects**, *Nan Muir Bodensteiner*, Univ. of Houston, Box 234, 2700 Bay Area Blvd., Houston, TX 77058, muir@cl.uh.edu

Students' research projects and internship activities are highlighted to describe how the MOT program at the University of Houston Clear Lake is linked to commercial activities via a regional technology transfer center located at the university.

4) **Implementing Advanced Manufacturing Technologies: The Role of Learning Before Doing**, *Mark Frohlich*, Boston Univ. & London Bus. Sch., Op. Mgmt. Dept., 595 Commonwealth Ave., Boston, MA 02215

We focus on how manufacturers learn about new AMT performance issues before they purchase the new technology. Specifically, we focus on how AMT implementors try to avoid unexpected technical and organizational problems via 3 forms of learning (vicarious, simulations and prototype learning). Empirical results are presented.

MC16 Strategy & Learning

Sponsor: College on Organization Science

Sponsored Session

Chair: Paul Ingram, Carnegie Mellon Univ., GSIA Room 316A, Pittsburgh, PA 15213, ingram+@andrew.cmu.edu

1) **The Red Queen in Organizational Growth**, *Bill Barnett*, Stanford Univ., Grad. Sch. of Business, Stanford, CA 93505-5015, barnett_william.@gsb.stanford.edu

Organizations learn in response to competition, intensifying competition, forcing rivals to learn to become stronger competitors, triggering further learning. I show that such "red-queen" evolution caused some retail banks to grow quickly and generate strong competition but some were more likely to succumb to competency traps, slowing their growth. I also identify a "rare enemy" effect in which facing competitors of widely-varying size slows growth.

2) **Towards a Dynamic View of Internal Stickiness: A Stages Model of the Replication of Best Practices within the Firm**, *Gabriel Szulanski*, Univ. of PA, Wharton School, 2000 SH-DH, Philadelphia, PA 19104-6370, szulanski@wharton.upenn.edu

I advance a dynamic perspective on internal stickiness - the failure of a viable replicator routine. I characterize 4 replication sub-routines, initiation, implementation, ramp-up and integration, based on literature review and evidence collected through in-depth study of transfers of best practices within firms. Results shed light on the dilemmas of rent appropriation inherent in a strategy of replication.

3) **Population Level Learning & Interactions of Routines: Illustrations from Practices Related to Commercialization of University Inventions**, *Anne S. Miner*, Univ. of WI, 3523 Tally Ho Ln, Madison, WI 53796, asminer@facstaff.wisc.edu

Several contemporary theories emphasize interactions between organizational routines. I explore different types of interactions between routines, including interactions over time and within and between organizations. Illustrative data are drawn from a qualitative study of population level learning of university practices related to the generation and commercialization of inventions.

4) **Cognition & the Evolutionary Dynamics of Organizations**, *Daniel Levinthal*, Univ. of PA, 2000 SH-DH, Philadelphia, PA 19104-6370, levinthal@wharton.upenn.edu, *Giovanni Gavetti*

A hierarchical model of organizational cognition is advanced. The pace and extent of change in cognition is argued to vary inversely with one's level within a hierarchy. We also explore linkages between the cognition of actors at different levels. The model provides an incrementalist perspective on radical organizational change, and more broadly, begins to bring cognition to bear on evolutionary views of the firm.

MC17 Health Care Applications

Sponsor: Health Applications Section

Sponsored Session

Chair: Sharon Schweikhart, OH State Univ., Health Serv. Mgmt. & Policy, 1583 Perry St., Columbus, OH 43210, schweikhart.1@osu.edu

1) ACG Adjusted Physician Profiling: Physician Attitudes & Impact on Practice, Sandra Potthoff, Univ. of MN, Carlson Sch. of Mgmt., 420 Delaware St. SE, Box 97, Minneapolis, MN 55455, pott001@tcc.umn.edu, **Brent Metfessel, Elise Jensen, Bruce Lindgren**

One hundred and thirty physicians in a managed care organization responded to a survey to measure their attitudes towards their individual case-mix adjusted quarterly utilization profile reports. The relationship between their attitudes and impact on their member-per-month costs over a 3-year period were analyzed.

2) Managed Care & the Future of Quality Improvement in Health, Curtis P. McLaughlin, Univ. of NC, Bus Sch & Sch of Public Health, Carroll Hall, CB3490, Chapel Hill, NC 27599-3490, mclaughc.bsacd1@mhs.unc.edu, **A. D. Kaluzny**

When managed care is viewed as an industrialization of the health care system, future roles of continuous quality improvement can be identified using the dynamic stability model of Boynton, Victor & Pine (1993). We outline those roles and suggest major changes for continuous quality improvement in the managed care environment.

3) Performance Measurement in Hospital Supply Management, Ivan Dacosta Claro, Ecole Polytech., Dept. of Math. & IE, CP 6079, Succ. Centre-ville, Montreal, Quebec, H3C 3A7, Canada, **Sophie D. Lapierre, Michael W. Carter, Claire Schaffnit**

We consider the problem of benchmarking hospital purchasing departments in order to identify the most efficient supply strategies. We present a DEA model and its application to data from Quebec hospitals.

4) Classifying Organizational Approaches to Health Care Teams, Sharon Schweikhart, OH State Univ., Health Serv. Mgmt. & Policy, 1583 Perry St., Columbus, OH 43210, schweikhart.1@osu.edu, **Vicki Smith-Daniels**

Multidisciplinary team structures and integrative work roles have emerged as pivotal components of work redesign initiatives in health care delivery settings. We discuss the results of a survey used to provide initial validation of a proposed multidisciplinary team model.

MC18 PANEL: Applying DEA

Cluster: DEA & Productivity
Invited Session

Chair: Lawrence M. Seiford, Univ. of MA, Dept. of IE/OR, 114 Marston Hall, Amherst, MA 01003-5220, seiford@ecs.umass.edu

1) PANEL: Applying DEA, Wade D. Cook, York Univ., wcook@bus.yorku.ca, **William W. Cooper,** Univ. of TX, **Robert G. Dyson,** Univ. of Warwick, **Jim Storbeck,** Magellan Group

The rapid growth and widespread acceptance of the methodology of DEA is testimony to its strengths and applicability. A panel of international DEA researchers will discuss their experiences in applying DEA models and selecting variables for specific problem areas, describing obstacles overcome and insights gained from actual DEA studies. Guidelines for performing an analysis will be proposed. DEA practitioners and researchers are invited to attend and contribute their personal observations.

MC19 Electronic Commerce

Cluster: Electronic Commerce
Invited Session

Chair: Ramayya Krishnan, Carnegie Mellon Univ., Heinz Sch. Public Pol. & Mgmt., 5000 Forbes Ave., Pittsburgh, PA 15213, rk2x+@andrew.cmu.edu

1) A Consolidator Approach to Agent Coalition Formation & Negotiation, Bill Robinson, GA State Univ., CIS Dept.

We define an automated buyer agent which negotiates contracts with potential suppliers on behalf of distributed individuals. The agent engages an iterative, preference learning process to derive potential buyer groups, followed by negotiation on behalf of the buyer groups. While adding a cost to the negotiation, the buyer agent reduces the costs to individual buyers.

2) Negotiations in Electronic Commerce, Arie Segev, Univ. of CA, Haas Sch. of Bus., Berkeley, CA 94720-1900

As many business processes are moved to a web-based environment, many questions arise concerning the processes themselves and the level of automation. Here, the business-to-business procurement processes will be emphasized. In those cases, current attempts to move to electronic catalogs deal with the need

for negotiation support. An architecture for such an environment will be presented and related information needs identified.

3) Brokering in Electronic Markets for Software Services: An Analysis, Hemant K. Bhargava, Naval Postgrad. Sch., Code SM-BH, 555 Dyer Rd., Monterey, CA 93943, bhargava@nps.navy.mil, **Ramaya Krishnan**

The design of brokers is a key issue in electronic markets for software services. Based on our experience with designing brokers on the Decision Net project, we will discuss alternative designs. The principal difference in these designs relates to the range and the type of services offered by the brokers who serve as intermediaries between service providers and consumers.

MC20 Software Process Improvement

Cluster: State-of-the-Art in Information Technology
Invited Session

Chair: Derek L. Nazareth, Univ. of WI, Sch. of Bus. Admin., PO Box 742, Milwaukee, WI 53201, derek@csd.uwm.edu

1) A Factor-Analytic Study of Self-Reported Workforce Capability in Organizations, William E. Hefley, Carnegie Mellon Univ., Dept. of Social & Dec. Sci., 5000 Forbes Ave., Pittsburgh, PA 15213, hefley@andrew.cmu.edu

Benefits of improved workforce practices have been demonstrated. The people capability maturity model (sm) provides a framework for characterizing an organization's human resources practices and improving these practices. We present an unrestricted (exploratory) factor analysis of P-CMM-based questionnaires administered in a high technology organization to investigate the factor structure of the instrument.

2) Comparing Management Practices for Software Development in the US & Japan, Ram Nidumolu, Univ. of AZ, Dept. of Dec. & Info. Systems, Coll. of BPA, Tucson, AZ 85721, rnidumolu@bpa.arizona.edu

We present the results of a study comparing management practices for software development in the US and Japan. We focus on the effects of process customization, component reusability and cultural factors on software process and competitive performance. The findings have significant implications for software product development.

3) Improving the Software Inspection Process, Padmal Vitharana, Univ. of WI, Sch. of Bus. Admin., PO Box 742, Milwaukee, WI 53201, padmal@csd.iwm.edu, **Derek L. Nazareth**

We present some ideas to improve the software inspection process. First, we highlight the importance of the individual preparation stage of the software inspection process and 2nd, we put forth a set of novel ideas that can be used to automate some critical tasks of the inspection process.

MC21 Theoretical Foundations of MMT VI

Cluster: Management of Medical Technology
Invited Session

Chair: Elias G. Carayannis, George Washington Univ., Sch. of Bus. & Public Mgmt., Washington, DC 20052, caraye@gwis2.circ.gwu.edu

1) Reengineering Rehabilitative Health Care Delivery in the 90s & Beyond A Systems Approach to Medical Technology, Quality & Cost Management, Elias G. Carayannis, George Washington Univ., Sch. of Bus. & Public Mgmt., Washington, DC 20052, caraye@gwis2.circ.gwu.edu, **Rajiv Mallick, Jeffrey Alexander, Richard Radecki, Bartholomew Vitelli**

The quality of rehabilitative health care delivery in the 90s and beyond hinges as much on improving management at the health provider level as on managing the systems and technologies the health providers rely on. A systems approach to managing the technological, economic, medical and organizational dimensions of health care entails examining the issues at hand from a multi-dimensional, integrative perspective...

2) Top Management Teams, Competency Development & Performance in the Pharmaceutical Industry, Helaine J. Korn, CUNY, Baruch Coll., Dept. of Mgmt., 17 Lexington Ave., Box F-1831, New York, NY 10010, hkorn@newton.baruch.cuny.edu, **Laura B. Cardinal, Donald E. Hatfield**

We explore factors that influence the development of core competencies among firms in the pharmaceutical industry. We integrate the growing body of research on competition based competencies with research on upper echelons theory. Adopting an intervening perspective, we look at the influence of top management teams in a high-technology environment.

3) **Information Architecture & the Management of Medical Technology**, *Jon W. Beard*, Univ. of Tulsa, 600 S College Ave., Dept. QM/MIS, Coll. Bus. Adm., Tulsa, OK 74104-3189, beardjw@centum.utulsa.edu

Medicine is the application of "understanding" for treatment of illness and injury. Information architecture is "the design of understanding" (Wurman, 1996). This manuscript uses information architecture as a framework to define and explore management and technology for medical applications.

MC23 Logistics & Supply Chain Management IV
Contributed Session

Chair: Awi Federgrun, Columbia Univ., Grad. Sch. of Bus., 419 Uris Hall, New York, NY 10027, afedergr@research.gsb.columbia.edu

1) **Distribution & Third Party Logistics**, *Anu Bask*, Helsinki Sch. of Econ., Runeberginkatu 22-24, Helsinki, 00100, Finland, abask@hkkk.fi, *Ari Vepsalainen*

Customer requirements for better service and diversification of risks call for new distribution structures including channel separation and specialization/divergence of services. We discuss the role of third party logistics providers as part of emerging distribution networks.

2) **Institutional Limits to Global Distribution**, *Ella P. Juneja*, Helsinki Sch. of Econ., Runeberginkatu 22-24, Helsinki, 00100, Finland, juneja@hkkk.fi, *Ari Vepsalainen*

The move to global distribution - national units being replaced by a few distribution centers - is limited by the existing market institutions, company, customers, channel members and competitors. We study the evolving institutional relationships and their impact on demand and distribution systems. Both corporate and country-based constraints are discussed.

3) **The Benefits of Postponement - Revisited**, *Yossi Aviv*, Columbia Univ., Grad. Sch. of Bus., 419 Uris Hall, New York, NY 10027, ya14@columbia.edu, *Awi Federgrun*

We characterize the benefits of postponement or delayed differentiation strategies in a setting where the parameters of future demand distributions become known progressively with increased precision on the basis of observed sales data. We show how the benefits extend beyond those explained in earlier studies.

MC24 Marketing I
Contributed Session

Chair: Jie Pan, St. Joseph's Univ., Dept. of Math. & Comp. Sci., Philadelphia, PA 19131-1395, jpan@sju.edu

1) **Game Theoretic Models of Research Incentives for Developing Health Claims**, *Jie Pan*, St. Joseph's Univ., Dept. of Math. & Comp. Sci., Philadelphia, PA 19131-1395, jpan@sju.edu, *Nancy M. Childs*

The Nutrition Labeling and Education Act permits the use of approved health claims on food labels. We construct game theoretic models with and without market exclusivity for a new health claim. Under some economically reasonable assumptions, the existence and uniqueness of a Nash equilibrium for each of the models are analyzed.

2) **Relative Performance as a Strategic Commitment Mechanism**, *Amit I. Pazgal*, Northwestern Univ., Kellogg Grad. Sch. of Bus., 2001 Sheridan Rd. # 576, Evanston, IL 60208, pazgal@nwu.edu, *Nolan Miller*

Can managers' personality traits be of use to profit maximizing firm owners? We investigate the case where managers have a variety of attitudes toward relative performance that are indexed by their type. We consider 2-stage games where profit maximizing owners select managers in the first stage and these managers, knowing each other's types, compete in a duopoly game in the second stage...

3) **Channel-Based Pricing of High Technology Volume Goods**, *Kaij E. Karrus*, Helsinki Sch. of Econ. & Bus. Admin., Runeberginkatu 22-24, Helsinki, 00100, Finland, karrus@hkkk.fi, *Ari Vepsalainen*

High technology volume goods such as PCs face eroding prices and margins. Suppliers choice of price quotation strategy, from daily to semi-annual, for different channels (single or multi-brand retailers, direct selling) is studied. Implications for life cycle pricing and product generation roll-over are discussed.

4) **Mathematical Model for Product Launch**, *Vijay Gupta*, Temple Univ., MSOM Dept., Sch. of Bus. & Mgmt., Philadelphia, PA 19122, vgupta@sbm.temple.edu

While launching a new commodity product in the competitive market, a major decision the companies have to make is about the time and quantity to launch in a particular place. This decision becomes very important because it helps the companies in maintaining their competitive edge over the competition and in maximizing the revenues while not exceeding the limited production capacity...

MC25 Nonparametric Statistics in Marketing: Recent Developments

Cluster: Statistics & Reliability
Invited Session

Chair: Kirthi Kalyanam, Santa Clara Univ., Mktg. Dept., 121 St. Joseph's Hall, Santa Clara, CA 95053, kkalyanam@scu.edu

1) **A Nonparametric Investigation into the Differential Consumer Response to Price & Deal-Discounts**, *Richard A. Briesch*, NYU, Mktg. Dept., MC 0259, Stern Sch. of Bus., New York, NY 10012, rbriesch@stern.nyu.edu, *Pradeep Chintagunta*, *Rosa L. Matzkin*

There is some debate in marketing whether or not consumers respond differently to temporary price changes and permanent price changes. Further, the shape of consumer response to temporary price changes is not known. We investigate both issues using a variety of flexible estimation techniques and several different data sets.

2) **Identifying Latent Relationships in Marketing: Nonparametric Estimation of Binary Latent Regression**, *Thomas Shively*, Univ. of TX, CBA 5.202, MSIS Dept., Austin, TX 78712, shively@mail.utexas.edu, *Greg M. Allenby*, *Robert Kohn*

We develop a nonparametric hierarchical Bayes random effects profit model and apply it to a conjoint study of a motor boat engine. The respondent coefficients are assumed to be related to demographic variables such as age and income through unknown functions. The unknown functions are estimated using polynomial smoothing splines.

3) **Semiparametric Models for Parameter Heterogeneity**, *Peter Lenk*, Univ. of MI, Bus. Sch., Ann Arbor, MI 48109-1234, plenk@umich.edu

Hierarchical Bayes models explicitly recognize variation in individual-level parameters by assuming that these parameters vary across the population according to a specified distribution. Model identification is difficult because individual-level parameters are not observable. Semiparametric techniques are developed to confirm the adequacy of the model and to provide robust inferences.

4) **Estimating Irregular Pricing Effects: A Stochastic Spline Regression Approach**, *Kirthi Kalyanam*, Santa Clara Univ., Mktg. Dept., 121 St. Joseph's Hall, Santa Clara, CA 95053, kkalyanam@scu.edu, *Thomas Shively*

Markets respond to prices in complex ways. The result is market response functions that are frequently non-monotonic and irregular. We use a stochastic spline regression approach within the framework of a hierarchical Bayes model that permits the estimation of irregular pricing effects and apply the approach to several data sets.

MC26 Global Optimization

Sponsor: Applied Probability Section
Sponsored Session

Chair: Jim Calvin, NJIT, Dept. of Comp. & IS, Newark, NJ 07102-1982, calvin@cis.njit.edu

1) **Bayesian Heuristic Approach to Discrete & Global Optimization**, *Audris Mockus*, Bell Labs., Lucent Tech., 1000 E Warrenville Rd., 1G-361, Naperville, IL 60566-1444, *Jonas Mockus*

We describe ways to speed up the search in a discrete optimization problem by combining several heuristics. The Bayesian heuristic approach defines an a priori distribution on a set of heuristic decision rules and continuously updates decision probabilities while solving a problem. We use examples to illustrate how any heuristic can be improved by mixing it with other decision rules.

2) **An Application Development System for Lipschitz Global Optimization**, *Janos D. Pinter*, Pinter Consulting Services, 129 Glenforest Dr., Halifax, Nova Scotia, B3M 1J2, Canada, pinter@tuns.ca

Global optimization is aimed at finding the best solution of decision models in the (possible) presence of multiple local solutions. The program system Lipschitz global optimization serves to solve global optimization problems under very general structural assumptions: this generality makes possible its application to a wide range of general optimization problems...

3) Visualization of Search by Means of Multidimensional Scaling, *Antanas Zilinskas*, Inst. of Math. & Informatics, Akademijos str.4, Vilnius, LT2600, Lithuania

The visualization of optimization processes is important to understand the strategies of global search. The visualization by means of 2-dimensional scaling is based on global minimization of a stress function, which expresses the difference of the structures of multidimensional and 2-dimensional sets. The features of stress function are analyzed...

4) A New Bound on the Average Complexity of Optimization on the Weiner Space, *Jim Calvin*, NJIT, Dept. of Comp. & IS, Newark, NJ 07102-1982, calvin@cis.njit.edu

This presentation is concerned with the average behavior of global minimization algorithms under the Wiener measure. We focus on a version of the p-algorithm, which at each step maximizes the probability that the new value falls below a threshold. To achieve an error of size h, roughly $\log(1/h)$ steps are required.

MC27 Machine Learning in Manufacturing

Sponsor: College on Artificial Intelligence

Sponsored Session

Chair: Anurag Agarwal, Kent State Univ., Coll. of Bus. & Admin., Kent, OH 44242-0001, aagarwal@kent.edu

1) Learning to Simulate, *Rahul De*, Bowie State Univ., Dept. Bus., Pub. Admin. & Econ, 0-327 MLK Bldg., Bowie, MD 20715, rahul.de@bowiestate.edu

An autonomous agent that cooperates with other agents to schedule activities on a manufacturing shop floor is considered. First, the agent has to learn the structure of the shop floor and then simulate the activities through this structure. An algorithm for learning the simulation is presented with test results.

2) Augmented Neural Networks for Job Shop Scheduling, *Anurag Agarwal*, Kent State Univ., Coll. of Bus. & Admin., Kent, OH 44242-0001, aagarwal@kent.edu, *Varghese S. Jacob, Hasan Pirkul*

An augmented neural network approach is used for solving the mxn job shop scheduling problem. This approach integrates neural network and heuristic problem solving concepts. Results obtained using the network are compared with other competing approaches such as the Hopfield network and TS approach.

3) Real-Time Price/Delivery Date Setting in Stochastic Manufacturing, *Mohsen El Hafsi*, Univ. of CA, Anderson Grad. Sch. of Mgmt., Riverside, CA 92521-0203, mohsen.elhafsi@ucr.edu, *Erick Rolland*

We study a make-to-order manufacturing system consisting of several centers subject to failures and repairs. Our objective is to build a model that can be used as a tool for negotiating the delivery date and the price of a certain upcoming order. The model takes into account the congestion level of the shop floor at the time the order is about to be placed. Based on the workload of the centers, the model splits the order into lots...

MC28 Production/Operations Management Applications

Cluster: Integer Programming

Invited Session

Chair: Wen-Chyuan Chiang, Univ. of Tulsa, Coll. of Bus., Dept. of QM/MIS, 600 S College Ave., Tulsa, OK 74104-3189, qm_wc@centum.utulsa.edu

1) Optimal Commonality in Component Design, *Margaret L. Brandeau*, Stanford Univ., IE/EM Dept., Stanford, CA 94305-4024, brandeau@stanford.edu

We consider a manufacturing process with products built to order and components built to stock. The problem is to determine how many unique variants of a component to produce and which features to include in each variant. We present an optimal solution methodology and a heuristic, along with computational results.

2) An Adaptive Resource-Constrained Project Scheduler, *Dan Zhu*, Univ. of IA, Dept. of MS, Coll. of Bus. Admin., Iowa City, IA 52242, xhu@dollar.bix.uiowa.edu

We introduce a new method to solve the project scheduling problems with multiple resource limitations. Experimental results are reported and compared with those from literature.

3) The Integrated Machine Allocation & Layout Problem, *Timothy L. Urban*, Univ. of Tulsa, QM/MIS Dept., 600 S College Ave., Tulsa, OK 74104-3189, qm_thu@centum.utulsa.edu, *Wen-Chyuan Chiang, Robert A. Russell*

The integrated machine allocation and layout problem incorporates the product assignment problem with the machine layout problem and can be formulated as a cubic assignment problem with linear side constraints. We present a mixed-integer formulation of the problem through a linearization of the objective function and develop a lower bound.

4) The Structure of Global Manufacturing Networks, *Wen-Chyuan Chiang*, Univ. of Tulsa, Coll. of Bus., Dept. of QM/MIS, 600 S College Ave., Tulsa, OK 74104-3189, qm_wc@centum.utulsa.edu, *Panos Kouvelis*

We discuss issues relevant to the structure of global manufacturing network. We present an optimization framework and discuss various heuristic approaches. Sensitivity analysis on various market-, product- and country-specific factors and the effect on the structure of the network is discussed.

MC29 Enhancement Techniques in Interior Point Methods

Cluster: Linear Programming & Related Topics

Invited Session

Chair: Amr S. El-Bakry, Rice Univ., Dept. of Comp. & Applied Math., Houston, TX 77005, elbakry@caam.rice.edu

1) Robust Linear Algebra for Interior-Point Methods, *Stephen J. Wright*, Argonne Nd. Lab., MCS Division, Argonne, IL 60439, wwwwright@mcs.anl.gov, *Joseph J. Czyzyk*

A major issue for interior-point LP software is robust solution of large linear systems constructed from the coefficient matrix and the current primal and dual slack variables. We specify these issues and discuss them with particular reference to the code PCx.

2) New Directions in Finite Termination Techniques, *Pamela J. Williams*, Rice Univ., CAAM Dept., MS 134, 6100 Main St., Houston, TX 77005-1892, pjwill@caam.rice.edu, *Richard A. Tapia, Amr S. El-Bakry*

We discuss new as well as existing approaches to finite termination in interior-point methods for LP. We also describe several modifications to existing methods with extensions to LPs with upper bounds. Numerical comparisons are presented.

3) On a Basis Identification Procedure in Linear Programming, *Erling D. Anderson*, Odense Univ., Dept. of Mgmt., Campusvej 55, Odense, DK-5230, Denmark, eda@busieco.ou.dk

We discuss the basis identification procedure implemented in the XPRESS-MP barrier code. In particular, we discuss how to exploit the problem structure to improve the efficiency of the procedure. Moreover, we discuss when to terminate the interior-point algorithm and start the basis identification.

4) Enhancing the Behavior of Interior-Point Methods via Identification of Variables, *Maria de los Angeles Gonzalez-Lima*, Univ. Simon Bolvar, Dept. Mat. Puras y Aplicadas, Apdo. 8900, Caracas, 1080-A, Venezuela, mgl@cesma.usb.ve

The behavior of primal-dual interior-point methods is affected by the variables presented in the problem. In particular, the presence of unbounded variables (and null variables) in the solution set severely hurts the performance of interior-point methods generating iterates which converge to the analytic center of the solution set. We discuss the effect of some groups of variables on the behavior of primal-dual interior-point methods...

MC30 Recent Developments in Production Scheduling I

Cluster: Scheduling

Invited Session

Chair: Chung-Yee Lee, TX A&M Univ., Dept. of IE, 238 Zachry Bldg., College Station, TX 77845, cylee@acs.tamu.edu

1) Scheduling with Fixed Delivery Dates, *Nicholas G. Hall*, OH State Univ., Dept. of MS, 1775 College Rd., Columbus, OH 43210-1399, hall.33@osu.edu, *Maseka Lesaona, Christopher N. Potts*

We consider several scheduling problems where jobs are dispatched at delivery dates which are fixed before the schedule is determined. Single and parallel machine, flowshop, jobshop and openshop environments are studied using various classical objectives. For each problem, an algorithm or proof of intractability is provided.

2) Project Scheduling with Flexible Processors, *George Vairaktarakis*, Marquette Univ., College of Bus. Admin., Milwaukee, WI 53201-1881

We consider the problem of minimizing a cost function expressed as a linear combination of the activity completion times of a project. The project network is assumed to be a tree or forest. The project activities are to be processed by processors with different flexible characteristics.

3) Scheduling Stochastic Jobs with Asymmetric Earliness & Tardiness Penalties, *X. Q. Cai*, Chinese Univ. of Hong Kong, Dept. of Systems Eng., Shatin NT, Hong Kong, *S. Zhou*

We consider a stochastic counterpart of an earliness-tardiness scheduling problem in which n stochastic jobs are to be processed on a single machine. The objective is to minimize the expectation of a weighted combination of the earliness penalty, the tardiness penalty and the flow time penalty.

4) Heuristic Algorithms for Multiple Machine Scheduling with the Objective of Minimizing Total Weighted & Unweighted Tardiness, *Bahram Alidaee*, Univ. of MS, Mgmt. & Mktg. Dept., University, MS 38677, *alidaee@busiolemiss.edu*, *Jaideep T. Naidu*, *Ed L. Gillenwater*

This study is concerned with minimization of total weighted and unweighted tardiness in single and multiple machine scheduling. New simple heuristic rules are presented, and some perturbation heuristics based on so called "noising method" and "space smoothing methods" are presented. Extensive computational experiment for comparison of solutions generated by the heuristics are presented.

MC31 Heuristics for Scheduling

Cluster: **Combinatorial Optimization**
Invited Session

Chair: **Celso C. Ribeiro**, Catholic Univ. of Rio de Janeiro, Dept. of Comp. Sci., R Marques de Sao Vicente 225, Rio De Janeiro, 22453-900, Brazil, *celso@inf.puc-rio.br*

1) Tabu Search for the Identical Parallel Machine Problem with Due Dates, *Vinicius A. Armentano*, Univ. Estadual de Campinas, FEEC-UNICAMP, CP 6101, Campinas, Sao Paulo, 13803-970, Brazil, *Denise S. Yamashita*

We present a TS approach for scheduling jobs on identical parallel machines with the objective of minimizing the mean tardiness. Diversification strategies are incorporated in the search. Computational tests are performed on problems with up to 10 machines and 150 jobs and the heuristic performance is evaluated through a lower bound.

2) Solving Large-Size Resource Constrained Project Scheduling Problems, *Peter J. Brucker*, Univ. Osnabrueck, Postfach FB6, Osnabrueck, 49069, Germany, *peter@mathematik.uni-osnabrueck.de*, *Sigrid Knust*, *Tonius Baar*

A new TS heuristic is presented for the resource constrained project scheduling problem. Furthermore, lower bounds which are based on LP-relaxations and column generation are derived. The methods are applied to benchmark problems with 60 and 90 activities. 65% of these problems have been solved optimally.

3) Multipoint Routing Algorithm for ATM Networks, *Reinaldo Vallejos*

No abstract supplied.

4) A GRASP for a Matrix Decomposition Problem in Traffic Assignment, *Celso C. Ribeiro*, Catholic Univ. of Rio de Janeiro, Dept. of Comp. Sci., R Marques de Sao Vicente 225, Rio de Janeiro, 22453-900, Brazil, *celso@inf.puc-rio.br*, *Marcelo Prais*

We describe a GRASP approach to the problem of finding the decomposition of a given traffic matrix into a sum of matrices with at most one element per row and per column, minimizing the sum of the largest element of each matrix appearing in the decomposition.

MC32 Case Studied II: Developing End-User Applications Using Optimization Modeling

Sponsor: **CSTS**

Sponsored Session

Chair: **Bjarni Kristjansson**, Maximal Software Inc., 2111 Wilson Blvd., Ste. 700, Arlington, VA 22201, *bjarnik@site.gmu.edu*

MC33 Software Demonstrations II

Sponsor: **CSTS**

Sponsored Session

Chair: **Bjarni Kristjansson**, Maximal Software Inc., 2111 Wilson Blvd., Ste. 700, Arlington, VA 22201, *bjarnik@site.gmu.edu*

1) LINDO, LINGO, WHAT'S BEST, *Mark Wiley*, LINDO Systems, Inc., 1415 N Dayton St., Chicago, IL 60622

2) Ketron Management Science, *Joseph B. Creegan*, Ketron,

1755 Jefferson Davis Hwy, Ste. 901, Arlington, VA 22202

Monday 14:45-16:15

MD01 Assessing the Railroad Market

Sponsor: **Railroad Applications SIG**
Sponsored Session

Chair: **Joseph Plaistow**, **Snavely, King, Majoros, O'Connor & Lee**, 1220 L St. NW, Ste. 401, Washington, DC 20005-4013, *jplaistow@snavely-king.com*

1) Quality Service Design & Reliable Service Marketing Using MultiRail, *Min Luo*, CONRAIL, 2001 Market St., 14-D, Philadelphia, PA 19101, *mlo@ix.netcom.com*

MultiRail is a leading railroad service design and planning tool used by almost every major railroad in North America. The proposed system will extend its capability for designing and evaluating service plans and overcome some of its inherited design limitations. It will provide not only the regular service design functionality for planning personnel, but also the capability for marketing/sales people to check and verify the available capacity...

2) Visualizing the Freight Transportation Market, *Joseph Bryan*, *Reebie Associates*, *reebieass@aol.com*

No abstract supplied.

MD02 Applications in Manufacturing & Process Industries

Cluster: **Applications**
Invited Session

Chair: **Tayfur Altioek**, Rutgers Univ., Dept. of IE, Piscataway, NJ 08855, *altioek@rci.rutgers.edu*

1) Manufacturing Calcium Carbonate (Kaolin) for Paper Mills, *Kenneth Buxton*, GA Inst. of Tech., Econ. Devel. Inst., Atlanta, GA 30332

A simulation model is developed as a design tool for current and future expansion plans for manufacturing Kaolin to be used in paper mills. The issues analyzed are production scheduling, finished storage capacity planning and equipment allocation for desired production levels.

2) Improving Melt Scheduling in Steel Manufacturing Processes, *S. David Wu*, Lehigh Univ., Mfg. Logistics Inst., 200 W Packer Ave., Mohler Lab., Bethlehem, PA 18015, *sdwl@lehigh.edu*, *Kedar S. Naphade*, *Robert H. Storer*

The ingot formation or "melt" process is the first step in many steel-making operations. This process involves melting steel and alloys for desired chemical composition, then pouring it into a variety of ingot models. Complex technological and resource constraints make the melt scheduling problem extremely challenging.

3) Automation in the Pharmaceutical Industry, *Mohsen Jafari*, Rutgers Univ., Dept. of IE, Piscataway, NJ 08855, *jafari@rci.rutgers.edu*

Pharmaceutical manufacturing systems need to be fully validated in their start-up. This is often a lengthy and costly process during which the system is not productive. We focus on issues of control and design to be studied at the initial stage of automation to shorten the validation effort in such systems.

4) Transportation Model for a Major Liquefied Natural Gas Project, *Ward Whitmore*, Yukon Pacific Corp., 1049 W 5th Ave., Anchorage, AK 99501

The Trans-Alaska Gas System will transport a minimum of 2 BSCFD of natural gas from Alaska's north slope for delivery to Asian LNG markets. A newly developed computer model combines operating and cost data for the LNG facilities and LNG tankers to allow evaluation and optimization of potential project configurations.

5) Bottleneck Analysis in Bauxite Mining & Transportation Operations, *Tayfur Altioek*, Rutgers Univ., Dept. of IE, Piscataway, NJ 08855, *altioek@rci.rutgers.edu*

A model for performance analysis and design is developed to test the capacity of a major bauxite production site. It consists of 3 major components: rail delivery of ore to plant, plant operations and port operations to ship dried ore to customers. Issues of analysis have been train scheduling, drying plant operations and capacity and ship loading performance.

MD03 Airline Yield Management I

Sponsor: **Aviation Applications Section**
Sponsored Session

Chair: Gregory L. Campbell, Decision Focus Inc., 650 Castro St., Ste. 300, Mountain View, CA 94041-2055, gregc@dfi.com

1) The Impact of Availability Control Structure on System Profitability, Christian Ternoey, Decision Focus Inc., 650 Castro St., Ste. 300, Mountain View, CA 94041, cternoey@dfi.com

Two types of availability control structure are prevalent in airline revenue management systems: pooled fare class structure and nested fare structure. Our study uses object-based simulation to estimate the impact of control structure selection on system profitability. A hybrid of the pooled and nested structures is also reviewed.

2) Path-Based Demand Forecasting at United Airlines, Anca Brad, United Airlines, 1200 E Algonquin Rd., Elk Grove Village, IL 60007, abrad@ual.com, **Ajay Singh**

Significant revenue benefits are to be derived from a path-based demand forecast at a major airline. We will discuss both the technical and business aspects of developing such a system and the challenges in making the transition from a current flight-leg-based forecast.

3) The Effect of Demand Driven Dispatch on Yield Management, Garrett J. van Ryzin, Columbia Univ., Grad. Sch. of Bus., 412 Uris Hall, New York, NY 10027, gjv1@columbia.edu, **Tuncer Ozcan**

Yield management models typically assume a fixed capacity. With demand driven dispatch, seat capacity at departure is uncertain. We investigate the effect of such flexible capacity options on the structure and behavior of traditional yield management controls.

4) Modeling Passenger Sell-Up in Airline Yield Management, Peter P. Belobaba, MIT, 77 Mass. Ave., Room 33-215, Cambridge, MA 02139, belobaba@mit.edu

Many airlines believe that the propensity for a passenger to accept a higher fare when lower fares are unavailable can be tapped to increase revenues. We use the Boeing PODS simulation model to explore questions of how this propensity can best be represented and incorporated into yield management algorithms.

MD04 Issues in Air Force & Army Operations Modeling

Sponsor: Military Applications Section
Sponsored Session

Chair: Jack M. Kloeber, Jr., Dept. of the Air Force, AFIT/ENS, 2950 P St., Bldg. 640, WPAFB, OH 45433, jkloeber@afit.af.mil

1) Modeling a Chemical Battlefield in a Theater-Level Model, Todd M. Gesling, AFIT, AFIT/ENS, WPAFB, OH 45433, **Jack M. Kloeber, Jr.**

We develop the assumptions and methodology to model chemical weapons used in the Joint Staff's Joint Warfare Analysis Experimental Prototype. We focused on the NBC principles of avoidance, detection and decontamination to model the probable use of chemical weapons by threat forces and reactions to such use by US forces.

2) Determining Economic Plausibility of Dual Manifesting Reusable Launch Vehicles & Reusable Orbital Transfer Vehicles for Replenishment, Crystal Evans, AFIT/ENS, Dept. of Op. Sci., 2950 P St., Bldg. 640, WPAFB, OH 45433, **Thomas Glenn Bailey, William P. Murdock, Jr.**

Currently, the Air Force launches military satellites on expendable launch vehicles to low earth orbit, then moves the satellites to a higher orbit. An economical alternative is to utilize reusable launch vehicles and reusable orbital launch vehicles. This concept could achieve greater savings if satellites were dual manifested.

3) Mean Value Analysis of Mobility Airfield Operations, Denny Dietz, AFIT, AFIT/ENS, 2950 P St., Bldg. 640, WPAFB, OH 45433, ddtiz@afit.af.mil

An analytical queuing network model of mobility airfield operations is developed and implemented. The airfield system is represented as a capacitated open system of multiserver queues and fork-join constructs which capture concurrent airfield flow through subnetworks of activities. Performance measures generated include system throughput, aircraft ground time and resource utilizations.

MD05 PANEL: teaching Multiobjective Decision Analysis

Sponsor: Decision Analysis Society
Sponsored Session

Chair: Craig W. Kirkwood, AZ State Univ., Dept. of Mgmt., Tempe, AZ 85287-4006, craig.kirkwood@asu.edu

1) PANEL: Teaching Multiobjective Decision Analysis, Dennis M. Buede, George Mason Univ., dbuede@gmy.edu, **James S. Dyer,** Univ. of TX, **Abe Feinberg,** CA State Univ., **James C. Felli,** Naval Postgraduate Sch., **Craig W. Kirkwood,** AZ State Univ., **Don N. Kleinmuntz,** Univ. of IL, **Gregory S. Parnell,** VA Commonwealth Univ.

This panel will consider the role of MDA in professional academic programs. Panelists will report on their experiences teaching MDA and discuss the relationship of MDA instruction to more traditional DA methods as well as the future role of MDA in academic programs.

MD06 PANEL: The Role of OR/MS in MBA Programs

Cluster: Education in OR/MS
Invited Session

Chair: Wayne L. Winston, IN Univ., Sch. of Business, Room 570, Bloomington, IN 47405, winston@big.bus.indiana.edu

1) PANEL: The Role of OR/MS in MBA Programs, Wayne L. Winston, IN Univ., winston@big.bus.indiana.edu, **Samuel E. Bodily,** Univ. of VA, **Ellen S. Jordan,** Tiffin Univ., **Arnold Barnett,** MIT

Participants will discuss how OR/MS impacts aspects of the MBA program beyond the particular required or elective course taken by students. In particular, participants will discuss how OR/MS ideas can (favorably) impact the teaching of other disciplines such as finance and marketing.

MD07 Recent Advances in Pull Systems

Sponsor: MSOM

Sponsored Session

Chair: Valerie Tardif, Univ. of TX, Grad. Program in OR/IE, Austin, TX 78712-1063, vtardif@mail.utexas.edu

1) Dynamic Make-to-Stock Scheduling to Minimize Loss, Mark P. Van Oyen, Northwestern Univ., IE/MS Dept., 2225 N Campus Dr., Evanston, IL 60208-3119, vanoyen@iems.nwu.edu, **Eungab Kim**

We model the scheduling of a shared machine with setup costs, no backordering and lost sales penalties. These insights are used to construct an effective heuristic policy for dynamically scheduling a machine shared by 2 production lines with a CONWIP release policy. The heuristic can be precomputed using analytical expressions.

2) Beyond Kanban: Creating & Analyzing Lean Shop Floor Control Policies, Stanley B. Gershwin, MIT, OR Ctr., Cambridge, MA 02139, **Asbjorn M. Bonvik**

We present a unified view of some common shop floor control policies for repetitive manufacturing, including kanban, basestock and CONWIP control. This view focuses on the patterns of information flow in systems controlled by these policies. By combining the information flows from several policies, new hybrid policies can be created. These policies can attain the same throughput and service levels as traditional policies...

3) A Flexible CONWIP Control Strategy for a Job Shop, Sarah M. Ryan, Univ. of NE, 175 Nebraska Hall, Lincoln, NE 68588-0518, smryan@unlinfo.unl.edu, **Fred Choobineh**

Applying a CONWIP control policy to a job shop requires determining both the overall WIP allowed in the shop and its allocation among products. We use an approximate queuing network performance analysis to design a flexible allocation of WIP to product classes that responds to competing demands.

4) Adaptive Pull Systems, Valerie Tardif, Univ. of TX, Grad. Program in OR/IE, Austin, TX 78712-1063, vtardif@mail.utexas.edu, **Lars Maaseidvaag**

When a company experiences variations in supply and demand, determining good static kanban levels is difficult. We investigate the problem of initially determining, and dynamically readjusting, kanbans to match current operating conditions and thus improve performance. We discuss the pros/cons of such an approach and present simulation results.

MD08 Manufacturing Marketing Interfaces

Sponsor: MSOM

Sponsored Session

Chair: Susan A. Slotnick, SUNY, Harriman School, 317 Harriman Hall, Stony Brook, NY 11794-3775, slotnick@pegasus.har.sunysb.edu

1) The Impact of Manufacturer-Supplier Relationships on Adoption of Technological Advancement in the Automobile Industry, Leslie Olin Morgan, Univ. of UT, David Eccles Sch. of

Bus., Salt Lake City, UT 84112, mgtlm@business.utah.edu

We explore the impact of the manufacturer-supplier relationship on the manufacturer's decision to adopt an advanced mechanization technology. Both the manufacturer and supplier firms' positionings in the marketplace (in terms of target markets and competitive advantage) are affected by the technology adoption decision.

2) **The Role of OR Models in the Sales & Operations Planning Process**, *Susan L. Monroe*, Weyerhaeuser Fine Papers, Operations Analysis Group, 620 Lee Rd., Wayne, PA 19087, monroes@wdni.com

Over the last year Weyerhaeuser Fine Papers has implemented a sales and operations planning process in order to facilitate communications between manufacturing, sales and marketing and logistics. We look at the role of planning tools in this process.

3) **On Encouraging Marketing to Make Manufacturing Decisions When Parts Commonality Exists**, *Thomas A. Grossman*, Univ. of Calgary, 2500 University Dr. NW, Fac. of Mgmt., Calgary, Alberta, T2N 1N4, Canada, grossman@mgmt.ucalgary.ca

Manufacturers making multiple products with parts commonality might want to consider an alternative process for making product-mix decisions. Rather than using a forecast, or reacting to orders, a manufacturer could allow marketing staff to determine the final assembly mix "on the fly." This requires providing timely and comprehensible information to non-technical marketing personnel.

4) **Radical vs. Incremental Innovation: Bundling Features as Technology Advances**, *Susan A. Slotnick*, SUNY, Harriman School, 317 Harriman Hall, Stony Brook, NY 11794-3775, slotnick@pegasus.har.sunysb.edu, *Kathy A Paulson Gjerde*, *Matthew J. Sobel*

We model a firm's decisions about product and process innovation, including when to initiate development, which features to improve or change and when to introduce the new product to market. Our model maximizes the expected present value of profits and considers costs of innovation and costs of production.

MD09 SRC/NSF Initiative: Operational Methods in Semiconductor Manufacturing

Cluster: OR Applications in Semiconductor Manufacturing
Invited Session

Chair: Ronald S. Gyurcsik, Semiconductor Research Corp., 1101 Slater Rd., Brighton Hall, Ste. 120, Research Triangle Pk, NC 27703, rsg@src.org

1) **SRC/NSF Initiative: Operational Methods in Semiconductor Manufacturing**, *Ronald S. Gyurcsik*, Semiconductor Research Corp., 1101 Slater Rd., Brighton Hall, Ste. 120, Research Triangle Pk, NC 27703, rsg@src.org

The Divisions of Design, Manufacture and Industrial Innovation and Electrical and Communications Systems of the National Science Foundation and the Factory Sciences Program of the Semiconductor Research Corporation plan jointly to support research activities directed at the development of innovative new operational methods that will enable factory performance to keep pace with ongoing improvements in equipment and processes. The major theme of this initiative is the development of modeling, analysis and optimization techniques based on fundamental principles leading to factory-level models that allow for effective control of semiconductor manufacturing operations...

MD10 Facilities Location

Contributed Session

Chair: Ronald S. Tibben-Lembke, Univ. of NV, Dept. of Managerial Sci., MS 028, Reno, NV 89557, rtl@unr.edu

1) **A New Method for Large-Scale Maximum Covering Problems**, *Ronald S. Tibben-Lembke*, Univ. of NV, Dept. of Managerial Sci., MS 028, Reno, NV 89557, rtl@unr.edu, *Mark S. Daskin*

To locate facilities among N candidate locations with software capable of considering $m < N$ locations, standard methods aggregate locations. We divide the N locations into regions of size $\leq m$, solve the regions separately and combine using DP. We present computational results using actual data.

2) **Structured Uncapacitated Facility Location Problems on the Line with Applications in Production Planning**, *Vernon Hsu*, George Mason Univ., Sch. of Bus. Admin., 5F4, Fairfax, VA 22030, vhsu@gmu.edu

We consider a specially structured UFLP where potential service facilities and customers are located at n locations on the line. Our model generalized several

well-known polynomially solvable instances of the UFLP in the existing literature. We solve our model with an LP algorithm.

3) **Maximum Dispersion Location Models**, *Jay B. Ghosh*, Bilkent Univ., PO Box 292439, Dayton, OH 45429-0439, ghosh@bilkent.edu.tr, *Senay Agca*, *Burak Eksioglu*

We look at maximum dispersion location models and provide Lagrangian and other heuristics for the solution of these models. Computational comparisons are reported.

4) **ILP Model with Logic Constraints for Facility Selection**, *Hong Yan*, Hong Kong Polytech. Univ., Dept. of Mgmt., Hung Hom, Kowloon, Hong Kong, mshyan@polyu.edu.hk

We study a facility selection problem. It is formulated as a 0-1 ILP problem with logical constraints. We show how the logical constraints are embedded into an ILP model and develop the idea of partially representing the symbolic constraints into linear constraints. The effectiveness of computations under different strategies is shown.

MD11 In Tribute to Robert Herman

Sponsor: Transportation Science Section

Sponsored Session

Chair: Hani S. Mahmassani, Univ. of TX, Dept. of Civil Eng., ECJ 6.204, Austin, TX 78712, masmah@mail.texas.edu

MD12 Information Sharing in Supply Chains

Cluster: Supply Chain Operations

Invited Session

Chair: Gerard P. Cachon, Duke Univ., Fuqua Sch. of Bus., Durham, NC 27708, gpc@mail.duke.edu

1) **Value of Cost Information in a Supply Chain**, *Christopher S. Tang*, UCLA, Anderson Sch. of Mgmt., Los Angeles, CA 90095, chris.tang@anderson.ucla.edu, *Charles J. Corbett*

We analyze the value of cost information in a single-buyer single-supplier supply chain. Though the supplier will benefit from knowing the buyer's costs, the buyer is reluctant to reveal the true costs unless given an incentive. We develop an optimal supply contract that will entice the buyer to reveal the true costs.

2) **Timely Information & Delayed Differentiation**, *Sridhar R. Tayur*, Carnegie Mellon Univ., Grad. Sch. of Ind. Admin., 5000 Forbes Ave., Pittsburgh, PA 15217, stayur@grobner.gsa.cmu.edu

We study a 2-stage supply chain with a capacitated supplier and 2 customers. In presence of random demands to the customers from their end-users, we study different information sharing options at the customer-supplier interface as well as delaying differentiation at the supplier stage.

3) **Vendor Managed Inventory in a Promotional Retail Environment**, *Ananth V. Iyer*, Purdue Univ., Krannert Grad. Sch., 1310 Krannert Bldg., W Lafayette, IN 47907-1310, *Jianming Ye*

We focus on a grocery supply chain consisting of customers, stores and a warehouse. Inventory is held at each of these levels. Warehouse inventory is managed by the manufacturer. The retail store faces a promotion sensitive customer environment at their stores. Thus the retailer varies store prices to maximize profits when selling to a heterogeneous customer population with varying response to promotions. We address the role of promotion information sharing on manufacturer and retailer profits.

4) **Information & Control Issues in Supply Chains**, *Paul H. Zipkin*, Duke Univ., Fuqua Sch. of Bus., Durham, NC 27708-0120, zipkin@mail.duke.edu, *Gerard P. Cachon*

Consider a supply chain whose stages are controlled by different firms. There are several possible control schemes involving different degrees of centralization and several alternative mechanisms to transmit information about demands. We use a game-theoretic framework to compare the performance of these structures to each other and to the system-optimal policy.

MD13 Warranty Issues in New Product Development

Cluster: New Product Development

Invited Session

Chair: Izzet Sahin, Univ. of WI, Sch. of Bus. Admin., PO Box 742, Milwaukee, WI 53201, sahin@csd.uwm.edu

1) **Warranty Strategy in New Product Development**, *Wallace Blischke*, Univ. of Southern CA, Dept. of Info. & Op. Mgmt., Los Angeles, CA 90089-1421, blischke@bus.usc.edu, *D. N. P. Murthy*

Warranty has become increasingly important in today's marketplace, both as a competitive tool and quality assurance to the buyer. This has important implications regarding product reliability. We discuss warranty in the context of

new product development. Technical and commercial aspects and their interactions are considered with emphasis on strategic issues.

2) Role of Extended Service Options in Product Development, Hakan Polatoglu, Suffolk Univ., Dept. of Mgmt., Boston, MA 03108-2770, hpolatog@acad.suffolk.edu

I examine extended service contracts which cover the repair costs that are not covered under the manufacturer's original warranty. I demonstrate the use of critical performance measures, including profitability, risk-of-loss, expected cost, profit and expected cost rate in the development of service options.

3) A Dynamic Model for Optimal Design Quality Warranty Policies Including Warranty Cost, Samar K. Mukhopadhyay, Univ. of WI, Sch. of Bus. Admin., PO Box 742, Milwaukee, WI 53201, samar@csd.uwm.edu

The cost of servicing warranty is justified by increased acceptance of the product in the market. The relationship between product design activities improve quality and cost of servicing warranty are established. I present managerial guidelines for optimal quality and warranty decisions over the product life cycle.

4) Product Quality & Warranty Policy Design, Izzet Sahin, Univ. of WI, Sch. of Bus. Admin., PO Box 742, Milwaukee, WI 53201, sahin@csd.uwm.edu

The manufacturer of a new product might consider offering a more generous warranty than what prevails in the market, or it might be forced by the market to offer a more generous warranty than it could afford. I discuss the role that product quality (reliability) plays in warranty policy design.

MD14 Performance of Financial Institutions

Sponsor: Financial Services Section

Sponsored Session

Chair: Patrick T. Harker, Univ. of PA, OPIM Dept., 1300 SH-DH, Wharton Sch., 3620 Locust Walk, Philadelphia, PA 19104-6315, harker@wharton.upenn.edu

1) Economic Value Added Model to Assess Bank Performance, Paul Damien, Univ. of Michigan Bus. Sch., Ann Arbor, MI 48109-1234, pdamien@umich.edu, *Tige Savage*

A general method is developed to determine EVA for consolidated bank companies and a statistical model is developed to explain and predict market capitalization of a bank based on its EVA.

2) Drivers of Customer Satisfaction for Financial Services, Mayuram S. Krishnan, Univ. of Michigan Bus. Sch., CIS, Ann Arbor, MI 48109, mskrish@umich.edu, *Mary C. Meyer, Venkatram Ramaswamy, Paul Damien*

We discuss a full Bayesian analysis of the drivers of overall customer satisfaction, based on 1280 responses from customers of a large financial services firm. We explicitly accommodate missing data and infer the posterior distribution of the impact of these drivers across customers.

3) Process Variation as a Determinant of Service Quality & Bank Performance: Evidence from the Retail Banking Study, Frances X. Frei, Univ. of Rochester, Simon Sch. of Bus., 3-345 Carol Simon Hall, Rochester, NY 14627, frei@mail.ssb.rochester.edu, *Ravi Kalakota, Leslie M. Marx*

Conventional wisdom in retail banking states that firm performance is dependent on higher average process performance. We provide empirical evidence which demonstrates that low process variation contributed significantly to firm performance. More specifically, we examine the effect of process variation on service quality and financial performance.

4) Efficiency, Profitability & Quality in the Provision of Banking Services, Stavros A. Zenios, Univ. of Cyprus, Soteriou Sch. of Econ. & Mgmt., 75 Kallipoleos St., PO Box 537, Nicosia, CY 1678, Cyprus, zenios@wharton.upenn.edu, *Andreas C. Soteriou*

We develop a general framework for combining strategic benchmarking with efficiency benchmarking of services. Three DEA models are developed in order to implement the framework in the setting of the bank's branches: an operational efficiency model, a quality efficiency model and a profitability efficiency model.

5) Discussion, Patrick T. Harker, Univ. of PA, OPIM Dept., 1300 SH-DH, Wharton Sch., 3620 Locust Walk, Philadelphia, PA 19104-6315, harker@wharton.upenn.edu

A discussant from industry will review the key findings from the 4 papers as well as present the importance of these results in practice.

MD15 Contemporary Research in Technology & Innovation Management

Cluster: Technology Management

Invited Session

Chair: Michael K. Badawy, VA Tech., Pamplin Coll. of Bus., 7054 Haycock Rd., Falls Church, VA 22043

1) Technology Assessment: A Socio-Cognitive Perspective, Raghu Garud, NYU, Stern Sch. of Bus., Tisch Hall, Mgmt. Dept., 40 W 4th St., New York, NY 10012, rgarud@stern.nyu.edu, *David Ahlstrom*

Researchers use different approaches for assessing technologies. We develop this proposition by examining differences in approaches that "insiders" and "outsiders" use in their assessment of health care technologies. We also illustrate how the juxtaposition of these contrasting approaches creates a dynamic technological field.

2) What Do We Know About Japanese Product Development?, Jeffrey Liker, Univ. of MI, Dept. of IOE, Ann Arbor, MI 48109-2117

I summarize some of the common features of Japanese product development, as well as point to what may be significant company differences. This talk is based on my own research as well as a broader review of the literature.

3) IC2 Institute's Innovative MS Degree Program: Lessons Learned in Year Two, Barbara Fossum, Univ. of TX, IC2 Institute, 2815 San Gabriel Ave., Austin, TX 78705, exec.ms@icc.utexas.edu, *David L. Gibson*

IC2 Institute, the University of Texas at Austin's degree program in Science and Technology Commercialization has benefited from 2 years of "experimental learning." We discuss how this commercialization projects being a central part of the degree program.

4) Some Research in the Management of Innovation, Michael K. Badawy, VA Tech., Pamplin Coll. of Bus., 7054 Haycock Rd., Falls Church, VA 22043

Some research issues in the field of MOT and innovation are identified. Directions for future research is explored.

MD16 Computational Approaches to Strategy & Evolution

Sponsor: College on Organization Science

Sponsored Session

Chair: Kathleen M. Carley, Carnegie Mellon Univ., Dept. of Social & Dec. Sci., Pittsburgh, PA 15213, kathleen.carley@centro.soar.cs.cmu.edu

1) Dynamic Design: Organizational Adaptation in a Changing Environment, Kathleen M. Carley, Carnegie Mellon Univ., Dept. of Social & Dec. Sci., Pittsburgh, PA 15213, kathleen.carley@centro.soar.cs.cmu.edu

Due to rapid technological, institutional and legal changes, organizations face changing environments. Can organizations adapt and improve their performance in dynamic environments? This issue is explored using a computational model employing adaptive agent techniques in which the organization anneals its performance in response to and in anticipation of environmental changes.

2) Agent-Based Models of Firm Formation & Growth: Some Elaborations, Robert Axtell, Brookings Institution, Economic Studies Program, 1775 Massachusetts Ave. NW, Washington, DC 20036, raxtel@brook.edu

Drawing on the basic Epstein/Axtell approach to growing artificial societies, I develop a model of firm formation and growth, discuss various strengths and weakness of existing approaches to such models and suggest several extensions of the current models.

3) Why Spin Glass Theory & Genetic Algorithms Matter for Strategy, Erhard Bruderer, Univ. of MN, Carlson Sch. of Mgmt., 271-19th Av S, Minneapolis, MN 55455, brude001@maroon.tc.umn.edu

I will outline how spin-glass theory gives us insights into the formation of business alliances. I then discuss how GAs are used to better understand organizational evolution and show how those models can be made more accessible to social scientists over the Internet.

4) A Theorist's Take on the Role of Computer Experimentation in Social Science, Michael Ryall, Univ. of Rochester, Simon Grad. Sch. of Bus., Rochester, NY 14627, mryall@ucla.edu

I examine the validity of computer experimentation as a form of social science, specific benefits and how the limitations of these new techniques are contrasted with those of more traditional scientific methods. I suggest quality yardsticks by

which to gauge computational research and identify pitfalls typically encountered by first-time modelers.

5) Microstate Modeling as a Basis of Macro Organizational Analysis, Bill McKelvey, UCLA, The Anderson Sch., 110 Westwood Plaza, Los Angeles, CA 90095-1481, mckelvey@anderson.ucla.edu

The use of adaptive learning models and idiosyncratic microstates for the purpose of modeling emergent organizational structure in a competitive context is discussed. Particular attention is paid to joint micro- and macro-coevolutionary analysis. Kauffman's NKC model is reviewed as one example of an approach attempting both levels of organizational analysis.

MD17 Health Care Applications in Canada

Sponsor: Health Applications Section

Sponsored Session

Chair: Michael W. Carter, Univ. of Toronto, Dept. of Mech. & IE, 5 King's College Rd., Toronto, Ontario, M5S 3G8, Canada, carter@mie.utoronto.ca

1) Impact of Data Quality on Intelligent Systems: The Coding Obstetrics Database Experiment Project, Amy Fish, Univ. of Toronto, Dept. of Mech. & IE, 5 King's College Rd., Toronto, Ontario, M5S 3G8, Canada, afish@torhosp.utoronto.on.ca

The purpose of the CODE was to see if ICD9-CM coding could be done through a database at the point of care, bypassing the need for a coding clerk. Expert coders worked with a programmer to develop a series of algorithms to code "simple" labor and delivery cases and route the more complex cases to a coding clerk for review. Results of a 3-month pilot showed that while the system was technically accurate, the data being fed was incomplete and/or inaccurate 51% of the time...

2) A Goal Programming Approach to Resource Allocation in Acute Care Hospitals, John Blake, Univ. of Toronto, Dept. of Mech. & IE, 5 King's College Rd., Toronto, Ontario, M5S 1A4, Canada, blake@prim.rose.utoronto.ca, Michael W. Carter

In an era of decreasing funding, hospitals must make the best possible use of their resources. We discuss a model for allocating resources in acute care hospitals that satisfies the economic and clinical goals of both the hospital and its medical staff. Results from a practical application at Toronto's Mt. Sinai Hospital will be presented.

3) A Benchmark Study of Hospital Supply Systems, Sophie D. Lapiere, GERAD/Ecole Polytech., Dept. of Math. & IE, CP 6079, Succ. Centre-ville, Montreal, Quebec, H3C 3A7, Canada, sophiel@crt.umontreal.ca, Ivan Dacosta Claro, Jacques Fontaine, Gilles St-Laurent

We describe a study of Quebec hospital purchasing departments and look at their current supply strategies. The importance of performance indicators in improving this supply process is discussed. We present a set of performance measurements which we have developed to benchmark a hospital's supply activities with those of other institutions.

4) A Tabu Search Heuristic for the Emergency Medical Service Vehicle Location Problem, Gilbert Laporte, Univ. de Montreal, CRT, CP 6128, Succ. Centre-ville, Montreal, Quebec, H3C 3J7, Canada, gilbert@crt.umontreal.ca, Michel Gendreau, Frederic Semet

We present a TS approach for locating EMS vehicle bases. We first give a new covering location model where the objective is to maximize the proportion of the demand which is covered by at least 2 vehicles. Numerical results are presented.

MD18 Quality Management I

Cluster: Quality Management

Invited Session

Chair: Kingshuk K. Sinha, Univ. of MN, 271 19th Ave S, Minneapolis, MN 55455, ksinha@csom.umn.edu

1) An Overview of Research on Quality Management at the University of Minnesota, Roger G. Schroeder, Univ. of MN, 332 M&E Bldg., Carlson Sch. of Mgmt., Minneapolis, MN 55455, rschroeder@csom.umn.edu

The Quality Leadership Center was established in 1994 with the mission of accelerating research and teaching in the area of quality management at the University of Minnesota. An overview of the content of the ongoing research program, including 12 different projects - 3 of which are NSF funded - are presented.

2) Identifying & Understanding Best Practice in Chronic

Disease Management, Sandra Potthoff, Univ. of MN, Carlson Sch. of Mgmt., 420 Delaware St. SE, Box 97, Minneapolis, MN 55455, pott001@tcc.umn.edu

This research uses DEA, followed by physician decision making and clinic level analyses to identify and understand the treatment of adult type II diabetes. DEA is used to identify best practice physicians and clinics. Understanding what leads to best practice then is studied by practicing physicians and clinics on the frontier for in-depth analyses.

3) Examining the Impact of Work Teams on Yield Variability: A Field Study, Joy Field, Univ. of MN, Carlson Sch. of Mgmt., 271 19th Ave. S, Minneapolis, MN 55455, jfield@csom.umn.edu

We empirically examine the impact of work teams on yield variability using data from 4 production lines in 1 plant. Results indicate that yield variability is reduced significantly after the implementation of work teams. The development of a theoretical framework for understanding their relationship aids in interpretation of the results.

4) Quality Management in Electronic Business-to-Consumer Services, Gregory R. Heim, Univ. of MN, Carlson Sch. of Mgmt., 271 19th Ave. S, Minneapolis, MN 55455, gheim@csom.umn.edu

We introduce a framework underlying business-to-consumer services in electronic commerce. We use the framework to develop theoretical constructs and measurement instruments of service quality for these services. Theory is developed about quality to be tested empirically as drivers of electronic business-to-consumer service quality.

MD19 Intermediaries in Electronic Markets

Cluster: Electronic Commerce

Invited Session

Chair: Sulin Ba, Univ. of Southern CA, Marshall Sch. of Bus. Admin., Dept. of IOM, Los Angeles, CA 90089-1421, sulin@rcf.usc.edu

1) The Importance of Intermediation in Electronic Markets, Charles Steinfield, MI State Univ., Dept. of Telecomm., E Lansing, MI 48824-1212

Contrary to expectations of electronic commerce enthusiasts, electronic markets will generally require as much intermediation than traditional markets. Anecdotal evidence for this abounds in the form of the emergence of a range of new intermediaries. A theoretical framework and propositions regarding the role of intermediaries in electronic markets are discussed.

2) Intermediaries in Cloud-Computing: A New Computing Paradigm, Ramnath Chellappa, Univ. of TX, Ctr. for Res. on Elect. Comm., MSIS Dept., Grad. Sch. of Bus., Austin, TX 78712, ram@cism.bus.utexas.edu

Computing has evolved from a main-frame-based structure to a network-based architecture. While many terms have appeared to describe these new forms, the advent of electronic commerce has led to the emergence of "cloud computing." This work aims at analyzing the role of agents and intermediaries enabling this framework.

3) Comparison Agents on the Web, Dave King, Comshare, Inc., dave@comshare.com

Business-to-consumer commerce on the WWW offers buyers an unprecedented opportunity to "comparison" shop. To save buyers the pain of searching across the Web, software agents provide the means to automate the process. We review the technology's underlying "comparison" agents and examine commercial and research products that provide this functionality.

4) Profit-Oriented Knowledge Brokering, Sulin Ba, Univ. of Southern CA, Marshall Sch. of Bus. Admin., Dept. of IOM, Los Angeles, CA 90089-1421, sulin@rcf.usc.edu

A new organizational construct, the knowledge broker, motivated by organizational goals of profit maximization and enabled by the technological development in electronic commerce, is introduced as a profit-oriented intermediary to manage organizations' knowledge resources. It will enable organizations to carry out value-added "knowledge-rich" transactions in the electronic marketplace.

MD20 State-of-the-Art Information Technology Metrics

Cluster: State-of-the-Art in Information Technology

Invited Session

Chair: Sandeep Puroo, GA State Univ., CSI Dept., Atlanta, GA 30302-4015, spuroo@gsu.edu

1) Complexity in Information Systems, Scott Scheberger, Univ. of Western Ontario, Ivey Sch. of Bus.y, 1151 Richmond St. N, London, Ontario, N6A 3K7, Canada, sschene@ivey.uwo.ca

With the rapid movement from centralized IS architectures to distributed architectures (including client/server), businesses face serious technical and managerial challenges, dealing with inherent system complexity. Uncontrolled complexity can lead to runaway system development, infrastructure, software maintenance, testing, training, personnel and user support costs. IS complexity factors are discussed.

2) **Metrics in Object-Oriented World, Rajendra K. Bandi**, GA State Univ., Dept of CIS, PO Box 4015, Atlanta, GA 30302-4015, rbandi@gsu.edu

We focus on describing the current research directions in the area of metrics for object oriented systems. IT covers the issues of the why and how of differences between object oriented metrics and metrics for traditional systems. IT also highlights the areas in which gaps exist in terms of research efforts.

3) **An Organizing Framework for Object-Oriented Metrics, Sandeep Purao**, GA State Univ., CSI Dept., Atlanta, GA 30302-4015, spurao@gsu.edu

We suggest a framework for object oriented metrics comprised of 3 dimensions. The 1st dimension, internal is derived from measurement theory. The 2nd, external is based on the goal-question-metric paradigm. The last specifies the subject, the system development process. The framework has been used to classify current research.

4) **Quality Measures for Agent-Assisted Computing, Srinivas Vuppuluri**, Univ. of IL, MIS Dept., Springfield, WI, vuppuluri@uis.edu

An agent-assisted system is an extension of an object oriented system. An agent is a knowledge-based entity that exhibits reactive and proactive behaviors, and immobile in a specified domain. Such an agent can effect various changes at different sites in the domain which raises the issues of how such changes can be detected, monitored and, if necessary, reversed. Additional concerns arise about the traceability of agent actions and the bounds on its autonomy...

MD21 Theoretical Foundations of MMT VII

Cluster: Management of Medical Technology

Invited Session

Chair: Joseph Tan, Univ. of British Columbia, Dept. Healthcare/Epidemiology, Fac. of Med., 5804 Fairview, Vancouver, BC, V6T 1Z3, Canada, joseph@unixg.ubc.ca

1) **MMT: Management of Health Information Systems in Primary Care, Joseph Tan**, Univ. of British Columbia, Dept. Healthcare/Epidemiology, Fac. of Med., 5804 Fairview, Vancouver, BC, V6T 1Z3, Canada, joseph@unixg.ubc.ca, **Douglas Lee**

Health management ISs have numerous applications that can be used to improve primary care. We present a framework to organize these applications along various organizational levels and the activities of service providers. Health management ISs can operate on a mix of these levels to improve communication and integration between activities of service providers in areas of administration, communication, education and clinical care...

2) **Fuzzy Front-End Issues in Medical Technology Development, David Wilemon**, Syracuse Univ., Innovation Mgmt. Program, Sch. of Mgmt., Syracuse, NY 13244-2130, dwilemon@som.syr.edu

Determining what products to develop is a complex, difficult task. In the medical technology area exacting performance requirements, user preferences, switching costs and the pressure for cost containment make early product definition particularly challenging. We focus on a few "front-end" research methodologies which can help guide the definition and development of new medical technology products...

MD23 Decision Analysis I

Contributed Session

Chair: Sam Dennis, Belmont Univ., Massey Grad. Sch. of Bus., 1900 Belmont Blvd., Nashville, TN 37212, denniss@belmont.edu

1) **On Ratios of Proportions in Tree-Structured Experiments, Sam Dennis**, Belmont Univ., Massey Grad. Sch. of Bus., 1900 Belmont Blvd., Nashville, TN 37212, denniss@belmont.edu

This presentation concerns the calculation of Bayes estimators of ratios of proportions in tree-structured experiments having multinomial-type sampling schemes. An illustrative numerical example concerning an analysis of a simple tree-structured mortality model for medical patients who have suffered an acute myocardial infarction (heart attack) is also included.

2) **Public & Private Policy Analysis Using the SUFG Motor Model Optimizer, Kevin L. Stamber**, Purdue Univ., State Utility Forecasting, 1293 Potter Ctr., Rm. 334, W Lafayette, IN 47907-1293,

stamber@ecn.purdue.edu

SUFG uses an end-use model to forecast electricity demand by industrial motors. The model's optimization subroutine can be useful to public and private sources, such as motor manufacturers who wish to market share. We examine economic scenarios to graphically define the frontiers at which purchasing options compete.

3) **On the Maximum Number of Feasible Ranking Sequences in a Multi-Criteria Decision Making Problem, Bo Shu**, LA State Univ., Dept. of IE, 3134 CEBA Bldg., Baton Rouge, LA 70803-0001, bshu@unixl.sncc.lsu.edu, **Evangelos Triantaphyllou**

In a deterministic MCDM problem with fixed performance values for the N alternatives and changeable criteria weights, the rankings of the alternatives change accordingly. Intuitively, one expects that the maximum number of all possible rankings is at most equal to N! However, we demonstrate that the actual number of rankings is much smaller.

4) **Value Function Analysis, Jonathan Barzilai**, Dalhousie Univ., PO Box 1000, Halifax, Nova Scotia, B3J 2X4, Canada, barzilai@tuns.ca

We demonstrate fundamental difficulties with the common use of decomposition of criteria for assessing value functions.

MD24 Marketing II

Contributed Session

Chair: Manfred Krafft, Univ. of Kiel, Chair of Mktg., Olshausenstrasse 40, Kiel, D-24098, Germany, krafft@bwl.uni-kiel.de

1) **Scheduling Sales Effort Reserved for Long-Term Customers, Ben S. Liu**, Univ. of IL, 328C Kinley Hall, Urbana, IL 61801, bliu3@ux6.cso.uiuc.edu, **Nicholas C. Petrucci, D. Sudharshan**

We develop an optimal time-phased allocation of sales effort to a customer who makes repeat purchases. Given that a customer's purchases are periodic and are influenced by a weighted average of the current and cumulative past sales effort provided, we prioritize when sales effort should be concentrated to maximize profit.

2) **Salesforce Incentive Schemes & Consumer Interfaces, Ajay Kalra**, Carnegie Mellon Univ., Grad. Sch. of Ind. Admin., Pittsburgh, PA 15213, kalra+@andrew.cmu.edu, **Mengze Shi, Kannan Srinivasan**

Existing literature has primarily examined alternative salesforce incentive schemes with the objective of inducing optimal salesforce effort. We examine this problem in markets with asymmetric information where consumer response function is based on sales effort and quality inferences. The sales agent knows the quality of the product whereas the consumer does not...

3) **A Dynamic Model of Everyday Low Pricing, Subramanian Balachander**, Clark Univ., Grad. Sch. of Mgmt., 950 Main St., Worcester, MA 01610, sbalachander@clarku.edu

We provide a market-based rationale for everyday low pricing in a competitive setting. We consider dynamic competition between 2 retailers and obtain an equilibrium in which one retailer commits to an EDP strategy while the other pursues hi-lo strategies.

4) **Team Selling: Emerging Issues in Team Compensation & Control, Manfred Krafft**, Univ. of Kiel, Chair of Mktg., Olshausenstrasse 40, Kiel, D-24098, Germany, krafft@bwl.uni-kiel.de, **Deepak Agrawal**

Issues of compensation and control of teams in personal selling are examined through within company, within industry and across industry surveys of US-based organizations. Research questions, hypotheses, research design and sampling plans are presented. Implications for further theory development are also discussed.

MD25 Adaptive Maintenance Policies

Cluster: Statistics & Reliability

Invited Session

Chair: John G. Wilson, Wake Forest Univ., Babcock Sch. of Mgmt., Box 7659 Reynolds Station, Winston-Salem, NC 27109, john_wilson@mail.mba.wfu.edu

1) **On Some Models of Minimal Repair & Maintenance, Shey-Huei Sheu**, Natl. Taiwan Inst. of Tech., Dept. of Indust Mgmt., Taipei, Taiwan, ROC, **William S. Griffith**

We review some minimal or imperfect repair models, indicate some connections with other models such as shock models and make some extensions to a case where there is a random learning effect. A maintenance model is studied when

the type of repair (perfect or minimal) depends on the type of failure.

2) A Generalized Age Replacement Policy with Random Leadtime, Shey-Huei Sheu, Natl. Taiwan Inst. of Tech., Dept. of Indust Mgmt., Taipei, Taiwan, ROC, Ta-Mou T. Chen

A generalized age replacement policy with age-dependent minimal repair and random leadtime is considered. A model for the expected cost per unit time based on the stochastic behavior of the assumed system, reflecting the cost of storing a spare as well as the cost of system downtime is developed. The determination of the minimum cost policy time is described and illustrated. As the model and its analysis are general, several exiting results are shown to be subsumed by the defined model.

3) Bayesian Minimal Repair Policy During Warranty Internal, Elmira Popova, Univ. of TX, OR/IE Group, Dept. of Mech. Eng., ETC 5.120, Austin, TX 78712, elmira@mail.utexas.edu

A fixed length warranty period is assumed in this paper. A maintenance policy which consists of minimal repair and preventive maintenance is analyzed for the case of known and unknown failure parameters of the item's lifetime distribution. For the 2nd case, tow types of Bayesian policies are proposed. An extensive simulation study comparing the performance of these maintenance policies is performed.

MD26 Performance Issues in Communication Networks

Sponsor: Applied Probability Section

Sponsored Session

Chair: Takis Konstantopoulos, Univ. of TX, ECE Dept., Austin, TX 78712, takis@alea.ece.utexas.edu

1) Measuring Quality of Service: Algorithms & Implementation, Stephan Robert, Univ. of CA, EECS Dept., Berkeley, CA 94720, Matt Siler, Jean Walrand

A communication network can use traffic and resource measurements to improve its operations and satisfy user QoS requirements. We discuss what the network should measure and how it can measure it. We study estimation algorithms that take hardware limitations into account. These limitations are on the processing speed and on the register space of the monitoring system.

2) Representing Capacity for Routing in Large-Scale Networks, Gustave De Veciana, Univ. of TX, ECE Dept., Austin, TX 78712, Michael Montgomery, W. Yang

We introduce and contrast 2 approaches to represent the available capacity of a subnetwork with a view on advertising the network state for hierarchical source routing algorithms. The first combines prediction with topology approximation while the second deals with an implicit notion of congestion, potentially useful for high-level adaptive routing.

3) The Constant Bit Rate Channel in Wired Broadband Networks, George Kesidis, Univ. of Waterloo, E&CE Dept., Waterloo, Ontario, N2L 3G1, Canada

A backbone B-ISDN focuses on a CBR and lightweight best-effort services. We describe an input-queued switch with a guaranteed-rate property using Slepian-Duguid connection-level fabric arbitration and hierarchical round-robin scheduling. Best-effort services are designed for IP traffic. The guaranteed-rate property is extended to cover end-to-end network properties over CBR channels.

4) Broadcast-Based Information Delivery to Massive User Populations, Leandros Tassiulas, Univ. of MD, EE Dept., College Park, MD 20742, Chi-Jiun Su

Broadcast data delivery is an efficient way of distributing information to a large user population in an asymmetric communication environment where traditional client-to-server communication is infeasible. Major issues discussed are scheduling the data on the broadcast channel so as to minimize the average latency of user's requests and user's memory management...

MD27 Fuzzy Sets & Fuzzy Decision Systems

Cluster: AI & OR Techniques in Project Management Decision Analysis
Invited Session

Chair: Augustine O. Esobue, GA Inst. of Tech., School of ISyE, 225 North Avenue, Atlanta, GA 30332-0205, augustine.esobue@isye.gatech.edu

1) Some Intelligent Control Applications to Manufacturing, Augustine O. Esobue, GA Inst. of Tech., School of ISyE, 225 North Av, Atlanta, GA 30332-0205, augustine.esobue@isye.gatech.edu

Fuzzy control has proven effective for complex, nonlinear, imprecisely-defined processes for which standard control models are either inefficient or impractical. Advances in manufacturing and computer technology have created a large number of complex computer-integrated manufacturing systems which can

benefit from the integration of fuzzy logic, neural networks and optimization techniques.

2) Fuzzy Sets, Fuzzy Relations & Economic Predictions, Benjoe A. Julianoo, Coastal Carolina University

Experienced economists often express imprecise but highly relevant economic predictions in vague terms. The applicability of fuzzy sets and fuzzy relations in economics is presented. The approach simplifies the process of expressing knowledge from expert economists facilitating the design of DSS for economic predictions.

3) Classification of Uncertainty in Information Warfare, Pamela McCauley-Bell, Univ. of Central FL, Dept. of IE/MS, PO Box 160450, Orlando, FL 32816-2450, bell@iems.engr.ucf.edu

We discuss a methodology for uncertainty management in IW and define a high level model for information classification within IW. The uncertainty is characterized as one of three types: nonspecificity, discord/strife or fuzziness. An approach for obtaining the corresponding linguistic values and numeric representations is presented.

4) Database Mining Supported by Approximate Reasoning Techniques, Lawrence J. Mazlack, Univ. of Cincinnati, Cincinnati, OH 45221, mazlack@uc.edu

Database mining seeks to recognize previously unknown, interesting information in a database. A computational approach to unguided discovery is explored. It is based on identifying relationships having the most information value. Both crisp and non-crisp data are subject to discovery. There is a concern with coherent, understandable results and methods.

5) Modeling Imprecision in Design & Manufacturing Using Fuzzy Possibilistic Programming, Giovanni Perrone, Univ. of Palermo, Dept. of Prod. & Mech. Tech., Viale Delle Scienze, Palermo, 90128, Italy, R. Young

The contribution of this paper is to generate an optimal, possibly locally optimal, solution to the hierarchical design problem using fuzzy possibilistic programming. The solution is optimized using a genetic algorithm in terms of both the value of its fuzzy sets and the level of imprecision of each fuzzy set.

MD28 Applications of Integer Programming in Scheduling

Cluster: Integer Programming

Invited Session

Chair: Renato E. de Matta, Univ. of IA, Coll. of Bus. Admin., 108 PBAB, Iowa City, IA 52242, renato-dematta@uiowa.edu

1) A Job Shop Problem in the Process Industry, Monique Guignard-Spielberg, Univ. of PA, Dept. of Decision Sci., Wharton Sch., 1320 SH-DH, Philadelphia, PA 19104-6366, guignard@dantzig.wharton.upenn.edu, Kurt Spielberg, Huan Yan

We discuss modeling issues for chemical production in batches. One minimizes the time needed to produce the demand. We propose a disaggregated model with a 0 objective function and solve it for increasing makespan values.

2) An Application of Lagrangian Decomposition to the Scheduling of Hot Charged Rolling in Steel Production, Dennis L. Bricker, Univ. of IA, Dept. of IE, Iowa City, IA 52242, dbricker@icaen.uiowa.edu, Ta-Cheng Chen, Soo Y. Chang

A scheduling problem for HCR in the continuous casting process, requiring both grouping and sequencing within each group, is modeled as a degree-constrained minimum spanning tree problem. We compare several algorithms employing Lagrangian decomposition and several heuristic methods.

3) Crew Scheduling for Multiple Intercity Bus Fleets, Emmanuel Peters, Univ. of IA, MS Dept., Iowa City, IA 52242, emmanuel-peters@uiowa.edu, Renato E. de Matta, Warren J. Boe

A crew scheduling problem with multiple bus fleets and crew types is modeled as a set covering problem. We find the minimal cost crew schedule subject to labor agreement restrictions and fleet schedules. We propose a column generation-based approach to solve the problem. Computational results are presented.

4) Minimizing Total Job Waiting Time in a Two-Stage Flow Shop, Rodney Traub, Univ. of IA, Coll. of Bus. Admin., Iowa City, IA 52242, Renato E. de Matta

We study a 2-stage process where products are to be produced in a pre-specified sequence in the second stage. Due to setups, jobs must be sequenced differently on the first stage. Our objective is to develop a sequence on the first stage which minimizes the total job waiting time between stages.

MD29 Interior Point Methods for Mathematical Programming

Cluster: Linear Programming & Related Topics
Invited Session

Chair: Renato D.C. Monteiro, GA Inst. of Tech., Sch. of ISyE, Atlanta, GA 30332, monteiro@isye.gatech.edu

1) **Polynomial Primal-Dual Affine Scaling Algorithms in Semidefinite Programming**, *Etienne de Klerk*, Tech. Univ. of Delft, Fac. TWI, Dept. SSOR, Mekelweg 4, Delft, 2628 CD, The Netherlands, e.deklerk@twi.tudelft.nl, *Cornelis Roos*, *Tamas Terlaky*

Two primal-dual affine scaling algorithms for LP are extended to semidefinite programming. The first is the Dikin-type affine scaling method of Jansen et al. and the second is the classic affine scaling method of Monteiro et al. The extensions of the respective algorithms have the same complexity as their LP counterparts.

2) **Polynomial Convergence of Primal-Dual Path-Following Algorithms for SDP & SDLCP Using the KSH Family of Directions**, *Renato D.C. Monteiro*, GA Inst. of Tech., Sch. of ISyE, Atlanta, GA 30332, monteiro@isye.gatech.edu, *Takashi Tsuchiya*

Kojima, Shindoh & Hara introduced a family of search directions for primal-dual path following algorithms for SDP and SDLCP which contains HRVW/KSH/M direction and NT direction. We show polynomiality of short-step path-following algorithms based on this family of search directions.

3) **Convergence of a Class of Primal-Dual Interior-Point Algorithms for SDP**, *Renato D.C. Monteiro*, GA Inst. of Tech., Sch. of ISyE, Atlanta, GA 30332, monteiro@isye.gatech.edu, *Yin Zhang*

We present a unified analysis for a class of long-step primal-dual path-following algorithms for semidefinite programming whose search directions are obtained through linearization of the symmetrized equation of the central path.

4) **Affine-Scaling Methods for the Linear Complementarity Problem**, *Tibor Illes*, Delft Univ. of Tech., Faculty TWI, Dept. SSOR, Mekelweg 4, Delft, 2628 CD, The Netherlands, t.illes@twi.tudelft.nl, *Cornelis Roos*, *Tamas Terlaky*

A family of primal-dual affine-scaling algorithms is presented for LCPs with SP * S -matrices. These algorithms were introduced earlier for LP and later for LCPs with positive semidefinite matrices. We show that the same algorithmic concept applies to LCPs with SP * S -matrices and that the resulting algorithms are polynomial.

MD30 Recent Developments in Production Scheduling II

Cluster: Scheduling
Invited Session

Chair: Chung-Yee Lee, TX A&M Univ., Dept. of IE, 238 Zachry Bldg., College Station, TX 77845, cylee@acs.tamu.edu

1) **Genetic Algorithms for Robust Job Shop Schedules**, *Jeffery Herman*, Univ. of MD, Inst. for Systems Research, AV Williams Bldg., College Park, MD 20742

Uncertainty complicates the analysis needed to construct good job shop schedules. Consider the problem of finding robust schedules that are near-optimal in every possible scenario. We describe a genetic approach to find such schedules for a 3-machine job shop when there exists combinatorially many scenarios and to solve similar robustness problems.

2) **Generating Experimental Data for Scheduling Problems**, *Nicholas G. Hall*, OH State Univ., Dept. of MS, 1775 College Rd., Columbus, OH 43210-1399, hall.33@osu.edu, *Marc E. Posner*

The OR literature provides little guidance about how data should be generated for the computational testing of algorithms or heuristic procedures. We discuss several data generation schemes which are widely used in the literature and we demonstrate that they may introduce biases into computational results.

3) **Local Search Algorithms for Reoptimization in Complex Job Shops**, *Ebru Demirkol*, Purdue Univ., Sch. of IE, W Lafayette, IN 47906, *Reha Uzsoy*

We present alternative reoptimization methods for the problems of minimizing maximum lateness in reentrant flow shops. Reoptimization methods considered cover various tabu search approaches tailored to the specific production environment. The performance of the best reoptimization method is compared to the performance of the best dispatching rule in both solution quality and computation time. Sensitivity analysis is carried to determine the effect of the particular reoptimization method on the quality and CPU time of the solution.

4) **Scheduling Multiprocessor Tasks Without Prespecified Processor Allocations**, *Chung-Yee Lee*, TX A&M Univ., Dept. of

IE, 238 Zachry Bldg., College Station, TX 77845, cylee@acs.tamu.edu, *X. Q. Cai*

We study the 1-job-on-r-machine scheduling problem, where r is a given positive integer. Minimizing weighted total completion time and minimizing maximum lateness are 2 criteria we address. The problem is NP-hard in the strong sense even just in a 2-machine case. Optimal algorithm as well as heuristic methods with an error bound analysis are provided.

MD31 Cooperative & Multithreaded Parallel Algorithms

Cluster: Combinatorial Optimization
Invited Session

Chair: Michel Toulouse, Univ. of Montreal, CRT, CP 6128, Succ. Centre-ville, Montreal, Quebec, H3C 3J7, Canada, toulouse@cs.ou.edu

1) **Communication Issues in Cooperative Parallel Tabu Search**, *Teodor Gabriel Crainic*, Univ. de Montreal, CRT, CP 6128, Succ. Centre-Ville, Montreal, Quebec, H3C 3J7, Canada, theo@cr.umontreal.ca

Cooperative parallel TS strategies are built on several independent TS processes which simultaneously explore the solution space. When and how tabu threads communicate significantly impacts the design and performances of the parallel method. We report and discuss various such strategies for fixed cost, capacitated, multicommodity network design problems.

2) **Cybernetic Optimization & Tabu Search**, *Mark Fleischer*, Old Dominion Univ., Dept. of Eng. Mgmt., 43rd St. Modular, Rm. 115, Norfolk, VA 23529-0248, maf100f@engr.enma.odu.edu

Use of probabilistic feedback control in cybernetic optimization improves the utility of parallel SA. Adding memory capabilities further enhances the utility of cybernetic optimization. Concepts of adaptive memory programming and TS in the context of cybernetic optimization and experimental results on convergence in the continuous domain are discussed.

3) **Multithreaded Implementation of a Max-Flow Algorithm on EARTH Multiprocessor**, *Parimala Thulasiraman*, Univ. of Delaware, Elect. Eng. Dept., Newark, DE 19716, *Guang R. Gao*

The max-flow problem has served as a critical building block in formulating solutions to many complex network optimization problems. Several sequential algorithms for this problem have been reported in the literature. We present a multithreaded implementation of Dinic-MPM algorithm on the EARTH-MANNA multithreaded architecture and discuss performance results.

4) **Cooperative Parallel Search: Impacts of Information Sharing**, *Michel Toulouse*, Univ. of Montreal, CRT, CP 6128, Succ. Centre-ville, Montreal, Quebec, H3C 3J7, Canada, toulouse@cs.ou.edu

A key to performance analysis of cooperative parallel search is the understanding of how information sharing affects the search behavior of the sequential threads. We show how search paths are deflected by information sharing and how a single path deflection can change the search behavior of all the other threads.

MD32 Case Studied III: Developing End-User Applications Using Optimization Modeling

Sponsor: CSTS
Sponsored Session

Chair: Bjarni Kristjansson, Maximal Software Inc., 2111 Wilson Blvd., Ste. 700, Arlington, VA 22201, bjarnik@site.gmu.edu

MD33 Software Demonstrations III

Sponsor: CSTS
Sponsored Session

Chair: Bjarni Kristjansson, Maximal Software Inc., 2111 Wilson Blvd., Ste. 700, Arlington, VA 22201, bjarnik@site.gmu.edu

1) Tom Sawyer Software

2) XPRESS-MP

Monday 16:30-18:00**ME01 Designing an Operating Plan to Respond to the Customer's Needs**

Sponsor: Railroad Applications SIG
Sponsored Session

Chair: Bruce W. Patty, MCGI, 185 N Redwood Dr., Ste. 200, San Rafael, CA 94903, bruce@mcgi.com

1) Designing an Operating Plan to Respond to the Customer's Needs, Bruce W. Patty, MCGI, 185 N Redwood Dr., Ste. 200, San Rafael, CA 94903, bruce@mcgi.com, Dharma Acharya

CSX Transportation has recently developed a new operating plan in order to respond to the needs of the customer. While railroads continuously adjust their operating plan, this development process started with a "clean sheet" of paper. We will discuss how the customer's needs were identified, the process used to develop a new operating plan, the tools used to support this process and lessons learned.

ME02 Applications in Semiconductor Manufacturing

Cluster: Applications

Invited Session

Chair: Robert C. Leachman, Univ. of CA, Dept. of IE/OR, Berkeley, CA 94720, leachman@ieor.berkeley.edu

1) A Production Planning System for Semiconductor Assembly, Masahiko Iwamoto, NEC Corp., 3rd Syst. Dept., Semi. Group, 1120 Shimikuzawa Sagamihara, Kanagawa, 229, Japan, iwamoto@swl.ci.nec.co.jp

NEC has developed systems for automated production planning of their semiconductor assembly plants. Rule-based scheduling takes into account delivery commitments, factory status and capacity to generate efficient schedules. We describe systems implemented to date and on-going development of next-generation systems.

2) Floor Scheduling Systems for Large-Scale Fabrication of Memory Devices, Young Hoon Lee, Yonsei Univ., Dept. of ISE 134 Shinchon-dong, Sudaemoon-ku, Seoul, 120-749, Korea, bongju@bubble.yonsei.ac.kr, Robert C. Leachman, S. Y. Kim, S. W. Hwang

Samsung has developed floor scheduling systems for their large-scale memory fab lines. Systems implemented to date establish target cycle times for process flows, dispatch lots at non-bottleneck work stations and schedule the bottleneck work station. Fab cycle time was cut by half while maintaining high factory throughput.

3) Optimization-Based Approach to Wafer Fabrication Floor Scheduling, Jeon Young Kang, Univ. of CA, Dept. of IE/OR, 4135 Etcheverry Hall, Berkeley, CA 94720, jykang@ieor.berkeley.edu, Robert C. Leachman

An IP model for fab floor scheduling is described. Unusual formulation techniques lead to strongly integer solutions of the LP relaxation. In tests on realistic fab data sets, implementation of the resulting schedule as dispatching priority lists outperforms basic dispatching rules such as FIFO and least slack.

4) Optimization-Based Approach to Incremental Production Planning, Robert Benson, Univ. of CA, Dept. of IE/OR, 4135 Etcheverry Hall, Berkeley, CA 94720, benson@ieor.berkeley.edu

Traditionally, production planning has been viewed as a batch exercise. This research converts planning into an on-line activity, continually updating plans as revisions to demand or supply information are received. While some semiconductor companies have developed heuristic or rule-based systems for incremental planning, an optimization-based approach is described.

ME03 Yield Management User Interfaces

Sponsor: Aviation Applications Section

Sponsored Session

Chair: Marc S. Meketon, US Airways, Inc., OR Crystal Park 4-DCA/H700, 2345 Crystal Dr., Arlington, VA 22227, marc_meketon@usairways.com

1) Decision Support from an Analyst's Perspective, Mark Brummer, PROS Strategic Solutions, Inc., Houston, TX

Given the wealth of data available to an analyst in the practice of revenue management, the search for efficiency in capturing potential revenue opportunities dictates the need to distinguish between vital and non-vital decision support elements. We focus on the mindset of analysts and their needs in an automated revenue management environment...

2) Yield Management User Interfaces, John Wallace, Aeronomics, Inc., Atlanta, GA

Today's revenue management systems require ever-increasing amounts of data to feed sophisticated forecasting and optimization routines. At the same time, data output is growing rapidly to meet the demand for information that can answer the basic question, "How can I maximize my revenues?" We address the difference between information that is interesting vs. information that is useful...

ME04 TRAC-White Sands Military Applications

Sponsor: Military Applications Society

Sponsored Session

Chair: Philipp A. Djang, US Army TRADOC Analysis Ctr., Attn: ATRC-WGA (Djang), WSMR, NM 88002-5002, djang@trac.wsmr.army.mil

1) An Analysis of the Captain Professional Military Education Program, Katherine M. Stapp, US Army TRADOC Analysis Ctr., Attn: ATRC-WGB (Stapp), WSMR, NM 88002-5502, stappm@trac.wsmr.army.mil

The Captain Professional Military Education Program is changing. The changes, to be implemented in 4 phases, will ultimately include distributed training technologies. The staff process will be taught electronically via teleconference. We determine the impact of these changes on training quality/quantity.

2) Assessing Task Force XXI (TF XXI) Digitization, Kenneth Dzierzanowski, US Army TRADOC Analysis Ctr., Attn: ATRC-WBB (Dzierzanowski), WSMR, NM 88002-5502, dzierzak@trac.wsmr.army.mil, Kevin S. Young

The purpose of this study was to assess the value gained by digitization of the battlefield. Ensuring the effective use of digitized equipment in the combat environment requires progressive modeling and simulation. The modeling results were compared to actual tactical exercises for calibration and verification.

3) Mobile Close Combat Tactical Trainer Requirements Analysis, Katta G. Murty, Univ. of MI, IOE Dept., 1205 Beal Ave., Ann Arbor, MI 48109-2117, murty@engin.umich.edu, Philipp A. Djang

We developed innovative optimization models for determining where to station and how to route a number of mobile simulators. Our efforts were reflected in contract modifications. Recent budget shortfalls required a new application of our approach. We present the approach and current results.

ME05 Decision Analysis Society Awards Presentation

Sponsor: Decision Analysis Society

Sponsored Session

Chair: Ward Edwards, Wise Decisions, Inc., 11466 Laurelcrest Rd., Studio City, CA 91604, wedwards@mizar.usc.edu

1) Decision Analysis Society Awards Presentation

The Decision Analysis Society of INFORMS presents awards for the best publication and the best student paper, which are typically presented annually. The Society also periodically awards the Ramsey Medal for lifetime contribution. Current awardees will be honored and will make presentations related to their work.

ME06 EDUCATION TUTORIAL: Teaching Probabilistic Analysis

Sponsor: Forum on Education

Sponsored Session

Chair: Samuel Chiu, Stanford Univ., Eng. Econ. Systems & OR, Stanford, CA 94305-4023, samchiu@leland.stanford.edu

1) EDUCATION TUTORIAL: Teaching Probabilistic Analysis, Samuel Chiu, Stanford Univ., Eng. Econ. Systems & OR, Stanford, CA 94305-4023, samchiu@leland.stanford.edu

Classes in introductory probability are usually taught topically oriented. Students are taught the mechanics of probability to manipulate well-formulated problems. This tutorial provides a teaching framework to bridge the gap separating mechanics and problem formulation/communication. We will share teaching materials, including software, developed over many years with many iterations of modifications, both radical and fine-tuning...

ME07 Organization of Flexible Workers & Control of Queues

Sponsor: MSOM

Sponsored Session

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

1) Inventory Management of a Service Facility with a Finite Capacity for Service, Eungab Kim, Univ. of Toronto, 105 St. George St., Fac. of Mgmt., Toronto, Ontario, M5S 2H8, Canada, ekim@fmgmt.mgmt.utoronto.ca, Oded Berman

We consider scheduling a facility that provides service to customers using items of inventory. The queueing capacity is finite and the arriving customers who find the queue is full are rejected with penalties. We show that the optimal policy never places an order when the system is empty or the inventory level is positive, and there exists a threshold optimal ordering policy.

2) **Control of a Tandem Queueing System with Multiple Servers**, *Hyun Soo-Ahn*, Univ. of MI, Dept. of IOE, Ann Arbor, MI 48109-2117, *Izak Duenyas, Rachel Q. Zhang*

We consider the optimal control of a 2 station tandem queueing system with 2 servers. We present some preliminary structural results and effective heuristics for this problem.

3) **The Advantages of Self-Organization in Manufacturing & Logistics Systems**, *John J. Bartholdi, III*, GA Inst. of Tech., Sch. of ISyE, Atlanta, GA 30332-0205, *john.bartholdi@isye.gatech.edu, Donald D. Eisenstein*

Some logistics systems can be configured to be self-organizing so that they spontaneously adjust themselves to achieve optimal productivity. We discuss implications based on our experience with such systems in manufacturing and warehousing.

4) **Limits of Performance for Production Systems with Flexible Workers**, *Mark P. Van Oyen*, Northwestern Univ., IE/MS Dept., 2225 N Campus Dr., Evanston, IL 60208-3119, *vanoyen@iems.nwu.edu, Wallace J. Hopp, Esma G. Senturk*

We consider queueing models of production systems and ask the question of how labor (servers) should be allocated dynamically to achieve optimal or effective performance. Using idealistic models, we are able to provide fundamental limits on the value of flexible or cross-trained workers and provide policies that achieve them.

ME08 Inventory Models & Management

Cluster: Inventory Management

Invited Session

Chair: Leroy B. Schwarz, Purdue Univ., Krannert Grad. Sch. of Mgmt., W Lafayette, IN 47907, *lee@mgmt.purdue.edu*

1) **Multi-Item Newsboy Model with Partial Variety Postponement**, *Nils Rudy*, Univ. of PA, Operations & Mgmt. Dept., Wharton Sch., Philadelphia, PA 19104-6366, *Yu Sheng Zheng*

Variety postponement is an effective strategy to cope with uncertain demand, but this strategy often incurs insignificant extra costs. Therefore, we propose a mixed strategy, under which both "generic" and specific products are produced. After meeting demand with specific products, the generic product is further processed to satisfy the remaining demand with specification.

2) **A Single-Item Inventory Model for a Non-Stationary Demand Process**, *Stephen C. Graves*, MIT, 439 Leaders for Mfg. Program, Bldg. E40, 1 Amherst St., Cambridge, MA 02139-4307

I analyze an adaptive base-stock policy for a single-item inventory system with a demand process for which exponential smoothing provides the optimal forecast. I show that the safety-stock requirements behave much differently when demand is non-stationary. I extend the model to a multi-stage or supply-chain context and quantify the bullwhip effect resulting from non-stationary demand.

3) **Assessing the Value of Customer-Order Information on Inventory Management**, *Nicholas C. Petrucci*, Univ. of IL, 328G Kinley Hall, 350 Commerce W, Urbana, IL 61801, *npetrucci@commerce.cba.uiuc.edu, Leroy B. Schwarz*

We examine the value of customer-order information when customer orders are subject to possible cancellation. We estimate the value by comparing the optimal inventory policy and the associated per-period profit to 2 alternative scenarios: customers do not place orders in advance and customers place orders, but may not cancel.

ME09 Planning & Control

Contributed Session

Chair: Bruce R Feiring, TX A&M Univ., Dept. of IE, College Station, TX 77843-3131, *feiring@acs.tamu.edu*

1) **Numerical Comparison of Stochastic Production Control Policies**, *Youxun Shen*, Univ. of CA, Dept. of IE, Berkeley, CA 94720, *yshen@ieor.berkeley.edu, Robert C. Leachman*

A new production control policy is proposed for an acyclic system in the face of various uncertainties. The robustness of the new policy is compared against other policies including rolling-horizon LP and some well-known heuristics used in practice. Numerical results are presented.

2) **Stepwise Production Smoothing**, *Sichong Guan*, Fruit of the Loom, 850 Wilkinson Trace, 203, Bowling Green, KY 42103,

sguan@fruit.com, Javad Seyed

We consider the production planning problem where stepwise production smoothing is required. Once the production rate changes, it has to be held for at least 4 months. We show how a carefully designed MILP can describe such problems. Numerical examples will be presented.

3) **A Stochastic Programming Model for Water Resource Planning**, *Bruce R Feiring*, TX A&M Univ., Dept. of IE, College Station, TX 77843-3131, *feiring@acs.tamu.edu, Tep Sastry*

A framework is offered for the evaluation of electricity generation and water supply for agricultural irrigation. This assessment is conducted through the construction of an appropriate stochastic optimization model. A recursive least squares algorithm is incorporated in the model which enables more accurate estimation of model parameters.

ME10 Facilities Layout

Contributed Session

Chair: Kazuho Yoshimoto, Waseda Univ., Sch. of Sci. & Eng., 3-4-1 Ohkubo Shinjuku-Ku, Tokyo, 169, Japan, *kazuho@yoshi.mgmt.waseda.ac.jp*

1) **An Integrated Approach to Solve AGV Flowpath Design with the Consideration of Machine Layout for Large-Sized Problems**, *Weerapat Sessomboon*, Waseda Univ., Grad. Sch. of Sci. & Eng., 3-4-1 Ohkubo Shinjuku-ku, Tokyo, 169, Japan, *weerapat@yoshi.mgmt.waseda.ac.jp, Kazuho Yoshimoto*

When addressing the AGV flowpath design problem, much of the research has ignored the effect of machine layout. We present an integrated technique employing GA and SA to solve the problem of large-sized AGV systems. GA is used to search for AGV flowpath direction while SA is simultaneously used to search for machine layout.

2) **A Heuristic Algorithm to Solve the Layout Problem of Refinery & Petrochemical Plants**, *Takashi Irohara*, Waseda Univ., Grad. School, 3-4-1 Okubo Shinjuku-ku, Tokyo, 169, Japan, *irohara@yoshi.mgmt.waseda.ac.jp, Kazuho Yoshimoto*

We present an efficient heuristic algorithm based on CARD-SA, which was developed for facility layout problems with rectangular departments of unequal area. The objective is the minimization of the total pipe length between equipment in a site.

3) **Popular MRP Lot-Sizing Techniques are Still the Best Choice**, *Salvador Nieto Sanchez*, LA State Univ., 3128 CEBA Bldg., Baton Rouge, LA 70803-6409, *snieto@lsuvm.sncc.lsu.edu, Evangelos Triantaphyllou, Dennis B. Webster, T. Warren Liao*

The add-drop heuristic, a new capacitated MRP technique, is compared against 4 uncapacitated ones: the lot-for-lot, fixed period quantity, least unit cost and the silve-meal heuristic. The costs were modified to make them comparable. We provide empirical and analytical results which demonstrate that the old techniques are still the best.

4) **Some Advancements on Single-Job Lot Streaming in Flow Shops**, *Mehmet Akansel*, Univ. of FL, 303 Weil Hall, Gainesville, FL 32611, *akansel@ise.ufl.edu, Suleyman Tufekci*

Lot streaming is the process of splitting a job into sublots to achieve overlapping operations on subsequent machines. We present a low-order algorithm to solve the general-size lot streaming problem in flow shops. We also discuss some developments on extending the basic model to include setups on machines.

5) **Revisiting the Asymptotic Optimality of the SPT Rule for the Flow Shop Average Completion Time Problem**, *Cathy H. Xia*, Stanford Univ., Dept. of OR, 420 Terman Eng. Ctr., Stanford, CA 94305, *xia@leland.stanford.edu, J. George Shanthikumar, Peter W. Glynn*

We consider the M-machine static scheduling problem with the objective of minimizing the average completion time of all the n jobs. When the processing times on the M-machines are i.i.d., we show that the SPT first scheduling rule based on the total processing time of a job on all M machines is asymptotically optimal as n goes to infinity...

ME11 In Tribute to Robert Herman

Sponsor: Transportation Science Section

Sponsored Session

Chair: Hani S. Mahmassani, Univ. of TX, Dept. of Civil Eng., ECJ 6.204, Austin, TX 78712, *masmah@mail.texas.edu*

ME12 The Role of Information in Multi-Echelon Systems

Cluster: Supply Chain Operations

Invited Session

Chair: Yehuda Bassok, Northwestern Univ., Dept. of IE/MS, 2145 Sheridan Rd., Evanston, IL 60208-3119, Chair

1) A Comparison of Dynamic & Static Policies for Replenishing Retailer Stocks, Vipul Agrawal, NYU, Stern Sch. of Bus., 40 W 4th St., New York, NY 10012, Sridhar Seshadri

We study a 2 echelon system, consisting of a DC and N retailers. All ordering decisions are centralized at the DC and unmet demands at the retailers are lost. The static policy consists of making 1 or more shipments to the retailers at predetermined times during the review period. The dynamic policy does not prespecify the timing of the shipments.

2) Options & Committed Orders in a Supply Chain with Positive Demand Correlation, Dawn C. Barnes-Schuster, Univ. of Chicago, Grad. Sch. of Bus., 11101 E 58th St., Chicago, IL 60637

We examine the use of options and committed orders in a retailer/supplier system with 2 production modes and positive demand correlation. We derive both the buyer's optimal ordering policy and the supplier's optimal production and pricing policies. We then compare this decentralized system's performance to the performance of a centralized system.

3) Information Systems vs. Inventory in a Manufacturing Firm's Supply Chain, Krishnan S. Anand, Northwestern Univ., Kellogg Sch. of Bus., 1503 Oak Ave., Apt. 314, Evanston, IL 60201, k-anand@nwu.edu, Haim Mendelson

We model the supply chain of a manufacturing firm facing demand uncertainty, and derive its optimal multi-period production, sales and inventory policies. We study the effects of informativeness and timing of IS on the optimal policies. Under quite general conditions, inventory and information are shown to be complements. The drivers of this relationship are studied.

4) An Exact Performance Evaluation for the Supplier in a 2-Echelon Inventory, Ki Ling Cheung, HKUST, Clear Water Bay, Kowloon, Hong Kong, Warren H. Hausman

We present a new approach to analyze continuous review, 2-echelon inventory systems with batch ordering, minimum order quantities and heterogeneous retailers. We obtain the exact steady-state behavior of the supplier and show that Poisson approximation schemes may produce significant cost penalties (e.g., up to 23%).

ME13 Flexibility in Integrated Product Development

Cluster: New Product Development
Invited Session

Chair: David M. Upton, Harvard Bus. School, Morgan Hall T41, Boston, MA 02163, upton@bhs.edu

1) Between Design & Delivery: Operations Support for Rapid Product Development, Andrew McAfee, Harvard Bus. School, Morgan Hall T40, Boston, MA 02163, mcabee@hbs.edu, David M. Upton

In many industries it is crucial to structure production activities to bring new products to market continuously and efficiently. We examine different operations strategies for accomplishing this, concentrating on those which have demonstrated their effectiveness and stressing the importance of improvement over time, instead of static optimization.

2) Product Development Failure & Organizational Competence, Michael Lewis, Univ. of Warwick, Warwick Bus. School, Coventry, CV4 7AL, UK, pomml@razor.wbs.warwick.ac.uk

This paper uses case data to describe how a theoretical model of the firm helps to analyze real product development failures. The model, built upon key elements from the competence literature (resources, processes and learning), is then used to help integrate product development concepts with a discussion of competitive advantage.

3) Lessons from the Auto Industry on Rapid Product Development, Fiona E. Murray, Univ. of Oxford, St. Catherine's Coll., Oxford, X1 3UJ, UK, fiona.murray@management-studies.oxford.ac.uk

Firms who dominate Formula One play a central role developing and testing engine technology before its integration into mainstream automobiles. This paper examines the extent to which the network of motorsports firms which surround auto manufacturing acts as a rapid, integrated and efficient conduit of cutting-edge technology into new products.

4) Developing Products on Internet Time, Alan MacCormack, Harvard Bus. School, Morgan Hall T17, Boston, MA 02163, amaccormack@bhs.edu, Marco Iansiti

We describe a new model for product development emerging in the internet software and workstation industries. Effective projects in these environments are based upon extreme levels of flexibility. Concept and implementation stages

overlap, allowing the design to "evolve" over time as new information on technologies and markets becomes available.

ME14 Legal Issues in Energy Development

Sponsor: ENRE

Sponsored Session

Chair: Phillip G. Neal, Northeastern IL Univ., Dept. Acct. Bus. Law & Finance, 5500 N St. Louis, Chicago, IL 60625-4099

1) Energy Production & the Accounting for Natural Resources Royalty Trusts, Robert H. Sarikas, Boise State Univ., Dept. of Accountancy, Coll. of Bus., Boise, ID 83725, Dale Velkovic

In the US, significant quantities of production stage energy resources are owned under royalty trust arrangements. The specialized tax and accounting structures of these entities have important implications for capital allocation in the energy production industry. We consider these issues and the implications for future energy production.

2) Land Owner/Lessor vs. Energy Producer/Lessee: Allocation of Liability under CERCLA, Matthew M. Liss, Innovative Health Services, Inc., 3343 Peachtree Rd. NE, Ste. 805, Atlanta, GA 30326

Energy production is a complicated endeavor which may result in hazardous contamination of property. Often, the party responsible for the contamination may be the lessee of the land or one who owns only the mineral rights to the property. Under CERCLA, both landowner and lessee may face responsibility for the clean-up of a hazardous contamination caused by one of the parties. We consider issues and implications for future energy production.

3) Energy Production & Potential CERCLA Liability: What are the Defenses?, Phillip G. Neal, Northeastern IL Univ., Dept. Acct. Bus. Law & Finance, 5500 N St. Louis, Chicago, IL 60625-4099

We examine the defenses available to energy producers who face potential CERCLA liability for environmental contamination. In addition, recommendations are provided that can be useful to energy producers at points of acquisition, exploration, development, operation and sale.

ME15 PANEL: Lessons Learned from UT-Austin's Innovative MS Degree Program in Science & Technology Commercialization

Cluster: Technology Management
Invited Session

Chair: David L. Gibson, Univ. of TX, IC2 Inst., 2815 San Gabriel Ave., Austin, TX 78705, davidg@icc.utexas.edu

Co-Chair: Barbara Fossum

1) PANEL: Lessons Learned from UT-Austin's Innovative MS Degree Program in Science & Technology Commercialization

UT-Austin is offering a 1-year MS Degree in Science & Technology Commercialization. Using 2-way video and IT, the program is taught simultaneously in TX and Fort Belvoir, VA. We present an overview of the 2-year old program with presentations from 4, "experiential learning laboratories," technology commercialization projects managed by student teams. laboratories," technology commercialization projects managed by student teams.

ME16 Advances in Understanding & Modeling the Random Component of Utility in Consumer Choice

Cluster: Marketing
Invited Session

Chair: Jordan Louviere, Univ. of Sydney, Dept. of Mktg. Rm. N154B, H03 - Institute, Sydney, 2006, Australia, jordanl@bullwinkle.econ.su.oz.au

1) Analyzing In-Market Choice Experiments with Unobserved Consideration Sets, Scott Cardell, WA State Univ., Dept. of Economics/Statistics, Todd 437D, Pullman, WA 99164-4741, cardella@wsu.edu, Dan Steinberg

Market researchers frequently conduct in-market experiments to estimate response rates and profitability; however, such analyses are suspect when competing offers are unobserved. We address how information on competing offers can be used to improve market response models when in-market revealed-preference data is pooled with stated-preference survey data.

2) Random Preferences & Respondent Behavior in Surveys & Experiments, Michael Hanemann, Univ. of CA, Dept. Agri. & Resource Econ., 207 Giannini Hall, Berkeley, CA 94720-3310, hanemann@are.berkeley.edu

Response effects can be viewed as systematic efforts by respondents to use various behavioral strategies for fathoming the task and formulating a response. We describe several ways to model these, involving modifications to both the deterministic and stochastic components in the conventional random-utility-maximization model, applying them to empirical survey data.

3) The Role of Consumer Brand Assessment & Assessment Confidence in Models of Longitudinal Choice Behavior, Joffre D Swait, Intelligent Marketing Systems, 12 W University Ave., Gainesville, FL 32601, joffre_swait@imsi.ca, E. Craig Stacey

Random utility theory postulates 2 constructs affecting choice behavior: the deterministic utility component and the variance in the deterministic component, typically representing purchase dynamics purely in terms of the deterministic component. We introduce a general model capturing mix carryover with distributed lags, as well as nonstationary variance, with applications.

4) Random Component Differences Between Data Sets & Between Alternatives Within Data Sets, Jordan Louviere, Univ. of Sydney, Dept. of Mktg. Rm. N154B, H03 - Institute, Sydney, 2006, Australia, jordanl@bullwinkle.econ.su.oz.au, Joffre D Swait

We empirically demonstrate the key role played by the random component in explaining choice process differences over time, space, multiple preference/choice measures and choices within the same data set. Progressively relaxing the constant-variance assumption, we introduce several model forms explaining how they account for observed choice, implications for estimation, comparison and prediction.

ME17 IS/OR/MS Applications in the Management of Technology in Health Care

Cluster: Health Care Management
Invited Session

Chair: Arnold Reisman, Reisman & Assoc., 1284428 Parkland Dr., Shaker Heights, OH 33122, 102126.1551@compuserve.com

1) Scheduling Cardiac Procedures: A Knowledge-Based Approach, Anandhi Bharadwaj, Emory Univ., Goizueta Business Sch., 1602 Mizell Dr., Atlanta, GA 30322, anandhi_bharadwaj@bus.emory.edu, A. Sen, Ajay Vinze

No abstract supplied.

2) Decision Making on Information Technology in US Hospitals, Eliezer Geisler, Univ. of Wisconsin, Coll. of Bus. & Econ., Whitewater, WI 53190-1797, Ori Heller

No abstract provided.

ME18 Quality Management II

Cluster: Quality Management
Invited Session

Chair: Saurabh Gupta, Univ. of TX, Dept. of Mgmt., CBA 4.202, Austin, TX 78712, sgupta@mail.utexas.edu

1) Implementation of Multiple Process Improvements: Managing Synergy & Conflict, Janice E. Carrillo, Washington Univ., CB 1133, One Brookings Dr., St. Louis, MO 63130-4899, carrillo@wuolin.wustl.edu, Cheryl Gaimon

Through critical to long term competitiveness, process improvements can cause serious short term disruptions. Moreover, the disruptions and subsequent deterioration in performance are compounded when firms implement several process changes simultaneously. A model is introduced to assess both adverse and beneficial interactions when multiple process changes are implemented concurrently.

2) The Long-Run Stock Price Performance of Firms with Effective TQM Programs as Provided by Quality Award Winners, Kevin B. Hendricks, Coll. of William & Mary, School of Bus., Tyler Hall, Williamsburg, VA 23185, kbhend@dogwood.tyler.wm.edu, Vinod R. Singhal

We document the long-term stock price performance of quality award winners. During the implementation period, there is no difference in the performance of winners and control firms. During the post-implementation period, winners significantly outperform control firms by an average of 36% to 48% on the control sample used.

3) An Empirical Test of the Malcolm Baldrige Quality Framework, Soumen Ghosh, GA Inst. of Tech., School of Mgmt., Atlanta, GA 30332-0520, soumen.ghosh@mgt.gatech.edu, Robert Handfield

The objective of this study is to 1) test empirically the implied relationships

proposed in the Malcolm Baldrige Quality model and 2) determine the strength of the relationship between the core elements of the Baldrige Framework and financial performance. The testing is done using a structural equations modeling approach using survey data.

4) What is Process Orientation?, Saurabh Gupta, Univ. of TX, Dept. of Mgmt., CBA 4.202, Austin, TX 78712, sgupta@mail.utexas.edu, Uttayan Bagchi

By process orientation we mean the application of the concept of process in organizations. Based on a survey of the relevant literature and interviews with managers we develop an operational definition of process orientation. The purpose is to contribute to the development of a theory of process orientation.

ME19 Economic Product Implications of Electronic Markets

Cluster: Electronic Commerce
Invited Session

Chair: Jan Stallaert, Univ. of TX, CBA 5.202, Austin, TX 78712, stallaert@mail.utexas.edu

1) Estimating Internet Users' Demand Characteristics, Boris Jukic, Univ. of TX, MSIS Dept., CBA 5.324, Austin, TX 78712, borisjukic@mail.utexas.edu

We will show that classic estimation techniques are not best suited to handle the consumer information available in the Internet environment while proposing a method which fully exploits the advantages of rich information stream to produce quick and accurate estimates of demand characteristics which can be updated frequently.

2) Pricing Digital Products: Will Conventional Wisdom Prevail?, Manoj Parameswaran, Andrew B. Whinston

The emergence of electronic commerce has introduced a vast array of digital products with unique characteristics which impact the possible pricing strategies. Arguments are presented for the subscription vs. micropayment debate, and implications of quality on consumers' value distributions and on bundled and unbundled strategies are explored.

3) Decision Support Issues in Electronic Commerce, Jan Stallaert, Univ. of TX, CBA 5.202, Austin, TX 78712, stallaert@mail.utexas.edu

The Internet with its electronic commerce applications provides an abundance of readily accessible, real-time information. This presentation gives some guidelines on how this can be exploited and how this changes the design of DSS in Internet/Intranet/Extranet environments.

ME20 Information Systems Policies

Cluster: State-of-the-Art in Information Technology
Invited Session

Chair: Fatemeh Mariam Zahedi, Univ. of WI, PO Box 742, Sch. of Bus. Admin., Milwaukee, WI 53201, zahedi@ccsd.uwm.edu

1) Information Systems Policy on Intranets: An Agency Theory View, Judy E. Scott, Univ. of TX, Dept. of MSIS, Austin, TX 78712-1175, jescott@mail.utexas.edu

The Intranet phenomenon has caused an upheaval in IS departments. Management issues include establishing corporate controls, enterprise-wide standards, retraining mainframe developers and developing policies and guidelines to prevent disorganization and duplicate efforts. Agency theory provides a useful framework for analyzing, explaining and predicting IS policies on Intranets.

2) Diffusion of the Internet: Impact of & Implication for National Policy, Arun Rai, Southern IL Univ., College of Bus. Admin., Dept. of Mgmt., Carbondale, IL 62901, arunrai@siu.edu

The study examines the adequacy of diffusion of innovation models to explain the growth of the internet. Data on the growth in the number of internet hosts is used for the analysis. The results suggest that traditional diffusion of innovation models are inadequate in explaining internet growth, and some alternative models which should better inform capacity planners are examined.

3) Warranty, Maintenance & Upgrade Policies for Software & Information Systems, Izzet Sahin, Univ. of WI, Sch. of Bus. Admin., PO Box 742, Milwaukee, WI 53201, sahin@csd.uwm.edu, Fatemeh Mariam Zahedi

Changing an installed software system has major consequences for its supplier and customers. We use a theoretical framework to analyze the impact of market factors, such as quality, market volatility and technological obsolescence on the supplier's policies regarding the warranty, maintenance and upgrade of software systems and their impacts on the supplier's return.

4) Computer Investments in a Networked Office Environment, David C. Wierschem, Univ. of TX, Sch. of Mgmt., PO Box 830688, MS JO44, Richardson, TX 75083-0688, *Ray Patterson, Joakim Kalvenes*

Worker interaction is critical to group and individual output in networked and groupware office environments. Current investment models in these environments ignore co-worker interaction effects on productivity. We propose an equilibrium model formulation to optimize the investment in office automation, PCs and groupware technology which accounts for interaction between co-workers.

ME21 Theoretical Foundations of MMT VIII

Cluster: Management of Medical Technology

Invited Session

Chair: W.E. Spangler, West Virginia Univ., Morgantown, WV 26506

1) Patterns Derived from a Study of the Relationships among CPT and ICD9 Codes for Surgical Patients, W.E. Spangler, West Virginia Univ., Morgantown, WV 26506, *Jerrold H. May, Luis G. Vargas, David Strum*

ICD9 codes describe what is wrong with a patient. CPT codes describe what was done to fix the problem. We study the patterns of relationships between ICD9 and CPT codes for 59,864 patients and discuss the implications for medical auditing, coding IDSSs and multiple representations of related data.

2) Knowledge-Based Statistical Prediction of Surgical Times, Jerrold H. May, Univ. of Pittsburgh, Grad. Sch. of Bus., Pittsburgh, PA 15260, *Luis G. Vargas, David Strum, W.E. Spangler*

An IDSS for surgical scheduling must estimate procedure times for all patients. Data may not be available for certain procedures and is limited for patients undergoing multiple procedures. Using historical data on 59,864 patients and the CPT taxonomy, we construct knowledge-based statistical models for estimating those missing values.

3) Negotiating Medical Technology Implementation: Overcoming Power & Stakeholder Diversity, Terri L. Griffith, Washington Univ., Olin Sch. of Bus., CB 1133, St. Louis, MO 63130-4899, *griffith@wuolin.wustl.edu, Marion G. Sobol*

Negotiated implementation has been proposed as an alternative to more traditional top-down or even user involved technology implementation strategies. Negotiated implementation is based on integrative techniques where value is increased through problem solving approaches. The organizational structures of medical settings may pose unique questions for this form of technology implementation.

ME23 Decision Analysis II

Contributed Session

Chair: Lindsley G. Boiney, George Mason Univ., MSN #5F5, Grad. Bus. Inst., Fairfax, VA 22030-4444, *lboiney@gbi.gmu.edu*

1) The Optimal Frequency & Sequencing of Tests in the Inspection of Multi-Characteristic Components, Chen Shaoxiang, Nanyang Tech. Univ., Nanyang Bus. Sch., Nanyang Ave., Singapore, 639798, Singapore, *aschen@ntuvax.ntu.ac.sg, Marc R. Lambrecht*

We study the multicharacteristic component inspection problem where defective rates, testing errors and inspection costs are different across characteristics. What tests and how many times should a test be selected? In what sequence should they be conducted? Based on the theorems established here, an efficient algorithm for finding the optimal inspection plan is developed...

2) Global Transfer of Human Resources and AHP Approach, Mohammed K. Najdawi, Villanova Univ., 800 Lancaster Ave., Villanova, PA 19085, *najdawi@ucis.vill.edu, Matthew J. Liberatore*

We examine the values and costs of globalizing HR in order to facilitate the global growth of a corporation. It utilizes an AHP approach to identify the decisions needed to evaluate different alternative global HR strategies.

3) Just Enough to Get What I Want: Motivation & Judgment, Lindsley G. Boiney, George Mason Univ., MSN #5F5, Grad. Bus. Inst., Fairfax, VA 22030-4444, *lboiney@gbi.gmu.edu, Jane Kennedy, Pete Nye*

It is known that motivated DMs adopt information processing strategies likely to yield the desired conclusion. We show that motivated reasoning is systematic and "instrumental": people bias quantitative estimates more when more is needed to support the desired decision outcome, yet express high confidence in their estimates.

ME24 Consumer Behavior

Contributed Session

Chair: Michael H. Rothkopf, Rutgers Univ., RUTCOR, Fac. of Mgmt., PO Box 5062, New Brunswick, NJ 08903-5062, *rothkopf@rutcor.rutgers.edu*

1) On Misusing Auctions to Value Stranded Assets, Michael H. Rothkopf, Rutgers Univ., RUTCOR, Fac. of Mgmt., PO Box 5062, New Brunswick, NJ 08903-5062, *rothkopf@rutcor.rutgers.edu, Ronald M. Harstad*

A recent paper in The Electricity Journal proposes a particular use of auctions to value stranded assets. This presentation explains why the auction suggested is heavily biased against electricity consumers. Regulators wishing to use auctions to value stranded assets fairly must exercise judgment about the nature of the auction process.

2) The Effects of Manufacturer's Suggested Retail Price on Consumer Price Expectations and Reservation Prices, Tridib Mazumdar, Syracuse Univ., Dept. of Mktg., Sch. of Mgmt., Syracuse, NY 13244, *Chan Joo Suh, David Wilemon*

When a new product is introduced, potential customers experience considerable difficulty in assessing the product's worth as well as how much they are expected to pay. Customers often rely on externally available cues to make these estimates. We focus on one such cue, MSRP, and investigate how it influences consumers internal reference price and reservation price of a new product...

3) Rank Order Tournaments & Anomalies in Consumer Decision Behavior, Gerhard B. Holt, INSEAD, Blvd. de Constance, Fontainebleau, 77305, France, *holt@insead.fr*

Many judgment and choice situations involve explicit or implicit rank order tournaments, where relative position on an attribute or set of attribute-outcomes is decisive. Resulting seemingly biased or anomalous decision behavior is examined and discussed.

4) Knowledge & Attitude of Historically Black College Students Toward Software Piracy, Dalsang Chung, Jarvis Christian Coll., PO Drawer G, Hawkins, TX 75765, *dc69@rapidrap.com*

The use of microcomputer technology in black colleges continues to grow. The availability of computers induces more opportunities of involving unauthorized copying of software than before. This study will find black college students' understanding of the copyright laws, their attitude toward software piracy and the proposed conduct relative to software packages.

ME25 Modeling of Maintenance

Cluster: Statistics & Reliability

Invited Session

Chair: John G. Wilson, Wake Forest Univ., Babcock Sch. of Mgmt., Box 7659 Reynolds Station, Winston-Salem, NC 27109, *john_wilson@mail.mba.wfu.edu*

1) Bayesian Variable Reliability Growth Modeling, Thomas Mazzuchi, George Washington Univ., Dept. of Eng. Mgmt., Washington, DC 20052, *Linda J. Nichols, Refik Soyer*

We develop a framework for analysis and decision making for product development using variable reliability growth models. The approach is Bayesian in nature and requires a joint prior to be defined for the growth process. Posterior results are obtained in a form which allows for predicting system performance in future stages of testing and in the field.

2) Dynamic Influences in Multi-Component Maintenance, Ralph Wildeman, Erasmus Univ. Rotterdam, Econ. Inst., PO Box 1738, Rotterdam, 3000 DR, The Netherlands, *Rommert Dekker*

We consider a multi-component system with economically dependent components and compare the costs of a stationary-planning method with the costs according to an approach which can adapt this long-term plan to dynamically changing information, such as a variable use of components and the occurrence of maintenance opportunities...

3) Cost & Maintenance Issues in Reliability, Tony Christer, Univ. of Salford, Dept. of Comp. & Math. Sci., Manchester, M5 4WT, UK, *a.h.christer@cms.salford.ac.uk*

No abstract supplied.

ME26 Stochastic Analysis of Computer & Communication Systems

Sponsor: Applied Probability Section
Sponsored Session

Chair: Mark S. Squillante, IBM Research Div., TJ Watson Research Ctr., PO Box 704, Yorktown Heights, NY 10598, mss@watson.ibm.com

1) Queueing Delay & Rate Distortion Functions, C. S. Chang, Ntl. Tsing Hua Univ., Dept. of Elect. Eng., Hsinchu, Taiwan, 30043, ROC, cschang@ee.nthu.edu.tw, **Joy A. Thomas**

By treating queueing delay as a distortion measure between input and output of a queueing system, we define a rate delay function analogous to the rate distortion function in IT. This provides a link between the recently developed theory of effective bandwidth, which is used to analyze buffer overflow in high speed computer networks and the information theoretic capacity of a channel...

2) Stochastic Scheduling of a Multi-Class Queue with Feedback & Side Constraints, David D. Yao, Columbia Univ., IE/OR Dept., New York, NY 10027-6699, yao@ieor.columbia.edu, **Li Zhang**

A multiclass queue with feedback models a computing system in which jobs are routed between the CPU and IO devices repeatedly before completion. Motivated by prototype UNIX-based operating systems, we study the optimal scheduling of such systems, focusing on the extended polymatroid structure of the problem. We show that the optimal schedule under side constraints can be realized by a policy reminiscent of Kleinrock's delay-cost schedules...

3) Analysis of Affinity Scheduling & Load Balancing in Parallel Computer Systems, Mark S. Squillante, IBM Research Div., TJ Watson Research Ctr., PO Box 704, Yorktown Heights, NY 10598, mss@watson.ibm.com

In parallel computer systems, it is often more efficient to schedule a task on 1 server than on another. Due to the inevitability of imbalances in the amount of work at each, there exists a fundamental tradeoff between balancing workload and scheduling tasks where they run most efficiently. We analyze this tradeoff and a corresponding set of general load balancing policies. By varying 4 policy control parameters, we induce a rich family of scheduling policies.

ME27 OR Models for Project Planning & Control

Cluster: AI & OR Techniques in Project Management Decision Analysis
Invited Session

Chair: Simin Pulat, Univ. of OK, School of IE, 202 W Boyd, Ste. 124, Norman, OK 73019, pulat@mailhost.ecn.ou.edu

1) Time-Resource Trade-Off for Project Schedules, Simin Pulat, Univ. of OK, School of IE, 202 W Boyd, Ste. 124, Norman, OK 73019, pulat@mailhost.ecn.ou.edu

We present a methodology that compares project schedules with respect to time and resource usage. The time-resource trade-off problem is solved as a bicriteria project scheduling problem. Efficient project schedules for a range of project realization times are generated using two approaches: enumerative and interactive. Both approaches have desirable computational times.

2) Project Scheduling & Equipment Planning, Bajis M. Dodin, Univ. of CA, Anderson Grad. Sch. of Mgmt., Riverside, CA 92521, A. A. Elinam

We address trade-off between least-cost project schedules and the cost of acquiring, maintaining and operating project equipment. We consider the issues of buying or leasing, setup cost, leasing cost, depreciation, maintenance and operating costs. We formulate a mathematical programming model to capture the proposed trade-offs and illustrate it with a real-life project.

3) Autonomous Agent Heuristics for Resource-Constrained Project Scheduling, Gary Knotts, Univ. of AZ, MIS Dept., Coll. of Bus. & Public Admin., Tucson, AZ 85721, **Moshe Dror, Bruce C. Hartman**

We describe and analyze the performance of several project scheduling heuristics implemented on a collection of autonomous agents mapped one-to-one to project tasks. Such an implementation creates a project scheduling tool capable of greater scheduling flexibility than is generally available from existing approaches and allows greater parallelism.

4) Fast & Efficient Estimation of Modal Position for Unimodally Distributed Data in AI-Based Project Control, Milan Milatovic, Univ. of Oklahoma, **Adedeji B. Badiru**

We present an approach for fast and accurate estimation of the modal concentration in unimodally distributed data. The approach is based on five specific percentile values from the data and the methodology of Inclusive Graphic Skewness. The proposed methodology is useful for searching expert data bases for AI-based project control.

ME28 Combinatorial Issues in Network Design & Air Traffic Control

Cluster: Integer Programming
Invited Session

Chair: Oliver Goldschmidt, Laboratoire LEIBNIZ-IMAG, 46 av. Felix Viallet, Grenoble Cedex, 38031, France, oliver.goldschmidt@imag.fr

1) Combinatorial Issues of Air Traffic Optimization, Vincent Letrouit, Laboratoire LICIT-INRETS, 109 av. Salvador Allende, Bron Cedex, 69675, France, letrouit@inrets.fr, **Remy Fondacci, Oliver Goldschmidt**

The global positioning system allows aircraft to fly direct routes between their origin and destination. We study the impact of this new situation on air traffic management from a combinatorial point of view, especially the design of new airway's networks with applications to the European sky.

2) A New & Improved Algorithm for the 3-Cut Problem, Michel Burlet, Laboratoire LEIBNIZ-IMAG, 46 av. Felix Viallet, Grenoble Cedex, 38031, France, michel.burlet@imag.fr, **Oliver Goldschmidt**

We present a $O(m^3)$ time exact algorithm for finding a minimum 3-cut in an edge-weighted graph. This running time compares very favorably with the best known algorithm which takes $W(m^5)$ time in the worst case.

3) Two-Connected Graphs with Given Diameter, Alexandre Laugier, Ctr. Ntl. d'Etudes en Telecomm., 905 rue Albert Einstein, Sophia-Antipolis, 06921, France, alexandre.laugier@sophia.cnet.fr, **Florence Boyer, Oliver Goldschmidt**

We present a construction to obtain 2-connected subgraphs of the complete graph with diameter d and a minimum number of edges. This problem is of interest for telecommunication design problems. Survivability of networks involves redundancy of the equipments. On the other hand, low delay through the networks requires small values of the diameter.

4) Virtual Paths Configuration in an ATM Network, Pascal Chanas, Ctr. Ntl. d'Etudes en Telecomm., 905 rue Albert Einstein, Sophia-Antipolis, 06921, France, pascal.chanas@sophia.cnet.fr, **Oliver Goldschmidt, Alexandre Laugier**

We study the problem of configuring VPs in an ATM network. Given a capacitated physical network and a set of virtual circuits (VC), the VP set of VPs accommodates all VCs and satisfies link capacities. We devise efficient approximation algorithms for the VP problem based on parallel machines scheduling techniques.

ME29 Convex & Semidefinite Optimization

Cluster: Linear Programming & Related Topics
Invited Session

Chair: Tamas Terlaky, Tech. Univ. of Delft, Faculty TWI, Dept. SSOR, Mekelweg 4, Delft, 2628 CD, The Netherlands, t.terlaky@twi.tudelft.nl

Co-Chair: Cornelis Roos

1) A Simplex Generalization for SDP, Gabor Pataki, Columbia University, 400 W 119th St., New York, NY 10027, gabor@ieor.columbia.edu

We present a generalization of the simplex method for SDP. We give an upper bound on the increase in the rank necessary to move away from the current solution and a method to find an improving feasible direction when it is nondegenerate and nonoptimal. Finally, we present our computational experience.

2) On Path Following Algorithms in Semidefinite Programming, Etienne de Klerk, Tech. Univ. of Delft, Fac. TWI, Dept. SSOR, Mekelweg 4, Delft, 2628 CD, The Netherlands, e.deklerk@twi.tudelft.nl, **Cornelis Roos, Tamas Terlaky**

The long-step primal-dual central path-following method for LP was recently extended to SDP for the Nesterov-Todd direction. We give a weaker condition for a feasible full Newton step and show quadratic convergence to targets on the central path. We also consider large dynamic target updates still allowing full Newton steps.

3) Nonlinear Rescaling & Duality Issues in Constrained Optimization, Roman A. Polyak, George Mason Univ., Dept. of OR & Math., Fairfax, VA 22030-4444, rpolyak@vms1.gmu.edu

By rescaling the objective function and/or the constraints of a given constrained optimization problem, one obtains an equivalent problem for which the classic Lagrangian has some very important properties. It leads to some interesting properties of the dual function and the dual problem, which we discuss.

ME30 Resource Scheduling Using Auction & Bidding Models**Cluster:** Scheduling

Invited Session

Chair: S. David Wu, Lehigh Univ., Mfg. Logistics Inst., 200 W Packer Ave., Mohler Lab., Bethlehem, PA 18015, sdwl@lehigh.edu

1) **Auctions & Optimization: Methods for Closing the Gap Caused by Nonconvexities in Preferences**, *Patrick T. Harker*, Univ. of PA, OPIM Dept., 1300 SH-DH, Wharton Sch., 3620 Locust Walk, Philadelphia, PA 19104-6315, harker@wharton.upenn.edu, *Rinaldo Jose, Lyle Ungar*

We explore the solution of optimization problems by use of an augmented tonnement method to overcome the nonconvexities in preferences represented by LP agents in an auction system. Extension to nonlinear agents will also be presented.

2) **Real-Time Routing & Control of Material Handling Vehicles Using an Auction-Based Hot Potato Approach**, *D. Veeramani*, Univ. of WI, Dept. of IE, Mech. Eng. Bldg., 1513 University Ave., Madison, WI 53706-1572, *Norbert Rupp*

We describe a distributed approach to real-time routing and control in which the vehicles behave as passive entities whose movements are directed by autonomous traffic control nodes that reside at the junctions in the material handling network. Also, performance results from parallel and distributed simulation are discussed.

3) **The Use of Multi-Unit Auctions for the Scheduling of Electric Generation Resources**, *Wedad Elmaghaby*, Univ. of CA, Dept. of IEOR, Berkeley, CA 94720-1735, wood@cimsim.ieor.berkeley.edu, *Shmuel S. Oren*

We model an industry with few companies, capacity constraints, limited storage and intertemporal dependency of production costs. These firms compete to supply fluctuating demand. A prominent example is the electricity supply industry. We show the efficiency properties of auctions in a decentralized asymmetric information market.

4) **Distributed Resource Scheduling Using Auction & Lagrangian Relaxation**, *S. David Wu*, Lehigh Univ., Mfg. Logistics Inst., 200 W Packer Ave., Mohler Lab., Bethlehem, PA 18015, sdwl@lehigh.edu, *Erhan Kutanoglu*

We propose a scheduling method using the concept of auction where products in a diverse supply structure bid for resource capacities. We study the connection between auction mechanism and price directive decomposition using a classical scheduling problem as well as a problem from industry. Some interesting research findings are discussed.

ME31 Routing**Cluster:** Combinatorial Optimization

Invited Session

Chair: Paolo Toth, Univ. of Bologna, DEIS, Viale Risorgimento 2, Bologna, 40136, Italy, ptoth@deis.unibo.it

1) **Searching K-Best Strategies in a Labelled Transportation Network**, *A. Quilliot*, Univ. Blaise Pascal, ISIMA, BP 125, Campus des Cezeaux, Aubiere, 63173, France

We consider a network whose arcs are provided with labels in some alphabet A and length function parametered by these labels. Those labels may correspond, for instance, to various transportation modes whose frequencies have not been determined yet. Then, to any path corresponds some A-word called a routing strategy and 2 paths are said to be independent if their associated strategies are independent in some sense...

2) **Vehicle Routing Techniques Applied to a Milk Collection Problem**, *Maria E. Urquhart*, Univ. de la Republica, Dept. Inv. Operativa, INCO-FIA, J.H. y Reissig 565, 5to piso, Montevideo, Uruguay, *Omar Viera, Martin Gonzalez, Hector Cancela*

We present the prototype of a routing tool developed under the GIS arc/info. The application under consideration is the milk collection problem of the Uruguayan Cooperativa Nacional de Productores de Leche. The solution process is based in the cluster-first-route second strategy. The routing uses a heuristic originally proposed by Solomon. We extend this solution to suit the VRP where multiple plants, heterogeneous fleet and multiple time windows are under consideration.

3) **A Parallel GRASP for the Steiner Tree Problem in Graphs**, *Celso C. Ribeiro*, Catholic Univ. of Rio de Janeiro, Dept. of Comp. Sci., R Marques de Sao Vicente 225, Rio de Janeiro, 22453-900, Brazil, celso@inf.puc-rio.br, *Simone L. Martins, Mauricio C. de*

Souza

We propose a GRASP heuristic for the Steiner tree problem on the successive solution of minimum spanning tree problems. Approximate evaluation techniques are used to speed up the local search phase. Computational results are presented.

4) **Exact Algorithms for the Crew Rostering Problem**, *Paolo Toth*, Univ. of Bologna, DEIS, Viale Risorgimento 2, Bologna, 40136, Italy, ptoth@deis.unibo.it, *Alberto Caprara, Matteo Fischetti, Daniele Vigo*

The CRP calls for the determination of the minimum number of crews needed to sequence a given set of duties into rosters satisfying several operational constraints. We propose a B&B algorithm based on a tight Lagrangian lower bound and on dominance criteria. Computational results for instances from railway applications are presented.

ME32 Case Studied IV: Developing End-User Applications Using Simulation Modeling**Sponsor:** CSTS

Sponsored Session

Chair: Bjarni Kristjansson, Maximal Software Inc., 2111 Wilson Blvd., Ste. 700, Arlington, VA 22201, bjarnik@site.gmu.edu**ME33 Software Demonstrations IV****Sponsor:** CSTS

Sponsored Session

Chair: Bjarni Kristjansson, Maximal Software Inc., 2111 Wilson Blvd., Ste. 700, Arlington, VA 22201, bjarnik@site.gmu.edu**Tuesday 08:00-09:30****TA01 OR/MS Applications in the Travel Industry****Cluster:** OR/MS Applications

Invited Session

Chair: Warren Lieberman, Decision Focus Inc., 650 Castro St., Ste. 300, Mountain View, CA 94041-3656

1) **Yield Management Applied to Timeshare Exchange**, *Jim Mullin*, Decision Focus Inc., 650 Castro St., Ste. 300, Mountain View, CA 94041

Yield management concepts have been introduced in innovative ways to the vacation exchange process in the timeshare industry. This paper gives an overview of the industry. Similarities (e.g., demand and supply uncertainty) and differences (e.g., closed market and flat pricing structure) with other systems are discussed. Potential applications of the concepts to other industries are reviewed.

2) **Applying OR/MS Methods to Call Center Planning & Analysis Problems**, *Vijay Mehrotra*, Onward Inc., 888 Villa St., Ste 210, Mountain View, CA 94041, vijay@onward-net.com

I discuss some classical call center planning and analysis problems while describing modeling methods that our firm has successfully applied to such problems. In particular, I give an overview of CallSim, an integrated simulation modeling environment created by Onward and Systems Modeling for call centers.

3) **Lowering Airfare Costs for Cruise Lines**, *Warren Lieberman*, Decision Focus Inc., 650 Castro St., Ste. 300, Mountain View, CA 94041-3656

Airfare payments can exceed 20% of a cruise line's revenue. Each dollar paid represents \$1 less profit. We discuss decision support tools we provide cruise lines to identify lower cost routings while meeting specified levels. These tools also enable cruise lines to meet airline seat commitments.

TA02 Applications in Airline Transportation**Cluster:** Applications

Invited Session

Chair: Cynthia Barnhart, MIT, Ctr. for Transport. Studies, Rm. 1-229, Cambridge, MA 02139, cbarnhar@mit.edu

1) **A Combined Daily/Exceptions Crew Planning Model**, *Pamela H. Vance*, Auburn Univ., Dept. of ISE, Auburn, AL 36849-5346, *Alper Atamturk, Ellis L. Johnson, George L. Nemhauser, Cynthia Barnhart, Eric Gelman, Alamuru S. Krishna*

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.

2) Evaluating Automation Scenarios for Bottleneck Urban Highways, Teodor Gabriel Crainic, Univ. de Montreal, CRT, CP 6128, Succ. Centre-Ville, Montreal, Quebec, H3C 3J7, Canada, theo@crt.umontreal.ca, *Luminita Stematie, Brunilde Sanso*

Automated highways (and vehicles) are a very credible scenario for the next generation of motorway infrastructures. We study the applicability and potential benefits of automation and platooning concepts for an urban bottleneck subnetwork. Several scenarios are analyzed with respect to performance of the automated system for equipped and non-equipped drivers.

3) Dynamic Aspects of Airline Operations, Eric Feron, MIT, Dept. Aero/Astro. Eng., Cambridge, MA 02139, feron@mit.edu, *Nicolas Pujet*

Economic pressure is urging airlines to operate under ever tighter constraints and to make optimal use of their available resources. We present a modeling approach to understand the impact of information delay and decay on the quality of airline operations, including on-time departures and arrivals and irregular operations.

TA03 Crew Planning & Management

Sponsor: Aviation Applications Section

Sponsored Session

Chair: Steve A. Whitlock, US Airways, Inc., 2345 Crystal Dr., Crystal Park 4-DCA/H700, Arlington, VA 22227, steve.whitlock@usairways.com

1) Large-scale Crew Scheduling, Srinivasan Ramaswamy, United Airlines Corporate R&D, 1200 E Algonquin Rd., Elk Grove Village, IL 60173, sramaswamy@ual.com

Airline crew pairing problems are well known in the OR community - these problems are known to be NP-hard and are difficult to solve. Yet solving them, even approximately, is of interest to the airlines because of the millions of dollars in potential savings. United Airlines has developed the ACRUZER system for this purpose. ACRUZER uses a column generation B&P algorithm to solve the problem...

2) Design of Generic Crew Rules Legality Checks, Milorad Sucur, SABRE Decision Tech., 1 E Kirkwood Blvd., MD 7390 TSG, Southlake, TX 76092, milorad_sucur@sdt.com

Implementing or changing crew scheduling systems is costly because of the time needed to modify legality check rules. A generic legality check module would allow benefits to be achieved more quickly. We analyze reasons for inefficiency in implementing new rules and propose the design of a generic legality check module.

3) Crew Permanent Bid Movement Prediction, Kalyan K. Madhavan, US Airways, Crystal Park 4, DCA/H700, 2345 Crystal Dr., Arlington, VA 22227, kalyan_madhavan@usairways.com

US Airways makes changes to the allocation of pilots across equipment type, position and base 3-4 times a year. At these times, the pilots can bid for new positions. As these changes occur, the company incurs training costs as well as the unavailability of the pilots during their training periods. We present our method for predicting what these changes are given specific changes to the allocations...

TA04 VERT Simulation in Program Management, Consulting & Teaching

Sponsor: Military Applications Society

Sponsored Session

Chair: George M. Huntley, ATSZ-SAM, Bldg. P-12500, 2401 Quarters Rd., Ft. Lee, VA 23801-1705, huntley@lee-dns1.army.mil

1) VERT Simulation's Versatility for Consulting & Teaching, George M. Huntley, ATSZ-SAM, Bldg. P-12500, 2401 Quarters Rd., Ft. Lee, VA 23801-1705, huntley@lee-dns1.army.mil

The government-developed Venture Evaluation and Review Technique, VERT, does not have all the user-oriented niceties of modern simulation engines. However, it is relatively powerful and quick to learn and is free for government use. Examples show its versatility for "real world" consulting as well as "ivory tower" classroom usage.

2) Using VERT Simulation to Compare Military Systems, Joseph Shelton, Aegis Research Corp., Huntsville, AL 35806, jshelton@aegisrc.com

The VERT will be used to compare the relative merits of 2 competing missile

systems. Measures of effectiveness will include performance program duration and cost. Results of stochastic processes will be verified independently by network analysis and final result states overall probability of success.

3) Advances in VERT Simulation for Project Management, Gerald Moeller, Rock Is Arsenal, 1540 Broadview Dr., Bettendorf, IA 52722, gmoell@ria-emh2.army.mil

The VERT provides a quantitative trade space between life cycle cost, schedule, performance, producibility and risk; it can also report cost/schedule status. New features are related to using "cost" as an independent variable.

4) Improving VERT Simulation's Linkup with Project Management Data Systems, Nona Riley, USASMD, Huntsville, AL, riley@ssdch-usassdc.army.mil

The new acquisition environment has turned Joint Project offices into integrated management problem domains with the Army using one scheduling tool and their Air Force counterpart using another while their prime contractors are using even a different one. Thus, the operational implementation of risk management has become more complex. To reduce this complexity, the SDO has developed automated interface between PDM and ADM...

5) Automated PDM-to-ADM Network Conversion & VERT Network Plotting, Jon Schoenfeld, US Army Sp & Missile Defense Command, Huntsville, AL, schoenj@ssdch-usassdc.army.mil

We will describe an algorithm for converting project networks from a PDM format to an ADM format, as used in VERT. We will include a demo of a program that automates this conversion using MS Project PDM networks as input and produces PowerPoint plots of ADM and VERT networks.

TA05 Advances in Decision Analysis Applications

Sponsor: Decision Analysis Society

Sponsored Session

Chair: Detlof Von Winterfeldt, Decision Insights, Inc., 2062 Business Ctr. Dr., Ste. 110, Irvine, CA 92612, detlof@aol.com

1) Value Focused Thinking with Seagate Software, Ralph L. Keeney, Univ. of Southern CA, 101 Lombard St., Ste. 704W, San Francisco, CA 94111

Seagate Software is an emerging leader providing tools and applications for efficiently and securely managing and accessing information. To help identify key issues and specify decision opportunities, we obtained and structured objectives from 12 executives. These issues and opportunities were prioritized and appropriately pursued. Vision and mission statements were developed.

2) A Multiattribute Utility Analysis of Alternatives for Plutonium Disposition, John C. Butler, Univ. of TX, MSIS Dept., CBA 5.202, Austin, TX 78712-1175, jbutler@utxvms.cc.utexas.edu

The US DoD had recently announced its plan for the disposition of fissile materials. We supported this decision with a multiattribute utility analysis that accounted for non-proliferation, economic, technical, institutional, schedule, environmental and health and safety issues. A decision tree was also used to address Russian influence.

3) Expert Elicitation of Risks in a Simulated Nuclear Reactor Accident, Thomas Eppel, Decision Insights, Inc., 2062 Business Ctr. Dr., Ste. 110, Irvine, CA 92621, teppel@aol.com

A formal expert elicitation process was applied to estimate the outcomes of an experiment involving fuel-coolant interactions in a nuclear reactor accident. We summarize the elicitation methodology, individual estimates and average distributions for 6 experts and calibration data comparing the experts' judgments with the outcomes of the experiment.

4) A Value of Information Analysis for Characterizing High Level Nuclear Tank Wastes, Detlof Von Winterfeldt, Decision Insights, Inc., 2062 Business Ctr. Dr., Ste. 110, Irvine, CA 92612, detlof@aol.com

To characterize the contents of the nuclear wastes in 177 tanks at the Hanford site of the DoE, samples are taken at a cost of about 1 million dollars each. We show how value of information analysis can help improve the allocation of funds for characterizing tanks.

TA06 Industry Corner: What Do Employers or OR Graduates Think About OR Education

Sponsor: Forum on Education

Sponsored Session

Chair: Matt Carlyle, AZ State Univ., Ind. & Mgmt. Systems Eng. Dept, mcarlyle@asu.edu

Co-Chair: Leon S. Lasdon

1) **Experience is the Best Teacher**, *Laurie Dutton*, Praxair Inc., 175 E Park Dr., Tonawanda, NY 14151-0044, laurie_dutton@praxair.com

The end user of the decision support tools that an OR/MS professional develops are frequently not "OR savvy." OR/MS professionals need to convince decision makers that our tools can be successfully used and the results trusted. This is no small task! Experience may be the best teacher...but let's not wait until the "real world" strikes!

2) **The Training of an OR Consultant**, *Tom Baker*, Chesapeake Decision Sciences Inc., 200 South St., New Providence, NJ 07974, teb@chesapeake.com

Chesapeake Decision Sciences has a 30-consultant OR practice. We discuss our extensive training and certification process for new consultants, relationships between the young and old consultants and how differences between theory and practice are hammered out on the job.

3) **What Should OR Consultants Learn at School?**, *Robert L. Phillips*, Decision Focus Inc., 650 Castro St., Ste. 300, Mountain View, CA 94041, bobp@email.dfi.com

There is not necessarily a good match between what students learn in OR programs and what they actually do on the job. Issues of ambiguity, bad data, budget constraints, interpersonal skills, creativity and real breadth are important. There are opportunities for programs that provide knowledge of software engineering and PhD programs with less bias towards academic placement.

TA07 Dynamic Resource Allocation in Production/Logistics
Sponsor: MSOM

Sponsored Session

Chair: Daniel Adelman, GA Inst. of Tech., Logistics Eng. Ctr., Sch. of ISyE, Atlanta, GA 30332, bigd@isye.gatech.edu

1) **Minimizing General Cost Structures in a Flexible Service System**, *Noah Gans*, Univ. of PA, Dept. of OPIM, The Wharton Sch., Philadelphia, PA 19104-6366, gans@opim.wharton.upenn.edu, *Garrett J. van Ryzin*

We look at minimizing general backlog costs in a multi-class service system. The system can operate using a finite set of configurations, and the problem is to choose dynamic configurations to minimize a general cost function. Bounds and computational results are presented.

2) **Dynamic & Stochastic Resource Minimization**, *Anton J. Kleywegt*, GA Inst. of Tech., Sch. of ISyE, Atlanta, GA 30332-0205, anton.kleywegt@isye.gatech.edu, *Vijay S. Nori*, *Martin W. Savelsbergh*

We study a problem in which tasks arrive randomly over time. At discrete decision points, we decide how many resources to allocate to perform the tasks. All tasks have to be completed before a deadline, and allocated resources can be used until the deadline. The objective is to minimize the number of resources allocated.

3) **A Dynamic Programming Approximation for Stochastic Resource Scheduling Problems**, *Warren B. Powell*, Princeton Univ., Program in Stats. & OR, Dept. of Civil Eng., Princeton, NJ 08544, powell@princeton.edu, *Gregory A. Godfrey*, *Joel A. Shapiro*

We consider a general class of dynamic resource scheduling problems with dynamic attributes, which includes machine scheduling with setup times and costs as a special case. The method involves solving sequences of easy network problems. Numerical experiments demonstrate the effectiveness of the technique.

4) **Remnant Inventory Systems with Concatenations**, *Daniel Adelman*, GA Inst. of Tech., Logistics Eng. Ctr., Sch. of ISyE, Atlanta, GA 30332, bigd@isye.gatech.edu, *George L. Nemhauser*

Motivated by cable manufacturing, we consider IP-based, dual price-directed control of remnant inventory systems. In such systems, orders are satisfied with, and in turn may generate, partially consumed raw materials, or remnants, that can later be allocated to other orders. To reduce process scrap, we consider concatenations in which multiple orders are combined.

TA08 New Developments in Supply-Chain Models

Cluster: Inventory Management

Invited Session

Chair: Paul H. Zipkin, Duke Univ., Fuqua Sch. of Bus., Durham, NC 27708-0120, zipkin@mail.duke.edu

1) **Order-Based Backorders**, *Jing-Sheng Song*, Columbia Univ., Dept. of IE/OR, New York, NY 10027, song@ieor.columbia.edu

Order-based backorders are the number of customer orders, each of which

request several different items, that are not yet completely filled. The average order-base backorder is one of the primary performance measures and plays an important role in policy optimization in stochastic, multi-item inventory systems. We present an exact procedure to evaluate this measure in a based-stock system...

2) **Asymptotic Analysis of a Component Procurement Policy for Assembly Systems**, *Jeremie Gallien*, MIT, OR Ctr., Cambridge, MA 02139, *Lawrence M. Wein*

We consider the procurement policy for components that are subsequently assembled into products. Order lead times for components are random and the assemble process must idle if all components are not on hand. We perform an asymptotic analysis of this system using extreme value theory and closed queuing network theory.

3) **Analysis of Kanban Controls for Systems Prone to Defects**, *Rolf Forsberg*, Duke Univ., Fuqua Sch. of Business, Durham, NC 27708-0120, *Yves P. Dallery*, *Paul H. Zipkin*

Consider a multi-stage production system controlled by a kanban, or generalized or extended kanban, policy. Each stage may occasionally produce defective units. The yields, production times and customer demands are stochastic. We present and evaluate an approximation method for performance analysis.

TA09 Network Location Models

Sponsor: Section on Location Analysis

Sponsored Session

Chair: Richard L. Francis, Univ. of FL, 303 Weil Hall, ISE Dept., Gainesville, FL 32611, francis@ise.ufl.edu

1) **Location Problems Arising in Active Sound & Vibration Control of Cylinders**, *R. K. Kincaid*, Coll. of William & Mary, 126 Jones Hall, Dept. of Math., Williamsburg, VA 23187-8795, rrkinc@math.wm.edu

Active structural acoustic control seeks to determine the force inputs and sites for actuators so that interior noise is minimized, cylinder shell vibration is not increased and power is small. The selection of a good set of actuator/sensor sites is done via a reactive TS scheme.

2) **Polynomially Solvable Instances of Combined Facility Location-Network Design Problems**, *Sanjay Melkote*, OK State Univ., Sch. of IE & Mgmt., Stillwater, OK 74078-5018, melkote@hakimi.enden.okstate.edu, *Mark S. Daskin*

We show that although joint facility location-network design problems are NP-hard in general, there exist special cases solvable in polynomial time. We give exact algorithms in each instance and discuss their extension to variants of the basic model.

3) **A Genetic Algorithm for the p-Median Problem**, *Burcin Bozkaya*, Univ. of Alberta, Fac. of Bus., Edmonton, Alberta, T6G 2R6, Canada, *J. Zhang*, *Erhan Erkut*

There have been only 2 reported applications of GAs to location problems, with unpromising results. We have developed a GA that consistently outperforms the earlier ones, and generates solutions of quality comparable to the well-known Teitz-Bart exchange algorithm. We describe our algorithm and provide computational evidence.

4) **Row-Column Demand Point Aggregation for Clustered Data**, *C. M. Mattsson*, Berggatan 26D, Holmsund, 913 31, Sweden, carlmattsson@mbx300.swipnet.se, *J. F. Gothberg*, *Richard L. Francis*

Row-column demand point (DP) aggregation for the p-median model consists of dividing the DP region into cells, via rows and columns. Row and column widths are individually adjustable depending on DP data. We consider some modifications of this basic approach when DP data demonstrates noticeable clustering.

TA10 Traffic Incident Detection & Management

Sponsor: Transportation Science Section

Sponsored Session

Chair: Siamak A. Ardekani, Univ. of TX, Dept. of Civil Eng., Box 19308, Arlington, TX 76019-0308

1) **A Simulation-Based Method for Detection of Surface Street Incidents**, *Gang-Len Chang*, Univ. of MD, Dept. of Civil Eng., College Park, MD 20742, gang@eng.umd.edu

We will present a link-based simulation method for detection of incidents in urban networks. The proposed method, integrating both the event-based simulation features and multivariate statistical methods, is capable of detecting the incident location and the number of lanes being blocked.

2) **Incident Management Through Integrated Control of**

Variable Message Signs, Srinivas Peeta, Purdue Univ., Sch. of Civil Eng., W Lafayette, IN 47907-1284, *Debjit Das*

We propose an integrated approach to incident management that uses the coordinated control of variable message signs through varying degrees of information provision to influence driver behavior and system performance.

3) Field Calibration of a Traffic Diversion Algorithm, Siamak A. Ardekani, Univ. of TX, Dept. of Civil Eng., Box 19308, Arlington, TX 76019-0308, *Michael A. McDonald*

A real-time diversion algorithm has been calibrated. The chase-car method is used to identify destinations of traffic on roadway links scheduled for closure in order to verify OD estimates. Actual roadway incidents have been simulated and diversion routes identified. The results are compared to post-incident observations in the field.

TA11 Activity-Based Analysis & Microsimulation in Transportation

Sponsor: Transportation Science Section
Sponsored Session

Chair: Mariette Kraan, Univ. of TX, Dept. of Civil Eng., ECJ Hall, Ste. 6.2, Austin, TX 78712, *mariette@mail.utexas.edu*

1) The Effect of Replanning for Traffic Simulations of Dallas, Kai Nagel, Los Alamos Ntl. Lab., TSA-DO/SA MS 997, Los Alamos, NM 87545, *kai@lanl.gov*, *Christopher L. Barrett*

The TRANSIMS microsimulation is driven by individual route plans. It is shown how a simulation-based variant of the dynamic assignment method can lead to realistic traffic patterns for a rush-hour microsimulation.

2) A Varying Response Model of Trips Using Episodal Time Diary Data, Andrew S. Harvey, St. Mary's Univ., Dept. of Economics, Halifax, NS, B3H 3C3, Canada, *andrew.harvey@stmmarys.ca*, *Saleh Amirkhalkhali*

We examine trip generation from an activity and role constraint perspective using episodal data drawn from cross-national/cross-temporal time diary studies. A random coefficient model which can be viewed as a refinement of laws stated by Pratt & Schlaifer (Journal of Econometrics, 1988) is used. The model more correctly relates the trips to determinants and permits their impact to be group-specific.

3) The Allocation of Time & Money to Activity Patterns, Mariette Kraan, Univ. of TX, Dept. of Civil Eng., ECJ Hall, Ste. 6.2, Austin, TX 78712, *mariette@mail.utexas.edu*

Total activity patterns of individuals are considered. A model is formulated for the allocation of time and money to activities. Due to the lack of combined data on time and money expenditures, the model is estimated on Dutch Time Budget data of 1980, 1985 and 1990. The results are given.

TA12 Operational Hedging & Flexibility Issues

Cluster: Supply Chain Operations
Invited Session

Chair: Bardia Kamrad, Georgetown Univ., Sch. of Business, 37th & O Streets NW, Washington, DC 20057, *kamradb@gunet.georgetown.edu*

1) Option Pricing & Capacity Expansion, Kevin F. McCardle, James E. Smith, Duke Univ., Fuqua Sch. of Business, Durham, NC 27708-0120, *James E. Smith*

Option pricing applications to capacity expansion and other real asset problems often involve an efficient market assumption. In fact, real assets often involve some positive net present value that invalidates complete market efficiency. We consider various approaches to deal within completeness in markets for real assets that give bounds on the value of capacity expansions.

2) On Flexibility & Stochastic Process Assumptions in Real Options Models, John R. Birge, Univ. of MI, Dept. of IOE, 1205 Beal Ave., Ann Arbor, MI 48109-2117, *jrberge@umich.edu*

We examine the relationship between stochastic process assumptions and the values and exercise strategies for options associated with real projects. In particular, we consider the impact of mean reversion in prices on the value of an option to develop an oil or gas field as well as on options to curtail temporarily production at a developed field.

3) Production, Risk & Moral Hazard Valuation, Bardia Kamrad, Shreevardhan S. Lele, Georgetown Univ., Sch. of Business, 37th & O Sts NW, Washington, DC 20057, *kamradb@gunet.georgetown.edu*, *Shreevardhan S. Lele*

We consider a production environment characterized by market and operating uncertainties (e.g. price and failures, respectively). A Brownian motion signifies

price fluctuations; failures are modeled in accordance to a non-homogenous Poisson process. Using a CCA framework, we establish a value maximizing production and maintenance policy. This dual policy is then used to evaluate moral hazard concerns when an insurance option on failures exists.

4) Advertising & Pricing Policies Using Contingent Claims Valuation, Shreevardhan S. Lele, Georgetown Univ., Sch. of Bus., Washington, DC 20007-4109, *Bardia Kamrad, Robert J. Thomas*

The sales of a new product are modeled as a generalized Wiener process subject to control through advertising and price. The optimum value of the project is obtained using a "real options" framework. An important by-product of the valuation is the determination of the optimal advertising and pricing policies.

TA13 Concurrent Engineering Practices & Effectiveness

Cluster: New Product Development
Invited Session

Chair: B. J. Zirger, Univ. of Cincinnati, Dept. of Strategic Mgmt., PO Box 210165, Cincinnati, OH 45221-0165, *ziegerbj@emaiai.uc.edu*

1) Incorporating Concurrent Engineering Practices into Decision-Making in New Product Development Teams, Irene Johnston Petrick, PA State Univ., Coll. of Eng., 101 Hammond Bldg., University Park, PA 16802, *ijpdo@enr.psu.edu*, *Gerald Sudman*

Concurrent engineering suggests that new product development works best when cross functional teams consider design and manufacturability simultaneously. Effective collaboration can be studied through decision-making practices. We focus on ways that decision-making responsibility is shared for budget/schedule and technical/performance decisions. Distinctions are made based on each decision's risk profile.

2) Issues in Concurrent Engineering, Caroline Hays, Univ. of IL, Dept. of Computer Sci., Beckman Inst. for Adv. Sci., Urbana, IL 61801, *hays@cs.uiuc.edu*

In designing computer tools to assist in concurrent engineering, it is essential to consider not only technological issues, but also organization structures that will use the technology. This talk examines factors influencing concurrent engineering effectiveness and the use of task-based models in improving both technological and organizational structures.

3) A Model of Concurrent Engineering Effectiveness, Frank H. Hull, Paul Collins, Fordham Univ., Grad. Bus. Admin., New York, NY 10023, *Paul Collins*

A 6 factor framework for concurrent engineering effectiveness is proposed: dynamic market environment, rapid-reiterative redesign strategy, transformation of the organization (hierarchical to cross functional), process enabled, advanced in tools/technology and a closely coupled, flexible system. This framework is tested using survey data from 100 US and 17 case studies.

4) The Impact of Concurrent Engineering Structures on Team Learning, B. J. Zirger, Univ. of Cincinnati, Dept. of Strategic Mgmt., PO Box 210165, Cincinnati, OH 45221-0165, *ziegerbj@emaiai.uc.edu*, *James M. Comer*

No abstract supplied.

TA14 Information Issues in Energy Development

Sponsor: ENRE
Sponsored Session

Chair: Thomas Oxner, Univ. of Central AR, Dept. of Accounting, Conway, AR 72035

1) Multi-Attribute Decision Models in Energy Production & Development, Karen Oxner, Hendrix Coll., Dept. of Acct. Econ. & Bus. Ed, Conway, AR 72032

Decisions about production alternatives which affect the generation of hazardous wastes involve tangible and intangible factors difficult to capture in a traditional cost benefit analysis. Using a MAUT-based, decomposed approach allows the incorporation of both types in 1 model. Other advantages are the increase in reliability of decisions and the deeper understanding of the overall problems accruing to the decision maker.

2) Earning per Share & Information Content in Oil Company Statements, Terry Bechtel, Univ. of Central AR, Dept. of Accounting, Conway, AR 72035

We examine whether there is a significant difference between primary and fully diluted EPS for a sample of 61 oil and gas companies. If there is no significant difference, the information content of primary EPS for firms with a complex capital structure is also not significant. A lack of significance would seem to support the elimination of primary EPS.

3) Energy Company Reporting of Asset Impairments, Thomas Oxner, Univ. of Central AR, Dept. of Accounting, Conway, AR 72035

A recent pronouncement by the Financial Accounting Standards Board has had a great impact on some oil firms. It requires firms to decrease the value of long-lived assets whose unamortized historical cost exceeds the expected future cash flows. We describe the provisions of SFAS No. 121 and present the impact of its provisions on selected oil companies.

4) Using Neural Networks to Identify Energy Production Cost Drivers, Richard A. Rivers, Southern IL Univ., Dept. of Acct., Coll. of Bus., Carbondale, IL 62901, rrivers@siu.edu

Like all industries, energy production has seen considerable debt in determining the assignment of indirect costs to production processes. We review the cost structure of energy firms and suggest the use of AI programs in choosing cost drivers.

TA15 Agile Collaboration Through Integration of Technology, Process & People

Cluster: Technology Management

Invited Session

Chair: David L. Gibson, Univ. of TX, IC2 Inst., 2815 San Gabriel Ave., Austin, TX 78705, davidg@icc.utexas.edu

1) The Use of System Integration Architecture to Facilitate Collaboration Within & Along the Supply Chain, John J. Mills, Univ. of TX, Automation & Robotics Research, 7300 Jack Newell Blvd., Ft. Worth, TX 76118, jmills@arriss04.uta.edu

The area of interest is the use of system integration architecture to provide easy-to-use advanced technologies to facilitate collaboration within and along the supply chain. Based upon AAMRC companies which require the integration of functions from disparate applications used in message passing protocols along the supply chain (protocols include CORBA, <http://java>, rpc, OLE, Distributed OLE and COM).

2) The Design of Agile Business Processes, Laura Meade, Univ. of TX, Automation & Robotics Research, 7300 Jack Newell Blvd. S, Ft. Worth, TX 76118, Don Liles

The developed methodology to determine critical or core enterprise processes is presented. Additionally, an agile process configuration method based upon holistic evaluation model which considers both strategic and operational factors is included.

3) An Integrated Management Model for the Extended Enterprise: Vision, Strategy & Structure, Don Liles, Univ. of TX, Automation & Robotics Research, 7300 Jack Newell Blvd. S, Ft. Worth, TX 76118, dliles@arriss04.uta.edu, **Leigh Reid**

We present a collaborative management approach developed for the extended enterprise, including the virtual enterprise. Included is the reference model, the strategy development and deployment model for the extended enterprise, an organizational structure for the extended enterprise and a virtual enterprise life cycle. The specific questions of "how do we manage in this new agile environment" are addressed.

4) The Creation of Agile People to Facilitate Collaboration, Jeffrey Amos, Univ. of TX, IC2 Institute, 2815 San Gabriel Ave., Austin, TX 78705, jeff@icc.utexas.edu, **Richard Shafer, Lee Dyer**

The generalizable features of best agile practices from a host of industries are presented. Examples from companies that were using precepts of agility to facilitate collaboration are highlighted along with the results of data collected from over 15 in-depth company studies of the people side of agility. This work is based upon a research project sponsored by the Agility Forum in Bethlehem, PA.

TA16 Promotional Strategies & Competition

Cluster: Marketing

Invited Session

Chair: William P. Putsis, London Business Sch., Sussex Place, Regents Park, London, NW1 4SA, UK, william.putsis@yale.edu

1) A Cross-Category Analysis of Retailers' Promotional Strategies, Ronald T. Wilcox, Carnegie Mellon Univ., Grad. Sch. of Ind. Admin., 5000 Forbes Ave., Pittsburgh, PA 15213-3890, wilcox+@andrew.cmu.edu, **Chakravarthi Narasimhan**

We examine retailers' varying promotional strategies across categories, developing a simple game-theoretic model of retail competition where retailers compete on an item's price to attract customers to the store, where they may purchase additional items. Closed-form expressions for item (category) margins,

feature advertisement frequency and average promotional depth are derived, as well as data-based comparative statistics.

2) Measure Type & Market Share as Moderators of Asymmetric Price-Tier Effects, Raj Sethuraman, Univ. of IA, Coll. of Bus. Admin., 108 Pappajohn Bldg., Iowa City, IA 52242-1000, sethuraman@blue.weej.uiowa.edu

Price-tier theory suggests higher-priced brands are more "effective" in drawing sales from lower-priced brands through discounting than visa-versa. We demonstrate, based on data from 10 studies, 200 brands and 1000 cross-price effect observations, that strength of this asymmetric effect depends on how it is measured (proportional vs. absolute draw) and market share of the brands.

3) Category Expenditure, Promotion & Competitive Market Interaction: Can Private Labels Expand the Pie?, William P. Putsis, London Business Sch., Sussex Place, Regents Park, London, NW1 4SA, UK, william.putsis@yale.edu, **Ravi Dhar**

Previous research suggests that asymmetric price competition between private labels and national brands limits potential sales increases when private labels are promoted. Using IRI data (58 food categories, 59 geographic markets), we test and find support for the hypothesis that both private label and branded promotion can expand total category expenditure.

4) Duration Dependence & Heterogeneity Issues in Marketing: A Model Comparison Study, Demetrios Vakratsas, Univ. of TX, Sch. of Mgmt., Box 830688, Richardson, TX 75083, dvakrats@utdallas.edu, **Peter Sattler**

We examine and compare different ways in which duration dependence and heterogeneity can be accommodated in continuous time models. We calibrate the different models and compare their performance using 2 different marketing databases: a scanner panel data set on non-durable goods purchased and a direct marketing database.

TA17 Transfer, Innovation & the Management of Technology in Health Care

Cluster: Health Care Management

Invited Session

Chair: Arnold Reisman, Reisman & Assoc., 1284428 Parkland Dr., Shaker Heights, OH 33122, 102126.1551@compuserve.com

1) Meta Analysis of the Technology Management in Health Care Literature, Jaideep G. Motwani, Grand Valley State Univ., 301 West Fulton #510, Grand Rapids, MI 49504, **A. Kumar**

No abstract provided.

2) Organization Climate & the Adaption of Technological Innovations by Hospitals, A. L. Wilson, Univ. of WI, Whitewater, WI

No abstract provided.

3) The Transfer & Commercialization of University-Developed Medical Imaging Technology: Opportunities & Problems, Anthony A. del Campo, BCM Technologies, Inc., 1709 Dryden Rd., Ste. 901, Houston, TX 77030, delcampo@bcm.tmc.edu, **Robert C. Hill, Robert T. Keller**

No abstract provided.

TA18 PANEL: Teaching Service Operations Management

Cluster: Service Operations

Invited Session

Chair: James A. Fitzsimmons, Univ. of TX, Dept. of Mgmt., CBA 4.202, Austin, TX 78712, jfitz@mail.utexas.edu

1) PANEL: Teaching Service Operations Management, Ravi Behrava, George Mason Univ., **Michael E. Gleeson**, IN Univ., **David M. Lyth**, Western MI Univ., **Scott Sampson**, Brigham Young Univ.

Service management is a topic of growing interest among business and IE students and provides faculty with an opportunity to offer a course considered career relevant to a large segment of their students. The panel members discuss their experiences teaching service operations management as an undergraduate core operations course, as an elective IE course, in executive education, in overseas programs and as a MBA elective course for both day and night students...

TA19 Strategic Internet & World Wide Web usage**Cluster:** Electronic Commerce**Invited Session****Chair:** Sue Conger, SMU, Cox Sch. of Bus., Dallas, TX 75275, scong@aol.com**1) Web Application Design & the Need for Methods, Sue Conger, SMU, Cox Sch. of Bus., Dallas, TX 75275, scong@aol.com**

Strategic WWW applications should have several critical characteristics that are systematically designed into the application: effectiveness, affectiveness and navigational efficiency. Each of these characteristics are defined with examples of good and poor websites used to exemplify their importance.

2) Organizational Communication: Anywhere & Anytime, Ken Wilkinson, Greyhound Corp., Dallas, TX

The Internet represents a telecommunications infrastructure that is only partially tapped if its main use is for WWW applications. Greyhound undertook a study to develop the ability to do its operations (such as ticket sales) anywhere and anytime by using the Internet for its internal communications.

3) World Wide Web Technologies: Tradeoffs & Future, Carlos Mendez, Ambient Software, Dallas, TX

Website designs that use contemporary technologies are key to developing an organizational image of innovativeness. Yet, the vast majority of web users use Intel 386 level technology that is incapable of viewing the technology. Technologies such as Active-X, VBScript, CGI/Perl and Java and tradeoffs for their use are described.

TA20 Application Assembly Using Object Components**Cluster:** State-of-the-Art in Information Technology**Invited Session****Chair:** Hemant K. Jain, Univ. of WI, Sch. of Bus. Admin., Milwaukee, WI 53201, jain@csd.uwm.edu**1) Domain Modeling Approach to Distributed Organizational Process Modeling, Vijayan Sugumaran, Le Moyne Coll., Sch. of Bus. Admin., Syracuse, NY 13214, M. Tanniru**

Organizational processes are repetitive, interdependent and distributed and often modeled to study their relevance and efficiency. Domain modeling techniques can be applied to create generic process models, using which we can evaluate the existing processes in a particular domain. We propose a domain modeling framework and how it can be used in an organizational context.

2) Multiple Perspectives in Object Distribution, Sandeep Purao, GA State Univ., CSI Dept., Atlanta, GA 30302-4015, spurao@gsu.edu

This research recognizes the plurality of organizational stakeholders in object distribution by adapting and extending research in multiple-perspective requirements engineering. It involves codification of different forms of object distribution knowledge such as distribution heuristics, conflict categories and conflict resolution categories.

3) Application Assembly from Reusable Components: A New Paradigm, Hemant K. Jain, Univ. of WI, Sch. of Bus. Admin., Milwaukee, WI 53201, jain@csd.uwm.edu

The ability to assemble software applications from the standard reusable components has been the dream of software developers. The advances in object oriented development techniques and platform independent languages like JAVA are making it technically feasible to achieve this goal. The changing role of IS organization in the above context is examined.

TA21 Theoretical Foundations of MMT IX**Cluster:** Management of Medical Technology**Invited Session****Chair:** Curtis P. McLaughlin, Univ. of NC, Bus Sch & Sch of Public Health, Carroll Hall, CB3490, Chapel Hill, NC 27599-3490, mclaughc.bsacd1@mhs.unc.edu**1) Operations Management & the Theoretical Foundations of MMT, Curtis P. McLaughlin, Univ. of NC, Bus Sch & Sch of Public Health, Carroll Hall, CB3490, Chapel Hill, NC 27599-3490, mclaughc.bsacd1@mhs.unc.edu, Kit N. Simpson**

Operations management has focused on the reduction of variation. In health care, this is a mistake. Methods of technology assessment must take into account the inherent variability of patient and process. Techniques such as simulation and econometric modeling are essential to incorporating the epidemiological and personal variability aspects of health technology.

2) Management of Telemedicine Technology in Health Care Organizations, Olivia R. Liu Sheng, Hong Kong Univ. of Sci. &

Tech., Dept. of IS Mgmt., Kowloon, Hong Kong, olivia@usthk.ust.hk, Paul Jen-Hwa Hu, Chih-Ping Wei

Technology management has become a growing concern for health care organizations. This study is about managing telemedicine and aims at successful technology transfer from vendors and R&D laboratories to clinical setting. We analyze the critical issues and key factors/considerations from the organization's perspective in relationship to its main stakeholders.

3) Telemedicine: Issues in Technology Management, Keri Pearlson, Univ. of Texas, Dept. of MSIS, Grad. Sch. of Bus., Austin, TX 78712, kpearlson@mail.utexas.edu, David Paul

Technology management issues present major challenges to the widespread deployment and acceptance of telemedicine. We present a framework for the management of technology in telemedicine and discuss the critical issues of complexity, integration, support and legal liabilities. The work is based on data drawn from a study of 9 operational telemedicine projects.

TA22 Operations Management I**Contributed Session****Chair:** Robert H. Burgess, GA State Univ., Dept. of Mgmt., PO Box 4014, Atlanta, GA 30302-4014, rburgess@gsu.edu**1) Mass Customization Using Process Improvement: Dynamic Game Results, Robert H. Burgess, GA State Univ., Dept. of Mgmt., PO Box 4014, Atlanta, GA 30302-4014, rburgess@gsu.edu, Cheryl Gaimon**

Results of a dynamic game formulation of firms implementing a mass customization strategy are presented. Particular emphasis is placed on using process improvement as the means of modifying a firm's high volume production facility to meet demand for increased customization.

2) Continuous Training & Education Integrated with Learning While Producing: What is the Best Balance?, Scott Metten, Univ. of UT, Eccles Sch. of Bus., 4988 S Glen St., Murray, UT 84107, phdmgt-sm@business.utah.edu

I compare the cost/benefit ratio of learning by continuous training against the cost/benefit ratio of learning while producing. I develop a conceptual model to determine the amount of training that would be cost effective to enable production to start as close as possible to standard time on the experience curve.

3) Manufacturing Strategy & Competitiveness: A Synthesis & Research Agenda, Shekhar Jayanthi, Univ. of Cambridge, Mfg. Eng., Mill Ln, Cambridge, CB2 1RX, UK, sj215@eng.cam.ac.uk

Manufacturing firms are undergoing technological and organizational changes, guided by firm's manufacturing strategies, to achieve competitiveness. However, firms face "competitive gridlock" despite implementation of changes. By integrating different strands of literature, we develop a framework and propose research methods to understand the "missing link" between manufacturing strategy and competitiveness.

4) The Basic Course in POM: Are We Programming Robots, William R. Sherrard, San Diego State Univ., IDS Dept., Coll. of Bus., San Diego, CA 92182-8234, sherrard@mail.sdsu.edu, David R. Hampton

We illustrate how it is possible to measure the cognitive activity required to answer test bank multiple questions in 3 leading POM test banks and report the results of the cognitive level classification. Statistics reveal that the majority of MC questions in the publisher-supplied test banks of the OM textbooks require students to memorize facts rather than employ higher level cognitive ability...

5) The Inverse Newsvendor Problem, Scott Carr, Univ. of MI, 1120 Owana, Royal Oak, MI 48167, carr@engin.umich.edu, William Lovejoy

The classic NVP maps a known demand distribution into an optimal level of capacity. The inverse NVP maps known capacity into an optimal demand distribution. This problem is motivated by an industrial firm that wishes to know how much of their capacity to commit via contracts to client firms.

TA23 Decision Analysis III**Contributed Session****Chair:** Peter C. Anselmo, NM Tech., Box 3, Spere Hall, Socorro, NM 87801, anselmo@mailhost.nmt.edu**1) Risk Information & Portfolio Weighting, Peter C. Anselmo, NM Tech., Box 3, Spere Hall, Socorro, NM 87801, anselmo@mailhost.nmt.edu**

The relationship between the nature of risk information and portfolio construction is explored. Risk information may take one or more of many forms and portfolio weights may vary according to the type of risk considered. A simple illustrative example is presented.

2) Why Isn't Decision Analysis Used for Project Selection? A Survey, Fred Phillips, OR Grad. Inst. of Sci. & Tech., PO Box 91000, Portland, OR 97007, fphillips@admin.ogi.edu

Despite the fact that NPV methods reject promising projects, most corporate product development projects are evaluated based on the net present value method. We discuss reasons why organizational practice perpetuates this. A survey of managers in high-tech companies shows which of these reasons are most important.

3) Probability Assessments by Scatterplots, Frank Kirschnick, Stanford Univ., PO Box 8791, Stanford, CA 94309, frankir@leland.stanford.edu

A new, simple methodology for probability assessments will be presented. It allows experts to describe and communicate probability distributions graphically in the form of scatterplots. We will provide first results of an implementation of this methodology in practice, and discuss its impact on decision model transparency and consistency.

4) Risk Aggregation & the Efficient Selection of Joint Projects by a Consortium, John Aloysius, Univ. of AR, CISQA Dept., BADM 204, Fayetteville, AR 72701, aloysius@comp.uark.edu

Risk attitudes of decision makers could have a potential bearing on the efficiency of project funding decisions in research consortia. We show that in bidding for projects, firms should consider projects collectively rather than individually. We also show that participation in a consortium leads to more efficient funding decisions.

5) Modeling Intertemporal Choice Under Uncertainty, Ayse Onculer, Univ. of PA, OPIM, 1300 SH-DH, Wharton Sch., 3620 Locust Walk, Philadelphia, PA 19104, oncul69@opim.wharton.upenn.edu

The main idea of our experimental study is to examine if future uncertainty is treated differently than immediate uncertainty and future certainty. The findings suggest risk preferences depend on the time period over which the outcomes are evaluated. Specifically, risk aversion decreases with respect to future gains and increases with respect to future losses.

TA24 Project Management

Contributed Session

Chair: Genaro J. Gutierrez, Univ. of TX, Coll. of Bus. Admin., CBA 4.202, Austin, TX 78712

1) Uncertainty, Risk-Pooling & Sub-Contracting Mechanisms in Project Management, Anand A. Paul, Univ. of TX, Coll. of Bus. Admin., CBA 4.202, Austin, TX 78712, abraham@uts.cc.utexas.edu, Genaro J. Gutierrez

The problem of partitioning a project into sub-projects to be allocated to a pool of contractors has important implications for project success. Our research analytically addresses issues involved in diversifying risk for the project owner by partitioning the project and assigning the sub-projects to multiple contractors.

2) Human Resources' Planning for Multi-Projects' Management, Tsuyoshi Kutsukake, Waseda Univ., Dept. Ind. & Mgmt. Sys. Eng., 3-4-1- Ohkubo Shinjuku-ku, Tokyo, 169, Japan, 696b0123@mn.waseda.ac.jp, Hisashi Onari

There are various processes which require several specialties of engineers in a new product development project. We present the planning method of assigning jobs of multi-projects to engineers with due date restrictions.

3) Hi-Intensity Heuristics for Resource-Constrained Multiple Dependent Project Scheduling, Tamminh Tran Kapuscinka, Carnegie Mellon Univ., Schenley Park, Pittsburgh, PA 15213, tran+@cmu.edu, Thomas E. Morton, Prasad Rannath

We study extended dispatch methods (X-dispatch) for resource-constrained multiple dependent projects with the objective of minimizing the sum of weighted tardiness. X-dispatch are versions of dispatch heuristics with modifications that allow for inserted idleness. They have the potential of greatly enhancing the performance of dispatch methods at moderate extra cost.

4) Simulation-Based Learning Systems for Improving Project Management, Sharon Els, Pugh Roberts Assoc./PA Consulting Group, 41 William Linskey Way, Cambridge, MA 02142, sharon.els@pa-consulting.com, Kenneth Cooper

Development projects can make or break an organization. For 2 decades (December 1980 Interfaces) the authors have employed dynamic simulation models to diagnose project successes and failures. New work combines simulation, communication and training technologies in "learning systems," culling and disseminating past projects lessons to achieve sustained project performance improvement.

TA25 Statistics in Medicine

Cluster: Statistics & Reliability

Invited Session

Chair: Joseph Ibrahim, Harvard Univ., Dept. of Biostat., Sch. of Pub. Health, 44 Binney, Boston, MA 02115, ibrahim@jimmy.harvard.edu

1) Semiparametric Bayesian Analysis of Survival Data, Dipak Dey, Univ. of CT, Dept. of Stats. U-120, Storrs, CT 06269, Debajyoti Sinha

We discuss several semiparametric Bayesian approaches to model baseline hazard for multivariate survival data. We talk about frailty models, multiple event time with different censoring schemes. Special attention is given to prior elicitation, model checking and selection using predictive distributions.

2) Bayesian Model Averaging: An Application to Survival Analysis, Chris Volinsky, Univ. of WA, Dept. of Stats GN22, Seattle, WA 98195

BMA is discussed for proportional hazard models. We examine computational and theoretical problems associated with applying BMA, including approximations for integrated likelihoods and efficient negotiation of huge model spaces. When applied to a large clinical trial on stroke incidence, BMA results in an improved assessment of stroke risk.

3) Hierarchical Modeling of Multiple Related Case-Control Studies, Peter Mueller, Duke Univ., Box 90251, Inst. of Stats & Dec. Sci., Durham, NC 27708-0251, pm@stat.duke.edu, Giovanni Parmigiani, J. Schildkraut, L. Tardella

We propose an approach for analyzing case-control studies of risk factors. Our approach extends analyzing case-control studies of risk factors. We extend traditional methods including combination of case-control studies; combination of prospective studies; posterior and predictive inference in case-control studies and use of a non-linear regression approach, replacing the linear log odds ratio.

4) Conditional Categorical Models with Application to Treatment Compliance for & Survival of Acute Myocardial Infarction Patients, Alan Gelfand, Univ. of CT, Dept. of Stats., Storrs, CT 06269-3120, alan@merlot.stat.uconn.edu

For a sample of 2409 patients with a diagnosis of AMI, we examine extent of compliance, i.e., treatment received matches eligibility, and probability of survival given compliance. Influence of covariate information on these quantities is desired. Variation of these quantities across hospitals adjusted for case mix is also sought.

TA26 Queueing Networks

Sponsor: Applied Probability Section

Sponsored Session

Chair: Jim Dai, GA Inst. of Tech., Sch. of ISyE, Atlanta, GA 30332-0205

Co-Chair: John J. Hasenbein

1) Asymptotic Behavior of Several Parallel Queues with 2 Customer Types: Dedicated & Join-the-Shortest-Queue, Robert D. Foley, GA Inst. of Tech., Sch. of ISyE, Atlanta, GA 30332, David M. McDonald

We consider m parallel exponential servers with $m+1$ independent Poisson arrival processes. One of the arrival processes joins the shortest of the m queues with ties broken randomly. Each of the other arrival processes is dedicated to a particular queue. We look at the asymptotic behavior of this system as the total number of customers in the system reaches some large level $\{em1\}$.

2) Throughput of Timed Token Rings, Douglas G. Down, GA Inst. of Tech., Sch. of ISyE, Atlanta, GA 30332

We study the stability properties of timed token passing rings, such as those that arise in the implementation of the fiber distributed data interface protocol. Stability in this system is in relation to the arriving traffic: the timing mechanism keeps token cycle time finite. Sufficient conditions are obtained that are weaker than those obtained in previous studies.

3) On the Stability of Fluid & Discrete Networks, Jim Dai, GA Inst. of Tech., Sch. of ISyE, Atlanta, GA 30332-0205, John J. Hasenbein, John Vande Vate

We will discuss what is known about the global stability region of 2- and 3-station fluid networks and provide some new insights into the stability of networks with an arbitrary number of stations. In conjunction, we will discuss the problems that arise in formulating a satisfactory theory of stability for both fluid and discrete queueing networks.

TA27 Multiple Criteria Decision Making

Cluster: AI & OR Techniques in Project Management Decision Analysis
Invited Session

Chair: A. Ravindran, Univ. of OK, Sarkeys Energy Ctr., Ste. R208, 100 E Boyd, Norman, OK 73019-0628, aravi@ou.edu

1) A Goal Programming Model for Quality Function Deployment, Abu S. M. Masud, Wichita State Univ., IME Dept., Wichita, KS 67260-0035, masud@ie.twsu.edu, Samuel K. Lee

In traditional QFD no explicit attempt is made to apply any optimization technique in identifying the key characteristics and in setting improvement targets. A GPM has been developed to incorporate multiple criteria optimization in the QFD process. The proposed model is explained through an illustrative example.

2) Clustering of Multiple Criteria Alternatives with Application to Machine-Part Cell Formation, Behnam Malakooti, Case Western Reserve Univ., Dept. of SIE, Crawford Hall, Cleveland, OH 44106, bxm4@pap.cwru.edu, Ziyong Yang

Clustering discrete set of multiple criteria alternatives is developed. The set of alternatives is clustered into mutually exclusive groups based on similar features and the decision makers preferential information. Such clustering of multiple criteria alternatives facilitates the decision making process. An application example to machine-part cell formation problems is presented.

3) Integrating Evolutionary Strategy in Multicriteria Optimization, Anuradha Maria, SUNY, Dept. of Systems Sci. & Tech., Binghamton, NY 13902-6000

Heuristic search methods based on the principles of natural genetics include GA and evolution strategies. Their advantages can be leveraged in multiple criteria optimization. This paper presents a methodology to formalize the integration of evolutionary strategies and multi-criteria optimization by designing, implementing and evaluating several heuristics.

4) An Interactive Method for Multicriteria Simulation Optimization with Integer Variables, Wan S. Shin, Univ. of OK, shin@mailhost.eccn.ou.edu, A. Ravindran, Jae Y. Kim

An interactive multi-criteria method is proposed to optimize a simulation model with multiple response functions. To mitigate the cognitive burden on the DM and maintain consistency, an artificial neural network concept is applied. A computational study is performed to investigate the characteristics of the proposed method and the validity of neural networks.

TA28 Integer Programming: Methods & Applications

Cluster: Integer Programming
Invited Session

Chair: Vedat Verter, McGill Univ., Faculty of Mgmt., 1001 Sherbrooke St. W, Montreal, Quebec, H3A 1G5, Canada

1) A Lagrangian Relaxation of the Capacitated Multi-Item Lot Sizing Problem Solved with an Interior Point Cutting Plane Algorithm, Jean-Louis Goffin, McGill Univ., Fac. of Mgmt., 1001 Sherbrooke St. W, Montreal, Quebec, H3A 1G5, Canada, goffin@management.mcgill.ca, Olivier du Merle, C. Trouiller, Jean-Philippe Vial

The capacitated multi-item lot sizing problem with set-up times is handled by solving its Lagrangian relaxation, followed by heuristics. We compare 3 methods to handle the Lagrangian relaxation problem: the subgradient method, Kelly's cutting plane method - also known as Dantzig-Wolfe decomposition - and the analytic center cutting plane method.

2) Perturbation Strategies for IP Column Generation, Jacques Desrosiers, GERAD & HEC, 5255 Decelles, Montreal, PQ H3T 1V6, Canada, Olivier du Merle, Daniel Villeneuve

It is well known that column generation procedures are usually quite slow. This is mainly due to degeneracy phenomena or numerical instability. We propose some perturbation strategies to overcome these difficulties. Numerical results are presented in an IP context.

3) The Progressive Piecewise Linear Underestimation Technique

We present the PPLU technique. This proved to be an effective tool in solving certain concave minimization problems with combinatorial structure. The common feature of these problems is the availability of effective algorithms for solving the subproblems that arise at each iteration of the PPLU.

4) Branch & Cut in Semidefinite Programming, Christoph Helmberg, Konrad-Zuse Zentrum für Info., Racknitzer Steig 9, Berlin,

13593, Germany, helmberg@zib-berlin.de

Theoretical results indicate that semidefinite relaxations yield powerful bounds for constrained quadratic 0-1 programming problems. B&C approaches based on these relaxations seem to be an attractive choice for solving the underlying combinatorial problems. However, the corresponding bounds are expensive to compute. We will try to explore the potential and limits of this approach in theory and in practice...

TA29 Recent Progress in the Practical Interior Point Methods

Cluster: Linear Programming & Related Topics
Invited Session

Chair: Jacek Gondzio, Univ. of Geneva & HEC, Unimail, Dept. Mgmt. Studies, 102 Blvd. Carl-Vogt, Geneva, 1204, Switzerland, gondzio@divsun.unige.ch

1) On the Numerical Implementation of Interior-Point-Methods for SDP, Florian A. Potra, Univ. of IA, Dept. of Math., Iowa City, IA 52242, potra@math.uiowa.edu

A survey of recent implementations of interior-point-methods for SDP is given, including a detailed description of a software package developed by Brixius, Potra & Sheng based on the homogenous formulation of Potra & Sheng. The efficiency of different implementations are compared on a set of benchmark problems.

2) Recent Advances in the XPRESS-MP Barrier Code for Linear Programming, Erling D. Anderson, Odense Univ., Dept. of Mgmt., Campusvej 55, Odense, DK-5230, Denmark, eda@busieco.ou.dk, Knud D. Andersen

We present the recent advances in the XPRESS-MP barrier code. Some of the recent advances are that the code now is based on the homogeneous algorithm. The method of multiple corrections has been implemented. The code has been parallelized for a shared memory SGI.

3) When is Parallelization Advantageous to Interior Point Methods?, David J. Haglin, Mankato State Univ., Dept. of Mgmt., PO Box 8400, Mankato, MN 56002-8400, haglin@mankato.msus.edu, John A. Kaliski

What characteristics of your interior point methods and problems should you look for to determine whether or not to use parallel processing? We discuss method and problem attributes to consider when choosing serial vs. fine-grain, medium-grain or course-grain parallel computing environments. Computational experiences are presented.

4) New Features of HOPDM Public Domain IPM Code, Jacek Gondzio, Univ. of Geneva & HEC, Unimail, Dept. Mgmt. Studies, 102 Blvd. Carl-Vogt, Geneva, 1204, Switzerland, gondzio@divsun.unige.ch

We present recent advances in the HOPDM code. In particular, we address warm start option for the solution of the sequence of similar problems or reoptimization after adding a set of new columns. To facilitate embedding into various applications, HOPDM was transformed to a C callable library.

TA30 Shop Scheduling: Algorithms & Complexity

Cluster: Scheduling
Invited Session

Chair: Scott Webster, Univ. of WI, School of Bus., Madison, WI 53706-1323, swebster@bus.wisc.edu

1) Heuristic Procedures for Scheduling Job Families with Setups & Due Dates, Kenneth R. Baker, Dartmouth Coll., Tuck Sch. of Bus. Admin., Hanover, NH 03755-1798, kenneth.r.baker@dartmouth.edu

We examine a new solution procedure for the problem of scheduling jobs on a single machine to minimize the maximum lateness in the presence of setup time between different job families. We review the state of knowledge about the solution of this problem and examine the 2 heuristic procedures.

2) On the Complexity of Periodic Shop Scheduling Problems, Marc E. Posner, OH State Univ., Dept. of Welding, ISE, 1971 Neil Av, Columbus, OH 43210-1271, Nicholas G. Hall, Tae-Eog Lee

We consider scheduling problems in which jobs with at most k operations are scheduled repetitively to minimize cycle time. A linear time algorithm is provided for $k=2$. We prove binary NP-completeness if $k \geq 3$ and unary NP-completeness if $k \geq 5$. A pseudopolynomial time algorithm is developed for a special case when $k=3$.

3) Single Machine Scheduling with Controllable Due Dates, Mohammed Mehdi Liaee, Case Western Reserve Univ., Dept. of OR,

Cleveland, OH 44106, mmm16@po.cwru.edu, *Hamilton Emmons*

Consider scheduling n jobs, each having an initial cost-free due date which can be delayed at a certain cost, on 1 machine. We examine the complexity of bicriteria problems, the total due date assignment cost being 1 of the criteria. We classify each problem as NP-hard, polynomial solvable or open.

4) **Scheduling a Batch Processor**, *Scott Webster*, Univ. of WI, School of Bus., Madison, WI 53706-1323, swebster@bus.wisc.edu

We consider a model of a capacitated batch processor scheduling problem. The time to process a batch depends on the longest job in the batch and the objective is to minimize flow time. We summarize past results, investigate properties of the model and pose questions for future consideration.

TA31 Combinatorics

Cluster: **Combinatorial Optimization**

Invited Session

Chair: James B. Orlin, MIT, Rm. E53-357, Sloan Sch. of Mgmt., Cambridge, MA 02139, jorlin@mit.edu

1) **Reliability of Erasure Correction**, *C. J. Colbourn*, Univ. of VT, Dept. of Comp. Sci. & EE, Votey Bldg., Burlington, VT 05405, colbourn@emba.uvm.edu

Reliability of disk arrays for secondary computer storage is examined when failures result from disk erasure. A simple combinatorial model provides connections with the better studied model of communications network reliability. Characteristics of the most reliable erasure correcting codes are discussed.

2) **Learning Logic**, *K. Truemper*, Univ. of TX, Comp. Sci. Program EC31, PO Box 830688, Richardson, TX 75083-0688, truemper@utdallas.edu, *Giovanni Felici*

We describe a new method for extracting logic relationships from logic data for the purpose of classifying such data. Computational tests show that the method is fast, versatile and effective.

3) **Inverse Optimization**, *James B. Orlin*, MIT, Rm. E53-357, Sloan Sch. of Mgmt., Cambridge, MA 02139, jorlin@mit.edu, *Ravindra K. Ahuja*

Consider a feasible region P and a solution x^* in P . Let $INV(x^*, P) = \{d: x^* \text{ is optimal for minimize } (dx: x \text{ in } P)\}$. Given the optimization problem, minimize $(d-c:d \text{ in } INV(x^*, P))$. In general, if the inverse problem is solvable in polynomial time, then so is the inverse problem. We discuss this result, as well as many other results, in this domain.

TA32 Computational Combinatorial Optimization

Sponsor: CSTS

Sponsored Session

Chair: Jonathan H. Owen, Northwestern Univ., Dept. of IE/MS, 2225 N Campus Dr., Evanston, IL 60208-3119, owenj@iems.nwu.edu

1) **General-Purpose Modeling Language for Combinatorial Optimization via Logic Programming**, *Robert Fourer*, Northwestern Univ., Dept. of IE/MS, 2225 N Campus Dr., Evanston, IL 60208-3119, 4er@iems.nwu.edu

Modeling languages have not proved especially helpful for working with combinatorial optimization problems other than integer programs. We describe extensions to an algebraic language that permit combinatorial problems to be formulated naturally and solved directly by search algorithms that have their roots in the principles of logic programming.

2) **Animated Combinatorial Optimization**, *Jonathan H. Owen*, Northwestern Univ., Dept. of IE/MS, 2225 N Campus Dr., Evanston, IL 60208-3119, owenj@iems.nwu.edu, *Collette R. Coullard*, *David Dilworth*

We describe and demonstrate our software environment for network optimization, Graphical Implementation Development Environment for Networks, GIDEN. GIDEN features interactive graphical display and algorithm animation for network optimization problems. We discuss implementation issues for developing combinatorial optimization solvers within the GIDEN environment.

3) **On the P-Hub Location Problem: Models & Lower Bounds**, *Ernesto Santibanez-Gonzalez*, Catholic Univ. of Valparaiso, Sch. of IE, Valparaiso, Chile, esantiba@ucv.cl, *J. Macgregor-Smith*, *Charles J. Colbourn*

We analyze and discuss the mathematical programming formulations of the p-hub location problem. We discuss the NLP and NP formulations of the problem and present some easy to solve p-hub problems. The different methods for getting lower bounds for the p-hub problems are surveyed. We got optimal

solutions for problems up to 12 nodes and 3 hubs using the linear integer 0-1 mathematical formulation...

TA33 Software Demonstrations V

Sponsor: CSTS

Sponsored Session

Chair: Bjarni Kristjansson, Maximal Software Inc., 2111 Wilson Blvd., Ste. 700, Arlington, VA 22201, bjarnik@site.gmu.edu

1) **Alphatech**, *Kendra E. Moore*, Alphatech Inc., 50 Mall Rd., Burlington, MA 01803-4537

TA35 Machine Scheduling

Contributed Session

Chair: Jaideep T. Naidu, Univ. of MS, Mgmt. & Mktg. Dept., University, MS 38677, mknaidu@vm.cc.olemiss.edu

1) **Heuristic Approaches to Minimize Tardiness Problems on Single Machine with Sequence Dependent Set-Up Times**, *Jaideep T. Naidu*, Univ. of MS, Mgmt. & Mktg. Dept., University, MS 38677, mknaidu@vm.cc.olemiss.edu, *Bahram Alidaee*

A class of heuristic algorithms will be presented for the total weighted and unweighted tardiness problems on a single machine with sequence dependent set-up times for each job. Extensive computational results show that the proposed algorithm will create very good schedules.

2) **Batch Machine Scheduling to Minimize Weighted Completion Time**, *Michael X. Weng*, Univ. of South FL, Dept. of IMSE, 4202 E Fowler Ave., Tampa, FL 33620, weng@eng.usf.edu, *Kishor Panpaliya*

We focus on the problem of scheduling batch machines so as to minimize weighted completion time. TS is used to solve this NP-hard problem. Computational tests indicate that the approach is promising.

3) **Investigation of Single Machine Scheduling with Scheduled Preventive Maintenance**, *Tai-Fu T. Yang*, TX Tech. Univ., Dept. of IE, 2024 10th St. #11, Lubbock, TX 79401, atly@ttacs.ttu.edu, *Surya D. Liman*, *Milton L. Smith*

Single machine job scheduling with scheduled preventive maintenance is investigated. Maintenance must be performed during a time window. Performance measures include makespan, flowtime and weighted flowtime. Optimizing and heuristic algorithms are developed and evaluated. Heuristic algorithms are efficient and effective for problems with at least 100 jobs.

4) **Probabilistic Analysis of a Single Machine Scheduling Model**, *Philip M. Kaminsky*, Northwestern Univ., Dept. of IE/MS, 2225 N Campus Dr., Evanston, IL 60208, philk@iems.nwu.edu, *David Simchi-Levi*

We present new probabilistic analysis results for a single machine scheduling model.

TA36 General Queueing

Contributed Session

Chair: Alex Zhang, Univ. of Southern CA, IOM Dept., Sch. of Bus. Admin., Los Angeles, CA 90089-1421, xin@rcf.usc.edu

1) **The Newsboy Problem with Multiple Demand Classes**, *Alper Sen*, Univ. of Southern CA, IOM Dept., Sch. of Bus. Admin., Los Angeles, CA 90007, asen@rcf.usc.edu, *Alex Zhang*

We extend the newsboy model for sequentially realized multiple demand classes with decreasing and increasing prices. We obtain optimal order quantities and bounds for profit maximization and satisficing. The 2 cases with decreasing and increasing prices lead to different policy structures and application areas.

2) **Cost Minimization for Variable Service Rate Queues**, *Jennifer M. George*, Stanford Univ., Grad. Sch. of Bus., Memorial Way, Stanford, CA 94305-5015, mjgeorge@leland.stanford.edu, *J. Michael Harrison*

We develop a variable service rate queueing model, based on an M/M/1 queue, with continuous service rate effort costs and holding costs. We present characteristics of the optimal solution. Finally, we develop a numerical solution method giving an approximate solution with bounds.

3) **Stability of the Optimal Arrival Rate & Capacity Design for a Service Facility**, *Lizhi Ma*, SUNY, Dept. of IE, Amherst, NY 14226, lizhima@eng.buffalo.edu, *Christopher M. Rump*

We consider a service facility with nonlinear deadline delay cost and uniform

service value distribution. We prove that there exists at most 1 stability threshold of service capacity for equilibrium and optimal arrival rates. We also explore the global stability with polynomial, exponential and other delay-cost structures.

4) Admission Policies for a 2-Class Loss System, E. Lerzan Ormeci, Case Western Reserve Univ., 11408 Bellflower Rd., Cleveland, OH 44106, elo@po.cwru.edu, **Apostolos N. Burnetas, Hamilton Emmons**

Consider the admission/rejection problem for a multiserver, no-waiting-room queueing system with 2 customer classes, Poisson arrivals, exponential services with different rates. A lost customer cost is incurred depending on customer class. We characterize the optimal policy in terms of the preferred customer class and rejection thresholds for the non-preferred.

Tuesday 09:45-11:15

TB01 OR/MS Applications in Airline Industry A

Cluster: OR/MS Applications

Invited Session

Chair: Spyros Kontogiorgis, USAir, 2345 Crystal Dr., Arlington, VA 22227

1) The Unsung Cost Problem: Empty Seats, Ira Gershkoff, SABRE Decision Tech., PO Box 619616, MD 1426, DFW Airport, TX 75261-9616

The typical airline load factor of 60%-70% means that 30%-40% of the product is thrown away. Yield management approaches alone cannot reduce this waste significantly. This talk outlines an approach to withholding capacity in real-time from markets with low demand and reallocating it to those having high demand without affecting pricing or causing fare dilution.

2) The Impact of Free Flight on Real-Time Schedule Management in the Airline Operations Control Center, Margaret T. Jenny, USAir, 2345 Crystal Dr., DCA/H700, Arlington, VA 22227

As the air traffic management system evolves toward free flight, the airlines will have increasing flexibility to manage their operations. Within the operations control centers, real-time decision support tools built upon system-wide models and simulations, will enable planners and dispatchers to minimize costs and passenger inconvenience during irregular operations, and also support performance analysis and process improvement. This talk describes the airline OKAY environment of the future...

3) Dealing with Uncertainty in Optimizing Plans for Transportation Operations, Russell A. Rushmeier, IBM Watson Research Ctr., PO Box 952, Mount Kisco, NY 10549-0952

The lack of inventory buffers in transportation systems makes it critical that timing and demand uncertainty are considered as an integral part of the planning process. Approaches to effectively characterize and incorporate uncertainty measures in key optimization models for transportation DSSs are discussed.

4) Interactive Schedule Development: The Next Generation, Ilhan Ince, USAir, 2345 Crystal Dr., Arlington, VA 22227, **Spyros Kontogiorgis**

We present development WIP on an interactive, distributed, DSS for the production of US Air's flight schedules. The system integrates a suite of forecasting and optimization models. We discuss a multi-day general-purpose fleet assignment model and its integration in the object-oriented system architecture.

TB02 Applications in the Automobile Industry

Cluster: Applications

Invited Session

Chair: Marilyn J. Maddox, Ford Motor Co., 24500 Glendale, Redford, MI 48239, ufmcpvlv@ibmmail.com

1) A Logistics Study for an Automotive Assembly Plant, Hwa Sung Na, Ford Motor Co., Adv. Mfg. Tech. Develop. Ctr., 24500 Glendale, Redford, MI 48239, hna@ford.com

We describe an application of using discrete event simulation software as a decision support tool in handling logistic issues at an assembly plant. It offers the plant a tool to analyze the impact of product mixes, to evaluate its capacity under given constraints and to examine its operating policies.

2) A New Process for Order-to-Delivery, Sharon J. Bergeon, Ford Motor Co., Process Reengineering, 555 Republic Dr., Ste. 425, Allen Park, MI 48101, sbergeon@isp.ford.com

Ford Motor Company's order-to-delivery reengineering project is dramatically changing the vehicle ordering process. A new process was created using a

heuristic algorithm to generate suggested stock vehicle orders for dealers which are tailored to their individual markets and sales patterns. A brief overview of the process and the formulation of the optimization problem will be presented.

3) Decision Framework for Environmentally-Conscious Machining, Derek P. Bennett, Univ. of CA, IE/OR Dept., Berkeley, CA 94720-1777, bennett@ieor.berkeley.edu, **Candace A. Yano**

We describe a hierarchical decision framework for equipment and process selection that considers both economic and environmental factors. Detailed models of individual processes are embedded within simulation and optimization models for an entire production facility. Application to an engine plant of a US automobile manufacturer will be discussed.

TB03 Scheduling & Fleet Routing

Sponsor: Aviation Applications Section

Sponsored Session

Chair: Craig A. Hopperstad, Boeing Commercial Airplane Group, Analytical Tools & Methods, PO Box 3707, MS 75-14, Seattle, WA 98124-2207, craig.a.hopperstad@boeing.com

1) Database-Driven Timetable Analysis Model, Esmond E. Devun, The Boeing Co., MS 7L-20, PO Box 3707, Seattle, WA 98124, esmond.devun@pss.boeing.com, **Nicholas J. Walker**

Airline passengers can be characterized by their trip (earliest departure, latest arrival) time window. Coverage, the fraction of passengers with a path within their window, constitutes a measure of timetable effectiveness. A database method of subsetting/comparing timetable coverage is described.

2) A Demand-Driven Dispatch Model Using Bid-Price Information, Robert L. Phillips, Decision Focus Inc., 650 Castro St., Ste. 300, Mountain View, CA 94041, bobp@email.df.com, **Robert A. Flint**

The dynamic aircraft rotation model, developed for the Scandinavian Airline System, recommends aircraft gauge changes within 10 weeks of departure based on demand, yield and bid price forecasts from a dynamic O&D revenue management system. We describe the model and its application at SAS.

3) Leg Clustering for Static & Dynamic Fleet Assignment, Judy Pastor, Continental Airlines, 2929 Allen Parkway, Ste. 1200, Houston, TX 77019, jpasto@coair.com, **Roxy Kramer**

We describe how cluster analysis was used to group flight leg operations for a large airline network. It has been found that clustering yields information about flight markets which can be exploited in several ways including a variety of aircraft assignment schemes.

4) Comparison of Fleet Assignment Strategies Based on Leg Clustering, Matthew E. Berge, The Boeing Co., MS 7L-20, PO Box 3707, Seattle, WA 98124, matthew.berge@pss.boeing.com, **Craig A. Hopperstad**

Daily, weekly and dynamic fleet assignment strategies are compared for an airline schedule operating in a single season. Emphasis is placed on demand and revenue modeling of flight legs clustered by factors including day-of-week and week-of-season.

TB04 Task Force XXI Advanced Warfighting Experiment

Sponsor: Military Applications Society

Sponsored Session

Chair: William B. Carlton, HQ USA Operational Evaluation Command, Park Center IV, 4501 Ford Ave., Alexandria, VA 22302, carlton@optec.army.mil

1) TFXXI Assessment Strategy, William B. Carlton, HQ USA Operational Evaluation Command, Park Center IV, 4501 Ford Ave., Alexandria, VA 22302, carlton@optec.army.mil

The Army recently completed a series of experiments in which digital equipment was installed on more than 1000 combat platforms in a mechanized brigade. The brigade participated in a series of training exercises culminating with a rotation to the National Training Center. The training exercises were designed to assess the effectiveness of the digitized brigade in comparison to standardized brigades...

2) Analysis of TFXXI AWE Digital Data, William Marriott, HQ USA Operational Evaluation Command, Park Ctr. IV, 4501 Ford Ave., Alexandria, VA 22302

The Army conducted a series of exercises leading to a Brigade Task Force AWE at the NTC to help assess how it will organize and fight in the 21st century. A fundamental hypothesis is that "digitized" command and control will play an integral role. We discuss how we collected and analyzed data to assess the digitized C2 system.

3) Analysis of TFXI AWE Force Effectiveness Data, Tom Zeberlein, USA Operational Evaluation Command, Park Ctr. VI, 4501 Ford Ave., Alexandria, VA 22302

An application of correspondence analysis as a graphical technique to investigate which rows or columns of a frequency table have similar patterns of counts will be presented. Correspondence analysis has recently become popular in the US. The technique is useful for large tables where deriving useful information is difficult.

4) Analysis of Factors Affecting TFXI AWE Fratricide Incidents, Cary Moore

There are many factors that contribute to the incidence of fratricide. The importance of these factors should be reduced in order to assess the effect a system will have on the incidence of fratricide. Ideally, an experimental unit would conduct force on force engagement training without proposed equipment, then with the equipment, eliminating many of the unit's specific contributors to fratricide...

TB05 Asking the Right Questions: Pilot Models & Sensitivity Analysis

Sponsor: Decision Analysis Society

Sponsored Session

Chair: David G. Lowell, Strategic Decisions Group, 2440 Sand Hill Rd., Menlo Park, CA 94025-6900, dlowell@sdg.com

1) Sequential Development of a Decision Basis, Stephen L. Derby, Strategic Decisions Group, 2440 Sand Hill Rd., Menlo Park, CA 94025, sderby@sdg.com

Practical applications of DA reveal that this basis is developed incrementally as the decision maker clarifies the key reasons for choosing 1 alternative over another. We present a sequential methodology for DA that develops the basis for rational choice among risky alternatives efficiently and quickly.

2) Sensitivity Analysis for Dependent Variables, Terry Reilly, Univ. of OR, Lundquist Coll. of Bus., Eugene, OR 97403-1208, reilly@euclid.uoregon.edu

Independence among input variables is often assumed when applying sensitivity techniques, but this assumption may not be appropriate. Typically, the decision analyst models dependence relations via conditional distributions after performing a sensitivity analysis. We develop a strategy for incorporating dependence relations into sensitivity before assessing the conditional distributions.

3) Prioritizing Conditional Probability Assessment, David G. Lowell, Strategic Decisions Group, 2440 Sand Hill Rd., Menlo Park, CA 94025-6900, dlowell@sdg.com

We introduce a sensitivity analysis for prioritizing the probability assessments needed for a DA. The results demonstrate which assessments affect the choice of alternative and which do not, thereby guiding the decision analyst to assess only those conditional or marginal probability distributions that are material to the decision.

TB06 Case Studies & Sponsored Projects in OR

Sponsor: Forum on Education

Sponsored Session

Chair: Matt Carlyle, AZ State Univ., Ind. & Mgmt. Systems Eng. Dept, mcarlyle@asu.edu

Co-Chair: B. Curtis Eaves

1) The Case Study That Wouldn't Die: New Results Enrich the Case, Matt Carlyle, AZ State Univ., Ind. & Mgmt. Systems Eng. Dept, mcarlyle@asu.edu

No abstract supplied.

2) Large-Scope Field Projects: Necessary Skill, Matt Carlyle, AZ State Univ., Ind. & Mgmt. Systems Eng. Dept, mcarlyle@asu.edu

The case-study/sponsored-project sequence is intended to prepare students to work on projects in the real world, many of which last significantly longer than the 10 or 15 weeks of an academic term. We discuss how the skills in these classes help students prepare for these larger projects and discuss an actual long-term field project from the student perspective.

TB07 TUTORIAL: Set Partitioning, Linear Programming & Combinatorial Optimization in Supply Chain Management

Sponsor: MSOM

Sponsored Session

Chair: Valerie Tardif, Univ. of TX, Grad. Program in OR/IE, Austin, TX 78712-1063, vtardif@mail.utexas.edu

1) TUTORIAL: Set Partitioning, Linear Programming & Combinatorial Optimization in Supply Chain Management

A classic and recently popular method for solving many hard combinatorial problems is based on formulating these problems as set-partitioning models. This is done commonly for crew scheduling, vehicle routing, graph partitioning, machine scheduling, etc. We explain the excellent empirical performance of the set-partitioning technique for a number of problems including vehicle routing, bin-packing and parallel machine scheduling problems...

TB08 Production & Inventory Models

Cluster: Inventory Management

Invited Session

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

1) Pricing & Inventory Management Issues in a Simple Supply Chain, Tamer Boyaci, Columbia Univ., New York, NY 10027, Guillermo Gallego

We investigate pricing and inventory management issues that arise in the simplest possible supply chain consisting of 1 wholesaler, 1 retailer and a group of customers whose collective demand is price sensitive and assumed to be deterministic. The existing related marketing and operation management differ markedly in the way costs are charged. We present a general model that encompasses both literature streams...

2) Periodic Review Inventory Policies with Positive Fixed Order Cost & Finite Order Capacity, Alan Wolf, Carnegie Mellon Univ., Pittsburgh, PA 15213

We examine the nature of the optimal policy for periodic review inventory models with positive fixed order cost and finite order capacity. We outline situations where the optimal policy has a nice structure and for these cases provides simple second-best policies which perform well when compared to the more complex optimal policy.

3) Minimax Analysis for Finite Horizon Inventory Models, Jennifer K. Ryan, Northwestern Univ., Dept. of IE/MS, 2225 N Campus Dr, Evanston, IL 60208, Guillermo Gallego, David Simchi-Levi

We consider stochastic finite-horizon inventory models with discrete distributions that are incompletely specified by selected moments, percentiles or a combination of moments and percentiles. The objective is to determine an inventory policy that minimizes the maximum expected cost over the class of demand distributions satisfying the specifications described above. We show that many inventory models can be solved by a sequence of LPs.

4) The CELSP with P-W Linear Production Costs & General Holding Costs, Dong X. Shaw, Purdue University, W Lafayette, IN 47907

We consider the CELSP with piecewise linear production costs and general holding costs which is an NP-hard problem. For a single item problem, we present a dynamic programming procedure the running time of which is linear to the magnitude of the average demand.

TB09 Facility Location in a Stochastic Environment

Sponsor: Section on Location Analysis

Sponsored Session

Chair: Oded Berman, Univ. of Toronto, Fac. of Mgmt., 105 St. George St., Toronto, Ontario, M5S 1E6, Canada, berman@fmgmt.mgmt.utoronto.ca

1) Location of Inspection Facilities on Cyclic Networks, Pitu B. Mirchandani, Univ. of AZ, Dept. of IE, Tucson, AZ 85721, pitu@sie.arizona.edu, David E. Lucas

The problem: locate capacitated facilities on links of the network to maximize the probability that a moving unit (e.g., a vehicle) is inspected. In an earlier paper, an algorithm was developed for acyclic traffic networks. Here, we present an approximate algorithm for cyclic networks, with some computational results.

2) Improved Police Car Allocation in the City of Buffalo, Steve J. D'Amico, SUNY, Dept. of IE, 342 Bell Hall, Buffalo, NY 14260, sjdamico@daffodil.eng.buffalo.edu, Rajan Batta, Christopher M. Rump

We investigate the application of queueing theory and geometrical probability concepts to the determination of efficient spatial allocation of police patrol cars. This work involves extending software implementation for use by the city of Buffalo Police Department.

3) Robust Center Location on a Network, Oded Berman, Univ. of Toronto, Fac. of Mgmt., 105 St. George St., Toronto, Ontario, M5S 1E6, Canada, berman@fmgmt.mgmt.utoronto.ca, **Igor Averbakh**

We consider the 1-median problem on a network with uncertain weights. For each node, only an interval estimate is known. It is required to find the "minimax regret" location. We present the 1st polynomial algorithm for this problem on a network. For a tree network, we discuss algorithms with complexities improved over the algorithms known in the literature.

TB10 New Directions in Route Choice Modeling

Sponsor: Transportation Science Section
Sponsored Session

Chair: Maya Tatineni, Univ. of IL, Dept. of Civil & Materials Eng., 842 W Taylor St., Chicago, IL 60607, maya@voyager.utc.uic.edu

1) Effects of Alternative Error Assumptions in Stochastic Route Choice Models, Maya Tatineni, Univ. of IL, Dept. of Civil & Materials Eng., 842 W Taylor St., Chicago, IL 60607, maya@voyager.utc.uic.edu, **David E. Boyce, Pitu B. Mirchandani**

In the absence of real world data, several assumptions are made in implementing stochastic route choice models. We explore the implications of making alternative assumptions for the distribution of traveler perception errors on the solution of simple stochastic route choice models.

2) Enhancements & Applications of a Dynamic Route Choice Model, Der-Horng Lee, Oak Ridge Nat. Lab., PO Box 2008, 4500N, MS-6206, Oak Ridge, TN 37831-6206, leedh@ornl.gov, **David E. Boyce, Bruce N. Janson**

We present a dynamic route choice model with applications and enhancements. Incidents, spillback queues, signal setting/timing, capacity change and alternative route choice behavior are considered in the model and solution algorithm.

3) Forecasting Ridership After Implementation of APTS, Julian M. Benjamin, NC A&T State Univ., Economics Dept., Greensboro, NC 27411, benjamin@athena.ncat.edu

In a recent analysis of additional demand in response to an elderly and disabled van service APTS, a Poisson regression forecasted additional ridership. In a combined queueing model, expected demand is forecast for different service levels specifically considering the inter-dependence of the transit system and the desires of the riders.

TB11 Transportation Routing & Location Problems

Contributed Session

Chair: Linda Nozick, Cornell Univ., Sch. of Civil & Environ. Eng., Hollister Hall, Ithaca, NY 14853-3501, lkn3@cornell.edu

1) A Dynamic & Stochastic Formulation for the Bin-Packing Problem, Michael R. Swihart, Purdue Univ., Sch. of IE, 1287 Grissom Hall, W Lafayette, IN 47907, mswihart@ecn.purdue.edu, **Jason D. Papastavrou**

We analyze a dynamic bin-packing problem. Items arrive to a system and are packed into identical bins. Items must be packed immediately upon arrival. Once a bin is closed, it is shipped. The objective is to determine a policy for closing bins that minimizes a cost function.

2) Heuristics for Routing & Scheduling of Hazardous Materials Shipments When the Arc Attributes are Time Variant, Goro Suljoadikusumo, Cornell Univ., Sch. of Civil & Environ. Eng., Ithaca, NY 14853-3501, lkn3@cornell.edu, **Linda Nozick**

Making good routing and scheduling decisions for HAZMAT shipments requires the consideration of multiple objectives. The performance of individual roads typically varies by time of day with respect to many of these objectives. We discuss the performance of heuristics which can be used to identify good routes and schedules.

3) Locations of Hubs & Assignment of Interacting Facilities to Hubs in a Network, Subramanian Krishnan, PA State Univ., Dept. of IE, University Park, PA 16802, krishnan@psu.edu, **Tom M. Cavalier**

We present a path-flow based MIP for determining the location of p-hubs in a transportation network and the associated unique assignment of the nodes to hubs such that total transportation cost in the network is minimized. A solution procedure based on Lagrangian relaxation is proposed.

4) A Unified Solution Approach to Related Classes of Location-Routing Problems, Ripu Daman Singh, PA State Univ., Dept. of IE,

University Park, PA 16802, singh@grace.iddr.ie.psu.edu, **Tom M. Cavalier**

We address related classes of NP-hard location and routing problems using a unified B&B approach based on network transformation of the underlying graph. The problems are the location-routing problem, the location-routing problem with TSP-based hub interactions and the multi-depot VRP.

TB12 Real Options in Operations Management

Cluster: Supply Chain Operations

Invited Session

Chair: Arnd H. Huchzermeier, WHU, Otto-Beisheim-Hochschule, Grad. Sch. of Mgmt., Burgplatz 2, Vallendar, 56179, Germany, ah@whu-koblenz.de

1) Real Options & R&D Projects, Christoph Loch, INSEAD, Blvd. de Constance, Fontainebleau, 77305, France, loch@insead.fr, **Arnd H. Huchzermeier**

The real options framework has been proposed as an effective tool to evaluate uncertain R&D projects because it can capture asymmetric upside potentials. However, the method rests on several assumptions which are often not fulfilled for R&D projects, and it cannot be used for project portfolios. We show the limitations on an illustrative example, and we propose possible alternative approaches.

2) An Option Valuation Approach for Competitive Location Analysis, Ulrich Hommel, WHU, Otto-Beisheim Grad. Sch. Mgmt., Burgplatz 2, Vallendar, 56179, Germany, uhommel@whu-koblenz.de, **Arnd H. Huchzermeier**

We extend traditional approaches to competitive facility location analysis by incorporating multiple sources of uncertainty and their impact on the strategic interaction between firms. Firm investment decisions are modeled using contingent claims analysis. The framework is used to analyze market entry strategies of automobile manufacturers in emerging markets (i.e., India, Eastern Europe, Africa and South America) and to explain the persisting trends of excess capacity creation in the entire industry as well as in these regions.

3) Embedding Real Options in a Global Supply Chain Network, Richard Smith, Lucas Variety, Diesel Systems Div. 8, 9 Blvd. de l'industrie, Blois Cedex, 41008, France, smithr@liblois1.li.co.uk, **Arnd H. Huchzermeier**

This network LP model optimally structures a global supply chain yielding real, operational options that protect profitability from stochastic foreign exchange rate and demand fluctuations. Work is based on real cases from the automobile supplier industry where margins are razor thin and such tools are strategically invaluable yet rarely exploited.

TB13 New Product Development Process Perspectives

Cluster: New Product Development

Invited Session

Chair: Herbert Moskowitz, Purdue Univ., Krannert Grad. Sch. of Mgmt., W Lafayette, IN 47907-1310, herbm@mgmt.purdue.edu

1) Design Problem Size Reduction in Quality Function Deployment, Jong-Seok Shin, PA State Univ., Dept. of Ind. & Mfg. Eng., 201 Hammond Bldg., University Park, PA 16802, **Kwang-Jae Kim, Herbert Moskowitz**

One of the impediments to the adoption of QFD as a product design aid has been the large size of the design matrix called a house of quality chart. We present a formal approach to reducing the size of a house of quality chart using the concept of design decomposition.

2) Customer Learning in Dynamic Innovation Markets: Implications for Product Development & Strategy, Jonathan Bohlmann, Purdue Univ., Krannert Grad. Sch. of Mgmt., W Lafayette, IN 47906, jbohlman@mgmt.purdue.edu

New product development processes often incorporate customer perspectives through various market research techniques. For innovative products, however, understanding the customer is problematic due to uncertain and changing customer needs and technology. Our research considers how such market dynamics affect customer learning and the implications for new product development and product strategy.

3) New Product Development Process Perspectives, Thomas F. Brady, Purdue Univ., Krannert Sch. of Mgmt., Krannert Bldg. Rm. 423, W Lafayette, IN 47907-1310, brady@mgmt.purdue.edu

The new product development process is often represented quantitatively by PERT/CPM type methodologies. This paper presents an approach to stochastic modeling of the new product development process that includes a multi-criteria

optimization framework.

TB14 Power Markets

Sponsor: ENRE

Sponsored Session

Chair: John R. Birge, Univ. of MI, Dept. of IOE, 1205 Beal Ave., Ann Arbor, MI 48109-2117, jrbirge@umich.edu

1) **Imperfect Competition in Spot Electricity Markets: The Role of Different Contracting Schemes & Generating Technologies**, *Juan Benavides*, Univ. de Los Andes, Dept. of IE, Cra 1 este #18-40, Santa Fe de Bogota, Colombia, jbenavid@uniandindex.edu.co, *Monica Hernandez*

We follow the auction approach to modeling spot markets for electricity to derive pure and mixed Nash equilibria in power pool composed of 2 players with different technologies. Player 1, hydro, bids the opportunity cost of stored water and Player 2, fuel-fired, bids it avoided cost of generating electricity wherever the competitive outcome emerges. Otherwise, they behave strategically, exploiting their market power...

2) **Predatory Bidding in Spot Markets for Electricity**, *Alfredo Garcia*, Univ. of MI, Dept. of IOE, Ann Arbor, MI 48109, agarcia@engin.umich.edu, *John R. Birge*

We present conditions under which predatory bidding is an equilibrium outcome for spot markets for electricity that follow the first price auction format. The informational asymmetry in costs that underlies competitive hydrothermal power systems and the operational inflexibilities of thermal units are the key conditions that support the result. We present a list of alternative activity rules in the bidding process that may help alleviate the problem.

3) **Standardized Electricity Contracts in the Colombian Electricity Pool**, *Marcela Loboguerrero*, Univ. de los Andes, Dept. of IE, Cra 1 este # 18-40, Santa Fe de Bogota, Colombia, mlobo@uniandes.edu.co, *Juan Benavides*

We propose a market for standardized contracts: trying a weekly base-load contract of .250 MW, settled as a 2-way forward and traded through a single over-the-counter broker; after agents become familiar with the workings of financial contracts, we propose starting a series of public hearings with generators, distributors and electricity traders to identify more refined contracts, i.e., peak-load, and to formulate the basis of a futures market.

TB15 Project Scheduling

Cluster: Technology Management

Invited Session

Chair: Dwight E. Smith-Daniels, AZ State Univ., Dept. of Mgmt., Coll. of Bus., Tempe, AZ 85287-4006, dwight.smith-daniels@asu.edu

1) **Expansion & Compression of Activities in Project Networks**, *Arnold H. Buss*, Naval Postgrad. School, OR Dept., Monterey, CA 93943-5000, buss@or.nps.navy.mil, *Meir J. Rosenblatt*

We study the problem of maximizing net present value for a project whose activities have associated cash flows that are both fixed (duration-independent) and variable (duration-dependent). Compressing activity durations ("crashing") is not always beneficial. Profit may be increased by expanding the duration of some activities. We give examples of deterministic and stochastic activity durations.

2) **An Improved Solution Procedure for the Resource Constrained Project Scheduling Problem**, *Frederick Kaefer*, IN Univ., Dept. of Op. & Dec. Tech., 10th & Fee Ln, Bloomington, IN 47405-1701, fkaefer@indiana.edu

We identify a new lower bound for the resource constrained project scheduling problem. Computational results are reported that demonstrate the effectiveness of this bound when incorporated into an exact algorithm.

3) **The Role of Documentation in Mitigating the Effects of Preemption in Multi-Project Resource Constrained Scheduling**, *Robert Ash*, Univ. of ID, Bus. Dept., Coll. of Bus. & Econ., Moscow, ID 83844-3161, *Dwight E. Smith-Daniels*

The role of documentation in reducing the impact of the learning-forgetting-relearning cycle in multi-project scheduling is analyzed in a simulation test of heuristic scheduling and preemption rules. Initial results indicate significant interaction between decision rules and the level of documentation.

TB16 Price Effects in Consumer Choice

Cluster: Marketing

Invited Session

Chair: Bart J. Bronnenberg, Univ. of TX, Dept. of Mktg. Admin., CBA 7.202, Austin, TX 78712, bronnenb@utxvms.cc.utexas.edu

1) **Endogeneity in Consumer Choice**, *Miguel J. Villas-Boas*, Univ. of CA, Haas Sch. of Bus., 350 Barrows Hall, Berkeley, CA 94720-1900, villas@violet.berkeley.edu, *Russell S. Winer*

One problem in applying random utility models to scanner data concerns ignoring potential correlations between independent variables (price, promotion, etc.) in the deterministic and stochastic utility components. We test whether marketers' setting mix variables endogenously warrants consideration when estimating such models with scanner panel data, finding that ignoring endogeneity may result in substantially biased parameter estimates.

2) **Dynamic Pricing & Advertising Decisions with a Logit Demand Model**, *Pradeep Chintagunta*, Univ. of Chicago, Grad. School of Bus., 1101 E 58th St., Chicago, IL 60637, pradeep.chintagunta@gsbpop.uchicago.edu, *Vrinda Kadiyali*, *Naufel Vilcassim*

We investigate pricing and advertising decisions of competing firms whose demand functions follow a logit specification. Carry-over effects of advertising are modelled via goodwill stock accumulation over time. Firms choose the levels of price and goodwill stock that maximize their infinite horizon profit functions. "Naive" and "sophisticated" equilibria are investigated in this formulation.

3) **Modeling Consumer Heterogeneity & State Dependence in Consumer Choice Behavior**, *Michael P. Keane*, Univ. of MN, 1035 Mgmt. & Econ., Minneapolis, MN 55455, mkeane@atlas.socsci.umn.edu

In frequently-purchased consumer goods markets consumer brand choices exhibit substantial persistence across purchase occasions. Using Nielsen ketchup data, estimating a choice model admitting both preference heterogeneity and true state dependence yields evidence for the latter, even controlling for a rich heterogeneity structure. Simulation indicates that long-term promotional effects on future purchase probabilities is positive but small.

4) **Do Promotions Advertise Lower Price Brands?**, *Bart J. Bronnenberg*, Univ. of TX, Dept. of Mktg. Admin., CBA 7.202, Austin, TX 78712, bronnenb@utxvms.cc.utexas.edu, *Luc R. Wathieu*

When preferences are reference dependent and feature loss aversion, temporal price discounts generally increase sensitivity towards price upon retraction of the discount in subsequent price-quality trade-offs. Promoting a lower price brand may induce longer term preference for that brand, whereas the same is not always true for higher priced brands.

TB17 OR/MS in Health Care: Focus on the Year 2000 Computer Date Problem

Cluster: Health Care Management

Invited Session

Chair: Victor R. Prybutok, Univ. of North TX, UNT Box 305249, Denton, TX 76203-5249, prybutok@unt.edu

1) **Introduction to the Year 2000 Problem**, *Leon A. Kappelman*, Univ. of North TX, Bus. Computer IS Dept., Denton, TX 76203-5249, kapp@unt.edu

Dr. Leon A. Kappelman, author on the year 2000 date problem and Chair of the Society for Information Management Year 2000 Working Group, introduces the topic of the year 2000 computer date problem. He also addresses the problems that result for organizations that do not appropriately resolve the issues.

2) **Year 2000 Problem Differences Between Health Care Providers & Other Organizations**, *Kellie Keeling*, Univ. of North TX, Bus. Computer IS Dept., Denton, TX 76203-5249, keeling@cobaf.unt.edu

Data collected in a longitudinal year 2000 study sponsored by the Society for Information Management was used to describe: (1) differences in perceptions of IS practices and year 2000 date project approaches between healthcare providers and other organizations and (2) how these differences impact the adoption of year 2000 projects.

3) **How Much Will Year 2000 Compliance Cost Health Care Organizations?**, *Darla Fent*, Tarleton State Univ., TX A&M Univ. System, Box T-220, Stephenville, TX 76401, fent@tarleton.edu

A model for year 2000 cost and cost-estimating relationships using the Society for Information Management Year 2000 Working Group survey is proposed. The analysis found support for all categories of cost influences in the proposed model. Cost model issues that are relevant to Healthcare organizations are

discussed.

4) Using Baldrige Criteria for Self-Assessment Allows 1 Health Care Provider to Pursue Action Consistent with Critical Success Factors, Victor R. Prybutok, Univ. of North TX, UNT Box 305249, Denton, TX 76203-5249, prybutok@unt.edu

A Likert-style survey instrument based on the MBNQA criteria is used to assess quality practices at Baylor Health Care System. The participating BHCS executives use this information to support a critical action item (a \$50+ million IS transformation) that is consistent with their 7 critical success factors.

TB18 PANEL: Service Management Networking Workshop

Cluster: Service Operations
Invited Session

Chair: Scott Sampson, Brigham Young Univ., 689 TNRB, Marriott Sch. of Mgmt., Provo, UT 84602, soma@byu.edu

1) PANEL: Service Management Networking Workshop, James A. Fitzsimmons, Univ. of TX, jfitz@mail.utexas.edu, Michael J. Showalter, FL State Univ.

We are forming a network of individuals with interest in services management. Through our web site (<http://soma.byu.edu>) and other means we hope to advance services management as a field by exchanging ideas regarding research and teaching. Those interested in services should sign up at the session (or e-mail soma@byu.edu).

TB19 Consumer Perspectives in Electronic Commerce

Cluster: Electronic Commerce
Invited Session

Chair: Kar Yan Tam, HKUST, School of Bus. & Mgmt., Dept. of Info. & Systems Mgmt., Clear Water Bay, Hong Kong, kytam@uxmail.ust.hk

1) The Consumer Psychology in Internet Shopping, Eric Law, HKUST, Dept. of Info. & Systems Mgmt., Clear Water Bay, Kowloon, Hong Kong

While the WWW is a relatively recent phenomenon in the last 18 months, the private sector has realized that the Web is not just an easy way to browse the Internet but is a new mass communication medium and a business framework. The industry has estimated that electronic commerce, including consumer to business transaction services and marketing, will be a multibillion business at the turn of the century...

2) A Process & Factor Model of Consumer Perspectives of Electronic Shopping, Olivia R. Liu Sheng, Hong Kong Univ. of Sci. & Tech., Dept. of IS Mgmt., Kowloon, Hong Kong, olivia@ust.hk, Eric Law, Lung Hui, Terrisa Fuk, Kevin Kwan

The speed and the magnitude of the electronic commerce evolution depend, to a large extent, on consumers' perception of the tradeoff between electronic commerce and traditional commerce. We will identify the factors affecting consumer psychology in an electronic shopping process and discuss the empirical insights obtained from an exploratory study.

3) Electronic Shopping & User Interface Design: Some Empirical Evidence, Kishore Sengupta, Naval Postgrad. Sch., Code SM/SE, Monterey, CA 93943, Kar Yan Tam

User interface design of online shopping systems is a key issue facing content providers of narrowband services such as Internet and broadband service providers such as VOD and interactive TV. We report initial findings on a set of GUI design attributes on user behavior in the context of online shopping. Implications to system design and management of online services are also discussed.

TB20 Recent Developments in Decision Support Systems

Cluster: State-of-the-Art in Information Technology
Invited Session

Chair: Sean B. Eom, Southeast MO State Univ., Dept. of Mgmt., Cape Girardeau, MO 63701, c047bum@semovm.semo.edu

1) Visual Interactive Goal Programming: An Empirical Assessment, Sulaiman A. Al-Hudhaif, Univ. of Western Ontario, Ivey Sch. of Bus., London, Ontario, N6A 3K7, Canada, salhudha@sms.ivey.uwo.ca

Proposed work integrating visual interactive modeling (VIM) and goal programming to develop DSS is outlined. The main objective is to conduct an empirical study which compares VI-DSS to a traditional or non-visual DSS that

addresses the same multiobjective problem. The results provide empirical evidence on whether or not the VIM approach improves the effectiveness and efficiency of the system as well as supporting the user's learning.

2) Specification of Normative Aspects in Formal Business Communications, Young Ryu, Univ. of TX, Dec. Sci., Sch. of Mgmt., 2601 N Floyd Rd., Richardson, TX 70580, ryoung@utdallas.edu

Formal business communication, an alternative to traditional EDI, is a process-oriented environment for electronic interorganizational business transactions, whose communication inputs consist of speech acts which establish and discharge normative states of communicators. We propose a specification, i.e. representation and reasoning, scheme for normative aspects.

3) Intellectual Development & Structure of Decision Support Systems Research: A Longitudinal Perspective, Sean B. Eom, Southeast MO State Univ., Dept. of Mgmt., Cape Girardeau, MO 63701, c047bum@semovm.semo.edu

We examine the intellectual structure, major themes and reference disciplines of DSS over the last 2 1/2 decades, 1970-1995. The DSS area has undergone profound structural changes over the past 5 years, 1991-1995, and made meaningful progress over the past 2 1/2 decades. We highlight several notable trends and developments in the DSS research areas.

4) Implementation of a Decision Support System for Forecasting Commodity Prices, Ramesh Sharda, OK State Univ., Coll. of Bus. Admin., Stillwater, OK 74078-0555, sharda@okstate.edu

We discuss our experiences in implementing a DSS to assist a major food processor in forecasting short term commodity prices. The system includes neural network-based forecasting models as well as other approaches. We describe the models and the implementation issues.

5) Design of a Negotiation Support System on the Internet, Tung X. Bui, Naval Postgrad. Sch., Code SM/BD, Monterey, CA 93943, tbui@nps.navy.mil, Kim Blood

We discuss issues involved in the migration of a LAN-based multiattribute NSS to the Internet. In particular, we present a number of migration strategies from the design of browser-based interface to NSS applets.

TB21 Theoretical Foundations of MMT X

Cluster: Management of Medical Technology
Invited Session

Chair: Paul Sergius Koku, FL Atlantic Univ., Grad. Sch. & Coll. of Bus., Univ Tower, 220 SE 2nd Ave., Fort Lauderdale, FL 33301, koku@acc.fau.edu

1) On Enhancing the Subjective Evaluation of Medical Evidence: The Application of Fuzzy-Set Theory, Paul Sergius Koku, FL Atlantic Univ., Grad. Sch. & Coll. of Bus., Univ Tower, 220 SE 2nd Ave., Fort Lauderdale, FL 33301, koku@acc.fau.edu, Anique A. Qureshi

Physicians routinely evaluate many types of evidence in clinical decision-making. Implicit in any type of DA is the assumption that judgmental inputs can be accurately represented by a single precise number. However, it generally is not possible to quantify judgment with such precision. We use fuzzy-set theory (Zadeh, 1965, 1978) in medical evidence evaluation as a means to overcome some of the limitations of traditional DA.

2) A Conceptual Model for Bottom-Up Integration of Hospital Information Systems, Moshe Zviran, Tel Aviv Univ., Fac. of Mgmt., Ramat Aviv, Tel Aviv, 69978, Israel, zviran@post.tau.ac.il, Aviad Armoni, Chanan Glezer

We introduce a conceptual framework for bottom-up integration of hospital information systems and demonstrate its application through a real-life case scenario. The scope of the proposed framework is the integration of stand-alone clinical, administrative and financial information elements of a hospital into a unified system environment.

3) Models of Interfirm Networks in Adopting New Medical Technologies, Arch Woodside, Tulane Univ., Freeman Sch. of Bus., New Orleans, LA 70148, awoodside@office.sob.tulane.edu, Glenn Voss

The theoretical and empirical literature from Europe and North America is integrated with respect to the dynamic flows of communications and decisions occurring naturally in marketing-adopting new medical technologies. Two sets of 20 propositions are developed in alternative mental models (Senge 1990) of adoption/rejection processes.

TB22 Operations Management II**Contributed Session**

Chair: Patrick T. Harker, Univ. of PA, OPIM Dept., 1300 SH-DH, Wharton Sch., 3620 Locust Walk, Philadelphia, PA 19104-6315, harker@wharton.upenn.edu

1) **Capacity Allocation & Supply Chain Coordination Under Asymmetric Information, Suman Mallik**, Univ. of PA, OPIM Dept., 1300 SH-DH, Wharton Sch., 3620 Locust Walk, Philadelphia, PA 19104, mallik84@wharton.upenn.edu, **Patrick T. Harker**

Many multi-divisional firms make their production/allocation decisions based on demand and capacity forecasts from divisions and/or plants. This process is often characterized by conflict of interests between the center and the divisions. Motivated by the experiences of a US-based semiconductor manufacturer, we present a model to coordinate production allocation decisions...

2) **Decision Horizons and Order Quantities in a 2-Party Supply Chain, Timothy M. McClurg**, GA Southern Univ., PO Box 8152, Dept. of Mgmt., Statesboro, GA 30460, mcclurg@gasou.edu, **Z. Kevin Weng**

We develop a model to analyze a decision problem arising from a real-world managerial scenario facing a component manufacturer and a producer. Our focuses are on characterizing the structural properties, developing policies that maximize each party's objectives and on providing managerial insights into decision horizons and quantities.

3) **Information Technology & the Food Industry Supply Chain, Gary D. Scudder**, Vanderbilt Univ., Owen Grad. Sch. of Mgmt., Nashville, TN 37203, scudder@ctrvax.vanderbilt.edu, **Craig A. Hill**

IT has been a catalyst for change in the way the food industry's supply chain is managed; in particular, when IT is used for enhancing the performance of customer and supplier partnerships. Implementation and performance issues, as well as results from exploratory case study research, are presented.

4) **Nested Procedures for Revenue Maximization in the Hotel Industry, Sung-Ho Chang**, TX A&M Univ., Dept. of IE, College Station, TX 77843, s0c9604@acs.tamu.edu, **Alberto Garcia-Diaz**

Most of the revenue management procedures currently used by the hotel industry are very limited in capability. An efficient large-scale revenue-maximization methodology will be developed to include the following features: nested booking limits, arrival pattern of demands, overbooking, multiple night stays and group reservations.

5) **Diffidence Charts: A Graphical Tool to Determine the Number of Subgroups Necessary to Establish a Reliable Control Chart, Dan Trietsch**, Univ. of Auckland, MSIS, Private Bag 92019, Auckland, New Zealand, d.trietsch@auckland.ac.nz

Control charts are often based on small samples: 20-30 subgroups of 4-5 items. This may not suffice. Diffidence charts help judge whether enough data was collected. They include "control limits" for the control limits, thus creating diffidence bands. Reliable charts rarely have points within these. Only additional data can decrease the bands.

TB23 Multicriteria Decision Problems**Contributed Session**

Chair: Harold P. Benson, Univ. of FL, PO Box 117169, Gainesville, FL 32611-7169

1) **On the Maximum Number of Feasible Ranking Sequences in a Multi-Criteria Decision Making Problem, Bo Shu**, LA State Univ., Dept. of IE, 3134 CEBA Bldg., Baton Rouge, LA 70803-0001, bshu@unixl.sncc.lsu.edu, **Evangelos Triantaphyllou**

In a deterministic MCDM problem with fixed performance values for the N alternatives and changeable criteria weights, the rankings of the alternatives change accordingly. Intuitively, one expects that the maximum number of all possible rankings is at most equal to $N!$ However, we demonstrate that the actual number of rankings is much smaller.

2) **A Ranking Procedure Based on the Hierarchical Data Envelopment in Multicriteria Decision Problems, Eiji Takeda**, Osaka Univ., Fac. of Economics, Toyonaka Osaka, 560, Japan, takeda@econ.osaka-u.ac.jp, **Yoshio Tabata, Junko Satoh**

The hierarchical data envelopment in discrete alternative multicriteria decision problems establishes a ranking of alternatives by making the best use of the objective data. As an application of multi-level graphs in clusters of criteria, a ranking of prefectures in Japan is presented from the viewpoint of affluence.

3) **A Framework for Analyzing Stochastic MCDM Problems with Multiple Decision Makers, Zaharias Xanthopoulos**, Northeastern Univ., Dept. of Mech. Ind. & Mfg. Eng, 360 Huntington Ave., Boston, MA 02115, **Emanuel Melachrinoudis**,

Marius M. Solomon

DMs intervals, expressing stochastic parameters, are combined. The stochastic problem is converted into a deterministic one. Four prominent characteristics of MCDM problems are identified for use by DMs in the learning phase of interactive procedures. Best solutions of DMs are combined to find the best solution of the group.

4) **Multiple Objective Risk Management Strategies, Michelle M. Baron**, Victoria Univ., Sch. of Bus. & Government, PO Box 600, Wellington, New Zealand, michelle.baron@vuw.ac.nz

Most organizations operate under several distinct risk management objectives. In general, this is not recognized by traditional risk modeling approaches. Our research combines failure modeling techniques to explicitly identify relevant risk types. The result is a more comprehensive decision framework in the presence of competing objectives.

5) **An Outer Approximation Algorithm for Generating All Efficient Extreme Points in the Outcome set of a Multiple Objective LP Problem, Harold P. Benson**, Univ. of FL, PO Box 117169, Gainesville, FL 32611-7169

We present a finite algorithm, the outer approximation algorithm, for generating the set of all efficient extreme points in the outcome set of a multiple objective LP. Because it works in the outcome set, the algorithm has several advantages over decision set-based approaches.

TB24 Benchmarking**Contributed Session**

Chair: Jose H. Dula, Univ. of MS, Dept. of Mgmt. & Mktg., University, MS 38677, jdula@olemiss.edu

1) **A Computational Framework for Accelerating DEA Over Multiple Models & Orientations, Jose H. Dula**, Univ. of MS, Dept. of Mgmt. & Mktg., University, MS 38677, jdula@olemiss.edu, **Robert M. Thrall**

A new framework for DEA computation is presented that reduces computational times in the application of the analysis over its multiple models and orientations. The process is based on the identification of the "frame" (extreme elements) of the production possibility set for the variable returns model. The new framework accelerates computations and increases flexibility...

2) **Some Problematic Features of Polyhedral ARs in DEA with Suggestions of a Smooth AR Representation, Niels C. Petersen**, Odense Univ., Dept. of Mgmt., Campusvej 55, Odense M, DK-5230, Denmark, ncp@busieco.ou.dk, **Ole B. Olesen**

Some polyhedral ARs allow for a larger variation in some directions. The largest angle between the center of the AR-cone and the different extreme rays is shown to increase for an increasing number of inputs/outputs. Smooth ARs are suggested and their relation to probabilistic bounds is discussed.

3) **The Comparisons Between TQM & General Systems Theory, Te-Wei Wang**, Southern Illinois Univ., PO Box 2302, Carbondale, IL 62902, tewei@siu.edu

The process orientation of TQM could lead people to think that TQM is only an extension of scientific management or system theory (Dean & Bowen, 1994). In fact, some theorists think that TQM is a systems theory (Vancouver, 1996:167). Can we confidently say that TQM is a set of meta-theory like GST? We examine TQM from the sense of GST. Similarities and differences between TQM and GST are listed...

4) **Benchmarking: An Operational Definition, Orla Hegarty**, Univ. of Waterloo, Dept. of MS, Waterloo, Ontario, N2L 3G1, Canada, ohegarty@sail.uwaterloo.ca, **Paul D. Guild**

Benchmarking is a popular strategic organizational tool. Despite this popularity, the literature provides scant information on a concise and operational definition. An overview of existing writings on benchmarking is given and a succinct, specific methodology is detailed.

TB25 TUTORIAL: Probability Models & Statistical Inference for Software Reliability**Cluster: Reliability & Quality Engineering****Invited Session**

Chair: Nozer Singpurwalla, George Washington Univ., Dept. of OR & Stats., 707 22nd St. NW, Washington, DC 20052

1) **TUTORIAL: Probability Models & Statistical Inference for Software Reliability, Nozer Singpurwalla**, George Washington Univ., Dept. of OR & Stats., 707 22nd St. NW, Washington, DC 20052

We overview the salient developments for modeling and assessing the reliability of computer software. The models that seem to be promising are based on point processes and inferential issues invariably involve the Bayesian paradigm with

Markov chain Monte Carlo methods. Also, topics such as optimal testing and classification are discussed.

TB26 Applied Probability & Telecommunication

Sponsor: Applied Probability Section
Sponsored Session

Chair: Leslie D. Servi, GTE Labs. Inc., Network Mgmt. & Control Dept., 40 Sylvan Rd., Waltham, MA 02254, lds0@gte.com

1) On the Stability of the Kumar-Seidman Policy in Multiclass Queueing Networks with Setups, *Jim Dai*, GA Inst. of Tech., Sch. of ISyE, Atlanta, GA 30332-0205, *Otis B. Jennings*

It is known that many dispatch policies, including the setup avoidance policy, are inefficient. Kumar & Seidman (1990) introduced a dispatch policy that maintains a separate FCFS priority queue for large buffers at each server. Using a fluid limit model approach, we show that the Kumar & Seidman policy is efficient in stochastic multiclass queueing networks.

2) Delay & Reneging at Call Centers, *J. Keilson*, Univ. of Rochester, Simon Grad. Sch. of Mgmt., Rochester, NY 14627, *Leslie D. Servi*

Motivated by call centers, we derive the waiting time density for M/M/S systems with impatient customers reneging with a constant hazard rate. We present the seemingly paradoxical result that the probability of reneging under heavy traffic is essentially independent of the hazard rate for reneging. Clean closed form results are presented.

3) Service Systems with Incomplete or Imperfect Service, *Donald P. Gaver*, Naval Postgrad. Sch., Monterey, CA 93940, *Patricia A. Jacobs*

In various practical situations, i.e., in computer science and the military, service is neither complete nor perfect. Incomplete or imperfect service can generate premature reapplications for more extensive processing which can overload the system. Deliberate incompleteness can also serve as a control mechanism. Various models are furnished to illustrate the concepts and effects.

4) GI/G/1 First Passage Times, *J. Keilson*, Univ. of Rochester, Simon Grad. Sch. of Mgmt., Rochester, NY 14627, *Leslie D. Servi*

The mean, variance and distribution of the number of die rolls needed before their summation exceeds N is computed for large N . This work draws on the theory of additive processes on Markov chains, is empirically validated and then generalized to a GI/G/1 first passage time problem.

TB27 Interior Point Methods & Applications

Cluster: Interface Between AI & OR
Invited Session

Chair: Theodore B. Trafalis, Univ. of OK, 202 W Boyd, Ste. 124, Norman, OK 73019, trafalis@mailhost.ech.ou.edu

1) Unsupervised Neural Network Training via a Potential Reduction Approach, *Theodore B. Trafalis*, Univ. of OK, 202 W Boyd, Ste. 124, Norman, OK 73019, trafalis@mailhost.ech.ou.edu, *Tamas Terlaky*, *Joost P. Warners*, *C. Ross*

We present a new training to find the optimal weights of an unsupervised neural network architecture based on Linsker's model. It is based on an interior point potential reduction approach for quadratic optimization. Computational experience by using randomly generated instances are reported.

2) Nonlinear Primal-Dual Methods for Neural Network Training & Applications, *Nicolas P. Couellan*, Univ. of Oklahoma, Sch. of IE, 202 W Boyd, Rm. 124, Norman, OK 73019, *Theodore B. Trafalis*

We propose a new training algorithm for feed forward supervised neural networks on a primal-dual interior-point method for NLP. Computational results are given for odd parity problems with 2, 3 and 5 inputs, respectively. Approximation of nonlinear dynamical systems are also discussed.

3) A Circumscribed Ellipsoid Method for Multiobjective Optimization & Applications, *Tsutomu Mishina*, 4617 Brookwood Dr., Noble, OK 73068, *Theodore B. Trafalis*

We present an interactive multiobjective optimization method based on circumscribed ellipsoid method. Specifically, we calculate lower bounds on the pessimistic solution and upper bounds on the ideal solution by solving linear optimization subproblems on a circumscribed ellipsoid of the feasible region. Applications are also examined.

4) A Nonlinear Approach to Solving the Satisfiability Problem, *Joost P. Warners*, Tech. Univ. of Delft, TWI/SSOR, Mekelweg 4, Delft, 2628 CD, The Netherlands, j.p.warners@twi.tudelft.nl

The satisfiability (SAT) problem is the most well-known NP-complete problem and many algorithms have been developed for solving it. We discuss a number of algorithms for solving nonlinear models of the SAT problem. These are based on minimizing a nonlinear and nonconvex continuous function using a gradient descent algorithm or interior point method. Models and algorithms can also be used in the context of a branching scheme to obtain complete algorithms...

TB28 Integer Programming Applications in the High-Tech Industry

Cluster: Integer Programming
Invited Session

Chair: Alexis Takvorian, Motorola, 6501 William Cannon Dr. W, MD OE112, Austin, TX 78735, atak@risc.sps.mot.com

1) Modeling & Simulation at AMD, *Scott J. Mason*, AZ State Univ., TX, scott.mason@asu.edu, *Shekar Krishnashawamy*, *Kishore Potti*

The planning, development, execution and control of complex manufacturing processes, such as the operations required to transform a silicon wafer into a semiconductor, can all be improved through the use of modeling and simulation. We present some of the uses of modeling and simulation which have enabled AMD to improve their strategic and tactical decision-making.

2) Implementation of the Manufacturing Strategy Analyzer at Motorola, *Krishna Srinivasan*, Motorola, 1299 E Algonquin Rd., Schaumburg, IL 60196, krishna.srinivasan-aks010@email.mot.com, *Bob Irvine*, *Suresh Chandar*, *Scot Srodes*

We describe the implementation of the MSA in Motorola's wafer fabrication. The MSA is an optimization and queuing theory-based software for rapid performance analysis of manufacturing scenarios consisting of 4 modules: a pick-a-mix for estimation of utilization of work stations, a cost module for estimation of approximate cost per product, a queueing network analyzer for computing average cycle times by station and a capacity expansion analyzer for examining factory expansion tradeoffs...

3) Using Optimization & Simulation to Improve Customer Service at a Large Telecommunications Company, *George Kontoravdis*, PO Box 8507, Austin, TX 78713, condor@acm.org

Legislature changes and technology advances in the telecommunications industry have created new growth opportunities, but have also resulted in increased competition. We present how a regional Bell company uses optimization- and simulation-based methods to improve its market share through streamlining its daily operations, improved customer service and increased customer satisfaction.

TB29 Parallel & Supercomputing

Cluster: Stochastic & Robust Optimization; Parallel & Supercomputing
Invited Session

Chair: Anna Nagurny, Univ. of MA, Sch. of Mgmt., Dept. of Finance & Op. Mgmt., Amherst, MA 01003, nagurny@gbfn.umass.edu

1) Performance Study of Parallel Shortest Path Algorithms, *Michelle R. Hribar*, Northwestern Univ., 2145 Sheridan Rd., ECE Dept., Evanston, IL 60208-3118, michelle@ece.nwu.edu, *Valerie Taylor*, *David E. Boyce*

The performance of parallel labeling shortest path algorithms is affected by both the algorithm choice and the network decomposition. We identify factors of the decomposition which determine the performance of the different algorithms. We use these factors to identify good decompositions and to predict the best algorithm for a given decomposition.

2) Parallel Computation of Shortest Paths for Transportation Applications, *Ismail Chabini*, MIT, Dept. of Civil & Environ. Eng., 77 Mass. Ave., Rm. 1-263, Cambridge, MA 02139, chabini@mit.edu, *Michael Florian*, *Eric Le Saux*, *Nicolas Tremblay*

We present several parallel computing implementations of static and time dependent shortest path algorithms for use in network equilibrium models and mesoscopic traffic simulations. The computing platforms used are distributed SUN SPARC Ultra 1 workstations and a SUN SPARC Center 1000 shared memory machine.

3) Parallel Computing Approaches for Real-Time Fleet Management, *Michel Gendreau*, Univ. de Montreal, CRT/DIRO, CP 6128, Succ. Centre-ville, Montreal, Quebec, H3C 3J7, Canada, michelg@crt.umontreal.ca

Situations where vehicles must be dispatched in real-time to satisfy service requests over some territory are numerous and quite varied: ambulance

dispatching, pick-up and delivery operations, etc. We discuss 2 parallel computing approaches which may be used to implement in real-time sophisticated heuristic procedures for managing large fleets.

4) Parallel Computation of Dynamic Elastic & Fixed Demand Traffic Network Problems, Anna Nagurney, Univ. of MA, Sch. of Mgmt., Dept. of Finance & Op. Mgmt., Amherst, MA 01003, nagurney@gbfin.umass.edu, Ding Zhang

We present algorithms for the solution of dynamic traffic network problems modeled as projected dynamical systems. We provide convergence results as well as numerical results for the implementations on the Thinking Machines' CM-5 architecture.

TB30 Scheduling Algorithms & Systems

Cluster: Scheduling

Invited Session

Chair: Marcos Singer, Pontifica Univ. Catolica de Chile, Escuela de Admin., Vicuna Mackenna 4860, Santiago, Chile, singer@volcan.facea.puc.cl

1) A Robust Optimization Approach for Solving an Aggregated Production Planning Problem Under Uncertainty, Victor M. Albornoz, P. Univ. Catolica de Chile, Dept. de Ing. Ind. y de Sis., Casilla 306, Correo 22, Santiago, Chile, valbornoz@ing.puc.cl, Luis Contesse B.

We formulate and solve a robust optimization model of a real world multi-item, multi-period aggregated production planning problem with setup costs, under uncertainty in the demands as well as in the production costs. The resulting model is efficiently solved using Lagrangean relaxation techniques combined with standard MILP solvers.

2) A Heuristic for Minimizing Setup Times & Tardiness on a Single Machine, Sergio Flores, Univ. Catolica de Valparaiso, Av. Brasil 2147, Valparaiso, Chile, sflores@uvc.cl

We consider the problem of minimizing the setup times and the tardiness on a single machine. Our heuristic finds the trade-off curve of the problem such that each possible solution is Pareto optimal. Our results show that for middle sized instances the heuristic performs better than other techniques shown in the literature.

3) Decision Support System for Pollution Control in the Copper Industry, Including the Sulfuric Acid Market, Susana V. Mondsch, Univ. of Chile, Dept. of Ing. Industrial, PO Box 2777, Santiago, Chile, smondsch@dii.uchile.cl, Rene Caldentey, Eduardo Engel

We develop a DSS for investment projects in pollution abatement plants at state-owned copper smelters in Chile. We formulate a nonlinear-integer model to determine the optimal investment policy for this interrelated production-environmental problem. Our formulation endogenizes the price of sulfuric acid, reflecting the fact that optimal investment decisions both affect and depend upon this price.

4) A Shifting Bottleneck Procedure for Very Large Job Shops, Marcos Singer, Pontifica Univ. Catolica de Chile, Escuela de Admin., Vicuna Mackenna 4860, Santiago, Chile, singer@volcan.facea.puc.cl

Shifting bottleneck procedures divides the job shop problem into single machine subproblems. When the time horizon is too long, solving each subproblem becomes prohibitively expensive. We solve the problem by introducing a 2nd type of subdivision which defines overlapping time windows as done by the rolling horizon procedures.

TB31 Vehicle Routing & Crew Scheduling

Cluster: Combinatorial Optimization

Invited Session

Chair: Cesar Rego, Univ. Portucalense, Dept. de Informatica, Rua Dr. A. B. Almeida 541-619, Porto, 4200, Portugal, cesar@uporto.pt

1) A Vehicle Routing Model for Garbage Collection, Rui Oliveira, Instituto Superior Tecnico, CESUR, Av. Rovisco Pais, Lisboa Codex, 4069, Portugal, pmpe@civil19.civil.ist.utl.pt, Ana Matos

We deal with the problem of organizing a solid waste collection system in sparsely populated areas with emphasis on the optimization of the routes for the garbage trucks. Within an integrated framework, the model tackles the problem of defining a schedule of multiple visits to each location and of establishing routes for the waste trucks. A 2-phase heuristic is proposed...

2) Tabu Search for the Complete Crew Scheduling Problem,

Isabel Themido, Instituto Superior Tecnico, CESUR, Av. Rovisco Pais, Lisboa Codex, 4069, Portugal, pmpe@civil18.civil.ist.utl.pt, Marta Gomes, Luis Cavique, Cesar Rego

The CCSP can be viewed as the problem that maximizes the cover time when distributing cover crews evenly along the day for the minimum set of duties given by the solution of the traditional CSP. We describe a multilevel TS algorithm based on compound moves for the CCSP.

3) Subgraph Ejection Chains for the Crew Scheduling Problem, Cesar Rego, Univ. Portucalense, Dept. de Informatica, Rua Dr. A. B. Almeida 541-619, Porto, 4200, Portugal, cesar@uporto.pt, Luis Cavique, Isabel Themido

We describe an heuristic algorithm for the CSP and consider the case of the Lisbon Metro Company. The algorithm constructs an initial solution based on a run-cutting approach. Then, a subgraph ejection chain method is used in a TS procedure to reduce the number of duties in the initial schedule.

4) Column Generation & Tabu Search for the Fleet Mix Problem with Time Windows, Redouane Mechti, Univ. de Versailles, Laboratoire PRISM, 45 Ave. des Stats-Unis, Versailles Cedex, 78035, France, mechti@prism.uvsq.fr, Catherine Roucaïrol

We deal with organizing mail collected at several customer sites scattered around an urban area. The problem involves the design of a set of minimum cost routes originating and terminating at a central depot for a heterogeneous fleet of vehicles which services those customer sites with known demands. A TS approach which uses different types of moves is developed for determining the most economical vehicle fleet mix without violating problem constraints.

TB32 Modeling Systems & Language

Contributed Session

Chair: Madhay Erraguntla, Knowledge Based Systems, Inc., 1500 University Dr. E, College Station, TX 77840, merraguntla@kbsi.com

1) On the Better Use of Algebraic Formulations of Mathematical Programs, Emmanuel Fragniere, Univ. of Lausanne, HEC, BFSHI, Dorigny, Lausanne, 1015, Switzerland, emmanuel.fragniere.hec.unil.ch, Jacek Gondzio, Robert Sarkissian, Jean-Philippe Vial

Algebraic modeling languages, AMLs, lose important information the solver could have taken advantage of. We give a new framework for retrieving this information directly from the algebraic formulation. It can handle any special structure of the model, e.g., decomposable. Parallel IPM-based decomposition has been linked to an AML using that framework.

2) Tailor-Made MIP Solution Algorithms with a Model-Oriented Subroutine Library, Robert W. Ashford, DASH Associates Ltd., Quinton Lodge, Binswood Ave., Leamington Spa, Warwickshire, CV32 5TH, UK, rwa@dash.co.uk, Cristina Alvarez

Solutions to large MIPs can often only be obtained by exploiting model structure. Sub-model solution, structure specific cutting planes, adapted branching strategies, sequential relax-and-fix heuristics, etc. are known to work well. We present a means of implementing such techniques with modeler-defined objects, making them practicable for the first time.

3) Activity Modeling & Analysis for a Small Industry Using IDEF, Tae Bo Jeon, Kangwon Ntl. Univ., IE Dept., 192-1 Hyoja 2 Dong, Chuncheon Kangwondo, Korea, tbcjeon@cc.kangwon.ac.kr, Kyong Su Yun

A process modeling and analysis for a manufacturing industry applying IDEF methodology has been performed. The main focus is to analyze the current production, quality and material handling systems and establish a foundation for systematic integration. The approach taken is seen to be essential and effective for future system design.

4) Optimization Modeling Assistant, Madhay Erraguntla, Knowledge Based Systems, Inc., 1500 University Dr. E, College Station, TX 77840, merraguntla@kbsi.com, Satheesh Ramachandran, Perakath C. Benjamin

The inherent difficulties associated with model design has limited the effective use of optimization technology. We describe the OMA, a knowledge-based optimization modeling system. Starting from a domain description and a set of decision questions, OMA automates the design of an optimization model to answer the question.

TB33 Software Demonstrations VI

Sponsor: CSTS

Sponsored Session

Chair: Bjarni Kristjansson, Maximal Software Inc., 2111 Wilson Blvd., Ste. 700, Arlington, VA 22201, bjarnik@site.gmu.edu

- 1) Analytica & Crystal Ball
- 2) MagicWand, *Chris Dalton*, Applied Decision Analysis, 2710 Sand Hill Rd., Menlo Park, CA 94025

TB35 Flowshop Scheduling Contributed Session

Chair: Bryan A. Norman, Univ. of Pittsburgh, 1048 Benedum Hall, Pittsburgh, PA 15261, banorman@engrng.pitt.edu

- 1) Simultaneous Buffer Allocation & Job Sequencing in a Flowshop Environment, *Bryan A. Norman*, Univ. of Pittsburgh, 1048 Benedum Hall, Pittsburgh, PA 15261, banorman@engrng.pitt.edu, *Karunakaran Chakravarthy*

We consider the problem of scheduling jobs in a flowshop environment where there are finite buffers between each stage of machines. We consider the problem of simultaneously sequencing the jobs and allocating the buffers in order to minimize the makespan. A new solution methodology is introduced and computational results are presented.

- 2) Flowshop Scheduling with Separate Setup Times, *Ali Allahverdi*, Kuwait Univ., Dept. of Mech. & IE, PO Box 5969, Safat, 13060, Kuwait, allaha@kuc01.kuniv.edu.kw

A 2-machine flowshop scheduling problem is addressed when setup times are separated with the objective of minimizing mean flowtime. The problem is formulated and a dominance relation established. The analysis is extended to determine an optimal solution for special flowshops.

- 3) Comparison of Simulated Annealing Heuristics for Flow Shop Sequencing, *Joao Vitor Moccellini*, Univ. of Sao Paulo, EESC, Av. Dr. Carlos Botelho 1465, Sao Carlos SP, 13560-250, Brazil, jvmoccel@sc.usp.br

We deal with the problem of minimizing makespan in a flow shop by using SA. By combining different parameters, we obtain alternative SA procedures. Starting from a common initial solution, we compare the solution quality of such procedures with the same computational effort.

- 4) A Hybrid Heuristic for Flowshop Scheduling with Setups, *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 an improved heuristic for the makespan minimization in a flowshop with sequence-dependent setup times. The heuristic exploits the embedded asymmetric TSP. Computational experience over a large collection of data sets will be presented.

TB36 Queuing Models Contributed Session

Chair: Geert-Jan van Houtum, Univ. of Twente, WB/POM, Enschede, 7500 AE, The Netherlands, g.j.j.a.n.vanhoutum@wb.utwente.nl

- 1) Queuing Analysis of a Carousel with Batching, *Bart Rouwenhorst*, Univ. of Twente, WB/POM, Enschede, 7500 AE, The Netherlands, b.rouwenhorst@wb.utwente.nl, *Geert-Jan van Houtum*, *Henk Zijm*

We analyze the response time of a carousel system serving batches of jobs. Increasing the batch size improves the efficiency of the carousel but also increases the time needed to constitute a batch. We derive a closed form approximation for the response time and optimize the batch size.

- 2) Correlations in Departure Processes for Simple Queues, *Donald C. McNickle*, Univ. of Canterbury, Mgmt. Dept., Christchurch, New Zealand, dcm@mang.canterbury.ac.nz, *Ralph L. Disney*

Overflow and output process from simple finite Markovian queues are considered. The cross-correlation between the counting processes for these 2 processes can be positive, negative or even 0. The size of these cross-correlations suggests that these processes cannot be treated as independent.

- 3) Optimal Control of Parallel Queues with Batch Service, *Nicholas Bambos*, Stanford Univ., 420 Terman Eng. Ctr., Stanford, CA 94305-4023, *Cathy H. Xia*, *George Michailidis*, *Peter W. Glynn*

We study the problem of dynamic allocation of a single server with batch processing capability to parallel queues. Arrival processes are mutually independent Poisson flows with equal rates and batch services times are i.i.d.

with general distribution. Using a coupling argument, we prove that for infinite buffers, allocating the server to the longest queue stochastically maximizes the aggregate throughput of the system...

- 4) Numerical Transient & Steady-State Analysis of the M/D/2/K Queue, *Christoph Lindemann*, GMD Research Inst. FIRST, Rudower Chaussee 5, Berlin, 12489, Germany, lind@first.gmd.de

The method we introduce rests on observation, at equidistant time points, of the continuous-time Markov process that records the number of customers residing in the queueing system and remaining service times associated with each busy server. This results in the solution of a system of multi-dimensional Volterra equations rather than solution of a system of partial differential equations...

Tuesday 11:30-12:30

- TP37 OMEGA RHO PLENARY: Expanding OR/MS to New dimensions of Use & Research - From "Ex Ante" Planning to "Ex Post Evaluation"
Invited Session

Chair: Jonathan F. Bard, Univ. of TX, OR Group, ETC 5.160, Austin, TX 78712-1063, jbard@mail.utexas.edu

- 1) OMEGA RHO PLENARY: OR/MS - Where it's Been, Where It Should Be Going., *William W. Cooper*, Univ. of TX, Mgmt. Dept., CBA 4.202, Austin, TX 78712-1174

It is argued that movement toward the "control" aspects of management should be effected to expand OR/MS activities beyond their present (almost exclusive) emphasis on "planning" functions. This will involve increasing the amount of empirical-inferential approaches to research (based on ex-post data) as one way to help bring this about. Examples of such empirical-inferential research activities in OR/MS are supplied...

Tuesday 13:15-14:45

TC01 OR/MS Applications in Airline Industry B

Cluster: OR/MS Applications
Invited Session

Chair: Spyros Kontogiorgis, USAir, 2345 Crystal Dr., Arlington, VA 22227

- 1) 1 + 1 = 3 for Highly Optimized Flight Plans, *Renwick E. Curry*, Applied Aeronautical Systems, Inc., 4391 Northside Dr., Atlanta, GA 30327

Conventional flight planning systems solve 2 optimization problems: optimal route (for 1 vertical profile) with savings of about 1% and optimal vertical profile (for 1 route) with savings of about 1%. Highly optimized flight plans optimize profile and route simultaneously with savings of 3% or more.

- 2) A System Design to Support Real-Time Aircraft Routing Operations, *Debra J. Hoitomt*, United Airlines, Inc., World Headquarters WHQKB, PO Box 66100, Chicago, IL 60666, *Dave Rogoski*, *Parag M. Dixit*, *Bonnie Woeltje*, *Eric Gnat*, *Ed Buglio*, *Steven T. Morley*

Effective aircraft routing maximizes utilization of finite resources to carry more customers more miles. An extensive search over many possibilities may be required to find a "good" routing. We examine design criteria for development of a real-time aircraft routing system with benefits of approximately \$5 million per year.

- 3) Unconstraining Logic for Revenue Management Applications, *Rudy Elizondo*, PROS Strategic Solutions, 3223 Smith St., Ste. 1000, Houston, TX 77006, *E. Andrew Boyd*

One of the most fundamental problems in revenue management forecasting is that of generating unconstrained demand forecasts from actual booking data, which consist only of accepted passenger bookings. Computational results are presented for a variety of forecasts based on maximum likelihood estimation procedures using the expectation-maximization computational method.

- 4) Experiences with an Interactive Fleet Substitution Tool in Airline Schedule Planning, *Ashish Tripathy*, US Airways OR, 2345 Crystal Dr., Crystal Park 4, DCA/H700, Arlington, VA 22227, ashish_tripathy@usairways.com

In the final stages of schedule development, planners make localized fleet assignment modifications to satisfy marketing, maintenance and crew planning requests. We develop an automated tool to identify multiple fleet exchange options quickly, while maintaining schedule feasibility. A multi-criteria evaluation of the options allows the user to select the appropriate one.

TC02 PANEL: Industry-University Research Consortia

Cluster: Applications

Invited Session

Chair: Candace A. Yano, Univ. of CA, IEOR Dept., Berkeley, CA 94706, yano@ieor.berkeley.edu

1) **PANEL: Industry-University Research Consortia**, *Thomas L. Magnanti*, MIT, magnanti@mit.edu, *H. Donald Ratliff*, GA Inst. of Tech., *Shmuel S. Oren*, Univ. of CA, *Bruce W. Fowler*, US Army Missile Command

Panelists will discuss their experiences in initiating and building cooperative research programs.

TC03 Forecasting & Market Research

Sponsor: Aviation Applications Section

Sponsored Session

Chair: William J. Walsh, SABRE Decision Tech., 1 E Kirkwood Blvd., MD TSG 7200, Southlake, TX 76092, william_walsh@sdt.com

1) **Breaking the 58% Paradigm: Thirty Year Load Factor Trends Among US Airlines**, *Joseph T. Davis*, 2779 Clairmont Rd. NE, Ste. B4, Atlanta, GA 30329, 75701.2538@compuserve.com

Passenger load factor is a key indicator of airline performance. Prior to deregulation, conventional wisdom among airline managers was that if system average load factor rose above 57% or 58%, then the airline was turning away business. Today, as we approach the 20-year mark of operation in the deregulated environment, we see load factors in the high 60s and even into the 70% range among the major carriers...

2) **Optimal Load Factors: Coordinated Scheduling, Pricing & Yield Management Decisions**, *Richard Ratliff*, The SABRE Group, Inc., AA P&YM Support Group, 1 E Kirkwood Blvd., Southlake, TX 76092, richard_ratliff@sabre.com, *Barry C. Smith*, *Timothy L. Jacobs*

Significant advances in YM techniques have been made in recent years. Properly matching supply and demand in each market is important, in part to allow YM controls to operate optimally. When supply and demand are balanced at an O&D, optimal load factors are achieved among the different flight legs. What constitutes an optimal load factor for a given flight will be presented.

TC04 Complex Issues in Finance

Sponsor: Military Applications Society

Sponsored Session

Chair: Pauline P. Cason, SAIC, 6725 Odyssey Dr., Huntsville, AL 35806, pauline.p.cason@spm.x.saic.com

1) **Parametric Cost Estimating**, *Bill Kelberlau*, Texas Instruments, Defense Systems/Electronics, 6600 Chase Oaks Blvd., MS 8446, Plano, TX 75023, bwrk@dlepl1.itg.ti.com, *Anna Lambert*

TI uses parametric cost estimating tools to build models that assist in analyzing costs for major program and business decisions. We will discuss the use of parametric cost estimating tools at TI, including examples and efforts to interface these tools with typical systems engineering tools to enhance design trade-offs.

2) **Selection of a National Financial Management System for an Emerging Free Enterprise Nation**, *Michael K. Lamb*, Mekelexx Mgmt. Services, 8649 Oak Chase Circle, Fairfax Station, VA 22039

The author is currently involved in assisting an emerging free enterprise nation to select an appropriate financial management system from competing contractors. He will discuss some of the complexities of selecting and establishing a first time financial system at the national level.

TC05 Risks & Decision Making: Generic Models & Phenomena Across Cultures

Sponsor: Decision Analysis Society

Sponsored Session

Chair: L. Robin Keller, Univ. of CA, Grad. Sch. of Mgmt., 401 GSM, Irvine, CA 92697-3125, lrkeller@uci.edu

1) **Source of American-Chinese Differences in Preference for Risk, Uncertainty & Ambiguity**, *Elke U. Weber*, OH State Univ., Dept. of Psychology, 1885 Neil Ave., Columbus, OH 43210, weber.211@osu.edu, *Christopher K. Hsee*

Over the last 2 years, we have found respondents from the PRC to be consistently more tolerant of risk, uncertainty and ambiguity than Americans. We contrast economic explanations for this difference, e.g., current levels of

economic growth, with cultural explanations.

2) **Hitting Home: Cognitive Switching from Long-Run to Short-Run Perceptions of Risk**, *Jeffery Guyse*, Univ. of CA, Grad. Sch. of Mgmt., 350 GSM, Irvine, CA 92697-3125, jguyse@uci.edu

In the face of low probability-high payoff gambles, decision makers may change their behavior because of an incident that befalls someone "dear" to them. In essence, the situation "hits home." Explanations and insights relating this switching behavior to multiplicative and additive models or risk are given.

3) **The Effect of Experience & National Culture on Managers' Resource Allocation Decisions: The Role of Organizational Contexts**, *C. Janie Chang*, CA State Univ., Coll. of Bus. Admin., San Marcos, CA 92096-0001, chang@csusm.edu, *Joanna L. Y. Ho*, *Anne Wu*

We examine the effect of national culture, experience and organizational factors (performance evaluation method, degree of project completion and nature of additional information) on resource allocations. Managers and students from the US and Taiwan participated. As predicted, both experience and national culture influence subjects' resource allocations.

4) **Decision & Fairness Judgments on Health & Safety Risks by Americans vs. Chinese**, *Wen-Qiang Bian*, Univ. of CA, Grad. Sch. of Mgmt., 401 GSM, Irvine, CA 92697-3125, wqbian@uci.edu, *L. Robin Keller*

We studied the similarities and discrepancies in people's fairness perceptions and decisions toward public health and safety risks in the US and PRC by applying the same questionnaire in Keller & Sarin (1988) to Chinese subjects. An explanation based on cultural factors is proposed and implications to the phenomena are discussed.

TC06 Teaching the Practice of OR Using Cases & Projects

Sponsor: 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) **No Title Supplied**, *Tomas Larsson*, Chalmers Univ. of Tech., Energy Systems Technology, Goteborg, S41296, Sweden, tola@entek.chalmers.se

We report experiences from an introductory course in Systems Engineering with emphasis on communication and control. Graphical methods, primarily IDEFO, are used to illustrate engineering applications. The students do case studies on a manufacturing system or a local energy decision. Usenet newsgroups are used for tuition.

2) **An OR Practice Course**, *Frederick B. Buoni*, FL Inst. of Tech., 150 West Univ. Blvd., Coll. of Eng., Melbourne, FL 32901

For 16 years, we have presented a course in OR practice for MS/OR students. The course has 3 phases: lectures on conducting OR studies, small team case studies and a major project. Specific content and results will be discussed.

3) **Student Consulting Teams in an Undergraduate OR Program**, *Leonard J. Kelly*, US Coast Guard Academy, 15 Mohegan Ave., New London, CT 06320

The manner in which projects, summer internships and student consulting teams are utilized to engage students in the application of OR and statistical techniques is discussed. Details associated with implementing recent partnerships and providing student consulting opportunities as part of the capstone undergraduate OR course are presented.

4) **Tips for Success in Instituting Projects in the Business School 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

At the University of Calgary, we have been using projects as an integral part of our MBA and B.Comm MS science courses for several years. We share our experiences, describe some notable student success stories and provide suggestions for successfully instituting projects in the business school classroom.

TC07 Theory in the Retail Industry

Sponsor: MSOM

Sponsored Session

Chair: Robert B. Freund, Univ. of TX, Dept. of Mgmt., Austin, TX 78712, brittf@mail.utexas.edu

1) **Inventory Management of Products with Substitutes & Complements**, *Narendra Agrawal*, Santa Clara Univ., DIS Dept.,

Leavey Sch. of Bus., Santa Clara, CA 95053, nagral@mailers.scu.edu,
Stephen A. Smith

In retailing, customers often purchase complementary sets of items and may substitute among sets if some items are unavailable. This affects item demand as well as customer service level. We present an analytical model to determine the optimal assortments to carry. Key insights obtained from numerical examples are discussed also.

2) Rational Shopping & the Option Value of Variable Pricing, Teck H. Ho, UCLA, Anderson Sch., 110 Westwood Plaza, Box 951481, Los Angeles, CA 90095-1481, teho@anderson.ucla.edu, David Bell, Christopher S. Tang

Given variance in retail price format, how should cost-sensitive customers shop? If shoppers are cost-sensitive, what type of retail price format is more profitable, EDLP or HILO? We develop and test a model of grocery shopping behavior. We show that price variability increases customer shopping frequency and allows stores to charge a higher average price without running the risk of losing patronage.

3) A Logistics Model in a Promotion Sensitive Grocery Environment, Ananth V. Iyer, Purdue Univ., Krannert Grad. Sch., 1310 Krannert Bldg., W Lafayette, IN 47907-1310

We model a grocery logistics system consisting of a warehouse, managed by a manufacturer, that supplies stores, managed by a retailer. The retail environment is captured by a 3-segment retail customer model where segments differ in their reservation price, size and propensity to stockpile. The suggested model is fit to a dataset of sales of canned soup. The model parameters as well as the residual variance are included in a decision model...

4) Retail Inventory & Shelf Space Allocation, Robert B. Freund, Univ. of TX, Dept. of Mgmt., Austin, TX 78712, brittf@mail.utexas.edu, Hirofumi Matsuo

Traditionally, shelf-space decisions at grocery chains have largely ignored inventory costs with perhaps some rough consideration of replenishment costs. Research into this area has tended to focus on equalizing marginal revenues or profits given some knowledge of demand elasticities. However, the advent of bar-code scanners and EDI has made much better inventory management feasible...

TC08 Inventory, Bargaining & Games

Cluster: Inventory Management
Invited Session

Chair: Bruce C. Hartman, Univ. of AZ, MIS Dept., 430 McClelland Hall, Tucson, AZ 85721, Chair

1) Capacity & Credibility: Contracting to Assure Supply, Martin A. Lariviere, Duke Univ., Fuqua Sch. of Bus., Box 90120, Durham, NC 27708, Gerard P. Cachon

The manufacturer of a new product is dependent on a supplier for a critical component. Because the manufacturer is better informed about the product's demand, the supplier may not provide as much capacity as the manufacturer desires. We consider contracts that assure that the supplier delivers sufficient capacity.

2) Incentives for Production Joint Ventures, Shaoping Zhao, Richard Stockton Coll., Division of Business, Pomona, NJ

Are there incentives for parent firms to create a production joint venture in which the joint venture competes and cooperates with its parents? Under Cournot competition and certain cost assumptions the industry production improves to the pre-joint-venture case. But under Stackelberg-Cournot interaction, incumbents can deter entry by creating joint ventures. An optimal deterrence strategy is computed.

3) Relationships Between Delivery Frequency, Timeliness & Incentives, John R. Grout, SMU, Cox Sch. of Business, Dallas, TX 75275-0333

Linkages between incentives for on-time delivery and sizing issues in JIT deliveries using Stackelberg games are examined. These games characterize optimal incentives for on-time delivery and suppliers' responses to them.

4) Cooperative Inventory Management When Cost Parameters Vary, Bruce C. Hartman, Univ. of AZ, MIS Dept., 430 McClelland Hall, Tucson, AZ 85721, Chair, Moshe Dror

Sharing the cost of centralized inventory management of single-period stochastic correlated demand from stores is analyzed using a cooperative game framework. We give conditions on holding and storage costs for different subsets of the stores such that centralization remains optimal and such that equitable cost sharing is still possible via the core of the associated cooperative game.

TC09 Continuous Location Problems

Sponsor: Section on Location Analysis

Sponsored Session

Chair: Zvi Drezner, CA State Univ., Dept. of MS/IS, Fullerton, CA 92834, dreznzr@fullerton.edu

1) On the Feasible Points to the Weber Problem with Uncertain Weights, Zvi Drezner, CA State Univ., Dept. of MS/IS, Fullerton, CA 92834, dreznzr@fullerton.edu, Carlton Scott

The Weber problem using squared Euclidean distances is investigated. The weights are assumed to be in given ranges. The set of all possible solutions to the problem is found. The result is implemented for the minimax regret problem.

2) Estimating the Attractiveness of Retail Facilities, Tammy Drezner, CA State Univ., Dept. of Mktg., Fullerton, CA 92834, tdrezner@ccvax.fullerton.ca, Zvi Drezner

Existing methods for the determination of facility attractiveness are based on the assumption that the attractiveness of a facility is a composite of many attributes. Such methods require extensive research and analysis. We take the reverse approach. Readily available data from secondary sources are used and the attractiveness of the facilities is inferred from these data.

3) Locating a High-Level Nuclear Waste Repository Using the Continuous 1-Median Model, Erhan Erkut, Univ. of Alberta, Fac. of Bus., Edmonton, Alberta, T6G 2R6, Canada, erhan.erkut@ualberta.ca, Q. Emter

Used nuclear fuel is currently stored at 110 nuclear power plants in the US. A site in Nevada has been selected as the repository. We apply the continuous 1-median model to this problem (using EXCEL) to find an optimal location and evaluate the quality of the selected solution.

TC10 OR/MS in Public Transit

Sponsor: Transportation Science Section

Sponsored Session

Chair: Matthew G. Karlaftis, Purdue Univ., Dept. of Civil Eng., 1284 Civil Eng. Bldg., W Lafayette, IN 47907, karlafti@ecn.purdue.edu

1) Traffic Signal Preemption Strategies for Improved Transit Performance, K. Larry Head, Univ. of AZ, Dept. of SIE, Tucson, AZ 85750, Anna Kniazian

Given an operating objective, such as reduced passenger travel time, we present several strategies for improving transit performance through traffic signal preemption. Several strategies based on actuated traffic signal timing and new advances in real-time traffic adaptive signal control will be presented.

2) A Model for Transit Real-Time Control, Mark D. Hickman, TX A&M Univ., Dept. of Civil Eng., CE/TTI Bldg., College Station, TX 77843-3136, mark@ttidadmin.tamu.edu

Real-time vehicle location data can be used to establish DSSs for fixed-route transit services. A mathematical model is presented to evaluate strategies for real-time control of fixed-route transit services. The model allows analysis of vehicle insertion, holding, short-turning and dead-heading policies.

3) The Cost Structure of a Mass Transit Firm, Matthew G. Karlaftis, Purdue Univ., Dept. of Civil Eng., 1284 Civil Eng. Bldg., W Lafayette, IN 47907, karlafti@ecn.purdue.edu

Utilizing time-series data from the Indianapolis Public Transit Corporation, we estimate a general cost model which 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.

TC11 Dynamic Traffic Assignment II: Consistency Issues

Sponsor: Transportation Science Section

Sponsored Session

Chair: Srinivas Peeta, Purdue Univ., Sch. of Civil Eng., W Lafayette, IN 47907-1284

1) A Consistency Analysis & Restoration Model for a Real-Time Dynamic Traffic Assignment System, Athanasios Ziliaskopoulos, Northwestern Univ., Dept. of Civil Eng., Evanston, IL 60208, a-z@nwu.edu, Dong Le Duan, Hani S. Mahmassani

We present a general model for the consistency analysis and restoration of a real-time DTA system. The model observes field-measured variables from the real-world network via sensors and communication devices. Variables are fed (along with other variables from databases) into a module that estimates the likely state of the actual system, which is compared with the corresponding DTA internal modeled variables, triggering corrective action as required.

2) On-Line Consistency of Route Guidance with Link Measurements within a Rolling Horizon Framework, Srinivas Peeta, Purdue Univ., Sch. of Civil Eng., W Lafayette, IN 47907-1284, Srinivas Bulusu

A 2-stage optimization procedure is proposed to ensure consistency between predicted system states and actual link measurements for the on-line route guidance problem in traffic networks with advanced traffic management and IIS. A constrained Newton-Raphson algorithm is used to ensure consistency of path flows with actual system state at the lower level with a rolling horizon framework that seeks network performance optimization at the upper level.

3) Numerical Experiments with a Dynamic Traffic Assignment Procedure in a Rolling Horizon Framework, Yi-Chang Chiu, Univ. of TX, Dept. of Civil Eng., Austin, TX 78712, y-chiu@mail.utexas.edu, Hani S. Mahmassani, Yaser Hawas

We present simulation experiment results with a dynamic traffic assignment procedure with multiple user classes in a rolling horizon framework. The experiments are conducted to examine the robustness of the procedures under different scenarios which reflect temporally or spatially varied demand realizations.

TC12 Supply Chain Planning from a Software Perspective

Cluster: Supply Chain Operations
Invited Session

Chair: Anand Iyer, i2 Technologies, Inc., 909 E Las Colinas Blvd., Ste. 1500, Irving, TX 75039, iyer@i2.com

1) Financial Planning & Optimization with APS Software, Jeff Starr, i2 Technologies, Inc., 909 E Las Colinas Blvd., Ste. 1500, Irving, TX 75039, jeff_starr@i2.com

Current APS software allows companies to construct feasible production plans optimizing operational parameters such as customer service and inventory levels. The next step for the APS industry is to optimize directly financial metrics rather than those 1 or 2 steps removed. Companies are in the business of making money; they should have planning and scheduling software with that explicit objective function...

2) Master Planning in the Context of Supply Chain Planning, Chris Houck, i2 Technologies, Inc., 909 E Las Colinas Blvd., Ste. 1500, Irving, TX 75039, chris_houck@i2.com

Managing the supply chain requires the creation, maintenance and modification of a master plan. The master planning exercise brings together the capacities of the facility with the market demand to answer questions about what products to make, where to make the products and when to make the products.

3) Distribution Planning for the Consumer Packaged Goods Industry, Irfan M. Ovacik, i2 Technologies, Inc., 909 E Las Colinas Blvd., 16th Fl., Irving, TX 75039, irfan_ovacik@i2.com

Inventory planning, deployment planning and transportation planning problems in a consumer packaged goods environment traditionally have been dealt with separately due to the complexity of the problems as well as to the lack of proper tools to solve these problems. Truly integrated distribution planning where inventory, deployment and transportation planning all have to be done simultaneously poses challenging problems to application developers and academic researchers. We review some of these problems.

TC13 Cross-Functional Problems in Product Line Selection

Cluster: New Product Development
Invited Session

Chair: Gregory Dobson, Univ. of Rochester, Simon School, Rochester, NY 14627-0100, gdobson@tor.rochester.edu

1) Product & Parts Modularity Design, Rachel Yang, Univ. of IL, 350 Commerce West, Champaign, IL 61820, ryang@uiuc.edu, Reza Ahmadi

We examine a producer's product and parts design problem when experiencing competition from generic parts that provide positive externality for the product market. The modularity between product and parts is hence affected by the product life time and the nature of demands for product and parts.

2) Individual Upgrades vs. Subscriptions for Products with Changing Technologies, Gregory Dobson, Univ. of Rochester, Simon School, Rochester, NY 14627-0100, gdobson@tor.rochester.edu, Michael Pangburn

We investigate policies for introducing upgrades for a product for which the underlying technology is improving (e.g., computers, software). We show that selling subscriptions rather than individual upgrades allows the producer to capture more consumer surplus, and we derive the optimal frequency and pricing policy under a variety of assumptions.

3) Product Offering & Pricing Decisions with Shared Manufacturing Capacity, Gregory Dobson, Univ. of Rochester, Simon School, Rochester, NY 14627-0100, gdobson@tor.rochester.edu, Candace A. Yano

We model a monopolist producing a large variety of products (e.g., sizes, thicknesses) at a single facility. Each segment desires a given variety and is sensitive to price and delivery-time. We provide a method for determining the profit maximizing set of products and, for each product, its price, whether it is made to-order or to-stock and its delivery lead-time.

4) Benefits & Costs of Designing Products Based on a Common Platform, Saurabh Gupta, Univ. of TX, Dept. of Mgmt., CBA 4.202, Austin, TX 78712, sgupta@mail.utexas.edu, Viswanathan Krishnan

Developing products based on a common platform has the potential to reduce development and procurement costs, but may also lead to over designed components that would reduce the profits of lower-end products. We investigate the extent of benefits that can be achieved by using such an approach.

TC14 Decision & Risk Analysis in Environmental Remediation Technology Selection

Sponsor: ENRE

Sponsored Session

Chair: Jack M. Kloeber, Jr., Dept. of the Air Force, AFIT/ENS, 2950 P St., Bldg. 640, WPAFB, OH 45433, jkloeber@afit.af.mil

1) A Survey of Hierarchies Used for Environmental Restoration Technology Evaluation, 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, Bin Nan

We examine the value hierarchies that have been developed to evaluate existing and innovative technologies used for environmental restoration. Our research focus is CERCLA sites. We examine how the value hierarchies were developed and categorize the objectives and evaluation measures by the CERCLA criteria.

2) Developing a CERCLA-Based Hierarchy to Select Technologies for DNAPL Remediation, Christine Kerschus, AFIT/ENV, Dept. of Eng. & Environ. Mgmt., 2950 P St., Bldg. 640, WPAFB, OH 45433, ckerschu@afit.af.mil, Jack M. Kloeber, Jr., Jack A. Jackson, Richard F. Deckro

We use DA techniques to develop a CERCLA-based value hierarchy, including criteria, subcriteria and measures in support of the DNAPL problems faced by the DoE at the C-400 site, WAG-6, Paducah, Kentucky as well as other DNAPL sites. Two contaminants of concern and working with EPA and state regulators add to the complexity of this problem.

3) Quantifying Technological Risk of Innovative Technologies, 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, Mike Frimpon, John A. Barnes

After a preliminary deterministic analysis, an innovative environmental remediation technology was identified as the best performing technology. However, many study participants considered this technology high risk. We performed a DA to identify and quantify the development risks. An important benefit of this study was the identification of improved alternatives with reduced risk.

4) System for Decision Analysis Support on Complex Waste Management Issues, David E. Shropshire, ID Ntl. Eng. & Environ. Lab., Lockheed Martin ID Tech. Co., PO Box 1625, Idaho Falls, ID 83415-3710, des@inel.gov

A DSS called the Complex Wide Waste Flow Analysis has been developed for the US DoE. The system is being used to evaluate environmental management strategies to safely disposition wastes in the next 10 years and to reduce the environmental legacy resulting from nuclear material production over the past 40 years.

TC15 Knowledge Management & Information Technology

Cluster: Technology Management
Invited Session

Chair: Kathy L. Wohlert, Univ. of TX, Div. of Mgt. & Mkt., 6900 N Loop 1604 West, San Antonio, TX 78249, wohlert@ibm.net

1) Knowledge Management: A Reframing & Repackaging of a Familiar Phenomenon, Kathy L. Wohlert, Univ. of TX, Div. of Mgt. & Mkt., 6900 N Loop 1604 West, San Antonio, TX 78249,

wohlert@ibm.net

As organizations increasingly become aware that their intellectual resources are assets which can provide distinct competitive advantages, they are looking for ways to "manage" the knowledge that exists within their boundaries. Knowledge management, as used in the literature, is remarkably similar to what has been labeled "technology transfer." We compare these 2 phenomena.

2) Geographically Distributed Work Groups & IT: A Study of Working Relationships & IS Professionals, Diane Bandow, AT&T

IT has enabled individuals to participate in groups and teams while being separated by distance. In the past, research in groups, teaming, interpersonal relations and collaboration has focused on face-to-face communication. We examine how members of a systems development organization develop working relationships in today's environment which facilitate knowledge management when groups are required to work together in separate locations...

3) Knowledge Management & Knowledge Networks: Solutions to Problems, Gerald Wagner, Milagro Systems, Inc.

Knowledge management is rapidly becoming a household word in organizations following in the footsteps of the word "intranet." Knowledge management means different things to different people. To Milagro Systems, it is a "way of life" - a way of life that appreciates intellectual assets and appreciates that in human minds, somewhere there exists answers and solutions to all problems...

TC16 Consumer Dynamic Choice Processes

Cluster: Marketing

Invited Session

Chair: Tulin Erdem, Univ. of CA, Haas Sch. of Bus., 545 Student Svcs Bldg. 1900, Berkeley, CA 94720-1900, erdem@haas.berkeley.edu

1) A Bayesian Search Model for Household Choice, Greg M. Allenby, OH State Univ., Mktg. Coll. of Bus., Hagerty Hall, 1775 College Rd., Columbus, OH 43210, gma@osumkt.cob.ohio-state.edu

We develop a discrete choice model, incorporating forgetting, by temporal dispersion of the prior, differing search costs and in-store displays/features, in which households update their prior knowledge of prices through Bayesian search. The model, calibrated on ketchup purchase scanner data, describes consideration sets whereby consumers focus attention on a subset of items and reference price effects.

2) Estimating Price Expectations in the OTC Medicine Market: Application of Dynamic Structural Discrete Choice Models to Scanner Panel Data, Fusun Gonul, Carnegie Mellon Univ., Grad. Sch. of Bus., Pittsburgh, PA 15213-3890, fg0k@andrew.cmu.edu

We examine structural and reduced-form models in OTC medicine brand choice behavior, identifying dynamic factors influencing choice, e.g., prior brand experience, future price expectations. Two questions are examined: Do consumers maximize a discounted lifetime utility function and form future price expectations in current choices?

3) An Empirical Analysis of Umbrella Branding, Tulin Erdem, Univ. of CA, Haas Sch. of Bus., 545 Student Svcs Bldg. 1900, Berkeley, CA 94720-1900, USA, erdem@haas.berkeley.edu

We study the processes by which consumers' brand quality perceptions are affected by experience with the same brand in a different category. Additionally, we analyze the impact of marketing mix strategies in 1 product category on quality perceptions, consumer perceived risk and consumer choice behavior in a different category.

4) Consumer Price & Promotion Expectations: Capturing Consumer Brand & Quantity Choice Dynamics Under Price Uncertainty, Tulin Erdem, Univ. of CA, Haas Sch. of Bus., 545 Student Svcs Bldg. 1900, Berkeley, CA 94720-1900, USA, erdem@haas.berkeley.edu, Michael P. Keane

We develop and estimate a dynamic structural model in which consumers form future price and promotion expectations and decide when, what and how much to buy by maximizing expected utility over a planning horizon. The model incorporates the impact of alternative pricing strategies, price expectation updating and effects on consumer brand choice, purchase timing, quantity decisions and inventory holdings.

TC17 Health Applications I

Contributed Session

Chair: Timothy W. Butler, Wayne State Univ., Sch. of Bus. Admin., Detroit, MI 48202, tbutler@cms.cc.wayne.edu

1) The Impact of Group Size on Physician Efficiency, Ray-E Chang, Ntl. Taiwan Univ., Grad. Inst. of Admin. Health, No 19 Su-Chow Rd., Ste. 306, Taipei, Taiwan, ROCC, rchang@ccms.ntu.edu.

tw, Long-Hong Cheng, Chi-Jeng Hsieh

Physicians control most medical expenditure decisions. In Taiwan, physicians practice in groups rather than as individuals in large teaching hospitals. Few researchers have investigated the efficiency of physician groups in these hospitals. We intend to explore the effect of group size on the efficiency of physician groups.

2) Ownership & Efficient Characteristics of Hospitals, I-Chiu Chang, Chung-Hua Polytech. Inst., Dept. of Ind. Mgmt., No 21 Aly 46 Ln 780, Si-Da Rd., Hsin-Chu, Taiwan, ROC, puff@china8.chpi.edu.tw, Shih-Jung Hsiao, Ya-Li Wang

Theoretically, different types of ownership entitle decision makers different rights in economic resource utilization. Few studies have attempted to discern systematic differences in efficient characteristics across hospital types. This study employs ratio efficiency games to explore the differences in behavior and competitive strategies as a function of hospital ownership types.

3) Issues of Patient Classification in a Managed Lives Model, Douglas N. Fuller, Univ. of VA, 4018 Clinton Ave., Richmond, VA 23227, dnf8h@virginia.edu, William T. Scherer

To date, linear regression models have been of very limited use in predicting the expected medical costs for an individual. Results in which models account for 5% or less of the individual variability are typical. We explore the potential benefits of applying alternate techniques to this problem.

4) A Markov Process Model for Patient Flow in a Family Practice Clinic, Murray J. Cote, Trinity Univ., Dept. of Health Care Admin., 715 Stadium Dr., San Antonio, TX 78212-7200, mjccote@trinity.edu

A Markov process model is constructed and validated for patient flow in a family practice clinic. The model is evaluated to determine the effect of examining room capacity on individual patient sojourns.

5) Flexibility Initiatives for Hospital Competitiveness, Timothy W. Butler, Wayne State Univ., Sch. of Bus. Admin., Detroit, MI 48202, tbutler@cms.cc.wayne.edu, G. Keong Leong

We address flexibility as a clinical capability and as a competitive weapon within an operations strategy framework. We address the dimensions of flexibility and how they address areas of uncertainty within the health care environment. We discuss implementation issues associated with flexibility and the challenges and opportunities for administrators.

TC18 Forecasting Applications in New Jersey

Cluster: Forecasting

Invited Session

Chair: Kenneth D. Lawrence, NJIT, Sch. of Mgmt., Newark, NJ 07102, lawrence@tesla.njit.edu

1) The Demand for Water in New Jersey Municipalities, Robert Hordon, Rutgers Univ., Dept. of Geography, New Brunswick, NJ 08903, Kenneth D. Lawrence, Sheila M. Lawrence

We focus on the development of a municipal forecasting model for water usage in New Jersey. The forecasts will be included for municipally-operated and private systems in New Jersey. The basis of the forecast will be an econometrics forecasting model.

2) Forecasting Demand for Cable Modems in New Jersey, Joseph Wen, NJIT, Sch. of Mgmt., Newark, NJ 07102, Kenneth D. Lawrence

Within the remainder of the decade, cable modem services are likely to become involved in various communication services (internet, telephone). The subject of this research will be to forecast the growth of these services within the various municipalities of New Jersey.

3) Forecasting the Tax Revenue in New Jersey, Kenneth D. Lawrence, NJIT, Sch. of Mgmt., Newark, NJ 07102, lawrence@tesla.njit.edu, Gary B. Kleinman, Asokan Anadarajan

The forecasting of tax revenue is a most important portion of the budget process in the state of New Jersey. It is essential that accurate estimates be obtained so that appropriate levels of funding can be assured for all governmental needs. This particular research addresses the gross receipts income tax for New Jersey.

TC20 Telecom Network Design

Contributed Session

Chair: Ali Amiri, Weber State Univ., Sch. Bus. Admin., Coll. Bus., 3804 University Circle, Ogden, UT 84408-3804, aamiri@weber.edu

1) Stacked SONET Ring Design, Ramesh Nagarajan, Bell Labs./Lucent Tech., 101 Crawfords Corner Rd., Rm. 3M-318, Holmdel,

NJ 07733, rameshn@lucent.com, **Bharat Doshi, P. Harshavardhana**

We consider the problem of designing logical SONET rings on a specified ring topology. The problem is formally posed as a set partitioning problem which is NP-complete. Heuristics are hence proposed which compare favorably against bounds and the optimal solution computed via CPLEX for small-size problems.

2) ATM Network Topological Design & Network Modification, Shuzhi Z. Lo, AT&T Labs., 101 Crawfords Corner Rd., Holmdel, NJ 07733, shuzhi@qpc2.ho.att.com, Griff L. Bilbro, Salah E. Elmaghraby

We introduce a unified model for both ATM network topological design and network modification. In our model, both link capacity assignment and switch assignment for nodes are addressed. A heuristic was proposed to solve the problem. A lower bounding procedure is also proposed to evaluate the quality of the approximate solution.

3) The Bounded Cycle Cover Problem, Eli V. Olinick, Univ. of CA, Dept. of IEOR, 1615 Virginia St., Berkeley, CA 94703, olinick@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 network links so that no one cycle contains more than a given number of nodes. We present fast heuristic algorithms for finding near-optimal solutions and discuss empirical results.

4) The Bandwidth Packing Problem with Response Time Requirements, Ali Amiri, Weber State Univ., Sch. Bus. Admin., Coll. Bus., 3804 University Circle, Ogden, UT 84408-3804, amiri@weber.edu

We study the bandwidth packing problem that consists of selecting calls from a list of requests to be routed on an arc-capacitated network with the objective of maximizing profit. A minimum level of response time to network users is guaranteed by specifying a limit on the total network queueing delay. An efficient and effective solution procedure for the problem is developed.

TC21 Theoretical Foundations of MMT XI

Cluster: Management of Medical Technology

Invited Session

Chair: Paula Bobrowski, SUNY, Sch. of Bus., Oswego, NY 13126, bobrowsk@oswego.oswego.edu

1) External Integration in Medical Technology Development: A Theoretical Perspective, Paula Bobrowski, SUNY, Sch. of Bus., Oswego, NY 13126, bobrowsk@oswego.oswego.edu, Arun Ranchod

We explore external integration in medical technology development from a communication theory perspective. This position asserts that systems are rapidly evolving for the exchange and creation of information which is important for successful medical technology development. The findings are based upon in-depth case studies of 4 world leading manufacturers of medical diagnostic imaging technologies.

2) A Theoretical Framework for the Analysis of Relevant Coevolution Processes in MMT, Riccardo Varaldo, Scuola Superiore S. Anna, Via Carducci 40, Pisa, 56100, Italy, turk@sssup1.sssup.it, Giuseppe Turchetti

We analyze the evolution of medical technologies and of treatment protocols referring to specific pathologies in cardiovascular diseases. In particular, we aim to define a theoretical framework for the analysis of the coevolution among patterns of technological change, research funding procedures and insurance...

3) Toward the Development of a Process Theory of Clinical Information Systems Implementation, Guy Pare, Ecole des HEC, Dept of Info. Tech., 3000 Chemin dela Cote-Ste-Cath, Montreal, Quebec, H3T 2A7, Canada, guy.pare@hec.ca, Joyce Elam

We examine the implementation of 3 clinical ISs in a large tertiary care teaching hospital. The methodology was inspired by the work of Eisenhardt (1989) on building theories from case study research. A series of research propositions reflecting the dynamic of clinical IS implementation are derived from data analysis.

TC22 Operations Management III

Contributed Session

Chair: T. D. Klastorin, Univ. of WA, Dept. of MS, 370 Mackenzie Hall, Box 353200, Seattle, WA 98195-3200, tedk@u.washington.edu

1) An Inventory System with Uncertain Holding Costs, Emre Berk, Bilkent Univ., Fac. of Bus. Admin., Bilkent, Ankara, 06533, Turkey, eberk@bilkent.edu.tr, Asli Bayar

We consider an inventory system in the presence of cost of capital fluctuations

which arrive as random shocks. Control policy structure is discussed and expressions for operating characteristics of the system are provided. Numerical results are presented based on the data from Turkish capital markets.

2) Stochastic Scheduling with Global System Interruptions, Mark C. Cutler, Univ. of WA, Box 353200, Seattle, WA 98195, mcutler@u.washington.edu, T. D. Klastorin

We analyze single/multi-phase queueing systems to determine optimal scheduling rules which minimize the sum of earliness and lateness costs. At random intervals, the system is disrupted, although arrivals continue. We compare the results of our models with real-world and simulation data.

3) Determination of Inventory Stock Level for a Commonality Model, Haizhen Fu, PA State Univ., 107 Beam Bldg., State College, PA 16802, hxf6@psu.edu, Duncan K.H. Fong

We consider a 2-level product structure in an assemble-to-order system. Demands for end products are assumed to follow independent mixtures of Erland distributions. We present closed form expressions to compute the inventory stock level when introducing commonality and to evaluate the relative savings under different demand patterns.

4) Optimization of Capacitated Kanban Production Systems, Heshmat Beirjandi, Univ. of MD, Coll. of Bus. & Mgmt., College Park, MD 20742-1815, hbeirjandi@bmgmail.umd.edu, Arjang A. Assad

We address the optimal assignment of kanbans to stations of a multistage assembly system using a deterministic multiperiod model. The key feature of the model involves handling production capacities and initial inventories. We propose 3 algorithms to solve this problem under different assumptions on problem parameters and report computational experience.

5) Coordinating Orders in a Multi-Echelon Inventory System, T. D. Klastorin, Univ. of WA, Dept. of MS, 370 Mackenzie Hall, Box 353200, Seattle, WA 98195-3200, tedk@u.washington.edu, Kamran Moinzadeh, Joong Y. Son

We consider a single wholesaler-multiple retailer system where retailers order stock at a list price, or a lower (deal) price if the retailer reorders at a multiple of the warehouse's cycle time. We develop a model which indicates optimal coordination policies, including optimal reorder cycles and "deal" price.

TC23 Group Decision & Negotiation

Contributed Session

Chair: Jeryl L. Mumpower, SUNY, Milne Hall, Rm. 300C, 135 Western Ave., Albany, NY 12222, j.mumpower@albany.edu

1) Negotiation Support for Multi-Party Resource Allocation: Developing Recommendations for Decreasing Transportation-Related Air Pollution, Jeryl L. Mumpower, SUNY, Milne Hall, Rm. 300C, 135 Western Ave., Albany, NY 12222, j.mumpower@albany.edu, Thomas D. Darling, John Rohrbaugh, Anna Vari

Negotiation support was provided for a 5-member task force trying to reach agreement about priorities among programs for improving air quality in Budapest, Hungary. The research demonstrated the utility of resource allocation models for understanding and facilitating negotiation processes and illustrated the usefulness of analyses of n-dimensional feasible settlement spaces.

2) Characteristics of Multi-Issue Negotiation, May Tajima, Univ. of Waterloo, Dept. of MS, Waterloo, Ontario, N2L 3G1, Canada, mtajima@mansi.watstar.uwaterloo.ca, Niall M. Fraser

The trade-off process of multi-issue negotiation is modeled using logrolling. Logrolling is the exchange of loss in some issues for gain in others resulting in mutual overall gain. The efficient frontier and other characteristics are investigated when the negotiating parties' value functions are linear and non-linear.

3) Long Term Planning in the Automobile Industry: Decision Making, Models & Processes, Hernan Wurgajt, EDS, 750 Tower Dr., MS 6D, Troy, MI 48098, hernanwb@speedlink.com

We report our experience designing and supporting long term planning processes in one of the Big Three. 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.

TC24 Strategic Planning

Contributed Session

Chair: Michael G. Jacobides, Univ. of PA, Wharton Sch., 2055 SH-DH, Mgmt. Dept, 3620 Locust Walk, Philadelphia, PA 19103, jacobides@wharton.upenn.edu

1) **Information Technology & the Dynamics of Competition**, *Michael G. Jacobides*, Univ. of PA, Wharton Sch., 2055 SH-DH, Mgmt. Dept., 3620 Locust Walk, Philadelphia, PA 19103, jacobides@wharton.upenn.edu, *David C. Croson*

We examine IT's strategic ramifications, which, despite their importance, are so far overshadowed by IT's.

2) **Effects of Industry Life Cycles on Competitive Strategy & Performances**, *Reginald M. Beal*, FL A&M Univ., Sch. of Bus. & Ind., Tallahassee, FL 32307-5200, *Masoud Yasai-Ardekani*

The empirical study of 101 small manufacturing firms examines the relationships between competitive strategies and firm performance under different stages of industry life cycle. Results show that distinctly different strategies are associated with high performance under different life cycle stages.

3) **The Aswan Dam: Today's View vs. Original Expectations**, *Lillian R. Reyad*, LA Tech. Univ., 2000 W Barnett Springs, Apt. 222, Ruston, LA 71270

Political controversies, not technical expectations, dominated the Aswan Dam's birth. Today, the Dam is a dominant factor in Egypt's infrastructure. An inventory of original expectations compared to the Dam today reveals expectations met and not met plus some effects not anticipated.

TC25 Reliability Research

Cluster: Reliability & Quality Engineering
Invited Session

Chair: Alice E. Smith, Univ. of Pittsburgh, Dept. of IE, 1031 Benedum Hall, Pittsburgh, PA 15261, aesmith@engrng.pitt.edu

1) **The Implications of Axiomatic Design on Reliability**, *Kai Yang*, Wayne State Univ., Dept. of Ind. & Mfg. Eng., Detroit, MI 48202, *Basem El-Haik*

Axiomatic design is a conceptual design approach based on the deployment of design rules called the independent and information axioms. We find that these 2 measures can be combined into 1 measure: vulnerability. We discuss the mathematical relationship between vulnerability and reliability, and present approaches to reduce vulnerability.

2) **Nested Renewal Processes & Opportunistic Maintenance Strategies**, *Joel Nachlas*, VA Polytech. Inst. & State Univ., 302 Whittemore Hall, Blacksburg, VA 24061-0118, *Alfred T. Degbotse*

Age and block replacement policies provide enhancements to equipment availability, but ignore opportunistic maintenance. Assuming a series system, we define a model of behavior when opportunistic preventive maintenance is superimposed on an age replacement policy. This model represents equipment activity as a nested renewal process and yields time dependent results and limiting behavior that matches existing limiting results.

3) **Cost Optimized Maintenance Scheduling for Repairable Systems**, *John S. Usher*, Univ. of Louisville, Dept. of IM/IE, JB Speed A88-8783, Louisville, KY 40292, *Wasim S. Hashmi Syed*

We extend the model of Jayabalan and Dipak (1992) to schedule preventive maintenance and replacement times to minimize system operation cost. We propose a model which accounts for increasing costs of maintenance and replacement, time value of money and cost of failure. A GA searches for the optimal discrete maintenance schedule.

4) **Computational Algebra Applications in Reliability**, *Lawrence M. Leemis*, Coll. of William & Mary, Dept. of Math., Williamsburg, VA 23187-8795

Computational algebra languages can be used for probabilistic modeling and data analysis in reliability. Their advantages over standard packages include the capability to model transformations of random variables and the ability to add probability models for lifetime modeling.

5) **Systems Reliability Optimization Considering Standby Redundancy & Time Dependent Component Hazard Functions**, *David Coit*, Rutgers Univ.

The redundancy allocation problem involves the selection of components and levels of redundancy to maximize system reliability. An integer programming formulation is presented when there are multiple component choices for each subsystem, cold standby redundancy and component time-to-failure distributed according to a gamma distribution.

TC26 Global Optimization

Cluster: Global Optimization
Invited Session

Chair: Costas Maranas, PA State Univ., 112A Fenske Lab., University Park, PA 16802, cdm8@psu.edu

1) **A Reduced Space Branch & Bound Algorithm for Global Optimization**, *E. N. Pistikopoulos*, Imperial College, Ctr. for Process Systems Eng., London, SW7 2BY, UK, e.pistikopoulos@ic.ac.uk, *T. G. W. Epperly*

For certain classes of NLP, we describe a B&B algorithm in which branching is only required for a subset of the problem variables. Theoretical results including a convergence proof are given. Applications on illustrative examples including batch plant design problems under uncertainty are discussed.

2) **Phase Stability Analysis for Equation of State Models**, *James Z. Hua*, Univ. of IL, Dept. of Chemical Eng., 600 S Mathews Ave., Urbana, IL 61801, hua@turing.scs.uiuc.edu, *Joan F. Brennecke*, *Mark A. Stadtherr*

Reliable phase stability analysis and, in turn, reliable computation of phase equilibria can be formulated as a global optimization problem. Here, we report progress on the efficient use of interval analysis in solving phase stability problems involving equation of state models.

3) **Global Optimization in Financial Planning**, *Ioannis P. Androulakis*, Exxon Corporation, *Costas Maranas*, *Christodoulos A. Floudas*

The fixed-mix investment problem with transactions costs utilizing the mean-variance model is addressed. Based on an efficient rebalancing evaluation procedure the original constrained high-dimensional problem is equivalently recasted into an unconstrained form in the space of fractional asset allocation variables. A variation of a BB method is applied to the problem...

TC27 Machine Learning Applications in Health Care

Cluster: Neural Networks & Machine Learning
Invited Session

Chair: Rema Padman, Carnegie Mellon Univ., Heinz Sch. Public Policy/Mgmt., Pittsburgh, PA 15213

1) **Genetic Algorithms for Exploring High-Dimensionality Health Care Databases Analysis of the Gulf War Syndrome**, *Hemant K. Bhargava*, Naval Postgrad. Sch., Code SM-BH, 555 Dyer Rd., Monterey, CA 93943, bhargava@nps.navy.mil, *D. L. Jacobson*

For exploratory data analysis problems, involving a database with scores of attributes, we partition the search problem and apply separate, but intertwined, algorithms for attribute search and pattern search. We discuss application of this method on a real world database arising from the investigations into the Persian Gulf illness.

2) **Application of Neural Networks to Breast Cancer Detection**, *Murali S. Shanker*, Kent State Univ., Coll. of Bus., Dept. of ADMS, Kent, OH 44242-0001, mashanker@scorpio.kent.edu, *Michael Hu*, *Ming S. Hung*, *B. Eddy Patuwo*

We discuss our application of neural networks to breast cancer detection and prediction. Comparisons are made to other classifiers. Techniques for model selection are also discussed.

3) **Neural Network Application for AIDS/HIV Care Planning**, *Changwon Lee*, St. Louis Univ., 3674 Lindell Blvd., St. Louis, MO 63108, leec22@slu.edu

An application of neural networks to classify and predict the health status of HIV/AIDS patients is presented. A neural network model in classifying 5 different functional health status of HIV/AIDS patients is evaluated. Several different topologies are applied to AIDS cost and utilization survey datasets.

4) **Assessing Waste Treatment Plant Performance via Neural Networks**, *Victor L. Berardi*, Kent State Univ., Dept. of Admin. Sci., Kent, OH 44242-0001, vberardi@kent.edu, *Guoqi Zhang*

Recent federal clean water legislation has made consistent waste water treatment plant operations important. The use of neural networks in assessing waste treatment plant operations is investigated. Experiments are conducted comparing neural networks to traditional statistical methods and the results are reported.

TC28 Integer Programming in Application

Cluster: Integer Programming
Invited Session

Chair: Wilbert E. Wilhelm, TX A&M Univ., Dept. of IE, College Station, TX 77843, wilhelm@tamu.edu

1) **A Lagrangian Dual & Penalty Approach for Academic Scheduling at USMA**, *Patrick J. Driscoll*, US Military Acad., Dept. of Math. Sci., West Point, NY 10996, ap5543@xmail.usma.edu,

Hanif Sherali

We present an algorithmic approach to solving the academic scheduling and timetabling problem faced at the USMA which employs a sequential construction process. Since the formulation of the mixed integer program involves approximately 400,000 binary variables and close to 23,000 structural constraints, we devise a Lagrangian dual and primal L1-penalty function approach to solve this problem.

2) **Inference-Based Sensitivity Analysis for Discrete Optimization Problems**, *Milind W. Dawande*, Carnegie Mellon Univ., Grad. Sch. of Ind. Admin., Pittsburgh, PA 15213, milind@shortfall.gsis.cmu.edu, *John N. Hooker*

Several fundamental problems in manufacturing and operations can be modeled as discrete optimization mathematical programs. An important practical issue for these problems is to analyze the sensitivity of the solution obtained to changes in the data, also called post-optimality analysis. A new method of sensitivity analysis for such discrete optimization problems is derived from the idea of inference duality...

3) **A Facet Generation Procedure for Designing Flexible Assembly Systems**, *Wilbert E. Wilhelm*, TX A&M Univ., Dept. of IE, College Station, TX 77843, wilhelm@tamu.edu, *Radu Gadidov*

We model the flexible assembly system design problem for multiple product types, prescribing optimal design including specifying machines and tooling. We describe a facet generation procedure which exploits embedded structures, generating facets computationally within B&C. Computational results show dramatic gains in run time and number of nodes explored.

TC29 Stochastic Programming

Cluster: Stochastic & Robust Optimization; Parallel & Supercomputing
Invited Session

Chair: Kevin R. Wood, Naval Postgrad. School, Dept. of OR, Monterey, CA 93943, kwood@nps.navy.mil

1) **Multi-Vehicle Routing on a Stochastic Network**, *Astrid Kenyon*, Univ. of TX, Dept. of Mech. Eng., Austin, TX 78712, *David P. Morton*

We consider a MVRP on a network with random travel times. The problem is modeled as a stochastic integer program. Stochastic programming methods and heuristics are used to find near-optimal solutions. We discuss the practicality of the solutions for real-world implementation.

2) **New Bounds on the Expected Values of Superadditive & Subadditive Functions**, *Chang Yu*, Northern Telecom Inc., PO Box 833871, Richardson, TX 75083-3871

Bounds using $O(n^2)$ function evaluations are developed for superadditive and subadditive functions; standard Edmondson-Madansky bounds would require 2^n function evaluations. Computational examples show that the new bounds can be refined within a sequential approximation algorithm to solve 2-stage stochastic programs with recourse.

3) **Pre-Sampling vs. Sampling for Stochastic Programming**, *Gerd Infanger*, Stanford Univ., EES & OR Dept., Stanford, CA 94305-4022

Stochastic programs often are approximated by generating a random set of scenarios, then solving the corresponding stochastic programs. This contrasts with sampling within the decomposition algorithm, but both seek an unbiased solution to the true stochastic programs. We discuss probabilistic bounds for both techniques and compare results on practical test problems.

4) **A Polynomial-Time Solution to a Stochastic Maximum Flow Problem**, *David P. Morton*, Univ. of TX, Dept. of Mech. Eng., Austin, TX 78712, morton@mail.utexas.edu, *Kevin R. Wood*

The "restricted stochastic maximum flow problem," an example of "restricted recourse," finds the maximum expected flow in a network with unreliable arcs given that flow cannot be rerouted after arcs fail. We prove that the problem is solvable in polynomial time and give computational results on some real-world networks.

TC30 Intelligent Scheduling Systems

Cluster: Scheduling
Invited Session

Chair: Benjamin P.-C. Yen, HKUST, Dept. of IEEM, Clear Water Bay, Kowloon, Hong Kong, pcyen@usmail.ust.hk

1) **Fuzzy Rules for Production Scheduling**, *Heloisa Martins Shih*, HKUST, Dept. of IE & EM, Clear Water Bay, Kowloon, Hong Kong, iehshih@uxmail.ust.hk

The constraints and objectives of a multi-product manufacturing environment are subject to dynamic changes: machines break, materials are not available,

new orders arrive changing the priority of existing orders and so on. Here, fuzzy inference is used to select dynamically the most appropriate scheduling rule given the instantaneous conditions and goals of the manufacturing system.

2) **An Intelligent Agent for Decision Making in Production Scheduling**, *GuoHua Wan*, HKUST, Dept. of IE & EM, Clear Water Bay, Kowloon, Hong Kong, ieghwan@uxmail.ust.hk, *Benjamin P.-C. Yen*

We present a new architecture of DSS in production scheduling. Then the problem-solving oriented model construction of the embedded intelligent agents is discussed. By means of system prototyping, we conclude that the intelligent agents can support decision-making in production scheduling.

3) **Personalized Scheduling Systems**, *Benjamin P.-C. Yen*, HKUST, Dept. of IEEM, Clear Water Bay, Kowloon, Hong Kong, pcyen@usmail.ust.hk, *H. G. Huang*

We first propose an approach to design and development of interactive scheduling systems for the Internet users. The prototype systems are then extended to be cooperative scheduling servers. We also discuss the issues of personalized scheduling systems in a distributed scheduling environment.

TC31 TUTORIAL: Visualization Techniques for Optimization

Cluster: Tutorials

Invited Session

Chair: Chris Jones, Univ. of WA, MS Dept., Sch. of Bus. Admin., 353 Mackenzie Hall, Seattle, WA 98195, cvj@u.washington.edu

1) **TUTORIAL: Visualization Techniques for Optimization**, *Chris Jones*, Univ. of WA, MS Dept., Sch. of Bus. Admin., 353 Mackenzie Hall, Seattle, WA 98195, cvj@u.washington.edu

We present the current state of the art in using visualization to support all aspects of the modeling process, form model and algorithm development through to final results presentation. Topics covered include animation, virtual reality, sound, hypermedia, among others. We include extensive, live examples.

TC32 Computer Applications

Contributed Session

Chair: D. Keith Quarles, AT&T Labs., 101 Crawford's Corner Rd., Rm. 3M-329, Holmdel, NJ 07719-4469, kquarles@att.com

1) **Using Excel to Manage a Complex Workforce Assignment Problem**, *D. Keith Quarles*, AT&T Labs., 101 Crawford's Corner Rd., Rm. 3M-329, Holmdel, NJ 07719-4469, kquarles@att.com

The capability of common business PC software is greater than many people realize. We describe how we used Microsoft Excel to provide AT&T's Executive Teleconferencing Service with a tool to manage a complex agent assignment problem, including a GUI and heuristic assignment algorithm, in only 3 weeks.

2) **Managing Digital Student Portfolios**, *Judith Barlow*, American Univ., 4400 Massachusetts Ave., NW, Washington, DC 20016-8116, jbarlow@american.edu, *Sheila M. Ford*, *Sarah Irvine*

Portfolios are becoming popular assessment tools for students of all ages. We present 2 examples of integrated media portfolio management systems: an elementary school application including audio and video data and a graduate student portfolio system containing incompatible file types. Both are implemented and accessible via Oracle Webserver.

3) **Information Systems for Employee Drug & Alcohol Addiction Cases**, *Yuan-Shyi Peter Chiu*, Chaoyang Inst. of Tech., Dept. of IE & Mgmt., Taichung, 413, Taiwan, ypchiu@dec8.cyt.edu.tw, *Singa Wang Chiu*

We use value chain models to identify areas in HR where employee's drug and addiction records tracking systems can provide control over abusive absence, long-term absence and budgetary workforce quota. Upon accomplishment of this IS, we demonstrate its advantages in workforce planning as well as expenditure saving.

4) **Large Scale Interior Point Methods on Personal Computers**, *Federico Trigos*, ITESM Campus Toluca, 100 Mts. al Norte de San Anton, Toluca Edo de Mexico, 50252, Mexico, ftrigos@campus.tol.itesm.mx

We discuss the experience of solving LP problems with a large number of constraints and variables on an inexpensive PC. Issues such as numerical structures, numerical stability, PC memory and speed will be discussed. The numerical result will be illustrated using the Net-Lib set of problems.

5) Neural Network-Based Stereo Line-Feature Matching Method for Deriving 3D Information, Fang-Chieh Tien, 15-1 Yen-So St., Taipei, Taiwan, 105, ROC, fctien@dec8.cyt.edu.tw, Alec Chang, Chieh-Yuan Tsai

A line-feature-based method is proposed to solve the stereo matching problem, which is formulated as

TC33 Software Demonstrations VII

Sponsor: CSTS

Sponsored Session

Chair: Bjarni Kristjansson, Maximal Software Inc., 2111 Wilson Blvd., Ste. 700, Arlington, VA 22201, bjarnik@site.gmu.edu

1) TransCAD, Xu Jun Eberlein, Caliper Corp., 149 Waverley St., Belmont, MA 02178

2) ILOG Solver, Younes Alaoui, ILOG, 9 rue de Verdun, BP 855, Gentilly Cedex, 94253, France

TC35 Scheduling Algorithms

Contributed Session

Chair: Jatinder N. D. Gupta, Ball State Univ., Dept. of Mgmt., Muncie, IN 47306-0350, 00ingupta@bsuvc.bsu.edu

1) Capacity Constrained Scheduling Problems, Jatinder N. D. Gupta, Ball State Univ., Dept. of Mgmt., Muncie, IN 47306-0350, 00ingupta@bsuvc.bsu.edu

We show that scheduling problems where capacity constraints are explicitly recognized are NP-hard. Using existing frameworks of scheduling theory, we describe heuristics to solve the capacity constrained 2-stage flowshop scheduling problems and outline useful directions for future research in solving due date/capacity constrained scheduling problems.

2) Simulated Annealing Heuristics for the Makespan & the Number of Tardy Jobs Bi-Criteria Parallel Machine Problem, Alex J. Ruiz-Torres, FL Gulf Coast Univ., 312 W College Ave., #1, State College, PA 16801, aruiztor.@fgcu.edu

We investigate the performance of 4 heuristics to generate solutions for the identical parallel machine makespan and number of tardy jobs bi-criteria problem. Experiments showed good heuristic performance and a small number of efficient solutions; relevant to industrial settings as the user must consider few schedules.

3) Scheduling Jobs with Different Due-Date on Nonidentical Parallel Machines, Jong-Kwan Baek, Korea Univ., 1,5-Ga, Anam-Dong, Sungbuk-Gu, Seoul, 136-701, Korea, jkbaek@kucncx.korea.ac.kr, Hong-Chul Lee, Sung-Shick Kim

We consider the nonidentical parallel machine scheduling problem in which n jobs having different due dates are to be scheduled on m nonidentical parallel machines. A heuristic algorithm is developed to allocate and sequence jobs to machines based on the suitable measure for minimizing the number of tardy jobs.

4) Scheduling About an Unrestricted Common Due Window with Arbitrary Earliness/Tardiness Penalty Rates, Meral Azizoglu, Mid. East Tech. Univ., Dept. of IE, Ankara, 06531, Turkey, ma@rorqual.cc.metu.edu.tr, Scott Webster

We consider the problem of scheduling jobs on a single machine about an unrestricted due window. Earliness or tardiness cost is assessed when a job completes outside a time increment defining acceptable job completion. We present properties of an optimal schedule and report results from a computational experiment.

TC36 Traffic Control in Queueing Models

Contributed Session

Chair: Bok S. Yoon, GA Inst. of Tech., Sch. of ISyE, Atlanta, GA 30332, yoon@isye.gatech.edu

1) Heavy Traffic Resource Pooling in Parallel-Server Systems, Marcel J. Lopez, Stanford Univ., Grad. Sch. of Bus., Stanford, CA 94305, marty@gsb.stanford.edu, J. Michael Harrison

Consider a queueing system with multiple input streams and multiple resources. In general, an input class may be served by more than one of the resources. We define an appropriate notion of heavy traffic, provide necessary and sufficient conditions for complete resource pooling in the heavy traffic limit and describe an asymptotically optimal policy for dynamic scheduling.

2) Scheduling Multiclass Queueing Networks with Switchover Times: Stability & Performance of Discrete-Review Policies,

Constantinos Maglaras, Stanford Univ., Info. Systems Lab., Stanford, CA 94305-9505, maglaras@isl.stanford.edu

We study dynamic scheduling in multiclass networks with class dependent switchover times. Based on the recent idea of a discrete-review structure, a family of policies that guarantee stability is described. Given a convex cost rate function, a discrete-review policy is described that is asymptotically optimal under fluid scaling.

3) QN-GPH Method for Sojourn Time Distributions in General Queueing Networks, Bok S. Yoon, GA Inst. of Tech., Sch. of ISyE, Atlanta, GA 30332, yoon@isye.gatech.edu

The QN-GPH method to compute the sojourn time distributions in non-product form queueing networks is introduced. QN-GPH is based on GPH semi-Markov chain modeling for the location process of a typical customer. An efficient method computing the first passage time distributions in semi-Markov chains is also derived. Numerical examples are given.

Tuesday 15:00-16:30

TD01 OR/MS Applications in Logistics

Cluster: OR/MS Applications

Invited Session

Chair: Bruce W. Patty, MCGI, 185 N Redwood Dr., Ste. 200, San Rafael, CA 94903, bruce@mcgi.com

1) Managing Chassis at Intermodal Terminals, Thomas A. Feo, Optimization Alternatives, Ltd., Barton Oaks Plaza, Ste. 440, 901 South Mopac, Austin, TX 78746-5747, tom@aol.com

The provider of containerization and its resulting efficiency such as double stack rail transport always has been limited by the intermodal industry's ability to effectively manage chassis. This talk highlights several practical issues surrounding chassis management and the solutions that have been applied successfully.

2) Cross Dock Simulation Modeling, W. Cole Reeves, Customized Transportation Inc., 10407 Centurion Pkwy., Ste. 400, Jacksonville, FL 32256

A generalized cross dock simulation model is being developed which is intended to optimize travel distance and minimize congestion on cross dock floors by selectively placing inbound and outbound trailers. An important model feature is that through setup parameters and dynamic user interaction, model placement suggestions are flexible to accept expert recommendations.

3) Yield Management Applied to Bulk Advertising, Bruce W. Patty, MCGI, 185 N Redwood Dr., Ste. 200, San Rafael, CA 94903, bruce@mcgi.com

The largest mailer in the US distributes mail to over 59 million households each week. This talk describes the design, development and prototype usage of a yield management system to improve profitability.

4) Optimal Ordering Policies for Items with Inflation & Permissible Delay in Payment, A. M. M. Jamal, Southeastern LA Univ., Dept. of Mgmt., Hammond, LA 70402, ajamal@selu.edu, Bhaba R. Sarker, Shaojun Wang

A model is developed for determining the ordering policy for deteriorating raw material that is subject to inflation and purchased under permissible delay of payment. The cost function which is a complicated exponential function represents the interaction between the raw materials seller and buyers. A numerical search procedure is employed to solve the problem.

TD02 Transportation Applications

Contributed Session

Chair: John E. Kobza, VA Tech., 302 Whittemore Hall, Blacksburg, VA 24061-0118, jkobza@vt.edu

1) Addressing the Dependency Problem in Access Security System Architecture Design, John E. Kobza, VA Tech., 302 Whittemore Hall, Blacksburg, VA 24061-0118, jkobza@vt.edu, Sheldon H. Jacobson

We present a method for evaluating when multiple-device security systems with overlapping capabilities are cost effective. A dependency structure quantifies how technologies interact and measures the impact of dependence on error probabilities. Its use to identify optimal device usage and to determine whether new technologies warrant investment are discussed.

2) A Model for Behavioral Adaptations to Changes in the Road Transport System & Its Simulation Analysis, Chang Q. Jiang, Coll. of WV, Sch. of Bus., PO Box AG, Beckeley, WV 25802, cjiang@cwv.edu, Geoffrey Underwood

A preliminary theoretical model is developed for the mechanism of road users' behavioral adaptations to changes in road transport systems. The model describes the process of behavioral changes and explains the nature of adaptation phenomenon and its effects on road safety. The structure and function of the model are examined and validated using dynamical system simulation.

3) Analysis of Pilot Error Accidents & Incidents, Kathleen L. McFadden, Northern IL Univ., OMIS Dept., McMurry 205, DeKalb, IL 60115-2854, dmcfadden@niu.edu

USA Today reports that a major concern of US air travelers is pilot error. This study provides a model that identifies several factors associated with pilot error. The findings are based on the analysis of FAA data on the flying performance of 70,164 pilots in commercial air operations.

4) A Heuristic-Based Framework for Highway Incident Response Strategy, Raktim Pal, Purdue Univ., 1284 Civil Engineering Bldg., West Lafayette, IN 47907, pal@ecn.purdue.edu, **Jason D. Papastavrou**

Incident related congestion is a major concern in urban areas. Appropriate response strategies are required to alleviate such congestion. A heuristic-based framework is developed to make intelligent decisions of deploying response vehicles within an urban area. The performance of the incident response system is analyzed using the hypercube model and subsequently improved using mathematical programming...

TD03 Flexible Plant Layouts

Cluster: Facilities Layout

Invited Session

Chair: Saifallah Benjaafar, Univ. of MN, Dept. of Mech. Eng., Minneapolis, MN 55455, saif@staff.tc.umn.edu

1) A Comparison of Process, Fractal & Holonic Layout Strategies, Ronald G. Askin, Univ. of AZ, Dept. of SIE, PO Box 210020, Tucson, AZ 85721, ron@sie.arizona.edu, **Frank W. Ciarallo, Nicklas Lundgren**

Several layout strategies have been proposed in recent years to increase flexibility and to support agile manufacturing operations. We present the results of a study comparing the throughput time and total material handling distance of process, fractal and holonic layouts across a spectrum of manufacturing environments.

2) An Empirical Investigation of Factory Layout Organizations, Uday Venkatadri, Univ. of Laval, SORCIER Research Ctr., Pavillon JA de Seve, St.-Foy, Quebec, G1K 7P4, Canada, venkatadri@osd.ulaval.ca, **Benoit Montreuil, Ronald Rardin**

In contemporary factory layout organization theory, 4 types of pure organizations have been identified as contending alternatives for job-shops: group, function, fractal and holographic. We empirically contrast these for 7 cases from the literature according to flow and capacity criteria.

3) Design of Distributed Plant Layouts, Saifallah Benjaafar, Univ. of MN, Dept. of Mech. Eng., Minneapolis, MN 55455, saif@staff.tc.umn.edu, **Mehdi Zadeh**

We present a procedure for stochastic plant layout design with duplicated resources. We introduce an integrated model for simultaneous flow allocation and layout and show that in stochastic environments, the resulting layout is generally highly distributed. We also show that the desirability of department duplication and distribution increases in variability.

4) A Plant Layout Model with Flexible Shape Constraint, Jue Xue, City Univ. of Hong Kong, Dept. of MS, Tat Chee Ave., Kowloon, 01610, Hong Kong, **Yanjun Li**

We introduce a plant layout model that incorporates flexible shape constraints from real world applications. We will classify different complexity classes of such problems and provide solution methods to such problems, supplemented with preliminary computational results.

TD04 Texas Instruments Contributed Session

Sponsor: Military Applications Society

Sponsored Session

Chair: William F. Mann, Texas Instruments, Defense Systems/Electronics, 6600 Chase Oaks Blvd., MS 8446, Plano, TX 75023, wfm3@ti.com

1) BroadCAST - ARSI Combat Development Environment Project, David R. Durda, US Army TRADOC Analysis Ctr., Simulations Division, WSMR, NM 88002-5502, durdad@trac.wsmr.army.mil, **Robert R. Koury**

The TRADOC Analysis Center at White Sands Missile Range has entered into a

joint effort with an industry partner, the Defense Systems and Electronics Group of Texas Instruments, Inc. to build analytic tools and interfaces to utilize BroadCAST, a DIS compliant version of the CASTFOREM combat simulation model with Texas Instruments' ARPA Reconfigurable Simulator Initiative manned simulator, ARSI...

2) A Discriminating View of History, William F. Mann, Texas Instruments, Defense Systems/Electronics, 6600 Chase Oaks Blvd., MS 8446, Plano, TX 75023, wfm3@ti.com, **Kenneth W. Bauer, Jr.**

Which factor in combat has the greatest effect? The technological advantage, or sheer numbers, or perhaps the will of the soldiers? We attempt to identify those factors that determine if an attacking force is going to win a battle. Fifty desert battles are analyzed from the 1967 Six Day War and the 1973 October War using the US Army's Concepts Analysis Agency's Land Warfare database...

3) Three Dimensional Line of Sight Modeling, Julie S. Wells, Texas Instruments, Defense Systems/Electronics, 6600 Chase Oaks Blvd., MS 8446, Plano, TX 75023, wel2@msg.ti.com

We discuss the development and use of a 3-dimensional line of sight model with both military and commercial applicability.

TD05 Learning in Games & Choices

Sponsor: Decision Analysis Society

Sponsored Session

Chair: Teck H. Ho, UCLA, Anderson Sch., 110 Westwood Plaza, Box 951481, Los Angeles, CA 90095-1481, teho@anderson.ucla.edu

1) Breeding Competitive Strategies, David F. Midgley, Univ. of New South Wales, Australian Grad. Sch. of Mgmt., PO Box 1, Kensington NSW, 2033, Australia, **Lee G. Cooper**

We show how GAs can be used to evolve strategies in oligopolistic markets characterized by asymmetric competition. The approach is illustrated using scanner tracking data of brand actions in a real market. We show that the artificial agents bred in this environment outperform the historical actions of brand managers in the real market.

2) Payoff Assessments without Probabilities: A Simple Dynamic Model of Choice, Rajiv Sarin, TX A&M Univ., Dept. of Econ., College Station, TX 77843-4228, r-sarin@tamu.edu, **Robert E. Marks, Lee G. Cooper**

We study a decision maker who chooses among alternate strategies only on the basis of the payoff she assesses she would obtain from them. At each stage, the decision maker chooses the strategy myopically assessed to give the highest payoff. She updates her payoff assessments adaptively. We show that such behavior results in maximum choices. If the decision maker experiences shock on the assessment, she converges to stochastically choose the strategy to maximize payoff.

3) Empirical Learning with Automated Agents, Robert J. Meyer, Univ. of PA, Dept. of Mktg., Wharton Sch. of Bus., Philadelphia, PA 19104-6371, **Steven A. Lippman, Darryl T. Banks**

We examine patterns of learning in repeated games where players' strategies are implemented by automated agents of the player's own design. The data provide insight into the likely cause of slow learning in complex games with stochastic feedback: subjects excessively revise strategies after receiving feedback (even when the feedback is positive) and sample from a biased region of the strategy space...

4) Experience-Weighted Attraction Learning in Games: A Unifying Approach, Teck H. Ho, UCLA, Anderson Sch., 110 Westwood Plaza, Box 951481, Los Angeles, CA 90095-1481, teho@anderson.ucla.edu, **Colin Camerer**

We describe a general model, EWA learning, which includes reinforcement learning and a class of belief-based models as special cases. We report parameter estimates of the model of 5 data sets. Reinforcement learning models outperform the belief-based models but both special cases are generally rejected in favor of EWA.

TD06 EDUCATION TUTORIAL: A Beginner's Guide to Using OR/MS Cases in the Classroom

Sponsor: Forum on Education

Sponsored Session

Chair: Peter C. Bell, Univ. of Western Ontario, Ivey Sch. of Bus., London, Ontario, N6A 3K7, Canada, pbell@ivey.uwo.ca

1) EDUCATION TUTORIAL: A Beginners Guide to Using OR/MS Cases in the Classroom, Peter C. Bell, Univ. of Western Ontario, Ivey Sch. of Bus., London, Ontario, N6A 3K7, Canada,

pbell@ivey.uwo.ca

This tutorial will attempt to help the OR/MS instructor with the teaching of OR/MS cases. Topics will include: What is a "case?" Why use cases in an OR/MS course? Where do I find OR/MS cases? Choosing appropriate cases for your course. Preparing for a case class. Strategies and tactics in the classroom.

TD07 Pricing Policies in the Retail Industry

Sponsor: MSOM

Sponsored Session

Chair: Susana V. Mondschein, Univ. of Chile, Dept. of Ing. Industrial, PO Box 2777, Santiago, Chile, smonds@di.uchile.cl

1) Yield-Maximizing Production & Pricing Policies for Consumer Products, *Ralph D. Badinelli*, VA Tech., Dept. of MS/IT, Blacksburg, VA 24061-0235, ralph@vt.edu

The application of yield-management principles to manufactured products has received little investigation to date. Nevertheless, the concept of buffer markets and the incorporation of price elasticity in determining a production and inventory policy introduces very useful flexibility to production and inventory control. Policies that incorporate dynamic pricing and market segmentation are derived and evaluated.

2) Clearance Pricing & Inventory Policies for Retail Chains, *Stephen A. Smith*, Santa Clara Univ., DIS Dept., Leavey Sch. of Bus., Santa Clara, CA 95053, ssmith@scu.edu, *Dale D. Achabal*

Clearance pricing is important to retailers because pricing errors may result in loss of potential revenue or excess inventory to be liquidated. Pricing and inventory adjustment methods are developed that include the impacts of reduced assortments and seasonal changes on sales. Applications at 3 major retailers are discussed.

3) A Model of Retail Location & Assortment Decisions, *Garrett J. van Ryzin*, Columbia Univ., Grad. Sch. of Bus., 412 Uris Hall, New York, NY 10027, gjv1@columbia.edu, *Siddharth Mahajan*

We present a model of joint retail site location and assortment selection. The model provides insights into the trade-off between retail scale and locational convenience.

4) Coordinating Pricing Policies of Seasonal Products in Retail Chains, *Gabriel R. Bitran*, MIT, Sloan Sch. of Mgmt., E53-355, 30 Wadsworth St., Cambridge, MA 02139, gbitran@mit.edu, *Rene Caldentey*, *Susana V. Mondschein*

We develop a methodology for pricing perishable products in a retail chain with coordinated prices among its stores. We compare its performance using real data and the expertise of a product manager in Chile. Our methodology provides significantly better results than those obtained by current practices.

TD08 User Competition Operations Management

Cluster: Inventory Management

Invited Session

Chair: Pitu B. Mirchandani, Univ. of AZ, Dept. of SIE, Tucson, AZ 85721, pitu@sie.arizona.edu

1) Scheduling a Job-Shop for Two Competing Users, *Alessandro Agnetis*, Univ. of Roma La Sapienza, Dept. of Info Systems, Via Buonarroti 12, Rome, 00185, Italy, agnetis@dis.uniroma1.it, *Pitu B. Mirchandani*, *Dario Pacciarelli*, *Andrea Pacifici*

Scenario: 2 users compete to perform their jobs with due-dates on a common set of resources. We characterize the set of nondominated schedules over which the users may negotiate and develop a polynomial algorithm to find this set. If transfer payment is allowed, we develop a single "system optimal" schedule.

2) A Competitive Facility Location for Duopolists, *H. A. Eiselt*, Univ. of New Brunswick, Fac. of Admin., PO Box 4400, Fredericton, NB, E3B 5A3, Canada, eiselt@fac.fadmin.unb.ca, *Gilbert Laporte*

We investigate a competitive location model in which duopolists locate their facilities in 2 adjacent regions. The choice of region determines tax structure and the subsidies the facility planners have to incorporate in their decisions. We examine the existence of locational Nash equilibria and Stackelberg solutions.

3) Two-User Competition of Resources: A Nonlinear Dynamic Game, *Pitu B. Mirchandani*, Univ. of AZ, Dept. of SIE, Tucson, AZ 85721, pitu@sie.arizona.edu, *Giampiero E. G. Beroggi*

Problem: 2 users are competing for 2 substitutable facilities where the cost to a user for using any facility depends on its combined usage. This results in a nonlinear dynamic game where the final "solution" is one where both the users are satisfied. "User equilibrium" and nondominated points are discussed in this context. An interactive graphical approach is presented for obtaining a

"negotiated" solution.

4) Cooperative Games & Bidding in Resource Constrained Software Projects, *Bruce C. Hartman*, Univ. of AZ, MIS Dept., 430 McClelland Hall, Tucson, AZ 85721, Chair

An optimization model to maximize benefits of finishing on time reflects key features of software projects with resource constraints. With some assumptions, a cooperative game based on the model has nonempty core. Thus using bidding to allocate the benefits to users is equitable and justified.

TD09 Production & Scheduling

Contributed Session

Chair: Stuart J. Allen, PA State Univ., Station Rd., Erie, PA 16563

1) Scheduling of a Moving Server in a Serial Production Process, *Seyed M. R. Iravani*, Univ. of Toronto, Dept. of Mech. & IE, 4 Taddle Creek Rd., Toronto, Ontario, M5S 1A4, Canada, iravani@ie.utoronto.ca, *Morton J. Posner*, *John A. Buzacott*

We consider the optimal control of a single server that processes a batch of size M through an N-stage tandem queue in order to minimize the total average holding and switching cost. Two heuristic algorithms are presented and their performance evaluated.

2) A Heuristic for Multi-Item, Capacitated Scheduling with Setup Times & Costs, *Stuart J. Allen*, PA State Univ., Station Rd., Erie, PA 16563, *Jack Martin*, *E. W. Schuster*

Welch's uses dedicated product packaging lines with finite capacity. Set-up times and costs must be accounted for in the scheduling process. The Dixon-Silver heuristic accounts for set-up costs but not set-up times. We have developed and tested an extension to their work to incorporate set-up times.

3) Scheduling with Limited Shelf Life, *S. K. Goyal*, Concordia Univ., 1455 de Maisonneuve Blvd. W, Montreal, Quebec, H3G 1M8, Canada, sgoyal@vax2.concordia.ca

We deal with the problem of obtaining an economic feasible repetitive manufacturing schedule for a number of products produced on a single manufacturing facility.

4) A Survey of the Industrial Practice on Production Scheduling, *Anita Y. Lee-Post*, Univ. of KY, 425G Bus. & Econ. Bldg., Coll. of Bus. & Econ., Lexington, KY 40506-0034, dsanita@ukcc.uky.edu

A survey has been conducted to understand the current industrial practice on production scheduling. We discuss findings related to the gap between scheduling research and practice, the level of automation in scheduling and rescheduling, the extent of satisfaction with current scheduling support and the need for industry-university collaborations.

TD10 Transportation: Truck/Rail

Contributed Session

Chair: William H. VanMarter, Canadian Pacific Railway, 401 9th Ave SW, Ste. 400, Calgary, Alberta, T2P 4Z4, Canada, whvhoh@telusplanet.net

1) A Minimizing Railroad Scheduling Application, *William H. VanMarter*, Canadian Pacific Railway, 401 9th Av SW, Ste. 400, Calgary, Alberta, T2P 4Z4, Canada, whvhoh@telusplanet.net

Railroads can be viewed as a series of networks. Closed or constrained networks are amenable to LP or constraint-based analysis. We present a complete empty-load (bulk) car scheduling project which incorporates minimization techniques.

2) Decision Support System for Managing Rail Shipments, *Muthu Krishnan*, GE Capital, 105 W Madison, Ste. 1800, Chicago, IL 60602, srm.mkrishna@capital.ge.com, *Kim Ross*, *Ravi Krishnamurthy*

We present a suite of decision support tools that assist GE Capital in providing high quality logistics services to bulk railroad shippers, while maximizing profitability. A railcar assignment model and a capacity planning model, implemented using network and MIP techniques, are discussed.

3) Optimizing Intermodal Operations over the Rail Segment of Truck-Rail Intermodal Transportation, *Alexandra M. Newman*, Univ. of CA, Dept. IE/OR, 4135 Etcheverry Hall, Berkeley, CA 94720, newman@ieor.berkeley.edu, *Candace A. Yano*

Although rail intermodal transportation has been gaining popularity in recent years, a significant number of shippers complain about lengthy transit times. We present a formulation for minimizing rail (linehaul) operational costs while ensuring timeliness of deliveries and briefly describe our solution procedure. We illustrate our model with numerical results.

4) Analysis of Work Rules in the Trucking Industry, David E. Benson, Univ. of MI, 1929 Plymouth Rd., Apt. 2103, Ann Arbor, MI 48105, debenson@umich.edu, **Chelsea C. White, III**

Using models of a trucking operation, we develop the capability to offer specific information and analysis on the costs and benefits of differing work rules. We illustrate our approach by analyzing changes to the number of days drivers spend away from home on a tour.

TD11 Dynamic Traffic Assignment III: Distributed Schemes

Sponsor: Transportation Science Section
Sponsored Session

Chair: Athanasios Ziliaskopoulos, Northwestern Univ., Dept. of Civil Eng., Evanston, IL 60208, a-z@nwu.edu

1) A Cooperative Decentralized Architecture & A Communication Protocol for Dynamic Traffic Assignment, Yaser Hawas, Univ. of TX, Dept. of Civil Eng., ECJ 6.2, Austin, TX 78712, yhawas@mail.utexas.edu, **Hani S. Mahmassani**

We describe a decentralized architecture that utilizes a set of controllers for reactive route guidance. The control logic comprises heuristics together with the breadth-first algorithm. Adjacent controllers share information of the local traffic conditions in their vicinity. A communication protocol is designed to control the information sharing process.

2) A Common Object Request Broker Architecture-Based Distributed Dynamic Traffic Assignment System for Large-Scale Networks, Steven Travis Waller, Northwestern Univ., Dept. of Civil Eng., Evanston, IL 60202, Athanasios Ziliaskopoulos

A large-scale design of a DTA model is implemented in the inter-language unification package, a CORBA compliant object oriented distributed system. CORBA handles all communication and synchronization tasks for the system. The distribution of the modules to processors (or processor clusters) is discussed along with computational experience on a cluster of workstations.

3) ALLIANCE: A Decentralized Approach to System Optimal Routings in Dynamic Traffic Networks, Alfredo Garcia, Univ. of MI, Dept. of IOE, Ann Arbor, MI 48109, agarcia@engin.umich.edu, **Daniel J. Reaume, Robert L. Smith**

We introduce a novel procedure to compute system-optimal routing in a dynamic traffic network. Fictitious play is utilized within a game of identical interests wherein vehicles are treated as players with the common payoff of average trip time experienced. Conditions under which convergence holds are presented as well as results from a large-scale computational test on a real network.

4) An Integrated Architecture for Real-Time Dynamic Traffic Assignment, Yaser Hawas, Univ. of TX, Dept. of Civil Eng., ECJ 6.2, Austin, TX 78712, yhawas@mail.utexas.edu, **Hani S. Mahmassani**

We describe various operational modes of the dynamic traffic assignment system developed at the University of Texas at Austin, including a centralized rolling horizon predictive mode for multiple user classes for both descriptive and normative route guidance as well as a decentralized reactive mode with local search heuristics.

TD12 Contractual Arrangements in Supply Chains

Sponsor: Section on Logistics
Sponsored Session

Chair: Maqbool Dada, Northwestern Univ., Kellogg Grad. Sch. of Bus., MEDS Dept., 5th Fl., Evanston, IL 60208, m-dada@nwu.edu

1) Sourcing Decisions Under a Fixed Payment Contract, Maqbool Dada, Northwestern Univ., Kellogg Grad. Sch. of Bus., MEDS Dept., 5th Fl., Evanston, IL 60208, m-dada@nwu.edu, **Herbert Moskowitz, Dogan Serel**

We examine sourcing decisions of a firm that in addition to a traditional supplier has a fixed payment agreement with a preferred supplier. This agreement entails delivery of any desired portion of a reserved fixed capacity in exchange for a guaranteed payment by the buyer. For the case of the buyer who manages inventory with a stationary periodic review policy, we analyze the problem from perspectives of the buyer and its preferred supplier.

2) Investment & Contracting Under Demand Uncertainty: Outsourcing vs. Ownership, Jan Van Mieghem, Northwestern Univ., Kellogg Sch. of Mgmt., 2001 Sheridan Rd., Evanston, IL 60208-2009

We analyze the investment strategies of 2 firms, "contractor" and

"subcontractor," who have the option to cooperate in the face of uncertain market demands. The model is a 2-stage stochastic game. Investment decisions are made, market demands revealed and both firms can cooperate in setting production decisions, constrained by their earlier investment level. We present a threshold cost condition under which the contractor will outsource all production.

3) Cooperation Between Manufacturers & Retailers Under Supply & Demand Uncertainty, Rodney Traub, Univ. of IA, Coll. of Bus. Admin., Iowa City, IA 52242, **Z. Kevin Weng**

We analyze the interaction between a manufacturer and a retailer when both the output of the manufacturing process and the demand faced by the retailer are uncertain. Profit models are developed which allow us to compare the advantages due to information sharing with those due to joint decision making.

4) Supply Chain Contracting: The Case of Forecasting & Moral Hazard, Martin A. Lariviere, Duke Univ., Fuqua Sch. of Bus., Box 90120, Durham, NC 27708, **Gerard P. Cachon**

In many supply chains, not all members are capable equally of forecasting end consumer demand. The incentives of a party to forecast for the entire chain, of course, depend on the cost of forecasting and the contract governing intra-chain transactions. We consider contracts that assure the efficient use of forecasting.

TD13 New Product Development I
Contributed Session

Chair: Ely Dahan, Stanford Univ., 537 Hilbar Ln., Palo Alto, CA 94303-3026, edahan@stanford.edu

1) Optimal Parallel Experimentation for Multi-Component Products & Processes, Ely Dahan, Stanford Univ., 537 Hilbar Ln., Palo Alto, CA 94303-3026, edahan@stanford.edu, **Haim Mendelson**

A product or process consists of independent components, which together, determine overall profitability. Parallel prototypes of each component are modeled as draws from a probability distribution with the best compatible outcome selected. We analyze the optimal experimentation policy, compatibility between components and the valuation of options to abandon the project.

2) Estimating the Market Access Potential to New Products, Juliana Hsuan, Helsinki Sch. of Econ., Runeberginkatu 22-24, Helsinki, 00100, Finland, juliana.hsuan@kyppari.hkkk.fi, **Ari Vepsäläinen**

We demonstrate how distribution and marketing factors can be captured in the selection and prioritization of new product development projects. Our R&D project portfolio matrix links competitive advantages of the firm with benefits provided to customers. An extensive test on practical cases is reported.

3) New Product Development: Being First vs. Being, Douglas R. Johnson, Univ. of IL, 1206 S 6th St., Champaign, IL 61820, drjohn@uiuc.edu, **David Hoopes**

We characterize new product development as an uncertain search process. The firm, uncertain about consumer preferences, must manage the trade-off between launching the "right" product and launching first. We extend the model by including consumer preference "drift," improvements in search capabilities and game theoretic competitive interaction.

4) Commonality in Product Design: Cost Saving & Cannibalization, Kilsun Kim, Univ. of IL, 339 Commerce West, 1206 S 6th St., Champaign, IL 61820, kkim2@students.uiuc.edu, **Dilip Chhajed**

We address a tradeoff that arises when a modular product design is used to provide a variety of products. The main benefit is a cost savings due to economies of scale while the major drawback is the possible cannibalization that results from excess similarities between products in different classes.

5) The Impact of Engineering Design Strategy on Development Performance, Nagesh N. Murthy, GA Inst. of Tech., Dupree Sch. of Mgmt., 755 Ferst Dr., Atlanta, GA 30332-0520, nagesh.murthy@mgt.gatech.edu, **G. Keong Leong**

Engineering design function plays a significant role in the development of physical, discrete, engineered and manufactured products for both consumer and industrial products. We use empirical data to develop a framework to describe the interaction between engineering design strategy and new product development performance.

TD14 Logistics Models for Recoverable Products

Cluster: Recoverable Product Environments
Invited Session

Chair: Jonathan Linton, Old Dominion Univ., Dept. of Eng. Mgmt., Norfolk, VA 23429-0249, as001534@orion.yorku.ca

1) Carpet Recycling: An Illustrative Example of the Reverse Logistics Problem, Jane C. Ammons, GA Inst. of Tech., Sch. of ISyE, 765 Ferst Dr., Atlanta, GA 30332-0205, jane.ammons@isye.gatech.edu, **David Newton, Matthew Realf**

Reverse logistics represents a potentially significant opportunity for increased competitiveness by lowering costs and improving public perception of a product. We highlight some of the emerging issues in reverse logistics management. Problems and opportunities are illustrated through case studies in the recovery and reprocessing of carpet.

2) A Two-level Network for Recycling Sand: A Case Study, Rommert Dekker, Erasmus Univ. Rotterdam, Econometric Inst., PO Box 1738, Rotterdam, 3000 DR, The Netherlands, **A. I. Barros, V. Scholten**

In the Netherlands, the recycling of construction waste and in particular of sand creates an important logistic problem. New legislation ensures that land filling is reduced to a minimal level and this encourages recycling. Such measures cause an increase in the offer of sand (a sub product of recycling construction waste) and create the need for establishing an efficient sand recycling network. The problem falls into the field of reverse logistics management since it deals with processing returned goods (sieved sand)...

3) Simulating Reverse Distribution to Facilitate Logistics Decision Making, Jonathan Linton, Old Dominion Univ., Dept. of Eng. Mgmt., Norfolk, VA 23429-0249, as001534@orion.yorku.ca, **David Johnson**

Reverse distribution is a concern for firms that are recalling product, upgrading defective and obsolete product in-field or preparing to respond to emerging environmental laws and agreements. A multimedia reverse distribution simulation was developed to assist in planning in-field product upgrade of telecommunications products. The simulator explores how variations in quantity and timing of supply effect manufacturing capacity requirements and ability to fulfill market demand...

4) Adding Test & Disassembly Centers for Reuse to an Existing Distribution Network, Patrick Beullens, Univ. of Leuven, Ctr. for Ind. Mgmt., Celestijnenlaan 300, Heverlee, B-3001, Belgium, patrick.beullens@cob.kuleuven.ac.be, **Marc Salomon**

A product is distributed by an existing network consisting of 1 plant and several warehouses. A reverse flow is planned from the customers to new test and disassemble centers, and from these centers back to the plant or warehouses or a landfill site. We discuss several discrete optimization models for the location of test and disassemble centers. One realistic case considering the reuse of electronic appliances is discussed in detail.

TD15 Technology Management & Sustainable Development

Cluster: Technology Management
Invited Session

Chair: Pedro Conceicao, Univ. of TX, IC2 Inst., 2815 San Gabriel Ave., Austin, TX 78705, pedroc@uts.cc.utexas.edu

1) Policies to Efficiently Deal with Knowledge & Common Pool Resources, Pedro Conceicao, Univ. of TX, IC2 Inst., 2815 San Gabriel Ave., Austin, TX 78705, pedroc@uts.cc.utexas.edu

Knowledge and common pool resources are both non-rival goods. This means that purely competitive markets do not yield incentives for Pareto efficient production, opening the door for public policies. The creation of new knowledge, new technology, is deeply related to economic growth and development. On the other hand, common pool resources, such as fisheries and forests, are essential concerns in any sustainability discussion...

2) Life Cycle Assessment & Sustainability, Manuel V. Heitor, Paulo Ferrao

The challenge of building a sustainable global economy can be articulated in 2 operational dimensions: the quality of the environment needs to be sustained, namely by ameliorating the deleterious effects of industrial processes and on the reduction of natural resources and the economic development in which growth must proceed within a new paradigm. We add to these 2 pervasive arguments 2 more that are relevant in developing countries...

3) The Agile Approach to Sustainable Development, Sunil Tanka, Univ. of TX, IC2 Institute, 2815 San Gabriel Ave., Austin, TX 78705, sunil.icc.utexas.edu

Corporations will lead the transition to sustainability because they are positioned uniquely to access the required resources and technologies on a global scale. We show how they can fulfill this role and reconcile economic growth and environmental sustainability through the creative use of technology within an

agile management environment.

4) Global Interactions for Local Business Sustainability, Jeffrey Amos, Univ. of TX, IC2 Institute, 2815 San Gabriel Ave., Austin, TX 78705, jeff@icc.utexas.edu

We look at how principles of collaboration and agility can be utilized in regional economic development. Small business must be able to draw upon a global network of suppliers and partners in the face of unexpected changes in technology and markets without overtaking the company in terms of time or financial resources.

TD16 Shopping Basket Empirics

Cluster: Marketing

Invited Session

Chair: Jeongwen Chiang, HKUST, Sch. of Business, Clear Water Bay, Kowloon, Hong Kong, mkchiang@usthk.ust.hk

1) Modeling the "Shopping Basket": Some Random Utility-Based Approaches, Puneet Manchanda, Columbia Univ., Grad. Sch. of Bus., New York, NY 10027, pm74@columbia.edu, **Sunil Gupta, Asim Ansari**

We model the composition of the shopping basket to determine whether behavior across categories is dependent or independent through random part of utility. We then use another model to examine the dependence in detail through the deterministic part of the utility. We discuss the implications for both retailers and manufacturers.

2) Analysis of Cross-Category Dependence in Market Basket Selection, Gary J. Russell, Univ. of IA, Coll. of Bus. Admin., 108 Pappajohn BAB, Iowa City, IA 52242-1000, gary-j-russell@uiowa.edu

A typical shopping basket includes many product categories. We develop a conditional choice model which expresses each category choice as a function of both category marketing mix variables and the observed choices in other categories. The approach is applied to a dataset consisting of 4 paper goods categories.

3) Forward-Buying, Increased Consumption or Both?, Jeongwen Chiang, HKUST, Sch. of Business, Clear Water Bay, Kowloon, Hong Kong, mkchiang@usthk.ust.hk, **Chakravarthi Narasimhan**

Consumers often respond to deals by buying more of the promoted products. Is it a simple forward-buying scheme or because consumers want to consume more? Without controlling shopping trip frequency and product type, the answer is not obvious. We propose a model to investigate this issue using shopping basket data.

TD17 Health Applications II

Contributed Session

Chair: Zeynep Onay, Middle East Tech. Univ., Dept. of Mgmt., Ankara, 06531, Turkey, onay@man.metu.edu.tr

1) The Role of Information Systems in Health Care Reform, Zeynep Onay, Middle East Tech. Univ., Dept. of Mgmt., Ankara, 06531, Turkey, onay@man.metu.edu.tr

We will stress the crucial role of ISs and IT in the realization of a comprehensive National Health Care Reform Program in a developing country. We describe the components of a health IS supporting the reforms and discuss its impacts on a national scale.

2) An Application of Multiple Attribute Decision Making in Health Care Systems, Zhongxian Wang, Montclair State Univ., Info. & Dec. Sci. Dept., Upper Montclair, NJ 07043, wangj@saturn.montclair.edu, **Arun Kumar, Qiyang Chen**

We certainly have multiple, usually conflicting, attributes in our health care system. It can be quite difficult for decision makers to obtain the "optimal" solutions. Several MADM methods have been used to compare and analyze the different health care systems worldwide.

3) A Decision Model to Reduce the Rate of Nosocomial Infections in Post-Operative Patients, Amy R. Wilson, Univ. of CA, 4175 Etcheverry Hall, Berkeley, CA 94720, amy@icor.berkeley.edu, **Robert M. Oliver**

We propose a decision model to describe the evolution of hospital-acquired post-operative infections and to assess the efficacy of prevention measures. The risk of infection is conditional on patient characteristics and events occurring during the hospital stay. The model distinguishes between infection types and allows for multiple infections.

4) Continuous Quality Improvement in Health Care Operations:

A Case Study, Niranjan Pati, Univ. of WI, 418 G North Hall, 1725 State St., La Crosse, WI 54601, pati@mail.uwlax.edu, **Joan Benson**

We report on the application of CQI as a way to improve the operations of hematology laboratory of a medium-sized hospital and clinic. A case study involving the role of CQI to improve the laboratory operations will be presented.

TD18 Forecasting Applications in Transportation

Cluster: Forecasting

Invited Session

Chair: Kenneth D. Lawrence, NJIT, Sch. of Mgmt., Newark, NJ 07102, lawrence@tesla.njit.edu

1) **Forecasting Demand for Domestic Passenger Airline Travel, Richard H. Zeni**, US Air Inventory Mgmt., 2345 Crystal Dr., Arlington, VA

The forecasting of passenger traffic demand is an important part of an airline yield management system. The demand may exceed the capacity of the aircraft, but historical data is constrained to include any of those passengers who actively made reservations. We investigate methods of unconstraining the demand.

2) **Forecasting the Effect of Abnormal Situations on Tourist Traveling by Air, Michael D. Geurts**, Brigham Young Univ., Dept. of Bus. Mgmt., Provo, UT, mdgeurts@bygate.byu.edu, **David Whitlark**

We look at the effects that very good or very bad news have on tourists flying to Hawaii. We have developed an accurate model to forecast tourists flying to Hawaii. The model can be used to calibrate effects of extended bad weather or an outbreak of pollution on Waikiki Beach on tourist travel to Hawaii.

3) **Forecasting the Flows of Freight by Truck within the US, Kenneth D. Lawrence**, NJIT, Sch. of Mgmt., Newark, NJ 07102, lawrence@tesla.njit.edu, **Michael R. Barolucci**

We focus on the development of a forecasting model of freight by truck in the US. It is a multiregional model that will predict the flow of freight between origin and destination regions in the US.

4) **A Combined Mode Choice Traffic Assignment Model for Evaluating Commuter Travel Options, Maria P. Boile**, Lafayette Coll., Dept. of Civil & Environ. Eng., Easton, PA 18408, boilem@lafayette.edu, **Lazar N. Spasovic**

We present a formulation and solution of a model that can be used in the travel demand forecasting process to analyze commuter travel on intermodal networks. The model combines the mode choice and the traffic assignment steps of the urban transportation planning process. A case study is presented.

TD19 Development & Application of Simulation Methods

Sponsor: College on Simulation

Sponsored Session

Chair: David Kelson, Univ. of Cincinnati, Dept. of QAOM, PO Box 210130, Cincinnati, OH 45221-0116

1) **Assessing the Finite-Time Performance of Stochastic Algorithms for Accessibility, Sheldon H. Jacobson**, VA Polytech. Inst. & State Univ., Dept. of Ind. & Systems Eng., 302 Whittemore Hall, Blacksburg, VA 24061-0118, jacobson@vt.edu, **Enver Yucesan**

ACCESSIBILITY asks whether a finite sequence of events can be found so that a particular state can be reached. This problem is intractable, which indicates the need for heuristics. One difficulty in applying stochastic algorithms to ACCESSIBILITY is knowing a priori of whether such algorithms will be effective. We introduce the false negative problem. The probability of a false negative provides a finite-time performance measure for stochastic algorithms.

2) **Elimination of Parameter Uncertainty in Signal Extracting Using Monte Carlo Integration, Jae J. Lee**, Univ. of KS, School of Bus., 345 Summerfield Hall, Lawrence, KS 66045-2003, **Steven C. Hillner, John M. Charnes**

Given a signal extraction model with unknown parameters and using a Bayesian approach, Monte Carlo integration can be used to compute signal estimates that are not conditional on the unknown parameters. A simulation study is conducted to compare the performance of several Monte Carlo integration methods for this problem.

3) **Selecting the Best of K Configurations of a System When Performance is Measured by Multiple Attributes, Douglas J. Morrice**, Univ. of TX, MSIS Dept., CBA 5.202, Austin, TX 78712-1175, morrice@mail.utexas.edu, **John C. Butler, Peter W. Mullarkey**

In recent work, the authors have developed a computer simulation to model different configurations of a system. The performance of each configuration is measured by multiple attributes. We combine multiple attribute DA with ranking and selection in order to select the best of K possible configurations.

4) **Simulation of an Outpatient Clinic Network, James R. Swisher**, Biological & Popular Culture, Inc., 7335 Lee Hwy, Radford, VA 24141, **Jong B. Jun, Sheldon H. Jacobson**

We will present a discrete-event simulation model developed for Biological & Popular Culture, Inc. to support the design and development of an outpatient clinic network. Details of the model's object-oriented, visual design and results of model experimentation will be presented.

TD20 Telecommunications

Contributed Session

Chair: Phyllis Reuther, Carnegie Mellon Univ., Heinz Sch., 5000 Forbes Ave., Pittsburgh, PA 15213, pr0z@andrew.cmu.edu

1) **Toward a Structural Analysis of Webpage Linkages, Phyllis Reuther**, Carnegie Mellon Univ., Heinz Sch., 5000 Forbes Ave., Pittsburgh, PA 15213, pr0z@andrew.cmu.edu

Webpage attributes and relational characteristics can be used to form representation classes which may be amenable to network analysis. We develop a structural taxonomy for webpages and explore the possibility that hyperspace traversal networks may be modeled using mathematical programming techniques to uncover and explain underlying user browsing patterns.

2) **A Structural Analysis of Organizational WWW Sites Using Network Analysis Methods, Thomas R. Shaw**, Univ. of TX, MSIS Dept., CBA 5.202, Austin, TX 78712, shaw@mail.utexas.edu

We discuss the application of bibliometrics and other network analysis methods to the study of corporate WWW sites. The analysis attempts to discover key structural attributes, such as centrality, density, cliques and relatedness of successful WWW sites.

3) **Systems Analysis for Statewide Electronic Data Collection System for Virginia's Domestic Violence Programs, Margaret K. Mayer**, Univ. of VA, Thornton Hall, Systems Eng., Charlottesville, VA 22903, mkm6n@virginia.edu, **Stephan Anderson**

We present a systems analysis for a statewide electronic data collection system for Virginia's domestic violence and sexual assault programs. Three integrated ISs for data collection and retrieval were proposed, with a recommendation to adopt a distributed, platform independent solution. The technology used for each alternative will be discussed.

TD21 Theoretical Foundations of MMT XII

Cluster: Management of Medical Technology

Invited Session

Chair: Alvin A. Bicker, SUNY, Dept. of Anesthesiology, Brook, NY 11794, abicker@epo.som.sunysb.edu

1) **What We Don't Know CAN Hurt Us, Alvin A. Bicker**, SUNY, Dept. of Anesthesiology, Brook, NY 11794, abicker@epo.som.sunysb.edu, **John S. Gage, Paul Poppers**

Medical institutional investment in medical technology is still on the steep portion of its learning curve, implying that we are still in the process of discovering what we don't know. A method for discovering, enumerating and quantifying the unknowns that may affect investment decisions is presented.

2) **Elements of MMT from the Perspective of Organization Theory, Albert Rubenstein**, Northwestern Univ., Dept. of IE, MLSF, 2225 North Campus Dr., Evanston, IL 60208-3110

Organization theory contains a number of concepts which describe how organizations evolve, operate and relate to their environment. Using a set of categories from organization theory, the nature of the practice of MMT is explored and some of the conditions required of a mature practice and its underlying disciplines are examined. Among the concepts to be discussed are decision-making, control, organizational structure and process...

3) **Incorporating Technology Management in Anderson's Health Belief Model, Kimberlee D. Snyder**, Univ. of IL, Bus. Admin. Program, L-109, Springfield, IL 62794, snyder.kimberlee@uis.edu, **Uday Tate**

Hospitals investigate programs that attract consumers, personnel and markets. These programs, in some way, involve technology and improper management of technology can hurt its success. We review technology management research and discuss modifying Anderson's model of health belief to incorporate technology as a component of the model.

TD22 Operations Management IV

Contributed Session

Chair: Candace A. Yano, Univ. of CA, IEOR Dept., Berkeley, CA 94706, yano@ieor.berkeley.edu

1) Production Planning with Price & Lead Time Effects, Panupol Lersrisuriya, Univ. of CA, IEOR Dept., Berkeley, CA 94720-1777, panupol@ieor.berkeley.edu, **Candace A. Yano**

We consider pricing and production planning for multiple products on a single capacitated facility. Demands are random and affected by the prices and production lead times of the products. The objective is to maximize expected total profit. We illustrate how demand variability affects the optimal policy.

2) Flexibility, Adaptability & Efficiency in Production Planning, Sanjeev K. Bordoloi, Univ. of TX, CBA 4.202, Mgmt. Dept., Austin, TX 78712, bordoy@mail.utexas.edu, **William W. Cooper, Hirofumi Matsuo**

We identify shortcomings of existing definitions of flexibility and clarify some of the misconceptions by simultaneously considering flexibility, adaptability and efficiency. We illustrate their implications with an MIP model that minimizes total cost over a planning horizon. Numerical examples are provided that highlight the roles of flexibility and adaptability in production planning.

3) Optimal Product Pricing & Capacity Decisions Under Demand Uncertainty, John D. Drogoz, Univ. of MI, Dept. of IOE, 1756 Plymouth Rd., Ste. 366, Ann Arbor, MI 48105, drogoz@engin.umich.edu, **John R. Birge, Izak Duenyas**

Consider a firm that produces 1 or multiple products and has control over how much capacity it can buy or sell in a given period and/or the selling price it can set for its product(s). Optimal capacity and pricing strategies are discussed under various operating assumptions. Sensitivity of these optimal decisions to changes in operating costs and changes in demand parameters will be discussed.

4) Characterization of Demand for Multiple Generations of Products in the PC Industry, Nikhil T. Jain, Univ. of TX, Mgmt. Dept., CBA 4.202, Austin, TX 78712, nikhil@uts.cc.utexas.edu, **Hirofumi Matsuo**

Introduction of new technologies can significantly affect the demand of existing products. Based on data from a PC manufacturer, we characterize the demand for multiple generations of technologies and discuss implications for management of inventory.

5) Policies for Lot Sizing Substitutable Components, Ram Rachamadugu, Univ. of Toledo, ISOM Dept., Coll. of Bus. Admin., Toledo, OH 43606, ram.rachamadugu@utoledo.edu

We consider the issue of selecting the items for production and determining their lot sizes when "one way" substitution is possible among the items. We characterize optimal solutions, provide easily computable lower bounds and also develop DP-based iterative heuristic methods. Computational results will also be reported.

TD23 Strategic Planning

Contributed Session

Chair: Akkanad M. Isaac, Governors State Univ., Coll. of Bus. & Public Admin., University Park, IL 60466, a-isaac@govst.edu

1) Technological Progress & Technology Acquisition: Effects of Expectations, Rivalry & Uncertainty, Atiqur Rahman, McGill Univ., 1001 Sherbrooke St. W, Montreal, Quebec, H3A 1G5, Canada, rahman@management.mcgill.ca, **Richard J. Loulou**

A 2-period game is considered to study the effect of expectations regarding technological progress on a firm's technology decision in a duopoly. It is shown that expectations of better technology retards the adoption of the current technology. Uncertainty is shown to have either no effect or negative effects on the adoption process when Nash equilibrium holds...

2) 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

Construction of decision support tools for evaluating potential markets and network configurations for an expanding LTL service provider.

3) Information Technology Investment & Corporate Growth, Akkanad M. Isaac, Governors State Univ., Coll. of Bus. & Public Admin., University Park, IL 60466, a-isaac@govst.edu

We conducted a study of a selected number of Fortune 100 companies to understand the role of IT investment as a determinant of corporate growth and profitability. An attempt is made to use IT level (stage) as a predictor of the strategic direction of a company.

4) Value-Based Management: A Theoretical Analysis, Philippe Zarlowski, Universite de Tours, 50 avenue Jean Portalis, BP 0607, Tours, 37206, France, zarlowski@droit.univ-tours.fr

Several computer-aided value-based management methods were developed during the past 15 years. They intend to bridge the gap between the external valuation of the firm's assets on financial markets and the internal valuation of strategic plans. We discuss some of the financial and managerial hypotheses of these models.

TD24 Semiconductor Industries Applications

Contributed Session

Chair: Robert C. Leachman, Univ. of CA, Dept. of IE/OR, Berkeley, CA 94720, leachman@ieor.berkeley.edu

1) Complex Scheduling Problems in the Semiconductor Industry, Shishir K. Mukherjee, OR/AICON Intl., 1174 Scotland Dr., Cupertino, CA 95014, smoraicon@igc.apc.org

Semiconductor industry scheduling problems are inherently difficult due to the complexity of the fabrication, assembly and testing processes with reentrant product flows, sequence-dependent set-up times, large product families often sharing expensive equipment, tight due dates and conflicting management objectives. The formulation of a scheduling model and solution approaches are discussed.

2) Effective Multi-Stage Test Equipment Capacity Allocation for Semiconductor Fabrication Yield Enhancement, Kyle D. Chen, Stanford Univ., 2250 Latham St., Apt. 10, Mountain View, CA 94040, kyle.chen@stanford.edu, **Ram Akella**

In pursuance of our previous research, we developed a sample planning software package in Excel 5 Template for semiconductor fabrication lines. We present managerial insights and recommend strategies based on numerical analysis results. Furthermore, we demonstrate how to incorporate...

3) Internet-Enabled OR Methods for Supply Chain Management, Herbert B. Shulman, AT&T, 307 Middletown-Lincroft Rd., Rm. 3G-220, Lincroft, NJ 07738, hshulman@att.mail.com, **Alex Bangash**

OR methods have been used effectively in many areas of inventory management, production and logistics planning. As inter-business connectivity increases through the advent of the Internet, so does the application of these methods for enhanced supply chain management. We will provide examples of such Internet applications from the telecommunications/hi-tech industries.

TD25 Reliability Engineering Research

Cluster: Reliability & Quality Engineering

Invited Session

Chair: Hoang Pham, Rutgers Univ., Dept. of IE, PO Box 909, Piscataway, NJ 08855, hopham@princess.rutgers.edu

1) Aircraft Scheduled & Dispatch Reliability Assessment, Loan Pham, Rutgers Univ., Dept. of IE, PO Box 909, Piscataway, NJ 08855, **Hoang Pham**

The amount of air travel has increased significantly over the last decade. Due to convenient scheduling and price moderation in the competitive market, air traveling has been the preferred mode of transportation. We develop the scheduled and dispatch reliability models subject to several factors (such as weather phenomenon, maintenance, flight preparation, gate availability and air traffic congestion) which is used to assess an individual flight's scheduled reliability.

2) A Design for Reliability Knowledge Model, Michael Tortorella, Lucent Tech., 101 Crawford Corner Rd., Rm. 2L-536, Holmdel, NJ 07733-3030, mtortorella@lucent.com

The contemporary principles of quality management, derived from cost-of-quality models, include an emphasis on prevention, in preference to inspection, as the way to realizing quality products. As reliability is the persistence of quality over time, we are led to examine the actions that can be taken during product realization to anticipate and prevent failures - in short, to design for reliability. We discuss the kinds of knowledge needed to design effectively for reliability, the unified theory of physics and statistics that supports these actions...

3) A Generalized Accelerated Life Testing Model with Time Dependent Stress Coefficients, Xindong Wang, Rutgers Univ., Dept. of IE, PO Box 909, Piscataway, NJ 08855, **E. A. Elsayed**

We extend the proportional hazards model and develop a nonparametric accelerated life testing model which considers the effect of time dependent stress coefficients on reliability prediction. Cubic splines are used to represent the coefficient's nonlinear change with time, so that the problem of estimating a nonlinear time-dependent function is converted to estimating the spline's

parameters. Non-penalized and penalized function is converted to estimating the spline's parameters. Non-penalized and penalized partial likelihood functions are constructed to estimate the spline parameters...

4) Optimal Maintenance Strategies Under Intermittently Used Environment, Shunji Osaki, Hiroshima Univ., Dept. of ISE, 1-4-1 Kagamiyama, 1 Chome, Higashi-Hiroshima, 739, Japan, osaki@gal.sys.hiroshima-u.ac.jp, *Tadashi Dohi, Naoto Kaio*

The maintenance problems based on the age and the block replacement policies are considered under intermittently used environment. That is, supposing that a system is alternatively operative and inoperative (or under repair). We derive the optimal maintenance schedules which minimize relevant long-run average cost criteria and compare them with the ordinary ones for the continuously used system.

5) A Cost Model in Software Reliability Research, Xeumei Zhang, Rutgers Univ., Dept. of IE, PO Box 909, Piscataway, NJ 08855-0909, *Hoang Pham*

We present a cost model with warranty time and cost, cost to remove each error detected in the software and risk cost due to software failure after warranty period. The optimal release policies which minimize the expected total software cost are discussed. Numerical examples are provided to illustrate the results.

TD26 Global Optimization Algorithms & Applications

Cluster: Global Optimization

Invited Session

Chair: Nick Sahinidis, Univ. of IL, Dept. of Mech. & IE, Urbana, IL 61801, nikos@uiuc.edu

1) Black-Box Global Optimization with Nonlinear Inequality Constraints, Donald R. Jones, General Motors R&D Ctr., MC 480-106-359, 30500 Mound Rd., Bldg. 1-6, Warren, MI 48090-9055, djones@cmsa.gmr.com

The direct algorithm, published in 1993, introduced a fundamentally new way to balance local and global search in black-box optimization - a method that was extremely robust and eliminated the need for ad-hoc tuning parameters. This presentation will show how DIRECT can be extended to handle nonlinear inequality constraints.

2) Finiteness Issues in Global Optimization, Joseph Shectman, Univ. of IL, 1206 W Green St. #140, Urbana, IL 61801, shectman@archimedes.me.unic.edu, *Nick Sahinidis*

For multiextremal quadratic programming B&B can find a global optimum in finitely many steps. Using analytical properties, we can ensure that branching stops at a finite mesh size. We present this type of procedure for QP with degeneracy. Prior algorithms converge finitely only for nondegenerate instances.

3) A Penalty Method for Bilevel Programming Problems, Khosrow Moshirvaziri, CA State Univ., 7443 Densmore Ave., Van Nuys, CA 91406, moshir@csubl.edu, *Mahyar A. Amouzegar*

The bilevel programming problem is a mathematical model of the leader-follower game, a hierarchical decision model with a wide range of applications in network design, transport system planning, central economic planning and management. We present a penalty method for the numerical solution of this important class of global optimization problems.

TD27 Applications of AI Techniques

Cluster: Neural Networks & Machine Learning

Invited Session

Chair: Murali S. Shanker, Kent State Univ., Coll. of Bus., Dept. of ADMS, Kent, OH 44242-0001, mashanker@scorpio.kent.edu

1) Agents for Managing Information Overload in Managerial Decision Making, Douglas Kline, Kent State Univ., Dept. ADMS, Coll. of Business, Kent, OH 44242-0001, dkline@bsal.kent.edu, *Charlene G. Riggie*

The generally accepted attributes of agents are examined with respect to their ability to aid in managerial decision making. The issues of trust and competence are addressed in the management setting. Examples of implemented intelligent agent and multi-agent systems are given to aid in the evaluation.

2) Enhancing Human Computer Interfaces Using Agent Technology, Alan Burns, Kent State Univ., Dept. of ADMS, Coll. of Bus., Kent, OH 44242-0001, *Douglas Kline*

The attributes of agents are evaluated with respect to Norman's human-computer interaction model. Specifically, agents show promise for facilitating formation of user intention and interpretation of the system state. However, misguided use of agents can lead to confusion with respect to

formation of user intention and evaluation of the system state.

3) Exchange Rate Forecast with Neural Networks, Guoqi Zhang, Kent State Univ., Coll. of Bus., Kent, OH 44242-0001, gzhang@kentvm.kent.edu, *B. Eddy Patuwo, Christian X. Jiang, Michael Hu*

Forecasting foreign exchange rate is a difficult task. We investigate the potential of neural network models in prediction of the weekly British pound/US dollar exchange rate. We compare the performance of neural networks with that of the best Box-Jenkins models. Various predictive performances are evaluated.

4) An Exploration of Information Technology Infrastructure Values Using Neural Networks, Nancy Duncan, Kent State Univ., Dept. of ADMS, Coll. of Bus., Kent, OH 44242-0001, nduncan@bsa3.kent.edu, *Murali S. Shanker*

While the concept of infrastructure flexibility is extremely meaningful to IS managers, little research, theoretical or empirical, currently exists that defines the relevant factors that comprise infrastructure flexibility. Using empirical data collected from IS departments, we use ANN to selectively choose predictor variables to predict performance measures that evaluate a firm's infrastructure flexibility.

TD28 Interior Point Methods & Applications

Cluster: Integer Programming

Invited Session

Chair: Shuzhong Zhang, Erasmus Univer. Rotterdam, Econometric Inst., PO Box 1738, Rotterdam, 3000 DR, The Netherlands, zhang@few.eur.nl

1) Using Semidefinite Programming & Cutting Planes to Solve MAX-2-SAT Problems, Brian Borchers, NM Tech., Dept. of Math., Weir Hall, Socorro, NM 87801, bprcjers@mmt.edu

We present an approach to solving the MAX-2-SAT problem that combines a semidefinite programming relaxation with cutting planes to tighten the relaxation. Optimal or very nearly optimal solutions are obtained for problems with up to 150 variables and up to 2,500 clauses.

2) Interior Point Column Generation for Adaptive Filtering, Zhi-Quan Luo, McMaster Univ., Dept. of Elect. & Comp. Eng., Comm. Res. Lab., Rm. 225, Hamilton, Ontario, L8S 4K1, Canada, luozq@ssevox.cis.mcmaster.ca, *Kaywan Afkhami, Max K. Wong*

We present a novel application of IPCG algorithms to adaptive filtering. Since IPCG algorithms examine constraints one at a time, they are well suited in applications that require a solution to be updated adaptively. We apply IPCG to 2 classic filtering problems: adaptive channel equalization and adaptive system identification.

3) Potential Reduction Algorithms for Combinatorial Optimization Problems, Joost P. Warners, Tech. Univ. of Delft, TWI/SSOR, Mekelweg 4, Delft, 2628 CD, The Netherlands, j.p.warners@twi.tudelft.nl

It is well known that linear optimization techniques can be a valuable tool for solving combinatorial optimization problems. Recent developments in the field of optimization have led to the application of techniques from non-linear optimization to solve combinatorial optimization problems. These include the interior point potential reduction approach to solve NP-hard problems by Karmarkar...

4) Portfolio Selection Using Options: An Interior Point Method Approach, Shuzhong Zhang, Erasmus Univer. Rotterdam, Econometric Inst., PO Box 1738, Rotterdam, 3000 DR, The Netherlands, zhang@few.eur.nl, *Cees Dert, Bart Oldenkamp*

We discuss the problem of selecting a portfolio, which consists of a stock index and put/call options on that stock, over multiple time periods. This problem can be formulated as a convex feasibility problem and an interior point method is proposed for solving this problem.

TD29 PANEL: Parallel & Supercomputing

Cluster: Stochastic & Robust Optimization; Parallel & Supercomputing

Invited Session

Chair: Soren S. Nielsen, Univ. of TX, Dept. of MSIS, CBA 5.252, Austin, TX 78712, nielson@mail.utexas.edu

1) PANEL: Parallel & Supercomputing, Anna Nagurney, Univ. of MA, nagurney@gbfn.umass.edu, *Robert Bixby, CPLEX, Robert W. Ashford, DASH Associates Ltd., Greg Astfalk, SGI*

The parallel and supercomputer industry is advancing rapidly with quite a bit of turmoil. We discuss recent developments in the area, as well as future directions in hardware paradigms and in software issues, such as ease of development and porting. We represent both hardware manufacturers and software developers.

TD30 Scheduling**Cluster: Scheduling****Invited Session**

Chair: Subhash C. Sarin, VA Polytech. Inst. & State Univ., Dept. of ISE, Blacksburg, VA 24061-0118, sarins@vt.edu

1) Simulated Annealing Heuristics to Minimize the Number of Tardy Jobs & the Makespan Bicriteria Identical Parallel Machine Problem, Alex J. Ruiz-Torres, FL Gulf Coast Univ., 312 W College Ave., #1, State College, PA 16801, aruiztor.@fgcu.edu

We investigate a scheduling problem where the objective is to minimize both the number of jobs late and the makespan. Four heuristics based on simulated annealing and neighborhood search are proposed to generate the nondominated schedules that produce a compromise across both criteria.

2) General Multiprocessor Task Scheduling, Chung-Yee Lee, TX A&M Univ., Dept. of IE, 238 Zachry Bldg., College Station, TX 77845, cylee@acs.tamu.edu, **Jianer Chen**

Most papers in the scheduling field assume that a job can be processed by only 1 machine at a time. Motivated by human resource planning, diagnosable microprocessor systems, berth allocation and manufacturing systems which may require several resources simultaneously, we study the problem with a 1-job-on-r-machine model where r is a positive integer. The problem is to select an alternative from those available for each job...

3) Algorithm for Solution of a Parallel Machine Bicriteria Scheduling Problem to Minimize Total Flowtime Subject to Total Tardiness, Subhash C. Sarin, VA Polytech. Inst. & State Univ., Dept. of ISE, Blacksburg, VA 24061-0118, sarins@vt.edu, **Divya Prakash**

We present an algorithm for solving the bicriteria problem involving the primary criterion of minimizing total tardiness and the secondary criterion of minimizing total completion time. Also, computational experience with the algorithm is presented.

4) QoS in Timed Round Robin Networks, N. Gautam, Univ. of NC, Chapel Hill, NC 27599-3180, **V. G. Kulkarni**

Using bounds for cell loss probability, we derive the conditions under which the QoS criteria for timed round robin (deterministic polling) networks are satisfied. We formulate call admission control policies for such networks. Using the admissible regions obtained, we compare this technique with the effective bandwidth technique.

TD31 Combinatorial Methods**Contributed Session**

Chair: Gerald L. Thompson, Carnegie Mellon Univ., Grad. Sch. of IA, 5000 Forbes Ave., Pittsburgh, PA 15213-3890, gt04@andrew.cmu.edu

1) An Integral Simplex Algorithm for Solving Combinatorial Optimization Problems, Gerald L. Thompson, Carnegie Mellon Univ., Grad. Sch. of IA, 5000 Forbes Ave., Pittsburgh, PA 15213-3890, gt04@andrew.cmu.edu

To solve a set partitioning problem, the local integral simplex method starts with an all artificial basis and pivots on ones as long as possible. If the exhibited integral solution is not optimal, the global integral simplex method creates a subproblem search tree, the solution to at least one of which is the global optimum for the original problem.

2) Solving Striking Asset Allocation with Defender Suppression Problems, Vincent Li, TX A&M Univ., Dept. of IE, College Station, TX 77843-3131, li@marvin.tamu.edu, **Guy L. Curry**, **E. Andrew Boyd**

The strike force asset allocation problem with defender suppression consists of grouping strike force assets into attack packages and assigning these packages to targets and defensive assets so as to maximize the strike force damage yield. An NLP formulation is developed and transformed into an MIP problem. Computational approaches and results are discussed.

3) Bicriteria Assignment Problem, J. Teghem, Faculte Polytechnique de Mons, Rue De Houdain, 9, Mons, 7000, Belgium, teghem@mathro.fpm.ac.be, **E. L. Ulungu**, **D. Tuytens**

Our aim is to generate the complete set of efficient solutions, supported and non-supported. We develop 2 exact methods and an adaptation of the SA heuristic to the multicriteria framework. Numerical experiments are made to compare the efficiency of the 3 procedures.

TD32 Decision Support Systems**Contributed Session**

Chair: Chang-Kyo Suh, Keimyung Univ., Dept. of MIS, 2139 Daemyung-dong, Nam-gu, Taegu, 705-701, Korea, cksuh@kmucc.keimyung.ac.kr

1) An Investigation of Executive Information System Literature, Chang-Kyo Suh, Keimyung Univ., Dept. of MIS, 2139 Daemyung-dong, Nam-gu, Taegu, 705-701, Korea, cksuh@kmucc.keimyung.ac.kr, **Kyungrae Baek**

Our survey identified a sample of authors and papers that have had a significant impact on the historical development of EIS. The data presented were collected by hand from the major business computing research journals. The journal rankings generated are compared with those of earlier studies.

2) A Study for Applying Data Mining Tools for Database Marketing Based on Hotel Critical Database and Data Mart on the Intranet, Sung-Ho Ha, KAIST, 373-1 Kusong-dong, Yusong-gu, Taejeon, 305-701, South Korea, shha@cais.kaist.ac.kr, **Sang Chan Park**

We formulate strategic marketing plans through database marketing with the aid of data mining tools. After constructing data mart with critical database in hotel restaurant management and analyzing them using neural networks, we will conduct the customer type classification by RFM, the sequential pattern analysis of customer's restaurants usage and the strategic positioning for restaurants.

3) An Integrated Multi-Dimensional Information System, Amar S. Ramudhin, Universite Laval, FSA, pav. JA DeSeve, Ste-Foy, Quebec, G1K 7P4, Canada, ramudhia@osd.ulaval.ca

We present an integrated IS specifically designed for a holding company. Data from the transactional systems are first consolidated in a data warehouse. The IS includes tools for multi-dimensional analysis and forecasting. Various indicators and a dashboard are also included.

4) Systematic Approach to Simulation Model Validation, Steven R. Irvine, 3801A Dunnica, St. Louis, MO 63116-4914, irvinesr@slu.edu, **Reuven R. Levary**

We investigated the feasibility of using a DSS to extract information from a simulation environment, i.e., judgmental bias, project phase and model attributes, etc. An analysis of this knowledge will recommend the most appropriate validation strategies to be applied. This should provide a systematic approach to the validation process.

5) Application of a Method to Compute Measures of Interrater Reliability When the Behavior of Interest is Infrequent, Larry S. Seligman, Univ. of TX, GSB 5.202, Dept. of MSIS, Austin, TX 78712, lseligman@mail.utexas.edu, **Stefano Grazioli**

Process research often uses coding procedures in which human coders assign codes to processes or behaviors of interest. Our work offers a method to compute measures of coding reliability that improves upon the commonly used Cohen's Kappa. An extensive example from IS research is provided.

TD33 Software Demonstrations VIII**Sponsor: CSTS****Sponsored Session**

Chair: Bjarni Kristjansson, Maximal Software Inc., 2111 Wilson Blvd., Ste. 700, Arlington, VA 22201, bjarnik@site.gmu.edu

TD35 Scheduling Applications I**Contributed Session**

Chair: Mohan Gawande, AT&T, 101 Crawfords Corner Rd., Rm. 3J-321, Holmdel, NJ 07733-1988, gawande@hostare.att.com

1) Solving the American Baseball League Umpire Crew Scheduling Problem Using Integer Linear Programming Implemented in Lingo, Rene Leo E. Ordenez, IL Inst. of Tech., 869 Garden Way, Ashland, OR 97520, ordenez@sou.edu

The American League umpire crew scheduling is formulated and solved as a set of small set-partitioning subproblems. Finding an assignment, for 7 crews to officiate 7 cities over 8 series, that satisfies a number of conflicting criteria and that meets league-imposed travel restrictions is the objective of each subproblem.

2) Heuristics to Incorporate Side Constraints into Network-Flow-Based Network Scheduling Algorithms, Mohan Gawande, AT&T, 101 Crawfords Corner Rd., Rm. 3J-321, Holmdel, NJ 07733-1988, gawande@hostare.att.com

Workforce management involves scheduling the available workforce to best meet the projected demand. I describe a quasi-Newton heuristic that incorporates difficult side-constraints into existing network flow-based

algorithms to obtain good solutions to such problems with complex requirements on rest periods, "first-in, first-out" sequencing, skill mix and additional constraints on subsets of the workforce.

3) Link Scheduling Policies for Stable Load Distribution in Multi-Processor Systems, Murali S. Kodialam, AT&T Labs, 101 Crawfords Corner Rd., Holmdel, NJ 07733, murali@att.com

We consider the problem of load distribution in a multi-processor system. In the model considered, both the processor and the distribution links are constrained resources. The feasible space is shown to be a polymatroid which leads to the development of efficient algorithms.

4) An Optimization Method for a Special Case of Parallel Processors Problem, Johnny C. Ho, Columbus State Univ., Abbott Turner Sch. of Bus., Columbus, GA 31907-5645, ho_johnny@colstate.edu, **Jatinder N. D. Gupta, Scott Webster**

An algorithm is proposed to determine a schedule which will give the optimal trade-off of the makespan and flowtime criteria for the 2 identical parallel processors case. We also discuss a heuristic, based on the proposed algorithm to solve the general identical parallel processors problem.

5) Mining of SKU Data for Replenishment Decisions, Kasumu O. Salawu, NCR Corp., 175 Birchview Dr., Piscataway, NJ 08854-3571, kas.salawu@newyorkny.ncr.com

Inventory control is central to all retail businesses' DSSs. Increasingly, very detailed data at the stock-keeping-unit level of granularity are stored in data warehouses. The use of conditional and unqualified fuzzy propositions to complement applied probability models for inventory planning will be presented.

Tuesday 16:45-18:15

TE01 OR/MS Applications in the Food & Beverage Industry

Cluster: OR/MS Applications
Invited Session

Chair: Ross J. Hansen, PepsiCo Food Services, 14841 Dallas Parkway, Dallas, TX 75240, ross.hansen@pfs.sprint.com

1) The McDonald's System: At Home in Any Country, Brad Carter, PepsiCo., 14841 Dallas Pkway, Dallas, TX 75240

McDonald's enjoys great success in international market. The invisible infrastructure supporting each retail outlet is carefully planned using model based applications as a market matures. A country's culture is respected while McDonald's focuses on family, food and fun, common threads among all cultures.

2) Find A Better Way, Every Day: How PepsiCo Food Systems Uses OR/MS Model Applications to Deliver to PepsiCo's Restaurants, Steve Johnson, PepsiCo Food Systems, 14841 Dallas Parkway, Dallas, TX 75240

PepsiCo is the world's 2nd largest nonalcoholic beverage company (Pepsi), the world's largest salty snack company (Frito-Lay) and the largest restaurant chain company with over 25,000 stores (KFC, Pizza-Hut, Taco Bell). A discussion on how OR/MS techniques are used by PepsiCo Food Systems to support the restaurant business is presented.

3) No Title Supplied, Mike Ackley, Anheuser-Busch Co. Inc.

As the world's largest brewer, Anheuser-Busch faces a daily challenge to produce and distribute a large variety of products efficiently without compromising the quality and freshness promised to our customers. An LP based approach to the production planning problem faced by Anheuser-Busch is discussed.

TE02 Industrial Applications Contributed Session

Chair: Goutam Dutta, London Sch. of Econ. & Political Sci., Dept. of OR, Houghton St., London, WC2A 2AE, UK, g.dutta@lse.ac.uk

1) A Survey of Applications of Non-Optimization Techniques in an Integrated Steel Plant, Sankarshan Basu, London Sch. of Econ. & Political Sci., Dept. of Stats., Houghton St., London, WC2A 2AE, UK, s.basu@lse.ac.uk, **Goutam Dutta**

We survey about 80 published papers summarizing the applications of non-optimization techniques in an integrated steel plant. The papers are grouped by functions: queueing theory, simulation techniques, statistical process control, AI and other applications. We conclude the presentation by discussing the scope of further research.

2) Scheduling of Batch & Semi-Continuous Processing Plants

for Waste Minimization, Ali Elkamel, Kuwait Univ., Dept. of Chem. Eng., Fac. of Eng., PO Box 5969, Safat, 13060, Kuwait

There has been an increased interest in batch/semicontinuous processes due to the increasing market share of high value added specialty products. Some of the products produced include specialty chemicals, pharmaceuticals, biochemical and processed foods. Because typically these products are processed in small quantities, batch plants offer the prospect of producing several products in one plant...

3) An Optimization Model for Selecting & Retrofitting Pollution Control Strategies, Ahamed S. A. Riyadh, Kuwait Univ., Dept. of Chem. Eng., Fac. of Eng., PO Box 5969, Safat, 13060, Kuwait, **Ali Elkamel**

The rapid increase in developing industrial processes is accompanied by the release of substantial quantities of pollutants. These pollutants often have detrimental effects, directly or indirectly, on human health, animals, natural resources, the biosphere and construction materials and metal structures. New industrial processes must therefore be designed so that emissions are minimized...

4) A Resource Allocation Model for Power Restoration Process, Shaojun Wang, LA State Univ., Dept. of Ind. & Mfg. Syst Eng., Baton Rouge, LA 70803, swang2@unix1.sncc.lsu.edu, **Bhaba R. Sarker, Evangelos Triantaphyllou**

Cyclones cause serious problems to the people in the affected areas. A mathematical model is devised to allocate the resources to different points of demands so as to minimize the travel time of the power restoring crews and equipment to alleviate the suffering of the people. A heuristic is devised to solve large instances. An illustrative example is provided.

5) An NLP Model to Estimate Stranded Generation Investments in a Deregulated Electric Utility Industry, Robert F. Cope III, LA State Univ., 1356 Woodlong Dr., Baton Rouge, LA 70816, rcope@unix1.sncc.lsu.edu, **Dan B. Rinks, David D. Dismukes**

We develop an NLP model to estimate stranded electric power generation investments. Factors considered in the analysis include all forms of generation, transmission interconnection constraints, system average pricing and forecasted peak demand. An optimal peak-hour production schedule is determined to evaluate generation facility displacement in a deregulated environment.

TE03 Emerging Trends in Facility Layout & Material Handling

Cluster: Facilities Layout
Invited Session

Chair: George Iannou, VA Tech., ISE Dept.

1) Robust Layouts for Sheet Metal Production, Jeffery Herman, Univ. of MD, Inst. for Systems Research, AV Williams Bldg., College Park, MD 20742

Dynamic nesting of sheet metal parts and demand uncertainty complicate the analysis needed to layout production equipment optimally. The goal is to find a layout that is near-optimal in all possible production scenarios. We develop heuristics, including GAs, for finding good solutions.

2) A Construction Heuristic for the Concurrent Design of the Layout & the Aisle Network in Manufacturing Facilities, Volker Doerrsam, Univ. of Karlsruhe, Inst. fuer Foerdertechnik, Hertzstr.16, Karlsruhe, 76187, Germany

A practical layout construction algorithm is presented. The existing or given network of aisle-segments is considered for the optimal placement of facilities. Additionally, new aisle segments are added by the algorithm to improve the degree of optimality of the solution. Results of this algorithm will be discussed.

3) Locating a Single Finite-Sized Entity in an Existing Facility, Selcuk Savas, SUNY, Dept. of IE, 342 Bell Hall, Buffalo, NY 14260, **Rajan Batta, Rakesh Nagi**

We consider the problem of locating a single facility of finite size when there are existing barriers to travel, i.e., corresponding to other facilities such as groups of machines, material handling paths, etc. We assume the facilities are rectangles and the input/output points are located on the boundary of the facility. We provide a sweeping algorithm that searches through possible optimal points and returns the best solution...

4) A Stochastic Model of Empty-Vehicle Travel Time & Load Request Service Time in Light-Traffic Material Handling Systems, Yu-Cheng Shen, VA Polytech. & State Univ., Dept. of ISE, Blacksburg, VA 24061-0118, **John E. Kobza, Roderick J. Reasor**

Empty-vehicle travel time plays an important role in the design and control of AGVs. We examine empty-vehicle travel time in systems with low traffic intensity. The model uses a Markov chain based on vehicle location and

represents dispatching rules in the 1-step transition matrix.

TE04 Cost & Performance

Sponsor: Military Applications Society
Sponsored Session

Chair: Norman Keith Womer, Univ. of MS, Dept. of Econ. & Finance, University, MS 38677, womer@bus.olemiss.edu

1) **Analysis of Cost Performance Report Data, Norman Keith Womer**, Univ. of MS, 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. We will relate cost performance report data to a model of production with the goal of providing a justifiable basis for analysis. Examples will be provided.

2) **Cost Exchange Ratios, Pauline P. Cason**, SAIC, 6725 Odyssey Dr., Huntsville, AL 35806, pauline.p.cason@spmx.saic.com, **Bruce W. Fowler**

In an era of military spending dominated by reductions in new starts and increased instances of materiel change, replacement of existing materiel takes on additional importance. We describe a new system/force operational-cost effectiveness metric, the cost exchange ratio. The basic cost exchange ratio, similar to the fractional loss exchange ratio, uses costs of replacement of systems and munitions as a basis of aggregation...

3) **The Army's Active-Reserve Force Mix: A Budgetary Perspective, Bruce W. Fowler**, US Army Missile Command, Attn: AMSMI-RD-AC, Redstone Arsenal, AL 35898, fowler-bw@redstone.army.mil

This is a top-down historical analysis of the Army budget and manpower (active-reserve component) allocations, deriving costs for active and reserve augmented divisions - divisions plus their associated support structure and overhead. The result is an equation/graph which relates the Army's budget, its active-reserve mix and the number of augmented divisions that the Army can field...

TE06 The Best OR/MS Cases

Sponsor: Forum on Education
Sponsored Session

Chair: Peter C. Bell, Univ. of Western Ontario, Ivey Sch. of Bus., London, Ontario, N6A 3K7, Canada, pbell@ivey.uwo.ca

1) **The Best OR/MS Cases, Peter C. Bell**, Univ. of Western Ontario, Ivey Sch. of Bus., London, Ontario, N6A 3K7, Canada, pbell@ivey.uwo.ca

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.

TE07 PANEL: Operations Practice in the Retail Industry

Sponsor: MSOM
Sponsored Session

Chair: Robert B. Freund, Univ. of TX, Dept. of Mgmt., Austin, TX 78712, brittf@mail.utexas.edu

1) **PANEL: Operations Practice in the Retail Industry, Susana V. Mondschein**, Univ. of Chile, smonds@di.uchile.cl, **Hirofumi Matsuo**, Univ. of TX, **Garrett J. van Ryzin**, Columbia Univ., **Gabriel R. Bitran**, MIT

A panel of leading retail industry and academic professionals discusses the role that operations theory does and can play in practice. A key focus is to explore aspects of current retail operations that likely would benefit from a vigorous research effort.

TE08 Manufacturing I Contributed Session

Chair: Houmin Yan, Chinese Univ. of Hong Kong, Dept. of Systems Eng. & EM, Shatin NT, Hong Kong, yan@se.cuhk.edu.hk

1) **Optimal Setup & Production Scheduling: One Facility, Two Products Systems, Houmin Yan**, Chinese Univ. of Hong Kong, Dept. of Systems Eng. & EM, Shatin NT, Hong Kong, yan@se.cuhk.edu.hk, **Jun Yang**

Scheduling 2 products on a single facility is studied. The production quantity

per unit of time can be adjusted during production runs. To minimize the average inventory, backlog and setup costs, we provide an optimal production and setup schedule in a close form. The optimality is verified by HJB equation.

2) **Assembly Line Balancing When Scrap Impacts the Bottom Line, Mark R. Grabau**, CO Sch. of Mines, 6875 Curtis Dr., Coloma, MI 49038, **Ruth A. Maurer**

Coors' 16-ounce can production line was costing more than \$2 million in scrap. We built a simulation model of the line and used it to generate the scrap output from an experiment. Metamodeling and response surface methodology were used in the analysis, resulting in a cost savings of \$1.87 million.

3) **A Tire Production Scheduling System for Bridgestone/Firestone Off-the-Road, Zeger Degraeve**, Katholieke Univ. Leuven, Naamsestraat 69, Leuven, B-3000, Belgium, zeger.degraeve@econ.kuleuven.ac.be, **Linus E. Schrage**

We describe a scheduling system for the curing operation at BFOR, a manufacturer of large tires for heavy off-the-road machines. The core algorithm is a column generation procedure to produce a production schedule. The size of the problem posed several computational challenges.

4) **Designing an Information System for the Transportation Market, Jose V. Caixeta Filho**, Univ. de Sao Paulo, Av. Dr. Joao Conceicao, 944 Ap. 12, Piracicaba, 13401080, Brazil, jvcaixet@carpa.ciagri.usp.br

Due to the lack of quantitative data related to many aspects of transportation of commodities in Brazil, the Information System for Freights of Agricultural Commodities was developed. This provides freight rate time series with details about the major markets involved, O&D of the distribution and distance covered.

TE09 Production Planning

Contributed Session

Chair: Marvin D. Trout, Southern IL Univ., 214 Rehn Hall, Dept. of Mgmt., Carbondale, IL 62901-4627, trout@siu.edu

1) **A Cutting-Stock & Lot-Sizing Model for Production Planning, Anders Thorstenson**, Molde College, PO Box 308, Molde, N6401, Norway, anders.thorstenson@himolde.no, **Sigrid Lise Nonas**

We consider a multiple-item production planning model in which a cutting-stock and a lot-sizing problem are combined. The optimal lot-sizing solution depends on the cutting patterns chosen since the objective function includes the trim-loss costs in addition to the setup and holding costs for the lot sizes.

2) **Implicit Cost Estimation for Production Planning, Marvin D. Trout**, Southern IL Univ., 214 Rehn Hall, Dept. of Mgmt., Carbondale, IL 62901-4627, trout@siu.edu

Bowman's classic management coefficients theory shows how the past decisions of the firm can be used to suggest good future production planning decisions. Using Bowman's concepts and a minimum decisional inefficiency principle, we show how production-related costs can be estimated consistent with existing information.

3) **A 2-Stage Heuristic & Analysis for the Weighted Multi-Objective Mixed-Model Assembly Line Sequencing Problems, Fong-Yuen Ding**, ND State Univ., Dept. of IE & Mgmt., Fargo, ND 58105, fding@plains.nodak.edu, **Jin Zhu**

The 2-level and 2-goal mixed-model sequencing problems are solved using a weighted 2-stage heuristic based on a previously developed transformation from a part-to-product-level problem. A "goal" method is used to scale the various objectives. An analysis comparing the applications of various objectives is also presented.

4) **A Multiperiod Model of Job Selection, Herbert Lewis**, SUNY, Harriman Sch., Stony Brook, NY 11794-3775, **Susan A. Slotnick**

We develop a multiperiod model of job selection that maximizes profit by subtracting lateness penalties from job revenues. The managerial decision is whether to accept or reject a given job, based on its immediate profitability and the past history of the customer.

TE10 Traffic Network Assignment Algorithms & Path-Based Formulations

Sponsor: Transportation Science Section
Sponsored Session

Chair: R. Jayakrishnan, Univ. of CA, Dept. of Civil & Environ. Eng., Irvine, CA 92717, rjayakri@uci.edu

1) **Solving Path Flow Formulations of the Network Equilibrium Problem, David Bernstein**, Princeton Univ., Dept. of Civil Eng. &

OR, Princeton, NJ 08544, dhb@princeton.edu

Historically, researchers have tended to avoid so-called path flow formulations of the network equilibrium problem in favor of so-called arc flow formulations. We consider why path flow formulations are important and how they can be solved efficiently.

2) Path & Link Flow-Based Traffic Assignment Algorithms: A Computational Study, Anthony Chen. Univ. of CA, Dept. of Civil & Environ. Eng., Inst. of Transport. Studies, Irvine, CA 92697, anthony@translab.its.uci.edu, **R. Jayakrishnan**

We compare the performance of several path and link flow-based traffic assignment algorithms. These algorithms include the traditional link flow-based Frank-Wolfe and PARTAN algorithms, 2 state-of-the-art algorithms: restricted simplicial decomposition and disaggregate simplicial decomposition; and several recently developed path flow-based algorithms for real-time applications.

3) Simplicial Decomposition Where Equilibrium Assignment is a Subproblem, James E. Hicks. Univ. of IL, 1201 Newmark Civil Eng. Lab., 205 N Mathews Ave., Urbana, IL 61801, je-hicks@uiuc.edu

An application of simplicial decomposition with disaggregated representation (Larsson & Patriksson) methodology is considered for a multiclass equilibrium traffic assignment problem. The variational inequalities problem is typically solved via successively relaxed traffic equilibrium sub-problems. Reoptimization capabilities of simplicial decomposition with disaggregated representation in this variational inequality solution procedure are reported.

4) Path & Link Flow-Based Traffic Assignment Algorithms: An Analysis of Link-Flow & Path-Flow Patterns, Anthony Chen. Univ. of CA, Dept. of Civil & Environ. Eng., Inst. of Transport. Studies, Irvine, CA 92697, anthony@translab.its.uci.edu, **R. Jayakrishnan**

We examine the link-flow and path-flow patterns resulting from several path and link-based traffic assignment algorithms applied to test networks. Though path-flow solution is not unique, it can help us to better understand differences in the solutions of the various algorithms. Such differences can be distinguished by studying the individual paths generated between each OD pair and the flow allocations to these paths.

TE11 Intermodal Transportation Systems Management

Sponsor: Transportation Science Section

Sponsored Session

Chair: Kevin R. Gue, Naval Postgrad. Sch., Dept. of Systems Mgmt., Monterey, CA 93943, krgue@nps.navy.mil

1) Dynamic Management of Locomotives, Warren B. Powell. Princeton Univ., Program in Stats. & OR, Dept. of Civil Eng., Princeton, NJ 08544, powell@princeton.edu, **Arun G. Marar, Ajith B. Wijeratne**

We propose a novel dynamic programming approximation for the problem of dynamically managing locomotives on an operational basis. The modeling approach handles a variety of complex operational issues and works naturally in a hierarchical setting such as a railroad. A massive dynamic decomposition method is demonstrated on actual data.

2) Toward Good Structure in the Layout of Freight Terminals, Kevin R. Gue. Naval Postgrad. Sch., Dept. of Systems Mgmt., Monterey, CA 93943, krgue@nps.navy.mil

We present 2 different models to layout freight terminals in the LTL motor carrier industry; one that seeks to balance travel cost and congestion and another that seeks to exploit the scheduling policy of supervisors. We show that they produce layouts with similar structure. Simulation experiments confirm that layouts produced by 1 model perform extremely well with respect to the objective function of the other model and vice versa.

TE12 Issues in Logistics

Sponsor: Section on Logistics

Sponsored Session

Chair: Dajun Zeng, Carnegie Mellon Univ., GSIA, 5000 Forbes Ave., Pittsburgh, PA 15213

1) Warehouse Allocation Policy Under Multiple Allocation Opportunities, Ting Zeng. Purdue Univ., Krannert Grad. Sch. of Mgmt., 122-3 Marshall Dr., W Lafayette, IN 47906, tzeng@ecn.purdue.edu

We consider warehouse allocation policy when the warehouse has lower inventory costs than retailers and makes multiple allocations in a replenishment cycle. Each allocation has a fixed charge. It is found that equal allocation intervals are optimal under allocation assumption and EOQ well approximates the optimal number of allocations.

2) Cost Allocation of Shared Resources, Gilles Reinhardt, Northwestern Univ., Kellogg Grad. Sch. of Mgmt., MEDS Dept., 5th Fl., Evanston, IL 60208, g-reinhardt@nwu.edu, **Sunil Chopra, Maqbool Dada**

Consider N customers (differentiated by arrival rate) that share a resource. Each customer incurs a direct cost of using the resource and indirectly contributes to the congestion. We show how to allocate the total optimal cost to the N players using solution concepts from cooperative game theory.

3) Leadtime, Cost Tradeoffs in Supply Chain Management, Dajun Zeng, Carnegie Mellon Univ., GSIA, 5000 Forbes Ave., Pittsburgh, PA 15213, **Arthur Hsu, Katia P. Sycara**

We model a supply chain as a set of activities each with cost and leadtime. Each set of activities determines a supply chain configuration that includes decisions on supplier selection, subcontracting, production rates, transportation mode and inventory policy. We compute the entire set of efficient supply chain configurations.

TE13 New Product Development II

Contributed Session

Chair: Madeline E. Pullman, SMU, Cox Sch. of Bus., PO Box 750333, Dallas, TX 75275, mpullman@mail.cox.smu.edu

1) Alternatives & Improvements to Quality Function Deployment, Madeline E. Pullman, SMU, Cox Sch. of Bus., PO Box 750333, Dallas, TX 75275, mpullman@mail.cox.smu.edu, **Don G. Wardell, William Moore**

Traditionally, QFD has been used to incorporate the voice of the customer into product and process design. It requires customer attribute information which is translated into operating goals. Conjoint analysis is a preferred method for integrating this information into a wider range of process and product design problems.

2) Lead Time Models & Acceleration of Product Realization, Yadati Narahari, NIST, 304/12, Gaithersburg, MD 20899, narahari@cme.nist.gov, **Kevin Lyons**

We develop conceptual process models based on queueing networks for a generic product realization process. The models capture contention for human/engineering resources and we explore how product realization lead times can be reduced significantly using efficient project management and scheduling.

3) Multisource Product Design Using Bi-Directional Genetic Algorithms, Peter Tarasewich, Univ. of CT, OPIM Dept., U411M, 368 Fairfield Rd., Storrs, CT 06269, tarase@uconnvm.uconn.edu, **Suresh K. Nair**

Designer preferences are as important as consumer preferences in product design problems. Models for product design using conjoint data from both consumers and designers are presented. Heuristics incorporating GA and other techniques are developed to determine optimal designs based on market share and loss to society considering multiparty requirements.

4) New Product Development: Speed & Quality, Dinesh H. Wadhvani, Univ. of MN, 332 M&E Bldg., Minneapolis, MN 55455, wadhvani@msi.umn.edu, **Roger G. Schroeder**

We define the DPD process as a "value creation" process. Based on this definition, a model-based framework is developed which defines the relationship among time, cost, price and quality to maximize profit. We make recommendations for managerial decision making based on the insights gained from the model. An illustration of the model and framework is provided.

TE14 Planning & Control Issues for Recoverable Manufacturing Systems

Cluster: Recoverable Product Environments

Invited Session

Chair: Nagesh N. Murthy, GA Inst. of Tech., Dupree Sch. of Mgmt., 755 Ferst Dr., Atlanta, GA 30332-0520, nagesh.murthy@mgt.gatech.edu

1) Remanufacturing of Used Products: MRP Logic vs. Stochastic Control, Karl Inderfurth, Univ. of Magdeburg, Fac. of Econ. & Mgmt., Postfach 4120, Magdeburg, D-39106, Germany, nderfurth@ww.uni-magdeburg.de

We address the problem of integrating remanufacturing and disposal options into planning and control of material coordination within a regular supply chain. Assuming demands for new and returns of used products to be stochastic, we extend the traditional MRP approach and compare its results with optimal control strategy for the stochastic planning problem. We show how different control rules result from differences in cost parameters and processing times for remanufacturing and regular production.

2) **Batching Strategies for Remanufacturing Shops**, *Vaidyanathan Jayaraman*, Univ. of Southern MS, Div. of Bus. Admin., 730 East Beach Blvd., Long Beach, MS 39560-2699, jjaramn@medea.gp.usm.edu

Remanufacturing is characterized by a much higher degree of uncertainty in terms of material recovery, routings and processing times than traditional manufacturing. While batching policies have been studied in traditional flow shop, their effectiveness in remanufacturing flow shops is uncertain. We examine batching strategies in a remanufacturing flow shop.

3) **Demand Management in Recoverable Manufacturing Environments**, *Nagesh N. Murthy*, GA Inst. of Tech., Dupree Sch. of Mgmt., 755 Ferst Dr., Atlanta, GA 30332-0520, nagesh.murthy@mgt.gatech.edu

Product uncertainty in recoverable manufacturing exists in 2 areas: recovery of cores from the market and uncertain demand for remanufactured products as they compete with new products. The problem is compounded by imperfect correlation between cores obtained and remanufactured products demanded. Demand management is addressed in this context.

4) **A General Formulation of Firm Level Clean Manufacturing Strategies**, *Markus Biehl*, GA Inst. of Mgmt., DuPree Sch. of Mgmt., 765 Ferst Dr., Atlanta, GA 30332-0520, markus.biehl@mgt.gatech.edu, *Cheryl Gaimon*

A model is introduced to analyze strategies for the transition of a firm's manufacturing capabilities over time toward clean manufacturing to reflect both internal and public policy incentives. Insights are given regarding various clean manufacturing approaches including the development and design of new materials, products and processes. The model takes into account recycled and non-recycled input materials as well as the levels of reusability, source reduction and recyclability.

TE15 Organizational Theory/Management of Technology Contributed Session

Chair: Sandra Pride Shaw, Univ. of TX, Dept. of Speech Communication, Jesse Jones Communication Ctr., Austin, TX 78712, smpride@mail.utexas.edu

1) **The Organization's Quest for Legitimacy: Is an Organization a Credible Source of Messages?**, *Sandra Pride Shaw*, Univ. of TX, Dept. of Speech Communication, Jesse Jones Communication Ctr., Austin, TX 78712, smpride@mail.utexas.edu

We extend institutional theory incorporating the concepts of persuasion and source credibility into the legitimation process. Because persuasion is a communication process organizations use to convince their external constituencies of their legitimacy, organizations must be aware of their position of message source and the credibility issues associated.

2) **Improving the Selection & Evaluation of R&D Projects in the Steel Company**, *Kidae Chung*, POSCO Research Inst., Sam-Tan Bldg., 497-7 Daechi-Dong, Kangnam-Ku, Seoul, 135-280, Korea, kdchung@mail.posri.re.kr, *Kyung-Hee Jung*, *Un-Seog Lee*

We present new design concepts of the R&D project selection and evaluation system in the steel company. New selection and evaluation criteria are developed to improve R&D performance for the better technology management of the steel company. We also bring insights on how we seamlessly integrate 4 different project evaluation steps as a whole.

3) **Cost-Benefit Analysis of Information Technology**, *Kofi Kissi Dompere*, Howard Univ., Dept. of Econ., Washington, DC 20059

We present a framework for a comprehensive accounting of benefits and costs associated with investment projects of IT. The framework leads to the development of benefit and cost data that can be used to support an organizational decision to commit resources to beginning project of IT or to modernize existing facilities. The framework is through identification matrices from which cost and benefit aggregate are developed...

TE16 Competitive Marketing Strategies

Cluster: Marketing
Invited Session

Chair: Venkatesh Shankar, Univ. of MD, Coll. of Bus. & Mgmt., 3450 Van Munching Hall, College Park, MD 20742-1815, vshankar@bmgmail.umd.edu

1) **Asymmetric Perceptions & Competitive Advantage**, *Gregory S. Carpenter*, Northwestern Univ., Leverone Hall 2001 Sheridan Rd, Kellogg Grad. Sch. of Mgmt., Evanston, IL 60208, g-carpenter@nwu.edu, *Kent Nakamoto*

Analyses of marketing strategy have identified asymmetries in buyers' preference as 1 important source of competitive advantage, but the perceptions

of brands are typically assumed to be symmetric. We show how asymmetries in perception can create sustainable advantage, even if other sources of advantage are absent.

2) **The Impact of Competitive Context on the Allocation of Marketing Mix Resources**, *Douglas Bowman*, Purdue Univ., Krannert Sch. of Mgmt., W Lafayette, IN 47906-1310, [bowman@mgmt.purdue.edu](mailto:b Bowman@mgmt.purdue.edu), *Hubert Gatignon*

We investigate differences in the effectiveness of a brand's marketing mix decision variables over time caused by changes in competitive context due to new brand entry, brand exit and new features. The results show why managers should vary the allocation of resources across marketing mix instrument over time.

3) **The Impact of Timing & Sequence of International Market Entry in Creating Competitive Advantage**, *Venkatesh Shankar*, Univ. of MD, Coll. of Bus. & Mgmt., 3450 Van Munching Hall, College Park, MD 20742-1815, vshankar@bmgmail.umd.edu

Analyses of sequential market entry in domestic markets have shown advantages for pioneers and late entrants. We study the sources of advantage for brands in multiple international markets based on entry timing, finding that timing and sequence of entry are important sources of asymmetry in international market competition.

4) **Intra-Brand Competition & Channel Structure**, *Manish Kacker*, PA State Univ., Dept. of Mktg., 701 BAB Smeal Coll. of Bus., Philadelphia, PA 19104-6371, mxk28@psu.edu

The effect of intra-brand competition on channel structure is examined. A game-theoretic model is solved in the context of the carbonated soft drink industry to identify conditions when each of 3 structures, fully integrated channels, dual distribution and fully independent channels, is optimal.

TE18 Planning & Forecasting Contributed Session

Chair: Radoslaw A. Zapert, Coopers & Lybrand Consulting LLP, 1301 Avenue of the Americas, New York, NY 10019-6013, radek@esg.colybrand.com

1) **Fads & Fashion - Agent Based Model to Forecast Movies, Box Office and Music Hits**, *Radoslaw A. Zapert*, Coopers & Lybrand Consulting LLP, 1301 Av of the Americas, New York, NY 10019-6013, radek@esg.colybrand.com

We present a business application of a multi-agent simulation technology in forecasting trends in sales of music, CDs and summer movie going.

2) **An Empirical Study of the Effect of Information Systems Integration on Business Process Improvement Initiative in Service Firms**, *Suresh K. Tadisina*, Southern IL Univ., Dept. of Mgmt., Carbondale, IL 62901, suresht@siu.edu, *Ganesh D. Bhatt*

We focus on service firms and empirically examine the impact of enterprise IS integration, conceptualized as data integration and communications network integration, on business process improvement initiative, conceptualized as top management commitment, process improvement efforts and customer focus. The moderating effects of "time" and "information intensity" are also examined.

3) **The Ambidextrous Scenario Planner**, *Ronald N. Taylor*, Rice Univ., Jones Grad. School, 5516 Holly St., Houston, TX 77081

Scenario planning requires a combination of both intuitive and analytical processes. We examine the impact of processes of each type that have been found to be important in scenario planning. How the 2 types of scenario planning processes interact to produce effective scenario planning is discussed.

4) **A Strategic Scenario of the Internet Modeled Through Reduced & Signed Weighted Impact Structured Evaluation**, *Bartolomeo Sapio*, Fondazione Ugo Bordoni, Via Baldassarre, Castiglione 59, Rome, 00142, Italy, bsapio@fub.it, *Enrico Nicolo*

We present the application of a new scenario method, RS-WISE, to structure a future global landscape of the Internet. An in-depth analysis of the mutual interactions among a large set of multisectorial factors is provided, in order to model their capacity of influencing the evolution of worldwide networked multimedia.

TE19 Advances in Simulation Sampling Techniques

Sponsor: College on Simulation
Sponsored Session

Chair: James R. Wilson, NC State Univ., Dept. of IE, Box 7906, Raleigh, NC 27695-7906, jwilson@eos.ncsu.edu

1) **Towards Black-Box Sampling: A Random-Direction Interior-Point Markov Chain Monte Carlo Approach**, *Bruce W. Schmeiser*,

Purdue Univ., Sch. of IE, 1287 Grissom Hall, W Lafayette, IN 47907-1287, bruce@purdue.edu, *Ming-Hui Chen*

Markov chain Monte Carlo sampling is widely used to estimate properties of Bayesian posterior distributions. We discuss ideas for making such samplers more automatic, with the goal being to create a reasonably efficient sampler having no user-specified parameters. A key idea is to define the sample space as the interior of the posterior density, rather than its support.

2) **Latin Hypercube Sampling for Estimating Metamodels of Two-Stage Stochastic Linear Programs with Recourse**, *Thomas Glenn Bailey*, AFIT, AFIT/ENS, Bldg. 640, 2950 P St., WPAFB, OH 45433-7765, gbailey@afit.af.mil

Latin hypercube sampling is shown to guarantee a reduction in the variance of the estimator of the expected cost of 2-stage stochastic LP problems with recourse. Empirical results from a variety of such problems show a consistently large variance reduction when compared to random sampling and control variates, thus providing more accurate polynomial approximations.

3) **Efficient Comparison of Yield Management Scenarios Using Simulation with Common Random Numbers**, *Thanos Avramidis*, Cornell Univ., Sch. of OR/IE, Ithaca, NY 14853

A major European passenger rail operator uses a YM system to control its inventory. The YM system contains complex forecasting and optimization models that control the accept/reject decision of each customer request. To allow the evaluation of alternative scenarios of tuning the YM system's optimization models, a discrete-event simulation model was used. We discuss the simulation model and the application of the technique of common random numbers...

TE20 Telecommunications Network: Pricing & Performance

Contributed Session

Chair: William A. Massey, Bell Labs., Lucent Tech., 600 Mountain Ave., Off. 2C120, Murray Hill, NJ 07974-0636, will@research.bell-labs.com

1) **Optimal Profit for Leased Lines Services**, *William A. Massey*, Bell Labs., Lucent Tech., 600 Mountain Ave., Off. 2C120, Murray Hill, NJ 07974-0636, will@research.bell-labs.com, *Otis B. Jennings*, *Clement McCalla*

Inventory for private lines services can be modeled by the Erlang loss system. We formulate a new nonstationary queueing algorithm to estimate the profit-optimal number of private phone lines. Transient effects play a significant role and the classic steady state analysis can be seriously off the mark.

2) **Market Structures for Data Networks**, *Philipp Afeche*, Stanford Univ., Star Route #2, Box 350, La Honda, CA 94020, pafeche@leland.stanford.edu, *Haim Mendelson*

We compare price and capacity decisions in congestion-prone data networks for the cases of welfare maximization, monopoly and multiple profit-maximizing subnetworks which compete for or jointly carry traffic. Results show that market structure significantly impacts network pricing. Incentives for and consequences of industry integration and market segmentation are demonstrated.

3) **Efficient Pricing Schemes on ATM Network Pricing**, *Hyung-Sik Oh*, Seoul Natl. Univ., Dept. of IE, Coll. of Eng., Seoul, 151-742, South Korea, ohs@cybernet.snu.ac.kr, *Kug-Chang Kang*

We present efficient pricing schemes reflecting the full characteristics of ATM traffic. Considering the various parameters with respect to network controls and user controls, both economic efficiency and network efficiency of pricing schemes are derived. As a result, we propose how to design efficient pricing schemes on ATM networks.

4) **Analysis of Random Polling Systems with Infinite Coupled Servers & Correlated Input Process**, *Thomas Y. S. Lee*, Univ. of IL, IDS Dept., MC 294, 601 S Morgan St., Chicago, IL 60607, yslee@uic.edu

We analyze a random polling system with correlated input process and infinite servers. The infinite number of servers are coupled together and they visit the queues as one processing unit. Two classes of service disciplines, exhaustive and gated, are considered. We will derive several performance measures of the system.

TE21 Theoretical Foundations of MMT XIII

Cluster: Management of Medical Technology

Invited Session

Chair: Jane Marceau, Univ. of Western Sydney Macarthur, PO Box 555, Campbelltown, NSW 2560, Australia, j.marceau@uws.edu.au

1) **Networks of Innovation & Networks of Production: Collaboration & Competition in the Biomedical Industry in Australia**, *Jane Marceau*, Univ. of Western Sydney Macarthur, PO Box 555, Campbelltown, NSW 2560, Australia, j.marceau@uws.edu.au

The results of a study of firms in the medical device industry in New South Wales, Australia, indicate the complexity of interactions between major players in the innovation process. Purchasers (hospitals), regulators (government) and knowledge-producers (universities) play different innovation roles at different levels of technology.

2) **Conceptual & Operational Problems in the Design & Development of the Computer-Based Patient Record**, *Claude Sicotte*, Univ. of Montreal, Dept. Health Admin., Fac. Med., PO Box 6128, Station Downtown, Montreal, Quebec, H3C 3J7, Canada, sicotec@ere.umontreal.ca, *Francois Champagne*, *Jean-Louis Denis*, *Ann Langley*, *Pascale Lehoux*

A completely electronic CBPR project, conducted in 4 hospitals, which was initially sold on the strength of its capacity to facilitate medical tasks, enhance coordination between nursing and medical tasks and improve the quality of care resulted in information overload and standardization, increased tasks, more rigid work organization and hindrance of interprofessional collaboration.

3) **Justification of a Community Health Information Network: The ComputerLink for AD Caregivers**, *Fay Cobb Payton*, Augusta State Univ., Sch. of Bus. Admin., 2500 Walton Way, Augusta, GA 30904, fcobb-pa@ac.edu, *Patricia F. Brennan*

The ComputerLink is a free, public access community health information network. There are, however, (in)direct costs associated with community models. This study focuses on the costs and benefits incurred/gained by caregivers. This is supported by a cost-benefit analysis and is the first such effort using ComputerLink data.

TE22 PANEL: Publication Strategies & Direction of IEE Transactions on Engineering Management

Sponsor: Technology Management Section

Sponsored Session

Chair: Dunder F. Kocaoglu, Portland State Univ., Eng. Mgmt. Program, Portland, OR 97207-0751

1) **PANEL: Publication Strategies & Direction of 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 Wisconsin, *Donald Gerwin*, Carleton Univ.

The editor-in-chief and department editors of IEEE Transactions on Engineering Management will discuss critical issues of research and publications in engineering and technology management. Brief presentations will be followed by a Q&A period.

TE25 Reliability/Maintenance Modeling & Prediction

Cluster: Reliability & Quality Engineering

Invited Session

Chair: James Luxhoj, Rutgers Univ., Dept. of IE, PO Box 909, Piscataway, NJ 08855-0909, luxhoj@princess.rutgers.edu

1) **Simulation Modeling of Complex, Repairable Systems: Issues & Approaches**, *Bert Keats*, AZ State Univ., Dept. of IMSE, PO Box 875906, Tempe, AZ 85287-5906, bert.keats@asu.edu, *Stephen P. Chandal*

Increased simulation power offers the practitioner new perspectives for use in modeling system-level reliability with complex maintenance policies. Methods and approaches for assessing the impact of these policies are presented and discussed. Proven algorithms in current simulation software are also a part of the presentation.

2) **Reliability Prediction Based on Degradation Data**, *E. A. Elsayed*, Rutgers Univ., Dept. of IE, PO Box 909, Piscataway, NJ 08855-0909, elsayed@rci.rutgers.edu

Products experience performance degradation during their lifetimes. The environmental conditions and the product design directly affect the degradation rate of the product performance. For these products failure occurs when performance degradation reaches a threshold value. Once a relationship between the degradation and the performance of the product is determined, the time to failure of the product then can be predicted.

3) **A Useful Property of Best Linear Unbiased Predictors with Application to Life-Testing**, *N. Balakrishnan*, McMasters Univ.,

Dept. of Math. & Stats., Hamilton, Ontario, L85 4K1, Canada, bala@mcmaster.cis.mcmaster.ca

I show, for the Gauss-Markov model, that the best linear unbiased estimators of the model parameters remain unchanged if the predicted values of the dependent variable (based on best linear unbiased predictors) are used as observed values in estimating the parameters. This result not only provides a useful insight into the interpretation of best linear unbiased predictors, but also simplifies calculation of predictions in many cases. Also, I use this result effectively to construct large-sample approximate predictors...

4) Reliability Models Involving Multiple Weibull Distributions, D. N. P. Murthy, Univ. of Queensland, Dept. of Mech. Eng., Brisbane Old, 4072, Australia, murthy@sun.mech.uq.oz.au

This paper gives a brief review of several reliability models involving 2 Weibull distributions and discusses the shapes of the density and failure rate functions for these models. It then discusses extensions of these models and presents some preliminary results.

5) Models for Relating Manufacturing Process Quality to Product Reliability, Michael Tortorella, Lucent Tech., 101 Crawfords Corner Rd., Rm. 2L-536, Holmdel, NJ 07733-3030, mtortorella@lucent.com

Among the factors that influence product reliability is the performance of the manufacturing operation used to realize the product. We discuss some reliability models that include manufacturing process quality as an exogenous variable. The mechanism underlying the models is the introduction of latent defects into the product by the operation of the manufacturing process away from its target value. Mathematical representations of this idea are explored.

TE27 Optimization in Machine Learning

Cluster: Neural Networks & Machine Learning
Invited Session

Chair: Kristin Bennett, RPI, Math. Sci. Dept., Troy, NY 12180, bennek@rpi.edu

1) Classification of Censored Data for Cancer Prognosis, Nick Street, OK State Univ., Comp. Sci. Dept., 205 Mathematical Sciences, Stillwater, OK 74078, nstreet@ccs.okstate.edu

Optimization and machine learning techniques are applied to the clinically important medical prognosis problem of determining which patients may be spared post-operative therapy. Classification is done in the presence of censored data, making the class memberships partially unknown. Our results compare favorably with traditional prognostic methods that require additional surgery.

2) Linear Classification via LP Infeasibility Analysis, John W. Chinneck, Carleton Univ., Systems & Comp. Eng., 1125 Colonel by Dr., Ottawa, Ontario, K1S 5B6, Canada, chinneck@sce.carleton.ca

The problem of determining the smallest number of points to remove from a dataset such that the remaining points are linearly classifiable can be converted to a related problem in the analysis of infeasible LPs for which effective heuristics are available. Practical results are presented.

3) Incremental Nonlinear Primal-Dual Methods for Supervised Neural Network Training, Theodore B. Trafalis, Univ. of OK, 202 W Boyd, Ste. 124, Norman, OK 73019, trafalis@mailhost.ech.uu.edu, **Nicolas P. Couellan**

We propose a new incremental training method for supervised neural networks based on a primal-dual method for NLP. We cast the training problem as a constrained nonlinear least squares optimization problem. Preliminary computational results are also presented.

4) Multicategory Support Vector Networks, E. J. Bredensteiner, RPI, Math. Sci. Dept., Troy, NY 12180, bredee@rpi.edu, **Kristin Bennett**

A support vector network is used to produce polynomial discrimination functions for multicategory classification. This problem is formulated as a quadratic mathematical program with linear constraints. As the degree of the polynomial increases, the number of variables and constraints remain constant. Computational results on real-world datasets will be given.

TE28 Integer Programming I

Contributed Session

Chair: Nick Sahinidis, Univ. of IL, Dept. of Mech. & IE, Urbana, IL 61801, nikos@uiuc.edu

1) Complexity & Probabilistic Analysis for Chemical Process Planning, Shabbir Ahmed, Univ. of IL, Dept. of Mech. & IE, Urbana, IL 61801, s-ahmed1@uiuc.edu, **Nick Sahinidis**

We address the problem of multiperiod capacity planning and operation of chemical processes. We prove that this problem is NP-hard by reduction of

special cases to the capacitated lot sizing and knapsack problems. Subsequently, we develop an optimization-based heuristic. Through probabilistic analysis we prove asymptotic optimality of the heuristic.

2) A Genetic Algorithm for the Multiconstraint Knapsack Problem, John E. Beasley, Imperial Coll., Mgmt. Sch., London, SW7 2AZ, UK, j.beasley@ic.ac.uk

We present a heuristic based upon GAs for the multiconstraint knapsack problem. Computational results show that high-quality solutions can be obtained in reasonable computation times.

3) Extensions to Flow Covers, Alper Atamturk, GA Inst. of Tech., Sch. of ISyE, 765 Ferst Dr., Atlanta, GA 30332-0205, atamturk@akula.isye.gatech.edu, **George L. Nemhauser, Martin W. Savelsbergh**

We study a generalization of the single node flow model for fixed charge network flow problems. Using the new model, we derive valid inequalities for general MIP problems. The new inequalities include flow cover inequalities as a special case.

4) Baseball Playoff Elimination with "Wildcard" Teams, Alan L. Erera, Univ. of CA, Dept. of IE/OR, 4135 Etcheverry Hall, Berkeley, CA 94720, alerera@ieor.berkeley.edu, **Ilan Adler, Dorit S. Hochbaum**

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 website using these procedures to solve interactive "what-if" scenarios is described.

TE29 Stochastic Programming in Finance

Cluster: Stochastic & Robust Optimization; Parallel & Supercomputing
Invited Session

Chair: John R. Birge, Univ. of MI, Dept. of IOE, 1205 Beal Ave., Ann Arbor, MI 48109-2117, jrbirge@umich.edu

1) Creating Customized Financial Securities via Multi-Stage Stochastic Programs, John M. Mulvey, Princeton Univ., Dept. of Civil Eng. & OR, E-407 E Quad., Princeton, NJ 08544, mulvey@macbeth.princeton.edu

A multi-stage stochastic program is structured to identify scenarios that cause difficulties for a long-term investor. We re-shape the wealth path by purchasing/selling customized financial products with payoffs conditional on several economic factors, such as interest rate and inflation trends. An example is presented for a large re-insurance company.

2) Comparisons of Static & Dynamic Asset Allocation Models, John R. Birge, Univ. of MI, Dept. of IOE, 1205 Beal Ave., Ann Arbor, MI 48109-2117, jrbirge@umich.edu

The classical Markowitz portfolio model assumes a static environment in creating an efficient portfolio. We compare this approach with a stochastic program that optimizes asset allocation over a fixed time horizon with given liabilities and transaction fees. We use historical data for a collection of asset indices.

3) Financial Planning Model via Multistage Stochastic Programming, Yuan-An Fan, Frank Russell Co., 909 A St., Tacoma, WA 98402, yfan@mail.russell.com, **Steve Murray, Andy Turner**

We describe the implementation of a retail level Italian financial planning model. We include a description of the real world setting from a consumer view point, issues regarding its simplification into a large scale stochastic programming model and subsequent translation of the solution to the consumer's original context.

TE30 Scheduling & Inventory

Contributed Session

Chair: Bhaba R. Sarker, LA State Univ., Dept. of IE, Baton Rouge, LA 70803-6409, bsarker@unix1.sncc.lsu.edu

1) Dynamic Pacing by Workforce Allocation in an Assembly-Based System with Random Breakdowns, Lining Liu, Hong Kong Univ. of Sci. & Tech., Dept. of IEEM, Clear Water Bay, Hong Kong, liulim@uxmail.ust.hk, **John J. Liu, Hong Chen**

For an n-stage assembly-based manufacturing system with deterministic processing rates but random breakdowns, we study optimal allocation of a given K operators, e.g., assemblers, among n stages so as to maximize the utilization of the given capacity and minimize the expected long-term average costs, including a holding cost, a shortage cost, an operating cost and a repair cost.

2) A Life-Cycle Cost Model for a Production & Delivery System,

Gyana R. Parija, IBM Corp., Algorithms Development Group, Poughkeepsie, NY 12601-5400, parija@us.ibm.com, **Bhaba R. Sarker**

A life-cycle cost model is developed to determine the batch size and the number of kanbans for a production system that manufactures a product with a short life. The model describes the optimal planning scenarios for a new product at increasing (inception), constant (maturity) and decreasing (declining) demand.

3) Inventory & Investment in Setup Cost Reduction Under Return on Investment Maximization, **K. Jo Min**, IA State Univ., IMSE Dept., 205 Engineering Annex, Ames, IA 50011, jomin@iastate.edu, **Toshitsugu Otake**, **Cheng-Kang Chen**

We first formulate an inventory model with an option to invest in setup cost reduction under ROI maximization. Next, we characterize the unique global optimal solution and derive several interesting managerial insights. Finally, we obtain and analyze the closed-form solutions under linear and rational setup cost functions.

4) Scheduling Preventive Overtime in the Automotive Industry, **Robert R. Inman**, GM R&D Ctr., OR Dept., 30500 Mound Rd., Warren, MI 48090-9055, robert_inman@notes.gmr.com

Automotive assembly plants can run selected stations overtime to prepare for the next day. We present a heuristic for scheduling this "preventive overtime" which helps the plant run more efficiently tomorrow, and hence, reduces the overtime needed to meet the plant-wide production quota tomorrow.

TE31 Network & Graphs

Contributed Session

Chair: R. Chandrasekaran, Univ. of TX, Sch. of Mgmt., MS J047, Box 430688, Richardson, TX 75083-0688, chandra@utdallas.edu

1) Special Case of the Multicommodity Problem, **R. Chandrasekaran**, Univ. of TX, Sch. of Mgmt., MS J047, Box 430688, Richardson, TX 75083-0688, chandra@utdallas.edu, **Rajesh S. Jagannathan**

We discuss a multicommodity max-flow problem that occurs in telecommunication. It generalizes the matching problem, 2-dimensional transportation problem simultaneously. We give theoretical results as well as augmenting path type algorithms.

2) A 2-Commodity Capacitated Minimum Spanning Tree Problem, **Luis Gouveia**, DEIO-CIO, Fac. Ciencias da Univ. Lisboa, Bloco C2 Campo Grande, Lisbon, 1700, Portugal, lgouveia@fc.ul.pt, **Maria Joao Lopes**

This problem is a generalization of the capacitated minimum spanning tree problem which considers 2 sets of demands, a capacity constraint associated to each set and an aggregated capacity constraint. It is directly related to the design of LANs where 2 different transmission mediums, voice and image, motivating different capacity constraints have to be sent to a central processor...

3) The Asymmetric Traveling Salesman Problem: Aggregating a Multi-Commodity Flow Model into a Node Oriented Model, **Jose Manuel Pires**, ISCAL-CIO, Av. Miguel Bombarda, Lisbon, 1100, Portugal, **Luis Gouveia**

We show that an improved MTZ model presented previously by the authors can be seen as a node-oriented aggregation of the MCF model. In particular, we show that the aggregation process suggests generalizations of the MTZ constraints for set of arcs. Liftings of the generalized constraints not dominated by the subtour elimination constraints given in Dantzig, Fulkerson & Johnson (1954) are also presented.

4) Heuristics for MST with Hop Constraints Between Every Pair of Nodes, **Alcinda Barreiras**, Isep Rua S Tome, Porto, 4200, Portugal, **Eduardo Luis**

We discuss an MST problem with an additional set of constraints specifying that each path between every pair of nodes cannot have more than a fixed number of hops. Hop constraints can also model reliability constraints when designing telecommunication networks with fewer number of hops the route loss decreases probability. We present local-exchanges heuristics which transform optimal solutions for polynomially solvable cases...

TE33 Software Demonstrations IX

Sponsor: CSTS

Sponsored Session

Chair: Bjarni Kristjansson, Maximal Software Inc., 2111 Wilson Blvd., Ste. 700, Arlington, VA 22201, bjarnik@site.gmu.edu

TE35 Scheduling Applications II

Contributed Session

Chair: Kenneth E. Murphy, FL Intl. Univ., Dept. of Dec. Sci., Miami, FL 33199, murphyk@servms.fiu.edu

1) The Complexity of Scheduling Customer Orders, **Thomas A. Roemer**, UCLA, Anderson Sch., 110 Westwood Plaza, Los Angeles, CA 90095-1481, troemer@agsm.ucla.edu, **Reza Ahmadi**

The problem of scheduling customer orders is addressed. Each order requires processing on 2 different machines. An order is completed once both processes are finished. It is shown that minimizing the average completion time is NP-hard in the strong sense.

2) Analysis of Search Methods for Selecting Weights on Heuristics for Resource Constrained Project Scheduling, **Julia J. Pet-Edwards**, Univ. of Central FL, Dept. of IE & Mgmt. Systems, PO Box 162450, Orlando, FL 32816-2450, edwards@iems.engr.ucf.edu, **Mahdi Nasereddin**, **Basma Selim**

We present an exploratory analysis of the efficacy of using a GA over the currently used equal interval search for selecting the best set of weights on heuristics used in resource constrained project scheduling. Experimental results using the Kolish network set and several different scheduling heuristics are presented.

3) Manpower Scheduling Using Column Generation, **Kenneth E. Murphy**, FL Intl. Univ., Dept. of Dec. Sci., Miami, FL 33199, murphyk@servms.fiu.edu, **Anuj Mehrotra**

Column generation is a technique that has been applied for solving large 0-1 programs especially when the entire formulation is not explicitly available. We develop and test a column generation-based method for optimally solving manpower scheduling problems.

4) Scheduling Jobs at a Grocery Distribution Center as an LP Problem, **Ralph Sprague**, Northeastern IL Univ., 3516 N Neenah Ave., Chicago, IL 60634

An LP model has been developed that creates a feasible work schedule for a grocery distribution center. It takes into account all the incoming orders and their deadlines, the shifts of the employees, the option of hiring temporary workers and the logistics of the warehouse. The program is designed to create a schedule which requires the least amount of temporary help.

Wednesday 08:00-09:30

WA01 OR/MS Applications in Finance

Cluster: OR/MS Applications

Invited Session

Chair: Jim Armstrong, SABRE Tech. Solutions, 1 E Kirkwood Blvd., MD 7390, Southlake, TX 76092, jim_armstrong@sdt.com

1) Dynamic Investment Strategies via Stochastic Programming & Threshold Search, **John M. Mulvey**, Princeton Univ., Dept. of Civil Eng. & OR, E-407 E Quad., Princeton, NJ 08544, mulvey@macbeth.princeton.edu, **Adam Beger**

Multi-stage stochastic programming provides an ideal framework for allocating financial assets and liabilities. The modeling approach customizes the investment strategy to achieve financial goals on time, but suffers from the lack of intuitive decision rules. Threshold search overcomes these difficulties while maintaining MSPs rigor. An individual investor example is presented.

2) Preparing for Computer Performance Democratization on Wall Street, **Jonathan Sandberg**, Morgan Stanley, 750 7th Av, New York, NY 10019, jsand@morgan.com, **Morgan Stanley**

We examine the proposition that the democratization of floating-point performance will dramatically increase Wall Street's demand for performance improvements in computer-aided financial engineering. Particular examples are drawn from a recent rewrite of the multifactor Heath-Jarrow-Morton code for interest rate swaps on a Silicon Graphics multiprocessor.

3) A Comparison of Hedging Strategies in Swine Production, **Harold J. Schlee**, Lewis & Clark Coll., 0615 SW Palatine Hill Rd., Portland, OR 97219, schlee@lclark.edu

Cost and futures prices for corn, soybean meal and live hogs are used to evaluate several strategies for reducing risk in swine production. Hedge ratios are derived based on variance minimization. Each strategy is evaluated relative to a no hedge strategy (cash prices only). Price data are for the years 1970-96.

4) On the Expected Exchange Rate E(s), **Gary R. Waissi**, Univ. of MI, Sch. of Mgmt., 4901 Evergreen Rd., Dearborn, MI 48128, gwaissi@umich.edu

We propose a new definition and model for the expected value $E(s)$ of an exchange rate s . The model draws from the empirical evidence supporting reciprocal interaction between economic variables. The expected value of an exchange rate is obtained by adjusting a spot rate by a cumulative equilibrium seeking "factor-effect."

WA02 Service Industry

Contributed Session

Chair: Xin X. He, SC State Univ., Dept. of Bus. Admin., 300 College St., Orangeburg, SC 29117, xhe@scsu.edu

1) **Service Levels in the Food Industry**, *Xin X. He*, SC State Univ., Dept. of Bus. Admin., 300 College St., Orangeburg, SC 29117, xhe@scsu.edu, *Jack C. Hayya*, *Amy Z. Zeng*

The food industry in the state of South Carolina is represented by a supply chain, a mixture of assembly-like and arborescent structure. We find no universal service measure, although we are told that food companies generally use the average of the fill rate at the downstream, e.g., retailer, nodes.

2) **Allocating Parking Costs Among All Classes of User**, *Rick T. Olson*, Univ. of San Diego, 5998 Alcalá Park, San Diego, CA 92110, r_olson@acusd.edu

USD had to decide how to allocate the \$900k annual debt service for a parking structure among all classes of user. We present the issues raised, alternatives considered, analyses performed and policies adopted.

3) **Integrating Inbound Service & Outbound Sales Calls in Telephone Centers**, *Reynold E. Byers*, Univ. of Rochester, 625 Richardson Rd., Rochester, NY 14623, byersre@mail.ssb.rochester.edu

Integrating outbound telemarketing into a telephone service center requires new management techniques; however, is performance significantly degraded by these changes? Motivated by a movement in the retail banking industry to increase revenues, I examine various policies' effects on system performance and explore the important tradeoffs faced in an integrated service and outbound sales telephone center.

4) **Simultaneous Management of Demand & Supply in Services**, *Kenneth J. Klassen*, Univ. of Calgary, Fac. of Mgmt., 2500 Univ. Dr., NW, Calgary, Alberta, T2N 1N4, Canada, kklassen@acs.ucalgary.ca, *Thomas Rohleder*

Many services do not formally manage demand and supply and even fewer consider both simultaneously. We provide research into this sometimes ambiguous area and determine the value of managing demand and supply simultaneously. We draw on both operations and marketing and use a combination of simulation and analytical techniques.

WA03 Agile & Dynamic Facility Layout

Cluster: Facilities Layout

Invited Session

Chair: Brett Peters, TX A&M Univ., Dept. of IE, College Station, TX 77843-3367, bpeters@tamu.edu

1) **Facility Layout Using Layout Modules**, *Shahrukh A. Irani*, OH State Univ., Dept. of IWSE, Columbus, OH 43210

The framework of a new layout concept, facility layout using layout modules, which allows a layout to be expressed as a combination of standard layout configurations has been developed. A proposed methodology for implementation that uses string matching, graph matching and cluster analysis algorithms to identify these layout modules from operation sequence data will be described.

2) **Holographic Factory Design Given Agile Production Requirements**, *Suzanne Marcotte*, Univ. du Quebec, Trois Rivières, Dept. of IE, Quebec, Quebec, G9A 5H7, Canada, suzanne@marcotte@uqtr.quebec.ca, *Benoit Montreuil*

We present a new heuristic for holographic factory design. The heuristic involves an iterative probabilistic construction process taking advantage of current knowledge about agile production requirements. We then compare with other physical organizations such as fractal, cellular and process factories.

3) **Dynamic Facility Layout: A Genetic Algorithm-Based Approach**, *Jasmit Singh Kochhar*, RPI, Dept. of DS/ES, Troy, NY 12180, *Sunderesh S. Heragu*

We summarize our research in the area of dynamic facility design. We question the robustness of any design over a long planning period and propose that changes may need to be made frequently. We examine these issues and present a GA-based heuristic to solve the problem.

4) **Hybrid Dynamic Layout Formulations**, *Thomas Lacksonen*, OH Univ., IMSE Dept., 273 Stocker Ctr., Athens, OH 45701

Researchers have developed a variety of formulations for the dynamic layout problem. We review various DLP objectives, constraints and solution procedures and propose a hybrid formulation framework. Integrating DLP with process planning and detailed layout will also be discussed.

WA04 Combat Modeling: Issues & Technology

Sponsor: Military Applications Society

Sponsored Session

Chair: Bruce W. Fowler, US Army Missile Command, Attn: AMSMI-RD-AC, Redstone Arsenal, AL 35898, fowler-bw@redstone.army.mil

1) **ATR & Fratricide: Panacea, Status Quo or Pandora's Box**, *Gerald M. Evans*, US Army Missile Command, AMSMI-RD-AC, Redstone Arsenal, AL 35898, evans-rd-ac@redstone.army.mil

Fratricide is a concern in combat for obvious reasons. Previous work has shown the utility of ATR in a force-on-force engagement. This effort will compare 3 scenarios to see if there are noticeable efforts on fratricide by incorporating ATR into 2 of the scenarios. The base case scenario will feature force-on-force engagement without ATR. The platform ATR will place ATR capability on Blue's capability to the Blue shooting platform(s)...

2) **Valuing the Non-Killers**, *Donald R. Peterson*, US Army Missile Command, Adv. Systems Concepts Office, Missile RD&E Ctr., Redstone Arsenal, AL 35898-5242, peterson-rd-ac@redstone.army.mil, *Bruce W. Fowler*

We present initial findings of a new effort to investigate methodologies for estimating or assessing military worth of units other than killers and in environments other than decisive war. We explore a simple, aggregate force structuring model developed as an initial set of experiments in this effort.

3) **Initiating Battle in Models**, *Bruce W. Fowler*, US Army Missile Command, Attn: AMSMI-RD-AC, Redstone Arsenal, AL 35898, fowler-bw@redstone.army.mil

Experimental work by McNaught and examination of history and platform-level model results indicate that initiation of battles and engagements using Lanchester theory may be flawed. The phase aggregation model is used as a numerical laboratory to investigate battle initiation and Lanchester theory responses.

WA05 Military Applications I

Contributed Session

Chair: E. L. Perry, SR Investments Inc., 580 Old Jasmine Hill Rd., Wetumpka, AL 36093

1) **Experimental Design Applied to Theater Ballistic Missile Testing**, *Deanna Doan*, Logicon, 2100 Washington Blvd., Arlington, VA 22204, ddoan@logicon.com, *Darren McKnight*, *Lambert Sebastiani*

Intercept debris poses a range safety concern during theater ballistic missile defense system testing. The authors applied experimental design techniques to debris models to characterize parameters posing potential ground hazards. The analysis determined the sensitivity of the debris footprint of the target remnants to both controllable and uncontrollable parameters.

2) **Modeling the Performance of Imagery Exploitation Systems**, *Susan K. Parker*, MITRE Corp., 1820 Dolley Madison Blvd., McLean, VA 22102-3481, sparker@mitre.com

Intelligence imagery exploitation is the interpretation process that transforms imagery into information supplying the decision maker with critical knowledge of the situation of interest. This model parametrically evaluates the throughput and delay associated with an exploitation system while considering such factors as number of imagery analysts, exploitation rates and tools.

3) **A Tabu Search Movement Algorithm for Hex-Based Wargames**, *E. L. Perry*, SR Investments Inc., 580 Old Jasmine Hill Rd., Wetumpka, AL 36093

An intelligent movement algorithm for hex-based wargames is presented. The algorithm uses TS meta-strategy to move ground and sea units toward their objectives. The algorithm is able to move around many obstacles that appear in the path of movement.

WA06 PANEL: Distance Learning - Experience is the Best Teacher

Sponsor: Forum on Education

Sponsored Session

Chair: Ruth A. Maurer, Walden Univ., 155 Fifth Ave. S, Minneapolis, MN 55401, rmaurer@walden.edu

1) **PANEL: Distance Learning - Experience is the Best Teacher**,

Gwen Hillesheim, Walden Univ., **Andy Abbott**, **Marilyn Simon**, Walden Univ., **Judith Barlow**, American Univ.

We consider the problem of distance education on several levels. Each participant is active in the distance/distributed learning field, though each in a slightly different way. Various levels of education are covered from kindergarten through the doctorate. Each is approached differently so the discussion should provide a broad spectrum of experience. Two panelists represent the technology side of the problem to allow discussion of that aspect as well.

WA07 Queuing in Production Systems

Contributed Session

Chair: Shankar Sivaramakrishnan, OK State Univ., 74 S University Pl., #1, Stillwater, OK 74075, sivaras@ceatlabs.okstate.edu

1) **Analytical Models for Make-to-Stock Production Systems**, **Shankar Sivaramakrishnan**, OK State Univ., 74 S University Pl., #1, Stillwater, OK 74075, sivaras@ceatlabs.okstate.edu, **Manjunath Kamath**

We extend a decomposition approach developed for tandem multi-stage make-to-stock systems to include other manufacturing features such as batch processing, parallel servers and multiple part types. We also discuss extensions to model non-tandem configurations. We test the accuracy of the approximation scheme by comparing the results obtained with simulation.

2) **Approximate Analysis of CONWIP Systems with Compound Poisson Demands**, **Hyo-Seong Lee**, Kyung Hee Univ., Dept. of IE, 1 Seocheon, Kiheung, Yongin, Kyunggi-Do, 449-701, Korea, hslee@nms.kyunghee.ac.kr, **Yannick Frein**

We consider a CONWIP system with a compound Poisson demand process. We will model the CONWIP system as a closed queueing network with a synchronization station and develop an approximation method to obtain the steady state probabilities of the number of parts at each station.

3) **The Role of Capacity & Variability of Final Demand on Safety Stock under Kanban**, **Gary W. Clendenen**, Univ. of TX, 3900 University Blvd., Tyler, TX 75799, gclenden@mail.uttyl.edu

A nonlinear optimization model based on the restoration concept is used to emulate the pull characteristics of Kanban. A full factorial simulation experiment examines optimal safety stock levels vs. capacity and variability of final demand. Results show an intricate relationship between safety stock, capacity and variability of final demands.

4) **Modeling Queues with Deadlines**, **Anand Iyer**, i2 Technologies, Inc., 909 E Las Colinas Blvd., Ste. 1500, Irving, TX 75039, iyer@i2.com, **Anindya Datta**

We study a single server system where jobs have deadlines. Thus, jobs may leave the system either after being served or because their deadlines have expired.

WA08 Manufacturing II

Contributed Session

Chair: Susan W. Juge, Hughes Missile Systems Co., Bldg. 808 MS H6, PO Box 11337, Tucson, AZ 85734-1337, swjuge@ccgate.hac.com

1) **Optimal Buffer Allocations Under Alternative Performance Measures**, **Susan W. Juge**, Hughes Missile Systems Co., Bldg. 808 MS H6, PO Box 11337, Tucson, AZ 85734-1337, swjuge@ccgate.hac.com

Consider a serial production line with variable processing times and a fixed total number of buffer spaces. We describe the optimal buffer allocations for 3 separate objective functions. The first 2 are closely related profit functions, which are maximized. The third function is manufacturing cycle time, which is minimized.

2) **Popular MRP Lot-Sizing Techniques are Still the Best Choice**, **Salvador Nieto Sanchez**, LA State Univ., 3128 CEBA Bldg., Baton Rouge, LA 70803-6409, snieto@lsuvm.sncc.lsu.edu, **Evangelos Triantaphyllou**, **Dennis B. Webster**, **T. Warren Liao**

The add-drop heuristic, a new capacitated MRP technique, is compared against 4 uncapacitated ones: the lot-for-lot, fixed period quantity, least unit cost and the silver-meal heuristic. The costs were modified to make them comparable. We provide empirical and analytical results which demonstrate that the old techniques are still the best.

3) **Optimal Allocation of Work in Assembly Systems Revisited**, **Ishpal Singh Rekhi**, Purdue Univ., Krannert Sch. of Mgmt., W Lafayette, IN 47907, rekhi@mgmt.purdue.edu, **Suresh Chand**,

Herbert Moskowitz

We consider the problem of work allocation in stochastic assembly systems so as to optimize throughput. A recent study showed a counter-intuitive result that throughput could go up with an increase in number of components. We provide analytical insights into the effect of number of components on throughput and attempt to explain this counter-intuitive behavior.

WA09 Queuing/Inventory I

Contributed Session

Chair: Ulku Gurler, Bilkent Univ., Dept. of IE, Ankara, 06533, Turkey, ulku@bilkent.edu.tr

1) **A Delay Policy with Substitutable Products**, **Ulku Gurler**, Bilkent Univ., Dept. of IE, Ankara, 06533, Turkey, ulku@bilkent.edu.tr

An inventory problem is considered for 2 substitutable products. Constant lead time and unit demand is assumed, order quantity is restricted to 1 due to low demand and high inventory holding cost relative to unit shortage cost. A policy is considered where the order is placed D units of time after an item is sold.

2) **Application of Finite Mixture Models in Low Demand Inventory Systems**, **Xiaomei Ding**, Univ. of British Columbia, Fac. of Commerce, 2053 Main Mall, Vancouver, BC, V6T 1Z2, Canada, ding@markov.commerce.ubc.ca, **Martin L. Puterman**

We explore the use of finite Poisson and negative binomial mixture models for modeling low demand sales data. We pay special attention to the 0 inflated negative binomial models as special cases. We also investigate the impact of these models on inventory policy choice and performance.

3) **New Optimal Policies for a Unit Demand Inventory Problem**, **Kaan Katircioglu**, IBM, PO Box 218, Yorktown Heights, NY 10598, kaan@watson.ibm.com, **Derek R. Atkins**

We analyze a classic single-echelon, single-product, unit demand inventory problem with full backlogging. Under continuous review and no fixed order cost assumptions, we show that a delayed-(s-1,s) policy is optimal for a general IFR type interdemand time distribution. Furthermore, a delayed-(s,S) policy is optimal when a fixed order cost exists.

WA10 Transportation Policy, Evaluation & Design

Sponsor: Transportation Science Section

Sponsored Session

Chair: Kyriacos C. Mouskos, NJIT, Dept. of Civil & Environ. Eng., Inst. for Transportation, Newark, NJ 07102

1) **A Decision-Theoretic Framework for the Field Evaluation of Network Traffic Control Schemes**, **Stephen Mattingly**, Univ. of CA, Dept. of Civil & Environ. Eng., Inst. of Transport. Studies, Irvine, CA 92697, spmatt@translab.its.uci.edu, **R. Jayakrishnan**

We describe a framework for the multiobjective evaluation of network traffic control schemes being field tested in California. The field tests are for SCOOT and UTCS controls in the city of Anaheim and for the combined freeway ramp control and OPAC-based arterial traffic control in the city of Irvine.

2) **Heuristic Search Strategies for a Transportation Network Design Problem with Two Classes of Users**, **Qifeng Zeng**, NJIT, Inst. for Transportation, Newark, NJ 07102, **Kyriacos C. Mouskos**

Solution methodologies for a transportation network design problem with 2 classes of users, passenger cars and trucks with asymmetric interactions are presented. Several variations of SA and TS heuristic search strategies to solve the transportation network design problem are presented as well as the computational performance of each.

WA12 Supply Chain Optimization

Contributed Session

Chair: Thomas Glenn Bailey, AFIT, AFIT/ENS, Bldg. 640, 2950 P St., WPAFB, OH 45433-7765, gbailey@afit.af.mil

1) **Cost Impact Assessment in Supply Chain Optimization**, **Angela P. Giddings**, Office of Aerospace Studies, 3550 Aberdeen Dr. SE, Kirtland AFB, NM 87117-5776, giddinga@plk.af.mil, **Thomas Glenn Bailey**, **James T. Moore**

We investigate the use of experimental design techniques to approximate the optimal total cost function of large-scale facility location problems. We demonstrate how this method identifies which cost parameters most significantly affect total cost and describe an automated system that employs this approach for supply chain optimization.

2) **Internet-Enabled OR Methods for Supply Chain Management**, **Herbert B. Shulman**, AT&T, 307 Middletown-

Lincroft Rd., Rm. 3G-220, Lincroft, NJ 07738, hshulman@att.mail.com, **Alex Bangash**

OR methods have been used effectively in many areas of inventory management, production and logistics planning. As inter-business connectivity increases through the advent of the Internet, so does the application of these methods for enhanced supply chain management. We will provide examples of such Internet applications from the telecommunications/hi-tech industries.

3) Supply Chain Design Based on Customer's Sensitivity to Order Leadtime, Euthemia Stavroulaki, Univ. of Rochester, Simon Sch. of Bus. Admin., Rochester, NY 14627, stavroula@mail.ssb.rochester.edu, **Gregory Dobson**

We examine the final production and delivery stages of a supply chain serving customers from a number of warehouses. The profit function depends on optimally choosing the geographic area covered, the order processing capacity and the price charged. We explicitly account for the customer's waiting cost and consider non-homogeneous customers.

4) Economic Backorder Incentives in an Inventory System with Supply Disruptions, Gregory A. DeCroix, Univ. of WA, Sch. of Bus. Admin., Box 353200, Seattle, WA 98195-3200, dcroix@u.washington.edu, **Antonio Arreola-Risa**

We study a stochastic-demand inventory system with random supply disruptions and partial backorders. We explore the possibility of using economic incentives to increase the likelihood that a customer backorders. We obtain insights into what levels of incentives are optimal and when such incentives should be offered.

WA14 System Design Issues in Recoverable Manufacturing Systems

Cluster: Recoverable Product Environments

Invited Session

Chair: Julie Ann Stuart, OH State Univ., Indust., Welding & Syst. Eng., 1971 Neil Ave. 284 Baker Bldg., Columbus, OH 43210-1271, stuart.20@osu.edu

1) Systems for Acquisition of New Parts in Recoverable Manufacturing, W. C. Benton, OH State Univ., Fisher Coll. of Bus., Dept. of MS, 308C Hagerty Hall, Columbus, OH 43210, benton1@osu.edu

Recoverable manufacturing is characterized by uncertain material recovery from the cores which are to be remanufactured. Fallout of parts leads to purchasing of replacement parts. The problem is further compounded by secondary fallout during the remanufacture process. Purchasing implications in this uncertain environment are discussed.

2) Disassembly Center Design, Julie Ann Stuart, OH State Univ., Indust., Welding & Syst. Eng., 1971 Neil Ave. 284 Baker Bldg., Columbus, OH 43210-1271, stuart.20@osu.edu

Variability from numerous sources affects the disassembly time required for manual disassembly and sorting as well as the setup times for different shredding operations. This research addresses the development of techniques to reduce cycle time and to improve material flow and tracking.

3) Forecasting for Material Recoverability in Recoverable Manufacturing, Rajesh Srivastava, Air Force Inst. of Tech., Dept. AFIT/LAL, 2950 P St., Bldg. 641, WPAFB, OH 45433-7765, rsrivast@afit.af.mil, **V. Daniel R. Guide, Jr.**

Recoverability of materials from the used products to be remanufactured is uncertain. Fallout of material may occur on product disassembly, as well as in remanufacturing. Recoverability is influenced by several external conditions such as length of use, conditions under which used and previous remanufacturing. Forecasting models are developed.

4) Repair vs. Remanufacturing: An Evaluation of Operational Policies, V. Daniel R. Guide, Jr., Suffolk Univ., Mgmt. Dept. Sawyer Sch. Mgmt., 8 Ashburton Pl., Boston, MA 02108-2770, dguide@suffolk.edu, **Rajesh Srivastava, Mark E. Kraus**

Repair and remanufacturing are 2 options used within a recoverable environment to return used products back to the market in a renewed usable form. The difference between repair and remanufacturing are discussed, along with the impact of these 2 approaches on various operational policies.

WA15 Management of Technology I

Contributed Session

Chair: Rachel Yang, Univ. of IL, 350 Commerce West, Champaign, IL 61820, ryang@uiuc.edu

1) Strategic Management of Information & Communication Technologies: A Case Study of GE Monitoring & Diagnostics

Systems, Pratyush Bharati, RPI, 17 Valley View #23, Watervliet, NY 12189, bharap@rpi.edu, **Bou-wen Lin**

Recent advances in ICTs have changed the basis of competition. GE has exemplified it with their M&D systems, which provide real-time expert remedies. By changing its orientation to high technology services, GE has strategically managed ICTs and integrated them with its core competencies to gain a competitive advantage.

2) Examining the Relationship Between Cooperative Research Work Plans & Benefits, Richard M. Franza, AFIT/LAS, 2950 P St., WPAFB, OH 45433-7765, rfranza@afit.af.mil

The US government transfers technology to the private sector through CRDAs. Through these agreements, the government hopes to garner benefits such as royalty payments, work savings and technical expertise. This research statistically analyzes the relationship between the content of CRDA work plans and government benefits.

WA16 Brand Choice & Product Positioning

Cluster: Marketing

Invited Session

Chair: Peter Fader, Univ. of PA, The Wharton Sch., SH-DH, 3620 Locust Walk, Mktg. Sch., Philadelphia, PA 19104-6371, pete@marketing.wharton.upenn.edu

1) Rational Expectations & Brand Choice, B. P. S. Murthi, Univ. of TX, School of Mgmt., PO Box 830688, JO 5.1, Richardson, TX 75083-0688, murthi@utdallas.edu, **Ram C. Rao**

Some consumers, at least some of the time, are uninformed of prices but engage in brand purchase. To what extent do consumers use posted prices or expectations of prices in their choice? Secondly, how does a promotion affect consumers' evaluation of prices. We use scanner data to address the above issues.

2) Analytical Product Positioning Using Genetic Algorithms, Bruce R. Klemz, Univ. of Otago, Dept. of Mktg., PO BOX 56, Dunedin, New Zealand, **Thomas S. Gruca**

We address the problem of finding optimal product positions in joint-spaces of consumer ideal points and existing product locations. Our results, using simulated data, show that GAs perform better than specialized NLP programs for the single product problem. We also discuss the results for the product line positioning problem.

3) A Dynamic Inertial Model of Brand Choice Calibrated on Scanner Panel Data, Fred Feinberg, Univ. of Toronto, Fac. of Mgmt. Studies, 246 Bloor St. W, Toronto, Ontario, M5R 3E6, Canada, feinberg@fmgmt.mgmt.utoronto.ca

A model formulation is developed, similar to those in the Lightning-Bolt class, accounting for the similarity structure of the market along with state dependence, heterogeneity and inertia. When estimated on scanner panel data, the resulting interbrand similarity estimates allow standard MDS techniques for the creation of brand positioning maps.

4) The Evolution of Repeat Buying for New Products, Peter Fader, Univ. of PA, The Wharton Sch., SH-DH, 3620 Locust Walk, Mktg. Sch., Philadelphia, PA 19104-6371, pete@marketing.wharton.upenn.edu, **Bruce G. S. Hardie**

We investigate the relationship between interpurchase times and the level of depth of repeat for new CPG products. Our empirical observations directly contradict the assumptions underlying several popular published models. We develop a new, behaviorally plausible model that not only supports these observations, but offers excellent predictive validity.

WA19 Sampling in Simulation

Sponsor: College on Simulation

Sponsored Session

Chair: David Goldsman, GA Inst. of Tech., Sch. of ISyE, Atlanta, GA 30332, sman@isye.gatech.edu

1) Simulation Modeling to Facilitate Queueing Analysis: A Sample Allocation Procedure for Estimating Mean Waiting Time in M/Ek/1 Queue, Andrew F. Seila, Univ. of GA, Terry Coll. of Bus., 201 Brooks Hall, Athens, GA 30602-6255, andy@ms.uga.edu, **Shen Zheng**

A 2-stage procedure for sampling the interarrival and service time distributions is proposed and shown to be asymptotically optimal in the sense that the mean squared error of the estimator of the mean waiting time is minimized, subject to a constraint on the sample sizes, as the sampling budget gets large. Asymptotic normality is proved and simulation results for the M/M/1 system are shown to support theoretical results.

2) Parallel Simulation of Communication Systems by Time Segmentation, Mehdi Hoseyni-Nasab, Univ. of WI, Dept. of IE, Madison, WI 53607, gt8886a@prism.gatech.edu, Sigrun Andradottir

We investigate the applicability and efficiency of a recently developed parallel simulation approach: the time segmentation method in simulation of communication systems. In particular, we present a variety of models for ATM networks and study the applicability of our approach in parallel simulation of such networks.

3) A Random Walk Approach for Implementing Multinomial Selection Procedures, Eric Carlen, GA Inst. of Tech., Dept. of Math., Atlanta, GA 30332, carlen@math.gatech.edu, David Goldsman, Michael J. Smith, Dieter Vandenbussche

We study the problem of selecting the best of a number of competing simulated systems. One strategy for attacking this problem is based on procedures for finding the most probable multinomial cell. We show how to use multidimensional random walk and gambler's ruin results to calculate certain operating constants for a variety of multinomial selection procedures.

WA20 Simulation Applications

Contributed Session

Chair: Umesh Saxena, Univ. of WI, Dept. of IE, PO Box 784, Milwaukee, WI 53201

1) An Approximation for Modeling Duplicate Serial Workstations, David S. Kim, Univ. of MA, 220 ELAB, Dept. of Mech. & IE, Amherst, MA 01003, dkim@ecs.umass.edu, Bernice J. Lin

We present a simple method for modeling duplicate serial workstations within a larger production system. Theoretical justification and experimental results are presented.

2) An Agent-Based Simulation for Market Performance Measurement, Douglas A. Popken, Systems View, 9139 S Rdrunner St., Highlands Ranch, CO 80126, dpopken@systemsview.com, Atish P. Sinha

Agent-based simulations model the behavior of complex systems through the interactions of large numbers of relatively simple internal entities known as agents. We describe a hierarchical, agent-based approach to modeling consumer behavior. Consumers are modeled as agents responding to a variety of marketing stimuli.

3) Estimating Unscheduled Hourly Arrival Distributions for 500 Airports: A Practical Approach, Nastaran Coleman, TRW FAA, WDC9/7N205, One Federal Systems Park Dr., Fairfax, VA 22033-4416, nastaran.coleman@faa.dot.gov, Ellis Feldman, Daniel Citrenbaum, Stephen B. Cohen

Hourly general aviation arrival time distributions for use in NAS simulation models are estimated given stochastic departure rates, pairwise transition probabilities and transit times. Regressions estimate transit times for all city pairs using data for available city pairs. Distribution free techniques obtain subsamples, accounting for flight direction.

4) Simulation Model for Forklift Selection, Umesh Saxena, Univ. of WI, Dept. of IE, PO Box 784, Milwaukee, WI 53201

Two types of forklift trucks, propane and electricity, are used in material handling. A simulation model has been developed which allows users to input relevant data. The output can be used in selection of a truck.

WA21 Theoretical Foundations of MMT XIV

Cluster: Management of Medical Technology

Invited Session

Chair: Richard O. Mason, SMU, Cox Sch. of Bus., Dallas, TX 75275-0333, rmason@mail.cox.smu.edu

1) The Map of Life, Richard O. Mason, SMU, Cox Sch. of Bus., Dallas, TX 75275-0333, rmason@mail.cox.smu.edu

Within a decade, the project to map the 3 billion base pairs of the human genome will be completed. A Bayesian model is proposed to help manage this effort in the service of mankind.

2) Diabetic Foot Advisor: Preliminary Research & Application, Myron D. Tremaine, Anderson Clinic, Washington, DC, Elias M. Awad

Computer-aided medical advisory systems have been known to manage certain diagnostic procedures to assist patients in complex domains. This research uses an expert system technology to build a prototype that advises diabetic patients about the status of their feet and the alternatives available for proper and prompt care.

3) Critical Success Factors for Electronic Medical Records Access Systems, J. Pastor-Urban, Massey Univ., Dept. of Information Systems, Private Bag 11222, Palmerston North, New Zealand, j.pastor@massey.ac.nz, I. Hunter, R. Whiddett

We describe the development of a theoretical model to predict the use/implementation of an electronic medical records system by health professionals based on the technology acceptance model. The model was tested using a selected sample of primary health care professionals in Wellington, New Zealand.

WA22 Technology Management

Sponsor: Technology Management Section

Sponsored Session

Chair: Dunder F. Kocaoglu, Portland State Univ., Eng. Mgmt. Program, Portland, OR 97207-0751

1) Developing New Products Under Random Inputs of Venture Capital, Moren Levesque, Carnegie Mellon Univ., Grad. Sch. of Ind. Admin., Pittsburgh, PA 15213-3890

Entrepreneurs make important operational decisions during the development of a new product. Those decisions depend on various uncertainties associated with the development process. I investigate the conditions under which random inputs of capital are favorable to new product development. Results will be presented on which products/markets are expected to be more successful under random flows of capital.

2) Practices in Evaluation of Advanced Manufacturing Technologies, Dunder F. Kocaoglu, Portland State Univ., Eng. Mgmt. Program, Portland, OR 97207-0751, Tugrul Daim

We present the differences among US electronics manufacturers in the evaluation of technologies. Attribute types such as technological, economical, social or political and evaluation methodologies such as analytic methods, cost models and modeling/simulation approaches are utilized for certain types of technology evaluation and they lead to different types of impacts on the organization.

3) Achieving Competitiveness Through Technology Acquisition, Dunder F. Kocaoglu, Portland State Univ., Eng. Mgmt. Program, Portland, OR 97207-0751, Tugrul Daim

We report the results of a study on the impact of technology acquisitions on organizational, operational, market and sales competitiveness of a company. Different technology acquisition strategies result in different impacts. For example, it was found that in-house technology development stimulates new product development for commercial markets more than any other acquisition strategy.

WA25 Reliability

Contributed Session

Chair: Albert H. Moore, AFIT/ENC, 2950 P St., Bldg. 640, WPAFB, OH 54533

1) Consistency of Maximum Likelihood Estimators for Randomly Censored Samples, Jin Wang, Valdosta State Univ., Dept. of Math. & Comp. Sci., Coll. of Arts & Sciences, Valdosta, GA 31698-0040, jwang@valdosta.edu, C.-X. Feng

We discuss the problem of estimating the parameters of a life distribution when observations are always censored by a random variable which is independent of the lifetime. Sufficient conditions are found to ensure that the MLEs are strongly consistent. Application is made to usual life distributions.

2) Group Replacement Policies for Unreliable Queuing Systems, Gia-Shie Liu, Case Western Reserve Univ., 26151 Lakeshore Blvd., # 306, Euclid, OH 44132, gx123@po.cwru.edu, Apostolos N. Burnetas

We consider a queueing system with unreliable servers. There is a fixed cost of starting server repair and a holding cost associated with customer delays. We prove that the optimal group replacement policy is characterized by thresholds on the number of customers in the system.

3) Mission Reliability of an Automatic Control System Integrated with Distributed Intelligent Built-In-Test Systems, Wang-jin Yoo, Kunkuk University, Dept. of IE, Seoul, Korea, Kyung-Hee Jung

We introduce distributed-centralized BIT systems interfaced with an automatic control system. By using a block diagramming method, a complicated system is decomposed into mutually exclusive subsystems. The data produced by distributed BITs is sent to a central control processor. We present a Markov process approach to derive the mission reliability of an automatic control fault-tolerant system with distributed BITs.

4) Robust Parameter Estimation for the Mixed Weibull, Albert H. Moore, AFIT/ENC, 2950 P St., Bldg. 640, WPAFB, OH 54533, Donald A. Mumford, Edward A. Pohl

Robust parameter estimation is successfully applied to the mixed Weibull (7 parameters) using the method of maximum likelihood and minimum distance estimation. Sample sizes as low as 10 with mixing proportions down to 0.1 are investigated. Minimum distance estimates for the mixing proportion were found to be very effective.

WA26 Nonlinear Programming

Contributed Session

Chair: Mark J. Kaiser, Wichita State Univ., Dept. of Ind. & Mfg. Eng., Wichita, KS 67260, kaiser@ie.twsu.edu

1) Beautiful Blobs (Or, the Shapes of the Future are Here!), Mark J. Kaiser, Wichita State Univ., Dept. of Ind. & Mfg. Eng., Wichita, KS 67260, kaiser@ie.twsu.edu

A general framework and methodology for the creation of shape is outlined. The introduction of several new classes of objects, shape operators and the development of a generalized shape construction are presented. The formulation of natural extremal problems associated with the geometric structures are solved using numerical optimization techniques.

2) On the Local Convergence of a Predictor-Corrector Method for Semidefinite Programming, Jun Ji, Valdosta State Univ., Dept. of Math. & CS, Valdosta, GA 31698, junji@valdosta.edu, Florian A. Potra, Rongqin Sheng

We study the local convergence of a predictor-corrector algorithm for semidefinite programming problems based on the NZ unified direction whose polynomial convergence was recently established by Monteiro. We prove that the sufficient condition for superlinear convergence of Potra & Sheng applies to this algorithm and is independent of the scaling matrices...

3) Applications of Generalized Multiplicative Programming & Its Variants, Hong S. Ryoo, Univ. of IL, Dept. of Mech. & IE, 1206 W Green St., Urbana, IL 61801, ryoo@archimedes.me.uiuc.edu, Nick Sahinidis

GLMP and its variants have a variety of applications in multiple objective decision making problems and pattern recognition. We present extensive computational results with a global optimization algorithm for GLMP on the above applications.

4) Finding Globally-Convergent Trajectories in Nonconvex Large-Scale Optimization, Dimitris I. Tsoutsias, SABRE Dec. Tech., 1E Kirkwood Blvd., MD 7390 TSG, Southlake, TX 76092, dimitris@sdt.com

A novel framework for solving large-scale continuous formulations of discrete optimization problems is proposed. Globally-convergent trajectories of nonlinear nonconvex objective functions are computed by combining several techniques: deterministic annealing, multiscale optimization, attentional mechanisms and trust-region methods...

WA27 Neural Networks

Contributed Session

Chair: Patrick J. Lyons, St. John's Univ., Dept. of Mgmt., 214-56 32 Rd., Bayside, NY 11361-1605, lyonsp@stjohns.edu

1) Using the EXCEL Solver to Train Robust Neural Networks, Patrick J. Lyons, St. John's Univ., Dept. of Mgmt., 214-56 32 Rd., Bayside, NY 11361-1605, lyonsp@stjohns.edu

When using traditional algorithms to train neural networks, overtraining frequently occurs. This usually happens when several weights become large in absolute value. In biological systems, the strength of the connection is restricted by physical limitations. We introduce analogous models, which can be trained with the EXCEL solver.

2) Classifying Pilot Workload Using Artificial Neural Networks, Kelly A. Greene, AFIT, AFIT/EN034, 2950 P St., WPAFB, OH 45433-7765, kagreen@afit.af.mil, Kenneth W. Bauer, Jr.

We summarize research to date on classifying pilot workload via ANNs. Input features include EEG, heart rate, breathing rate and number of eye blinks. Efforts to use feedforward neural networks and recurrent neural networks will also be discussed.

3) Auto-Learning Approaches for Vendor Rating, Shashi Kaparthi, Univ. of Northern IA, Dept. of Mgmt., Cedar Falls, IA 50614, kaparthi@uni.edu, Chandrasekhar Das

We test several auto-learning approaches such as rule-induction, neural networks and statistical methods for rating vendors for a large manufacturing

organization. The independent variables include cost, quality and delivery performance.

4) Neural Network for Flexible Flow Shop Scheduling, Hong Wang, OH State Univ., Fisher Coll. of Bus., 1775 College Rd., Columbus, OH 43210, wang.51@osu.edu, Varghese S. Jacob, David A. Schilling

The flexible flow shop problem is an NP-complete problem which requires scheduling n jobs on m machines in s stages, where machines are identical at each stage and different among stages. We propose a neural network approach to solve it. Results of the neural network implementation will be discussed.

5) A Quasi-Optimal Neural Network for Short-Term Load Forecasting, M. Hisham Choueiki, Kuwait Univ., Dept. of Mech. & IE, PO Box 5969, Safat, 13060, Kuwait, choueiki@kuc01.kuniv.edu.kw

The ability to solve the short-term load forecasting problem with neural networks is investigated by conducting a fractional factorial experiment. The results of the experiment are analyzed and factors and factor interactions that affect the forecast errors are identified and quantified. From the analysis, we derive rules for building a quasi-optimal neural network to solve the specific problem.

WA28 Integer Programming II

Contributed Session

Chair: Roger B. Grinde, UNH, Dec. Sci. Dept., 15 College Rd., McConnell Hall, Durham, NH 03824, roger.grinde@unh.edu

1) A Generalized Maximum Cover Problem: Motivation, Formulation & Solution, Roger B. Grinde, UNH, Dec. Sci. Dept., 15 College Rd., McConnell Hall, Durham, NH 03824, roger.grinde@unh.edu, Karen Daniels

We present a generalization of the maximum cover location problem and a heuristic for its solution. Motivated by trim placement research in apparel manufacturing, we also illustrate how the formulation can be used to address generalized forms of the list selection and reserve selection problems from the literature.

2) Set Covering Approach to Process Network Synthesis, Ferenc Friedler, Univ. of Veszprem, Dept. of Comp. Sci., Egyetem u.10, Veszprem, H-8200, Hungary, friedler@des.vein.hu, Janos Fulop, Balazs Imreh

PNS is a fundamental problem in designing processing systems. In spite of its importance, the sizes of the solvable problems are very limited as a consequence of the complexity. The PNS problems of non-negative fixed charges are reformulated as set covering problems and compared to other combinatorial approaches.

3) On the Use of Primal-Dual Interior Point Method to Solve a Class of Mixed Integer Programming Problems, Cassandra M. McZeal, Rice Univ., 8299 Cambridge #203, Houston, TX 77054, cmooore@rice.edu

We study the use of a primal-dual interior point method in a B&C algorithm to solve a class of 0-1 MIP problems originating from the railroad industry.

4) Solving Mixed-Integer Linear Programs with General Integer Variables, Jonathan H. Owen, Northwestern Univ., Dept. of IE/MS, 2225 N Campus Dr., Evanston, IL 60208-3119, owenj@iems.nwu.edu, Sanjay Mehrotra

Recently, advances have been made for solving MILPs with binary variables using disjunctive programming. We present work towards developing a similar solution approach for MILPs with general integer variables. We compare the performance of 0-1 formulations of these problems with a direct solution approach.

WA29 Stochastic Optimization

Contributed Session

Chair: Golbon Zakeri, Univ. of Auckland, Dept. of Eng. Science, 20 Symonds St., Private Bag, Auckland, New Zealand, g.zakeri@auckland.ac.nz

1) Inexact Cuts in Benders' Decomposition, Golbon Zakeri, Univ. of Auckland, Dept. of Eng. Science, 20 Symonds St., Private Bag, Auckland, New Zealand, g.zakeri@auckland.ac.nz, Andrew Philpott, David M. Ryan

Benders' decomposition is a well-known technique for solving large LPs with a special structure. In particular, it is a popular technique for solving multi-stage stochastic LP problems. Early termination in the subproblems generated during Benders' decomposition (assuming dual feasibility) produces valid cuts which

are inexact in the sense that they aren't as constraining as cuts from an exact solution...

2) **An Adaptive Sampling-Based Algorithm for Integer 2-Stage Stochastic Programming**, *Julius Rachmanto*, Case Western Reserve Univ., 11457 Mayfield Rd., # 258, Cleveland, OH 44106, jjr6@po.cwru.edu, *Apostolos N. Burnetas, Kamlesh Mathur*

We present an iterative algorithm, motivated by adaptive sampling approach, for solving a 2-stage stochastic programming problem with discrete controls in the first stage. We also show that the method converges almost surely to a global optimum. Numerical applications are given for a class of stochastic VRPs.

3) **Solving Large-Scale Non-Linear Stochastic Network Problems**, *Chih-Hang Wu*, KS State Univ., 237 Durland Hall, Dept. of IMSE, Manhattan, KS 66506, chw@ksu.ksu.edu, *Toby Marks*

A new nested dual algorithm is proposed for solving large-scale portfolio management problems, which have been formulated as nonlinear, generalized stochastic networks with a quadratic objective function. In the past, solving realistic versions of these problems have shown that the proposed nested dual algorithm can handle large-scale problems on a PC...

WA31 Optimization/Complexity

Contributed Session

Chair: Kofi Kissi Dompere, Howard Univ., Dept. of Econ., Washington, DC 20059

1) **A Reformulation of the Conical Hull Problem in Multidimensional Space**, *Richard V. Helgason*, SMU, CSE Dept., Dallas, TX 75275, helgason@seas.smu.edu, *Jose H. Dula*

We present a new formulation of the conical hull problem which can be used in the efficient solution of computational geometry frame problems. Computational results will be given.

2) **Complexity of Integrated Location & Network Design Problems**, *Joyendu Bhadury*, Univ. of New Brunswick, Fac. of Admin., PO Box 4400, Fredericton, NB, E3B 5A3, Canada, bhaduryj@fac.fadmin.unb.ca, *L. P. Gewali, R. Chandrasekaran*

We consider some integrated models of location and network design. NP-hardness is proved for the basic problem and its variants.

3) **Polynomial-Time Dual Simplex Method for the Generalized Circulation Problem**, *Yang Xu*, Rutgers Univ., RUTCOR, PO Box 5062, New Brunswick, NJ 08903, xuyang@rutcor.rutgers.edu, *Ronald Armstrong*

We present a dual simple version of Goldfarb, Jin & Orlin's combinatorial algorithm for the generalized circulation problem. The algorithm uses node and arc excesses, strongly dual feasible tree and excess scaling to achieve the polynomial complexity.

4) **Clustering User Groups to Optimize Software Resource Requirements**, *Fan Tseng*, Univ. of AL, Dept. of Econ. & Finance, Huntsville, AL 35899, tsengf@email.uah.edu, *Chandrasekhar Das*

Given a number of user groups and their peak demand data - mean, variance and correlation of user requests for a particular software in a network, the problem is to create clusters of groups to minimize the number of software units needed for a given service level. This problem is solved using TS.

5) **Sensitivity of the Technical (LHS) Coefficients of Wagner's LP Regression Problem**, *John F. Wellington*, Capital Univ., Grad. Sch. of Admin., 2199 E Main St., Columbus, OH 43209-2394, runnerjohn@aol.com, *Subhash C. Narula*

The sensitivity of Wagner's LP formulation for estimating the unknown parameters of the MSAE linear regression model is discussed. A method for determining intervals for the technical LHS and RHS coefficients which maintain the optimality of the MSAE solution is proposed and illustrated with an example.

Wednesday 09:45-11:15

WB03 Transportation: Airline Industry

Contributed Session

Chair: Andrew I. Vakhutinsky, United Airlines, ISD R&D, 1200 E Algonquin Rd., Elk Grove, IL 60007, avakhutinsky@ual.com

1) **Over-Mountain Enroute Driftdown**, *Andrew I. Vakhutinsky*, United Airlines, ISD R&D, 1200 E Algonquin Rd., Elk Grove, IL 60007, avakhutinsky@ual.com, *Al J. Meilus, Amit S. Mukherjee, Baoxing Tang*

To comply with FAR 121.191, some 2-engine aircraft must provide a

contingency plan. The plan assumes one engine will fail enroute and either imposes weights limit to guarantee terrain clearance or requires listing reachable alternate stations along the route. We describe a means of computing both methods.

2) **Blocked Seats Allocation for Airlines**, *P. R. Narayanan*, PROS Strategic Solutions, Inc., 3323 Smith St., Ste. 100, Houston, TX 77006, pr@pros.prosx.com

Airlines allocate seats as blocks for various itineraries 6 months or 1 year in advance. Given the price, it is required to calculate the number of seats offered for each itinerary. We discuss the business considerations and a mathematical model for solving the problem.

3) **The Traffic Flow Management Rerouting Problem in Air Traffic Control: A Dynamic Network Flow Approach**, *Sarah A. Stock Patterson*, MIT, 1 Amherst St., Rm. E40-135, Cambridge, MA 02139, sstock@mit.edu, *Dimitris Bertsimas*

We address the problem of dynamically rerouting aircraft in the air traffic system in order to avoid low capacity airspace regions. The problem is formulated as a dynamic, multicommodity, integer network flow problem with side constraints and we use an approach termed the Lagrangian generation algorithm to solve real problems.

4) **Handling Random Delays in Airline Crew Scheduling**, *Joyce W. Yen*, Univ. of MI, 2828 IOE, 1205 Beal Ave., Ann Arbor, MI 48109-2117, jyen@engin.umich.edu, *John R. Birge*

Airline crew scheduling has been widely studied. However, random delay effects have yet to be included in crew scheduling algorithms. We examine current solution methods for crew scheduling, consider potential methods for handling random delays in an effective manner and identify problems which arise when considering random delays.

WB04 Advancing Military Science

Sponsor: Military Applications Society

Sponsored Session

Chair: Dean S. Hartley, III, Oak Ridge Ntl. Labs., 1099 Commerce Park, Ctr Modeling Simulation Gaming, Oak Ridge, TN 37830-8627, dhx@ornl.gov

1) **Statistical Perspective of Historical Analyses of Attrition Order**, *John P. Ballenger*, Raytheon Electronic Systems, Huntsville, AL 35803, jp_ballenger@raytheon.com

We present a statistical perspective of historical analyses of attrition order. Previous analyses have considered historical databases to examine the calculation of Lanchester attrition order. We examine the statistical significance of findings from these previous analyses.

2) **Interdicting a Repairable Transshipment Network**, *Dan Derbes*, Naval Postgrad. Sch., 582 A Michelson Rd., Monterey, CA 93940, hdderbes@nps.navy.mil

An interdictor attempts to disable components of an enemy's logistic network to decrease the enemy's combat potential. We interdict components to minimize the maximum time-weighted network flow subject to limited interdiction assets and while considering estimated repair times for interdicted components.

3) **Developing Psychopharmacology Algorithms**, *Dean S. Hartley, III*, Oak Ridge Ntl. Labs., 1099 Commerce Park, Ctr Modeling Simulation Gaming, Oak Ridge, TN 37830-8627, dhx@ornl.gov

Prescribing the correct medicine to alleviate psychiatric problems is not an exact science; however, there are algorithms that describe the current best practices. Communicating these algorithms to primary care physicians or lower echelon military doctors can save greatly in time and money.

WB05 Military Applications II

Contributed Session

Chair: David J. Rose, Naval Postgrad. Sch., Defense Resources Mgmt. Inst., 1522 Cunningham Rd., Monterey, CA 93943-5201, djrose@nps.navy.mil

1) **Managing Risk in Selecting Forces & Missions**, *David J. Rose*, Naval Postgrad. Sch., Defense Resources Mgmt. Inst., 1522 Cunningham Rd., Monterey, CA 93943-5201, djrose@nps.navy.mil

Defense missions are being expanded while resources are being reduced. It is important to understand the relationships among the mission portfolio, force structure and risk exposure. We illustrate these relationships with a multicriteria model of risk combined with a portfolio selection model.

2) **Efficient Distributions of Arms-Control Inspection Effort**, *Marc Kilgour*, Wilfrid Laurier Univ., Laurier Ctr. Mil. Strategy, Waterloo, Ontario, N2L 3C5, Canada, mkilgour@mach1.wlu.ca,

Rudolf Avenhaus

An inspector with fixed resources must ensure that potential violators respect certain rules. What level of resources is required to deter all violation, and how should resources be distributed over inspectees? Conclusions from game-theoretic models are applied to inspections supporting the Treaty on the Non-Proliferation of Nuclear Weapons.

3) **Navy Manpower Planning Tools**, *Rick Loffredo*, DynMeridian, 8996 Miramar Rd., Ste. 215, San Diego, CA 92126, rick@dyncorp-bksd.com, *Roy Jordan*, *Gary Ropp*

Navy community managers are responsible for the health and welfare of their respective communities. Various manpower database and planning tools are available to support community management responsibilities, such as school and advancement planning and inventory projection. Some of the current tools and plans for the future will be discussed.

4) **The Defense Acquisition Workforce Improvement Act (DAWIA) MIS**, *Sanjay Nayar*, DynMeridian, 8996 Miramar Rd., Ste. 215, San Diego, CA 92126, sanjay@dyncorp-bksd.com, *Gail Halkias*, *Anne Wahrenbrock*

We present a client-server DBMS designed to maintain detailed Navy acquisition personnel and position information. The data-driven system engine provides a powerful, flexible way to handle complex data domains and messy data. Expert acquisition knowledge embodied in easy-to-change mapping rules facilitates constant attention to data quality.

5) **Implementing Quality: When Fast Bad Changes Happen**, *Paulo A. Dasilva*, Military Inst. of Eng., Praca General Tiburcio, 80-DE/9-Urca, Rio de Janeiro, 22270-010, Brazil, paulo@ime.br

The Brazilian Army is implementing TQM, based on volunteerism. For this reason, a new Commandant can stop the program as it has occurred at the Military Institute of Engineer, technical consultant for the Army. We relate how the team's dismantling had an effect in the implementation.

WB06 Educational Technology**Contributed Session**

Chair: Edward T. Chen, Southeastern LA Univ., Box 350, Dept. of Mgmt., Hammond, LA 70402, echen@selu.edu

1) **Instructional Technology Resources for Teaching Statistics**, *Rob R. Weitz*, Seton Hall Univ., Stillman Sch. of Bus., South Orange, NJ 07079, weitzrob@lanmail.shu.edu

We provide a survey of instructional technologies applied to the teaching of introductory statistics. We will outline and provide references to web-based resources, commercially available products and current research in intelligent tutoring systems.

2) **Educating Systems-Engineering Policy-Analysts in Hypermedia**, *Giampiero E. G. Beroggi*, Delft Univ. of Tech., PO Box 5015, Delft, 2600 GA, The Netherlands, beroggi@sepa.tudelft.nl

The education of systems-engineering policy analysts requires a blending of problem solving capacity, theory and ISs. A hypermedia-based visual interactive decision modeling approach is discussed from the point of view of educator, student and practitioner. Experience and empirical evidence of using this approach are reported.

3) **Planning a Technology Infrastructure to Reengineer Business Education**, *Edward T. Chen*, Southeastern LA Univ., Box 350, Dept. of Mgmt., Hammond, LA 70402, echen@selu.edu

With the advance of Internet services, educators are going to incorporate technology as an integrated aspect of classroom instruction. A technology infrastructure must be in place to provide the accessibility. We address issues of development and design of the technology infrastructure to reengineer business education.

4) **Using Commercial Modeling Software as a Learning Tool in the Introductory MBA Management Science Course**, *Matthew J. Liberatore*, Villanova Univ., 800 Lancaster Ave., Villanova, PA 19085, liberator@ucis.vill.edu, *Robert L. Nydick*

Our MBA MS course has evolved into a 3-module sequence, each of which is supported by a software package: mathematical programming (LINGO), DA (Expert Choice) and simulation (Extend). We describe our successful experiences using commercial modeling software as a learning tool vs. spreadsheets.

WB07 Flexible Manufacturing**Contributed Session**

Chair: Nico Vandaele, Univ. of Antwerp, UFSIA-TEW, Prinsstraat 13, Antwerp, 2000, Belgium, nico.vandaele@ufsia.ac.be

1) **Batching for Mixed Model Production Lines**, *Nico Vandaele*, Univ. of Antwerp, UFSIA-TEW, Prinsstraat 13, Antwerp, 2000, Belgium, nico.vandaele@ufsia.ac.be, *Carlos Ocampo y Vilas*

We use an approximate queueing network model to analyze mixed model production lines. The objective is to decide on the batch size in order to minimize average product lead times. Effects studied include: setup times, product mix, capacity changes, demand fluctuations, uncertainty reduction, line (un)balancing, line length and product heterogeneity.

2) **An Expert System for Designing Flexible Manufacturing Systems**, *H. Felix Lee*, Southern IL Univ., IE Dept., Box 1805, Edwardsville, IL 62026-1805, hflee@siue.edu

We present a rule-based expert system that assists FMS designers in determining key resource parameters for FMSs. This expert system uses simulation to evaluate particular FMS designs and suggests recommendations for improving them. The system is user-friendly, automatically generates simulation codes and make iterations easy.

3) **Operations Sequence-Based Cell Formation for Multi-Product Flow Line**, *Yi Xu*, LA State Univ., Dept. of IE, Baton Rouge, LA 70803, xuyi@unix1.sncc.lsu.edu, *Bhaba R. Sarker*, *Zhiqiang Li*

Operations sequence plays an important role in the WIP movement in a manufacturing cell. The operation sequence-based part family for a cell has an overwhelming influence on the grouping of machines. A heuristic procedure is developed to minimize cost incurred due to the WIP movement and machine investment.

4) **Cell Formation with Alternative Routings for Multiple Products**, *Zhiqiang Li*, LA State Univ., Dept. of IE, Baton Rouge, LA 70803, zli@unix1.sncc.lsu.edu, *Bhaba R. Sarker*, *Yi Xu*

Jobs with alternative routings may cost differently depending on the routes and machine cells. A routing coefficient depending on the operations sequences is developed to form machine cells for processing multiple products with alternative routings. Results are demonstrated to compare with the traditional approaches.

5) **Engineering-Economics of Health Care Technology**, *Arun Kumar*, Montclair State Univ., Info. & Dec. Sci. Dept., Upper Montclair, NJ 07043, kumara@saturm.montclair.edu, *Zhongxian Wang*, *Qiyang Chen*

Health care represents a major sector of the GNP and is very much technology driven. This presentation focuses on a large variety of health care technologies. Engineering economy evaluates the monetary consequences of the health care technology and makes decisions by balancing expenses and revenues that occur now and in the future.

WB08 Manufacturing Control**Contributed Session**

Chair: James D. Blocher, IN Univ., Sch. of Bus., 10th & Fee Ln., Bloomington, IN 47405, dblocher@indiana.edu

1) **Throughput Time Reduction: Taking One's Medicine**, *James D. Blocher*, IN Univ., Sch. of Bus., 10th & Fee Ln., Bloomington, IN 47405, dblocher@indiana.edu, *Richard W. Garrett*, *Roger W. Schmenner*

Manufacturing contributes to a firm's competitiveness by carefully managing the product flow through the value chain in faster and more consistent ways. Managing throughput time and its relation to WIP inventory and customer service is our focus. Results show that production control decisions can lead to a vicious circle of increased levels of WIP and unpredictable throughput.

2) **Developing an Object-Oriented Simulator for CIM SW**, *Jin Jun*, Korea Univ., 1, 5-Ga Anam-Dong, Sungbuk-Gu, Seoul, 136-701, Korea, junjin@kucn.korea.ac.kr, *Chang-Ouk Kim*, *Sung-Shick Kim*

We developed an object-oriented simulator for verifying the practicality of CIM SW. The simulator is composed of virtual factory and virtual MES. The virtual factory can be customized easily through GUI and the virtual MES couples with appropriate CIM SW function or DB tuple.

3) **Development of Hierarchical Manufacturing Control S/W Using Object-Oriented Methodologies & Common Object Request Broker Architecture**, *Jun-Geol Baek*, Korea Univ., 1, 5-Ga, Anam-Dong, Sungbuk-Gu, Seoul, 136-701, Korea, jgbaek@kucn.korea.ac.kr, *Chang-Ouk Kim*, *Sung-Shick Kim*

We build a reusable hierarchical manufacturing control S/W using the following

techniques: object-oriented design techniques for software reusability, CORBA scheme for communication between distributed objects and workflow methods for automatically executing interrelated objects.

4) Completed Prototype of Fault-Tolerance Scheduling System, Viroj Buraparate, TX Tech. Univ., 4602 54th St., Apt. 222, Lubbock, TX 79414, atvrb@ttacs.ttu.edu, Surya D. Liman

The completed prototype of FTS and details on the design of preferred rule matrix, job characteristics detecting scheme and warning scheme will be presented. The statistics comparison between 4 performance measures obtained from FTS vs. 4 traditional dispatching rules under a simulated 6-machine job shop will be discussed.

WB09 Queuing/Inventory II

Contributed Session

Chair: Prakash L. Abad, McMaster Univer., 1280 Main St. W, Hamilton, Ontario, L8S 4M4, Canada, abad@mcmaster.ca

1) Determination of the Economic Production Quantity Under Conditions of Perishability & Partial Backordering, Prakash L. Abad, McMaster Univer., 1280 Main St. W, Hamilton, Ontario, L8S 4M4, Canada, abad@mcmaster.ca

We consider a product having a general deteriorating function and a finite production rate. We develop an exact procedure for determining the EPQ for this general case. We then extend the basic model to include the case of partial backordering.

2) A Stochastic Inventory Model with Return Policies, Dirk M. Beyer, Univ. of Toronto, Fac. of Mgmt., 105 St. George St., Toronto, Ontario, M5S 3E6, Canada, beyer@fmgmt.mgmt.utoronto.ca, Jose Beltran, Dmitry Krass, Sridhar Ramaswamy

Return policies, i.e., the right of the customer to return a product for refund, are very common in the North American retail sector. We investigate the structure of optimal policies for a 1-product inventory model with returns depending on the previous period's sales and partial backlog. In particular, the optimality of (s-S)-strategies with respect to inventory after returns is proved.

3) Inventory Management at a Service Facility: The Infinite Service Capacity Case, Eunghab Kim, Univ. of Toronto, 105 St. George St., Fac. of Mgmt., Toronto, Ontario, M5S 2H8, Canada, ekim@fmgmt.mgmt.utoronto.ca, Oded Berman

We consider a facility that provides service to customers using items of inventory. Customers arrive at the facility as a Poisson process and the service provided is exponentially distributed. An optimal policy is characterized and heuristics presented.

4) An (s,Q) Inventory System with Staggered Deliveries, Grace Chong, Bank of Montreal, MS Group, EBS, 3300 Bloor St. W, 6th Fl., Toronto, Ontario, M8X 2X3, Canada, S. H. Sim

We discuss an (s,Q) inventory system with staggered deliveries. Mean-value analysis is used to derive an analytical formula for the average inventory level. A Markov model is formulated and solved recursively to obtain system performance measures. A cost minimization model is then formulated and solved.

WB10 Multimodal Transportation Project Section

Sponsor: Transportation Science Section

Sponsored Session

Chair: Ron Hagquist, TxDOT, 125 E 11th St., Austin, TX 78701, rhagquis@mailgw.dot.state.tx.us

1) The State of the Art in Multimodal Transportation Project Selection, Ron Hagquist, TxDOT, 125 E 11th St., Austin, TX 78701, rhagquis@mailgw.dot.state.tx.us

The Intermodal Surface Transportation Act mandated that state DOTs give more consideration to multimodal transportation options in their planning. Each mode, i.e., car, bus, light rail, etc., has unique attributes which must be considered when evaluating alternative projects. The states have taken a variety of approaches to this difficult problem.

2) Elicitation & Comparison of Public Sector Agency Decision-Maker Preferences for Multimodal Strategic Project Selection, Jack Foster, TxDOT, 125 E 11th St., Austin, TX 78701, Hani S. Mahmassani

Resource allocation decisions among and within several models of transportation must be made in light of TxDOT's strategic mission and plan. Preferences of several TxDOT decision makers regarding trade-offs among various policy objectives and various transportation modes were assessed using the AHP embedded in a multi-stage framework.

3) Use of Data Envelopment Analysis for Multimodal Project Selection, Jim Storbeck, Magellan Group, PO Box 1510, Blanco, TX 78606, storbeck@texanet.net

Transportation encompasses many objectives such as mobility, safety and preservation - and each of these is comprised of many subobjectives. This is reflected in the process of project selection as multiple criteria. However, this multiplicity causes problems with both comprehension and computation. DEA is a new form of benefit/cost analysis specifically designed to handle such multiple criteria.

4) Linear Programming Approach to the Capital Rationing Problem in Transportation, Zelda Zabinsky, Univ. of WA, Dept. of IE, Box 352650, Seattle, WA 98195-2650, zelda@u.washington.edu, Debbie Niemeier

State transportation agencies must select projects for funding. We present the theoretical LP framework for identifying the optimal set of projects maximizing net present value to cost ratio under budget constraints and demonstrate the magnitude of differences between optimal project sets and a simple rank ordering of NPV/C.

WB12 Management

Contributed Session

Chair: Gene Murkison, GA Southern Univ., Dept. of Mgmt., Business Sch., Statesboro, GA 30460-8152, murkison@gsvms2.cc.gasou.edu

1) Adapting the Organizational Citizenship Behavior Research in Romania, Gene Murkison, GA Southern Univ., Dept. of Mgmt., Business Sch., Statesboro, GA 30460-8152, murkison@gsvms2.cc.gasou.edu, Gheorghe Ionescu

The OCB questionnaire was translated into Romanian and administered to a large sample of business and government employees. Authors double and back translated to insure accuracy of transfer. Comparisons between Romanian and US students, manufacturing employees and city workers are reported. Future research directions are suggested.

2) Trustomership: Incorporating Trust in a Model of Market Economy, L. L. Jayaraman, Montclair State Univ., Sch. of Bus. Admin., PA 433, Upper Montclair, NJ 07043, jayaraman@saturn.montclair.edu

Teachers, lawyers, doctors and business people are expected to act in the best interests of those they serve. In each case, the asymmetry of expertise (the ability to make informed choice) is explicitly admitted as a factor in the transaction. How does the imbalance in information affect the transaction between the parties, including pricing of services?...

WB14 PANEL: The International Aspects of Systems for Recoverable Products

Cluster: Recoverable Product Environments

Invited Session

Chair: V. Daniel R. Guide, Jr., Suffolk Univ., Mgmt. Dept. Sawyer Sch. Mgmt., 8 Ashburton Pl., Boston, MA 02108-2770, dguide@suffolk.edu

1) PANEL: The International Aspects of Systems for Recoverable Products, W. C. Benton, OH State Univ., benton1@osu.edu, Rommert Dekker, Erasmus Univ. Rotterdam, Luk N. Van Wassenhove, INSEAD, Karl Inderfurth, Univ. of Magdeburg

There is a growing interest in systems which support the concept of sustainable development and are environmentally conscious. We discuss trends in academic research and industry in Europe and the US in systems for recoverable products.

WB15 Management of Technology II

Contributed Session

Chair: Longy O. Anyanwu, 19 Julia Terrace, Dover, NJ 07801

1) Strategic Technology Outsourcing as a Competitive Advantage, Un-Seog Lee, POSCO Research Inst., Sam-Tan Bldg., 947-7 Daechi-Dong, Kangnam-Ku, Seoul, 135-280, Korea, uslee@mail.posri.re.kr, Kyung-Hee Jung, Kidae Chung

We define main considerations in strategic technology outsourcing and describe how they are contributed as a corporate competitive advantage.

2) A Mental Model's Approach Applied to R&D Decision Making: Project Selection in the Steel Industry, David M. Vislosky, Carnegie Mellon Univ., 5526 Fair Oaks #1, Pittsburgh, PA 15217,

visco@cmu.edu, *Paul S. Fischbeck, Wesley M. Cohen*

An empirical methodology is developed to systematically map an organization's R&D project-selection decision process from the cognitive beliefs of its key decision makers. Respondents' revealed decision-criteria maps are judged against a rational-normative model to reveal systematic departures from rational choice. The methodology is demonstrated within an industrial R&D organization.

3) Development of a Technology Audit Framework, Douglas I. Sparkes, Univ. of Waterloo, Dept. of MS, CPH 4326, Waterloo, Ontario, N2L 3G1, Canada, *disparke@mansi.watstar.uwaterloo.ca, Paul D. Guild*

The technology audit provides a firm with valuable information when undertaking strategic planning. It provides a vehicle for assessing the relationship between a venture's products and its present technology base. We present a general overview of the technology audit as well as a procedural framework.

4) Impact Analysis of Technological Innovation on the Accounting Process in a Small Business, Longy O. Anyanwu, 19 Julia Terrace, Dover, NJ 07801

The strategic bid to keep up with technological advances is necessary for businesses. So has it become an imperative for a small real estate company in New Jersey. We present an in-depth study of the impact of technological innovations on the accounting process at North Jersey Property Brokers, Inc.

WB16 Marketing Consumer Choice

Contributed Session

Chair: Ashish Sinha, Univ. of Waikato, Private Bag 3105, Hamilton, New Zealand, *asinha@waikato.ac.nz*

1) A Procedural Model of Consumer Choice, Ashish Sinha, Univ. of Waikato, Private Bag 3105, Hamilton, New Zealand, *asinha@waikato.ac.nz*

A dynamic brand choice model is proposed that explicitly assumes the computational limitations of consumers. The basic premise is that attention is a scarce resource. A probabilistic activation function is used to implement the construct of attention into formal models of choice. Scanner data is used for model testing. Comparisons are made to current models.

2) Investigating the Influence of Brand Attitudes on Consumer Variety Seeking Behavior, Subir Bandyopadhyay, McGill Univ., Fac. of Mgmt., 1001 Sherbrooke St W, Montreal, Quebec, H3A 1G5, Canada, *Kunal Gupta*

Marketing literature on brand switching generally treats consumer brand loyalty and variety seeking as behavioral phenomena. We argue that consumer brand switching behavior is not only influenced by the marketing mix but also by the attitude towards the competing brands. Using extensive survey data, we demonstrate that the loyal customers have consistently high scores at the attitudinal level...

3) Combining Stated & Revealed Preferences: A Bayesian Analysis of Customer Shopping Mall Choice, Peter T. L. Popkowski Leszczyc, Univ. of Alberta, Dept. of Mktg. & Econ Analysis, 4-30F Fac. of Bus. Bldg., Edmonton, Alberta, T6G 2R6, Canada, *ppopkows@gpu.srv.ualberta.ca, Ashish Sinha, Harry Timmermans*

We propose a novel Bayesian multinomial logit model of consumer (revealed) choices of shopping mall choice and incorporate stated preferences, through the usage of informative priors. Data on consumer shopping behavior is obtained from personal interviews, while stated preferences are obtained using a conjoint study.

4) On Using Markov Chains for Predicting Brand Choice Selection, Chaim M. Ehrman, Loyola Univ., 820 N Michigan Ave., Chicago, IL 60611, *Gerald Funk*

Markov chains have been used to predict brand choice behavior, especially for low involvement goods. A prerequisite is that the transition matrix must be known. We derive the transition matrix using past purchase behavior. Mathematical derivations as well as illustrations will be given.

WB20 Simulation Optimization

Contributed Session

Chair: Leyuan Shi, Univ. of WI, Dept. of IE, 1513 University Ave., Rm. 266E, Madison, WI 53706-1572

1) Stopping Criterion for the Nested Partitions Method for Stochastic Optimization, Leyuan Shi, Univ. of WI, Dept. of IE, 1513 University Ave., Rm. 266E, Madison, WI 53706-1572, *Sigurdur Olafsson*

We investigate the convergence properties of a recently developed method for stochastic optimization, the nested partitions methods. This is known to generate a Markov chain and converge asymptotically to a global optimum. We use the Markov model to develop a stopping criterion that is easily applied using simulation.

2) A Modified Comparison Scheme for Discrete Stochastic Optimization Algorithms, Mohamed A. El-Wakeel, Kuwait Univ., Coll. of Sci., Dept. Stats/OR, PO Box 5969, Safat, 13060, Kuwait, *wakeel@kuc01.kuiv.edu.kw*

We develop a new iterative search procedure for solving discrete simulation-based optimization problems. We present empirical results that illustrate the performance of our method. The modified comparison scheme shows better performance than the existing schemes.

3) A Reinforcement Learning Algorithm for Semi-Markov Decision Problems, Tapas K. Das, Univ. of South FL, Dept. of IMSE, ENB 118, Tampa, FL 33620-5350, *das@eng.usf.edu, Abhijit Gosavi*

Optimal seeking algorithms for large-scale SMPDs, such as value and policy iterations, suffer from the curses of dimensionality and modeling. We present computer simulation-based reinforcement learning algorithms and discuss results from a maintenance scheduling problem.

4) Necessary Conditions for Multiple Response Surface Optimization, Robert L. Armacost, Univ. of Central FL, Dept. of IE & Mgmt. Systems, PO Box 162450, Orlando, FL 32816-2450, *armacost@ucf.edu, Deborah M. Osborne, Julia J. Pet-Edwards*

We identify assumptions and conditions necessary for the use of combined methodologies for response surface optimization using multiple objectives. The resulting necessary conditions are developed in a DA framework based on vector optimization approaches. Examples are included.

WB21 Theoretical Foundations of MMT XV

Cluster: Management of Medical Technology

Invited Session

Chair: Gary R. Douglass, John Hunter Hosp., Hunter Area Pathology Service, Locked Bag No. 1, Newcastle NSW, 2310, Australia

1) The Effect of Macro-Environmental Variables on Leader Behavior in Clinical Pathology Laboratories, James Wood, Monash Univ., Monash Mt. Eliza Bus. Sch., Box 2224 Level 6 Chisholm Twr., Caulfield Junction, Australia, *Gary R. Douglass*

The effect of macro-environmental variables, general environment, context (size and technology) and structure upon leader behaviors, discretionary leadership and required leadership were analyzed in 74 clinical pathology laboratories in NSW and ACT, Australia. The study showed that as macro-environmental complexity increased, more discretion was needed to bridge the gap between predicted and real outcomes.

2) The Early Adoption & Diffusion of Medical Technology: Impelling Factors & Consequences, David Ahlstrom, NYU, Stern Sch. of Bus., Tisch Hall, Mgmt. Dept., 40 W 4th St., New York, NY 10012

Numerous advances in medical technology have been made during the 20th century. It is often argued that technologies diffuse by rational, scientific processes. Certain technologies, however, often diffuse before being formally assessed. An awareness of associated costs is needed. We highlight forces behind early adoption and address the consequences.

3) Managing the Safety of Medical Technologies: A Study in the Social Construction of Hazards, Michal Tamuz, Univ. of TX, Sch. of Public Health, 1200 Herman Pressler St., W230, Houston, TX 77030, *tamuz@utsph.sph.uth.tmc.edu*

Organizations tend to reduce the hazards of using medical technologies, but management methods designed to improve safety may undermine them. Specifically, using examples from the blood bank and medical devices industries, we show how organizations define and categorize hazard influences to identify deficiencies in product designs or procedures before they result in harm.

WB25 Process Improvement/Quality Control

Contributed Session

Chair: Chandrasekhar Das, Univ. of Northern IA, Dept. of Mgmt., Cedar Falls, IA 50614-0125, *das@uni.edu*

1) A DSS for Economic Design of X-Bar Control Charts, Chandrasekhar Das, Univ. of Northern IA, Dept. of Mgmt., Cedar Falls, IA 50614-0125, *das@uni.edu*

Determining sampling scheme parameters (n,h,k) for given performance measures is very complex by analytical methods. We develop a prototype decision system that uses computational means for the purpose.

2) Study of Florida Tech Freshmen Attrition (Phase I Report),
John J. Branard, FL Inst. of Tech., 1120 Old Parsonage Dr.,
 Merritt Island, FL 32952, **Eugenio Pichardo**, **Elijah Esemé**,
Frederick B. Buoni

This presentation aims to characterize major factors associated with Florida Tech's freshmen attrition, determine root causes for each factor and recommend process improvement related to individual root causes. The overall goal was to implement achievable, cost-effective process improvements which reduce Florida Tech's freshmen attrition rate.

3) An Optimized Scheme for the Design of Multivariate Control Charts with Multiple Control Regions, **Joel K. Jolayemi**, Univ. of Zululand, Private Bag X1001, KwaDlangezwa, 3886, South Africa, jkjolaye@pan.zululu.ac.za

We develop a model for the economic design of multivariate control charts with multiple control regions. When solved, the model produces the sample size, the sampling interval and the control limit constants for each control region. A computational method is developed for solving the model.

WB26 Dynamic Programming

Contributed Session

Chair: Young H. Chun, LA State Univ., 3190 CEBA Bldg.,
 Baton Rouge, LA 70803-6316, chun@unix1.sncc.lsu.edu

1) Optimal Timing of Buying & Selling an Asset in the Open Market, **Young H. Chun**, LA State Univ., 3190 CEBA Bldg., Baton Rouge, LA 70803-6316, chun@unix1.sncc.lsu.edu

Assuming that the market price is a random observation from a known distribution function, we consider the problem of buying an asset and selling it within a limited period of time. The optimal strategies maximize the present value of the expected profit. We also consider the infinite stage model where there are no time constraints.

2) Two-Person Zero-Sum Communicating Stochastic Games, **Zeynep Muge Avsar**, Rutgers University, IE Dept., PO Box 909,
 Brett & Bowser Rd., CoRE Bldg., Piscataway, NJ 08855-0909,
mavsar@rci.rutgers.edu, **Melike Baykal-Gursoy**

Two-person 0-sum communicating stochastic games with finite state-action spaces are considered under long-run average payoff criterion. An extension of Hoffman-Karp's algorithm is proposed to find optimal stationary strategies for communicating stochastic games that have optimal stationary strategies with a value independent of the initial state.

WB29 Stochastic Modeling & Analysis

Contributed Session

Chair: James L. Bander, Univ. of MI, IOE Bldg., 1205 Beal Ave., Ann Arbor, MI 48109-2140,
jim.bander@umich.edu

1) Solution Techniques for a Stochastic Shortest Path Problem,

James L. Bander, Univ. of MI, IOE Bldg., 1205 Beal Ave., Ann Arbor, MI 48109-2140, jim.bander@umich.edu, **Chelsea C. White**, **III**

We consider a variant of the shortest path problem in which the travel times along each arc are random variables whose distribution depends on the state of the network. The problem is formulated as a SMDP. We compare exact solution techniques to suboptimal designs.

2) A Probabilistic Analysis of the Generalized Assignment Problem, **Edwin Romeijn**, Erasmus Univ. Rotterdam, PO Box 1738, Rotterdam, 3000 DR, The Netherlands, e.romeijn@fac.fbk.eur.nl, **Nanda Piersma**

The GAP is studied under a probabilistic model for its cost and requirement parameters. A (tight) condition on the model ensuring feasibility (with probability 1) is derived. Under an additional condition, the normalized optimal value converges (with probability 1) to a constant.

3) Minimizing Weighted Squared Job Lateness in the Stochastic Single Machine Problem, **Hossein M. Soroush**, Kuwait Univ., Coll. of Sci., Dept. Stats./OR, PO Box 5969, Safat, 13060, Kuwait, hsoroush@kuc01.kuniv.edu.kw

We study a static single machine scheduling problem in which job processing times are stochastic, due-dates are distinct and deterministic and penalties are assessed for job earliness and tardiness. The objective is to determine an optimal sequence which minimizes the expected total weighted squared deviations of job completion times about their due-dates.

4) A Minimum Distance Parameter Estimation for the 3-Parameter Inverse Gaussian Distribution, **Ahmed M. M. Sultan**, Egyptian Air Force, Training Dept., 94 Wassef St. Ain Shams, Cairo, Egypt, **Albert H. Moore**

A technique is applied to estimate parameters of the 3-parameter inverse Gaussian distribution by minimizing the Cramer von Mises distance from a non-parametric density estimate and the parametric estimate at the order statistics. Maximum likelihood estimators were found and a comparison made with the new estimator. For different parameters of the true density, the new estimators were tested using a Monte Carlo experiment of size 1000...

Sunday 08:45-10:15

- SA01 PANEL: Reality of Implementing DDS-Critical Success Factors Associated with Customers, Data, Hardware, Training, Support
- SA02 TUTORIAL: OR Glue at the FAA - Making Good Decisions that Stick
- SA03 The Road to Free Flight
- SA04 Revolution in Military Affairs
- SA05 Decision Analysis & Finance
- SA06 EDUCATION TUTORIAL: Teaching Tips for New Teachers, or Just 'cuz You Know It Doesn't Mean You Can Teach It
- SA07 Supply Chain Management
- SA08 Cellular Manufacturing
- SA09 Flexible Manufacturing I
- SA10 Traffic Flow Theory
- SA11 Routing
- SA13 Managing Information Flows in the Product Development Process
- SA14 PANEL: Technology Transfer & the Military
- SA15 Perspectives on Knowledge Transfer
- SA16 PANEL: Dissertation Proposal Competition Awards
- SA17 AIDS Modeling I
- SA18 TUTORIAL: Data Envelopment Analysis - Theory, Methodology & Application
- SA20 Telecommunication Network Design
- SA21 Theoretical Foundations of MMT I
- SA23 Logistics & Supply Chain Management I
- SA25 Bayesian Diagnostics, Assessing Compatibility, Model Selection & Computation
- SA26 PANEL: The Importance of Student Chapters in Our Community
- SA27 Intelligent Heuristics in Logistics
- SA28 TUTORIAL: Lagrangean Relaxation, Extensions & Applications
- SA29 Nonlinear Programming Theory & Application
- SA30 Heuristics for Vehicle Routing & Transportation Problems I
- SA31 Boolean Combinatorics & Optimization
- SA32 Heuristic Approaches to Integer Network Problems

Sunday 10:30-12:00

- SB01 PANEL: Impact of Emerging Digital Technologies in OR/MS Applications
- SB02 TUTORIAL: Large-Scale Math Programming Computation with Applications in Airlines
- SB03 Free Flight - Implications for the Carriers
- SB04 Joint Warfare Systems I
- SB05 Copulas in Decision Analysis
- SB06 EDUCATION TUTORIAL: Marketing Engineering - Market Analysis & Planning in the Information Age
- SB07 Category Management
- SB08 Managing Information -Intensive Firms
- SB09 Flexible Manufacturing II
- SB10 Traffic Measurement & Estimation Algorithms
- SB11 TUTORIAL: Perspectives & Prospects in Time Constrained Routing
- SB13 Empirical Studies of Product Development
- SB14 Technology Transfer & NASA
- SB15 Strategic Dimensions of Technology Integration
- SB16 Strategy & Institutional Theory
- SB17 AIDS Modeling II
- SB18 Resource Sharing in DEA
- SB19 INFORMS New Member Welcome & INFORMS Meeting Orientation
- SB20 Database, Advertising & Economic Issues in Electronic Commerce I
- SB21 Theoretical Foundations of MMT II

- SB23 Logistics & Supply Chain Management II
- SB25 Adaptive Markov Decision Models in Reliability
- SB26 What's Hot in Operations Research
- SB27 Neural Networks & Tabu Search in Operations Research
- SB28 TUTORIAL: Projection & Inverse Projection in Linear Integer Optimization
- SB29 Theory of Error Bounds with Applications
- SB30 Heuristics for Vehicle Routing & Transportation Problems II
- SB31 Boolean Functions & Applications
- SB32 Modeling Environments for Combinatorial Optimization

Sunday 13:15-14:15

- SC37 BEALE KEYNOTE: Developments in OR/MS Increasing Both the Science & Impact of Industrial Maintenance Modeling
- SC38 EDELMAN KEYNOTE: Decision Support Scheduling Systems for SNCF

Sunday 14:45-16:15

- SD01 OR/MS Applications in the Energy Sector
- SD02 TUTORIAL: Revenue Management, OR at SABRE
- SD03 Airspace Models
- SD04 Joint Warfare Systems II
- SD05 Copula Applications in Decision & Risk Analysis
- SD06 EDUCATION TUTORIAL: Turning a Dud into a Winner
- SD07 Emergent Approaches to Production Line Management
- SD08 Planning for Producer & Consumer Flexibility
- SD09 Performance Analysis of Semiconductor Manufacturing Systems
- SD10 Freeway/Arterial Traffic Control
- SD11 Methods for Problem Representation in Routing & Scheduling I
- SD13 Issues in the Management of New Product Variety
- SD14 Technology Transfer & NIST
- SD15 Issues in Product Development & Design
- SD16 Strategy & Economics
- SD17 Economic & Efficiency Models of Health Care
- SD18 Resampling & Simulation Methods for DEA
- SD19 PANEL: George B. Dantzig Dissertation Award
- SD20 Database, Advertising & Economic Issues in Electronic Commerce II
- SD21 Theoretical Foundations of MMT III
- SD23 Logistics & Supply Chain Management III
- SD24 Finance
- SD25 Markov Chain Monte Carlo in Complex Problems
- SD26 Professional Program
- SD27 Computational Intelligence & Operations Research
- SD28 TUTORIAL: Computational Issues in Combinatorial Optimization
- SD29 Interior Point Methods for Nonlinear Programming
- SD30 Search Heuristics for Complex Systems
- SD31 Binary Optimization
- SD32 Interaction of Analytic Information Systems & Decision Technologies

Sunday 16:30-18:00

- SE01 OR/MS Applications in Manufacturing
- SE02 TUTORIAL: Real-Time, Mission-Critical Decision Support Systems for Controlling & Managing Airline Operations
- SE03 Operation Analysis & Performance Monitoring
- SE04 Future Air & Space Combat
- SE05 New Findings in Behavioral Decision Research: Implications for Decision Analysis
- SE06 Innovative Teaching with Spreadsheets
- SE07 Evaluating Production Schedules
- SE08 Product Variety & Store Choice

- SE09 Modeling of Semiconductor Manufacturing at Texas Instruments
- SE10 Network Traffic Control Algorithms
- SE11 Methods for Problem Representation in Routing & Scheduling II
- SE12 Large-Scale Supply Chains
- SE13 Models & Methods for Concurrent Engineering
- SE14 Financial Engineering
- SE15 Management of Risk in Complex Systems
- SE16 Strategy & Networks
- SE17 Quality & Productivity in Post-Acute & Long-Term Care
- SE18 Performance Measurement with DEA
- SE19 PANEL: Mentoring - How To Get It & How To Do It
- SE20 Integration Technology, Implications & Justifications
- SE21 Theoretical Foundations of MMT IV
- SE23 Logistics & Supply Chain Management VI
- SE24 Economics
- SE25 Recent Developments in Bayesian Modeling: Model Choice & Diagnostics
- SE26 Academic Program
- SE27 Generic Memory-Based Heuristic Search
- SE28 TUTORIAL: Heuristics for Discrete Optimization Problems
- SE29 Nonlinear Programming Algorithms & Applications
- SE30 Tabu Search for Difficult Scheduling & Routing Problems
- SE31 Network Design I
- SE32 Recent Developments in Logical Analysis of Data Methods & Applications

Monday 08:00-09:30

- MA01 OR/MS Applications in Passenger Rail
- MA02 Applications in Services
- MA03 Flight Planning
- MA04 Defense Enterprise Planning & Management
- MA05 Predicted vs. Experienced Utility
- MA06 Integrating Consulting & Teaching for OR Faculty: How & Why
- MA07 Production & Inventory Planning
- MA08 Strategic Considerations in Supply Chain Management & Product-Process Related Choices
- MA09 Modeling & Analysis of Semiconductor Manufacturing I
- MA10 Dynamic Traffic Assignment I: Network Stochasticity
- MA11 Fleet Management & Routing
- MA12 Management of Supply Chains
- MA13 Dew Product Development Process Perspectives
- MA14 Estimating Implied Probability Distributions from Option Prices
- MA15 Multicriteria Decision Making Involving Risk & Uncertainty
- MA16 Strategy & Technology
- MA17 Use of Expectations in Analysis of Quality of Care Data
- MA18 DEA Applications in Health Care
- MA19 TUTORIAL: Electronic Commerce
- MA20 Research Directions in Accounting Information Systems
- MA21 Theoretical Foundations of MMT V
- MA23 Logistics & Supply Chain Management V
- MA24 Advertising & Promotions
- MA25 Reliability Modeling & Bayesian Analysis
- MA26 Performance of Queueing Networks
- MA27 Theory & Applications of Genetic Algorithms
- MA28 TUTORIAL: Large-Scale Problem Reformulation
- MA29 TUTORIAL: Neural Networks & Linear Programming
- MA30 PANEL: The Future of Vehicle Routing Research
- MA31 Network Design II
- MA32 Case Studied I: Developing End-User Applications Using Optimization Modeling
- MA33 Software Demonstrations I

Monday 11:00-12:00

- MP37 PLENARY: Synergy for the 21st Century: Between Unstructured Problems & Management Planning & Controls

Monday 13:00-14:30

- MC01 Logistics & Automotive Support at Norfolk Southern Corporation
- MC02 Applications in Telecommunications
- MC03 What's Happening in Aviation OR?
- MC04 Tracking & Forecasting Defense Contractor Overhead Costs
- MC05 Decision Analysis Arcade
- MC06 VBA in OR/MS Education
- MC07 Stochastic Models of Supply Chains
- MC08 Yield Management, Inspection & Semiconductor Competitiveness
- MC09 Modeling & Analysis of Semiconductor Manufacturing II
- MC10 Developments in Urban Travel Forecasting Methods
- MC11 Dynamic Vehicle Dispatching
- MC12 Topics in Supply Chain Management
- MC13 New Developments in Integrated Product Development: Industrial & Academic Perspectives
- MC14 GARCH Models
- MC15 Emerging Issues in Management & Technology
- MC16 Strategy & Learning
- MC17 Health Care Applications
- MC18 PANEL: Applying DEA
- MC19 Electronic Commerce
- MC20 Software Process Improvement
- MC21 Theoretical Foundations of MMT VI
- MC23 Logistics & Supply Chain Management IV
- MC24 Marketing I
- MC25 Nonparametric Statistics in Marketing: Recent Developments
- MC26 Global Optimization
- MC27 Machine Learning in Manufacturing
- MC28 Production/Operations Management Applications
- MC29 Enhancement Techniques in Interior Point Methods
- MC30 Recent Developments in Production Scheduling I
- MC31 Heuristics for Scheduling
- MC32 Case Studied II: Developing End-User Applications Using Optimization Modeling
- MC33 Software Demonstrations II

Monday 14:45-16:15

- MD01 Assessing the Railroad Market
- MD02 Applications in Manufacturing & Process Industries
- MD03 Airline Yield Management I
- MD04 Issues in Air Force & Army Operations Modeling
- MD05 PANEL: teaching Multiobjective Decision Analysis
- MD06 PANEL: The Role of OR/MS in MBA Programs
- MD07 Recent Advances in Pull Systems
- MD08 Manufacturing Marketing Interfaces
- MD09 SRC/NSF Initiative: Operational Methods in Semiconductor Manufacturing
- MD10 Facilities Location
- MD11 In Tribute to Robert Herman
- MD12 Information Sharing in Supply Chains
- MD13 Warranty Issues in New Product Development
- MD14 Performance of Financial Institutions
- MD15 Contemporary Research in Technology & Innovation Management
- MD16 Computational Approaches to Strategy & Evolution
- MD17 Health Care Applications in Canada
- MD18 Quality Management I
- MD19 Intermediaries in Electronic Markets
- MD20 State-of-the-Art Information Technology Metrics

- MD21 Theoretical Foundations of MMT VII
- MD23 Decision Analysis I
- MD24 Marketing II
- MD25 Adaptive Maintenance Policies
- MD26 Performance Issues in Communication Networks
- MD27 Fuzzy Sets & Fuzzy Decision Systems
- MD28 Applications of Integer Programming in Scheduling
- MD29 Interior Point Methods for Mathematical Programming
- MD30 Recent Developments in Production Scheduling II
- MD31 Cooperative & Multithreaded Parallel Algorithms
- MD32 Case Studied III: Developing End-User Applications Using Optimization Modeling
- MD33 Software Demonstrations III

Monday 16:30-18:00

- ME01 Designing an Operating Plan to Respond to the Customer's Needs
- ME02 Applications in Semiconductor Manufacturing
- ME03 Yield Management User Interfaces
- ME04 TRAC-White Sands Military Applications
- ME05 Decision Analysis Society Awards Presentation
- ME06 EDUCATION TUTORIAL: Teaching Probabilistic Analysis
- ME07 Organization of Flexible Workers & Control of Queues
- ME08 Inventory Models & Management
- ME09 Planning & Control
- ME10 Facilities Layout
- ME11 In Tribute to Robert Herman
- ME12 The Role of Information in Multi-Echelon Systems
- ME13 Flexibility in Integrated Product Development
- ME14 Legal Issues in Energy Development
- ME15 PANEL: Lessons Learned from UT-Austin's Innovative MS Degree Program in Science & Technology Commercialization
- ME16 Advances in Understanding & Modeling the Random Component of Utility in Consumer Choice
- ME17 IS/OR/MS Applications in the Management of Technology in Health Care
- ME18 Quality Management II
- ME19 Economic Product Implications of Electronic Markets
- ME20 Information Systems Policies
- ME21 Theoretical Foundations of MMT VIII
- ME23 Decision Analysis II
- ME24 Consumer Behavior
- ME25 Modeling of Maintenance
- ME26 Stochastic Analysis of Computer & Communication Systems
- ME27 OR Models for Project Planning & Control
- ME28 Combinatorial Issues in Network Design & Air Traffic Control
- ME29 Convex & Semidefinite Optimization
- ME30 Resource Scheduling Using Auction & Bidding Models
- ME31 Routing
- ME32 Case Studied IV: Developing End-User Applications Using Simulation Modeling
- ME33 Software Demonstrations IV

Tuesday 08:00-09:30

- TA01 OR/MS Applications in the Travel Industry
- TA02 Applications in Airline Transportation
- TA03 Crew Planning & Management
- TA04 VERT Simulation in Program Management, Consulting & Teaching
- TA05 Advances in Decision Analysis Applications
- TA06 Industry Corner: What Do Employers or OR Graduates Think About OR Education
- TA07 Dynamic Resource Allocation in Production/Logistics
- TA08 New Developments in Supply-Chain Models
- TA09 Network Location Models

- TA10 Traffic Incident Detection & Management
- TA11 Activity-Based Analysis & Microsimulation in Transportation
- TA12 Operational Hedging & Flexibility Issues
- TA13 Concurrent Engineering Practices & Effectiveness
- TA14 Information Issues in Energy Development
- TA15 Agile Collaboration Through Integration of Technology, Process & People
- TA16 Promotional Strategies & Competition
- TA17 Transfer, Innovation & the Management of Technology in Health Care
- TA18 PANEL: Teaching Service Operations Management
- TA19 Strategic Internet & World Wide Web usage
- TA20 Application Assembly Using Object Components
- TA21 Theoretical Foundations of MMT IX
- TA22 Operations Management I
- TA23 Decision Analysis III
- TA24 Project Management
- TA25 Statistics in Medicine
- TA26 Queueing Networks
- TA27 Multiple Criteria Decision Making
- TA28 Integer Programming: Methods & Applications
- TA29 Recent Progress in the Practical Interior Point Methods
- TA30 Shop Scheduling: Algorithms & Complexity
- TA31 Combinatorics
- TA32 Computational Combinatorial Optimization
- TA33 Software Demonstrations V
- TA35 Machine Scheduling
- TA36 General Queueing

Tuesday 09:45-11:15

- TB01 OR/MS Applications in Airline Industry A
- TB02 Applications in the Automobile Industry
- TB03 Scheduling & Fleet Routing
- TB04 Task Force XXI Advanced Warfighting Experiment
- TB05 Asking the Right Questions: Pilot Models & Sensitivity Analysis
- TB06 Case Studies & Sponsored Projects in OR
- TB07 TUTORIAL: Set Partitioning, Linear Programming & Combinatorial Optimization in Supply Chain Management
- TB08 Production & Inventory Models
- TB09 Facility Location in a Stochastic Environment
- TB10 New Directions in Route Choice Modeling
- TB11 Transportation Routing & Location Problems
- TB12 Real Options in Operations Management
- TB13 New Product Development Process Perspectives
- TB14 Power Markets
- TB15 Project Scheduling
- TB16 Price Effects in Consumer Choice
- TB17 OR/MS in Health Care: Focus on the Year 2000 Computer Date Problem
- TB18 PANEL: Service Management Networking Workshop
- TB19 Consumer Perspectives in Electronic Commerce
- TB20 Recent Developments in Decision Support Systems
- TB21 Theoretical Foundations of MMT X
- TB22 Operations Management II
- TB23 Multicriteria Decision Problems
- TB24 Benchmarking
- TB25 TUTORIAL: Probability Models & Statistical Inference for Software Reliability
- TB26 Applied Probability & Telecommunication
- TB27 Interior Point Methods & Applications
- TB28 Integer Programming Applications in the High-Tech Industry
- TB29 Parallel & Supercomputing
- TB30 Scheduling Algorithms & Systems
- TB31 Vehicle Routing & Crew Scheduling
- TB32 Modeling Systems & Language
- TB33 Software Demonstrations VI

- TB35 Flowshop Scheduling
TB36 Queueing Models

Tuesday 11:30-12:30

- TP37 OMEGA RHO PLENARY: Expanding OR/MS to New dimensions of Use & Research - From "Ex Ante" Planning to "Ex Post Evaluation"

Tuesday 13:15-14:45

- TC01 OR/MS Applications in Airline Industry B
TC02 PANEL: Industry-University Research Consortia
TC03 Forecasting & Market Research
TC04 Complex Issues in Finance
TC05 Risks & Decision Making: Generic Models & Phenomena Across Cultures
TC06 Teaching the Practice of OR Using Cases & Projects
TC07 Theory in the Retail Industry
TC08 Inventory, Bargaining & Games
TC09 Continuous Location Problems
TC10 OR/MS in Public Transit
TC11 Dynamic Traffic Assignment II: Consistency Issues
TC12 Supply Chain Planning from a Software Perspective
TC13 Cross-Functional Problems in Product Line Selection
TC14 Decision & Risk Analysis in Environmental Remediation Technology Selection
TC15 Knowledge Management & Information Technology
TC16 Consumer Dynamic Choice Processes
TC17 Health Applications I
TC18 Forecasting Applications in New Jersey
TC20 Telecom Network Design
TC21 Theoretical Foundations of MMT XI
TC22 Operations Management III
TC23 Group Decision & Negotiation
TC24 Strategic Planning
TC25 Reliability Research
TC26 Global Optimization
TC27 Machine Learning Applications in Health Care
TC28 Integer Programming in Application
TC29 Stochastic Programming
TC30 Intelligent Scheduling Systems
TC31 TUTORIAL: Visualization Techniques for Optimization
TC32 Computer Applications
TC33 Software Demonstrations VII
TC35 Scheduling Algorithms
TC36 Traffic Control in Queueing Models

Tuesday 15:00-16:30

- TD01 OR/MS Applications in Logistics
TD02 Transportation Applications
TD03 Flexible Plant Layouts
TD04 Texas Instruments Contributed Session
TD05 Learning in Games & Choices
TD06 EDUCATION TUTORIAL: A Beginner's Guide to Using OR/MS Cases in the Classroom
TD07 Pricing Policies in the Retail Industry
TD08 User Competition Operations Management
TD09 Production & Scheduling
TD10 Transportation: Truck/Rail
TD11 Dynamic Traffic Assignment III: Distributed Schemes
TD12 Contractual Arrangements in Supply Chains
TD13 New Product Development I
TD14 Logistics Models for Recoverable Products
TD15 Technology Management & Sustainable Development
TD16 Shopping Basket Empirics
TD17 Health Applications II
TD18 Forecasting Applications in Transportation
TD19 Development & Application of Simulation Methods
TD20 Telecommunications
TD21 Theoretical Foundations of MMT XII

- TD22 Operations Management IV
TD23 Strategic Planning
TD24 Semiconductor Industries Applications
TD25 Reliability Engineering Research
TD26 Global Optimization Algorithms & Applications
TD27 Applications of AI Techniques
TD28 Interior Point Methods & Applications
TD29 PANEL: Parallel & Supercomputing
TD30 Scheduling
TD31 Combinatorial Methods
TD32 Decision Support Systems
TD33 Software Demonstrations VIII
TD35 Scheduling Applications I

Tuesday 16:45-18:15

- TE01 OR/MS Applications in the Food & Beverage Industry
TE02 Industrial Applications
TE03 Emerging Trends in Facility Layout & Material Handling
TE04 Cost & Performance
TE06 The Best OR/MS Cases
TE07 PANEL: Operations Practice in the Retail Industry
TE08 Manufacturing I
TE09 Production Planning
TE10 Traffic Network Assignment Algorithms & Path-Based Formulations
TE11 Intermodal Transportation Systems Management
TE12 Issues in Logistics
TE13 New Product Development II
TE14 Planning & Control Issues for Recoverable Manufacturing Systems
TE15 Organizational Theory/Management of Technology
TE16 Competitive Marketing Strategies
TE18 Planning & Forecasting
TE19 Advances in Simulation Sampling Techniques
TE20 Telecommunications Network: Pricing & Performance
TE21 Theoretical Foundations of MMT XIII
TE22 PANEL: Publication Strategies & Direction of IEE Transactions on Engineering Management
TE25 Reliability/Maintenance Modeling & Prediction
TE27 Optimization in Machine Learning
TE28 Integer Programming I
TE29 Stochastic Programming in Finance
TE30 Scheduling & Inventory
TE31 Network & Graphs
TE33 Software Demonstrations IX
TE35 Scheduling Applications II

Wednesday 08:00-09:30

- WA01 OR/MS Applications in Finance
WA02 Service Industry
WA03 Agile & Dynamic Facility Layout
WA04 Combat Modeling: Issues & Technology
WA05 Military Applications I
WA06 PANEL: Distance Learning - Experience is the Best Teacher
WA07 Queueing in Production Systems
WA08 Manufacturing II
WA09 Queueing/Inventory I
WA10 Transportation Policy, Evaluation & Design
WA12 Supply Chain Optimization
WA14 System Design Issues in Recoverable Manufacturing Systems
WA15 Management of Technology I
WA16 Brand Choice & Product Positioning
WA19 Sampling in Simulation
WA20 Simulation Applications
WA21 Theoretical Foundations of MMT XIV
WA22 Technology Management
WA25 Reliability

WA26 Nonlinear Programming
WA27 Neural Networks
WA28 Integer Programming II
WA29 Stochastic Optimization
WA31 Optimization/Complexity

Wednesday 09:45-11:15

WB03 Transportation: Airline Industry
WB04 Advancing Military Science
WB05 Military Applications II
WB06 Educational Technology
WB07 Flexible Manufacturing
WB08 Manufacturing Control
WB09 Queueing/Inventory II
WB10 Multimodal Transportation Project Section
WB12 Management
WB14 PANEL: The International Aspects of Systems for
Recoverable Products
WB15 Management of Technology II
WB16 Marketing Consumer Choice
WB20 Simulation Optimization
WB21 Theoretical Foundations of MMT XV
WB25 Process Improvement/Quality Control
WB26 Dynamic Programming
WB29 Stochastic Modeling & Analysis

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- Ardekani, Siamak A. TA10
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 Buede, Dennis M. MD05
 Buglio, Ed TC01
 Bui, Tung X. TB20
 Bulusu, Srinivas TC11
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 Buzacott, John A. MA07, TD09
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 Byrd, Richard SD29
 Cachon, Gerard P. MD12, TC08, TD12
 Cai, X. Q. MC30, MD30
 Caldentey, Rene TB30, TD07
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 Camerer, Colin TD05
 Campbell, Ann SB30, SE11
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 Chellappa, Ramnath MD19, SB20
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 Chopra, Sunil TE12
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 Ciarallo, Frank W. TD03
 Citrenbaum, Daniel WA20
 Clarke, Lloyd W. SB30, SE11
 Claro, Ivan Dacosta MC17, MD17
 Clemens, Robert MA05, SB05, SD05
 Clendenen, Gary W. WA07
 Cloos, John J. MC04
 Clyde, Merlise SE25
 Clyman, Dana R. MC05
 Cohen, Morris A. SA07
 Cohen, Stephen B. WA20
 Cohen, Wesley M. WB15
 Coifman, Benjamin SB10
 Coit, David SD27, TC25
 Colbourn, C. J. TA31
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 Coleman, Nastaran WA20
 Coleman, Thomas F. SD29
 Colletti, Bruce SE26
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 Collins, Paul TA13
 Comer, James M. TA13
 Comm, Clare L. MA11
 Compere, Kenneth MC10
 Conceicao, Pedro TD15
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 Cook, Bill SD28
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 Cooper, Kenneth TA24
 Cooper, Lee G. TD05
 Cooper, William W. MC18, SA18, TD22, TP37
 Cope III, Robert F. TE02
 Corbett, Charles J. MA02, MD12
 Cote, Murray J. TC17
 Couellan, Nicolas P. TB27, TE27
 Coullard, Collette R. SB32, SD23, TA32
 Cox, Tony MC02
 Crainic, Teodor Gabriel MA31, MD31, SD11, TA02
 Crawford, Jr., James M. SE01
 Creegan, Joseph B. MC33
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 Curry, Guy L. TD31
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 Daskin, Mark S. MD10, SD23, TA09
 Datta, Anindya WA07
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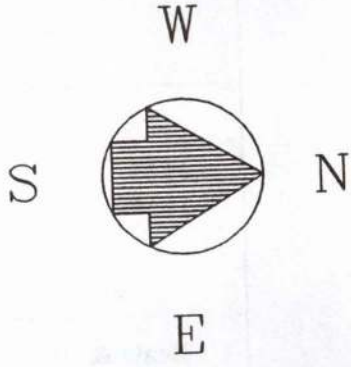
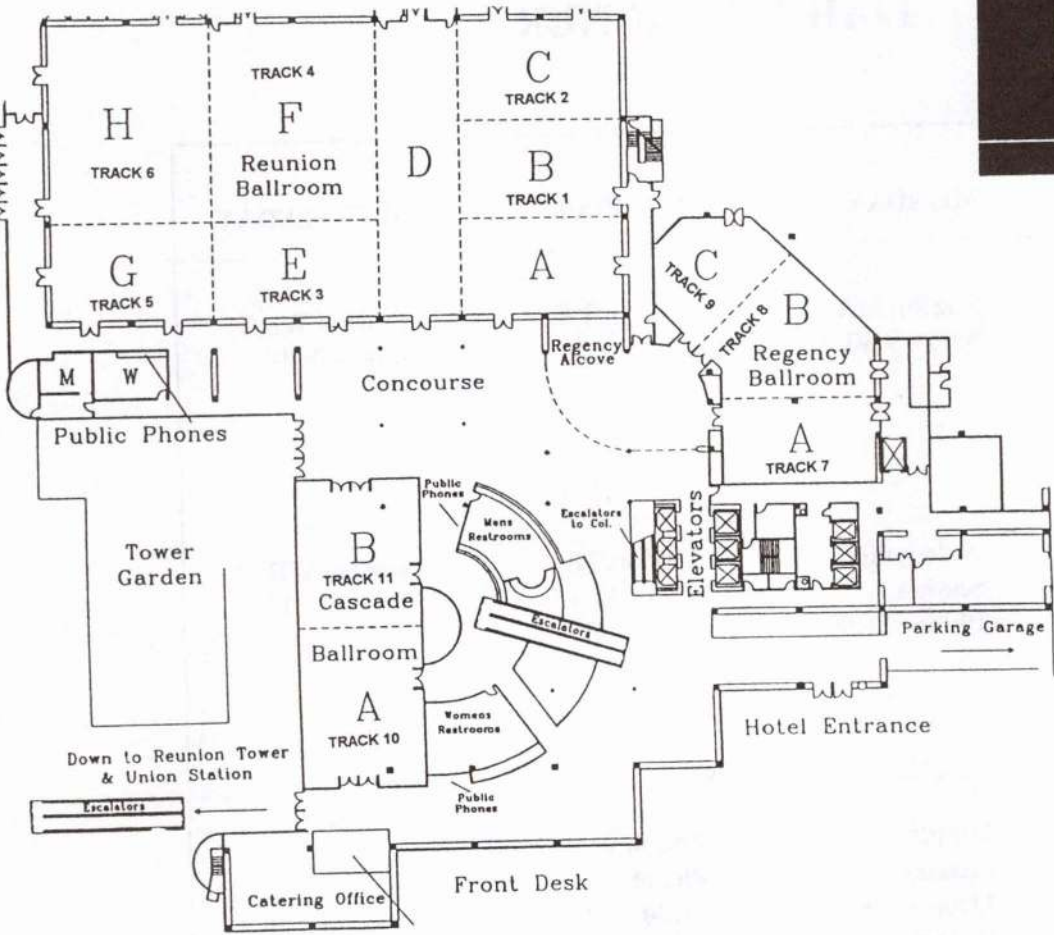
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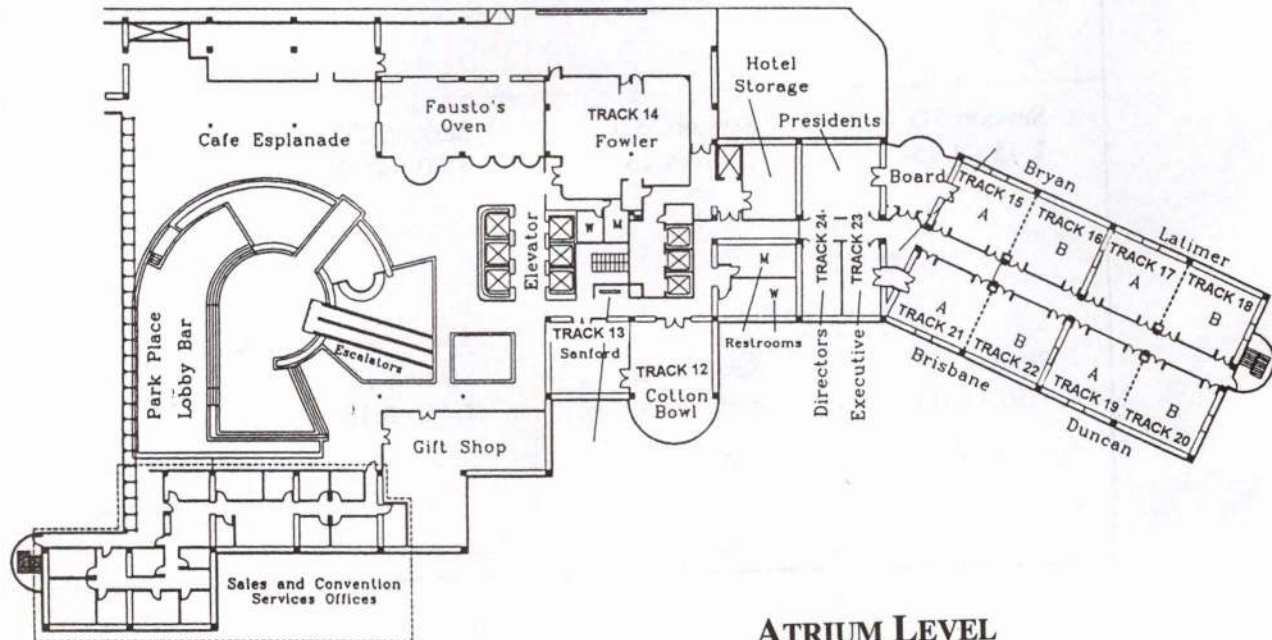
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 Zhang, Ping SE07
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 Zhang, Shuzhong SB29, TD28
 Zhang, Xeumei TD25
 Zhang, Yanjun SB01
 Zhang, Yin MD29
 Zhao, Shaoping TC08
 Zheng, Shaohui SB25
 Zheng, Shen WA19
 Zheng, Yu Sheng ME08
 Zhou, Chao MA10
 Zhou, S. MC30
 Zhu, Dan MC28
 Zhu, Jin TE09
 Zhu, Joe SE18
 Zhu, Lihua SA20
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 Ziliaskopoulos, Athanasios TC11, TD11
 Zilinskas, Antanas MC26
 Zipkin, Paul H. MD12, TA08
 Zirger, B. J. TA13
 Zviran, Moshe TB21
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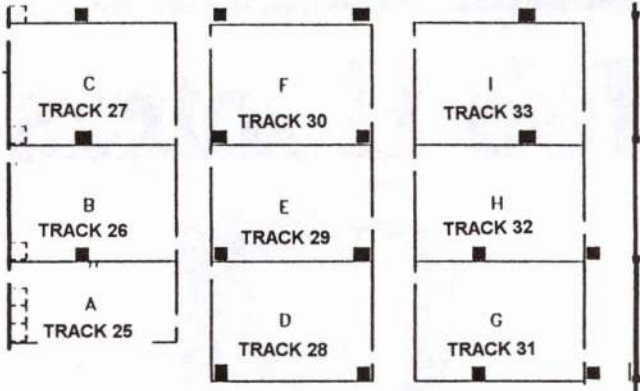
SUNDAY	MONDAY	TUESDAY	WEDNESDAY
Session SA 8:45 - 10:15	Session MA 8:00 - 9:30	Session TA 8:00 - 9:30	Session WA 8:00 - 9:30
Session SB 10:30 - 12:00	Welcoming Session 10:00 - 11:00	Session TB 9:45 - 11:15	Session WB 9:45 - 11:15
	Monday Plenary 11:00 - 12:00 George Kozmetsky	Tuesday Plenary 11:30 - 12:30 William W. Cooper	
Beale & Edelman Keynotes 1:15 - 2:15	Session MC 1:00 - 2:30	Session TC 1:15 - 2:45	
Session SD 2:45 - 4:15	Session MD 2:45 - 4:15	Session TD 3:00 - 4:30	
Session SE 4:30 - 6:00	Session ME 4:30 - 6:00	Session TE 4:45 - 6:15	



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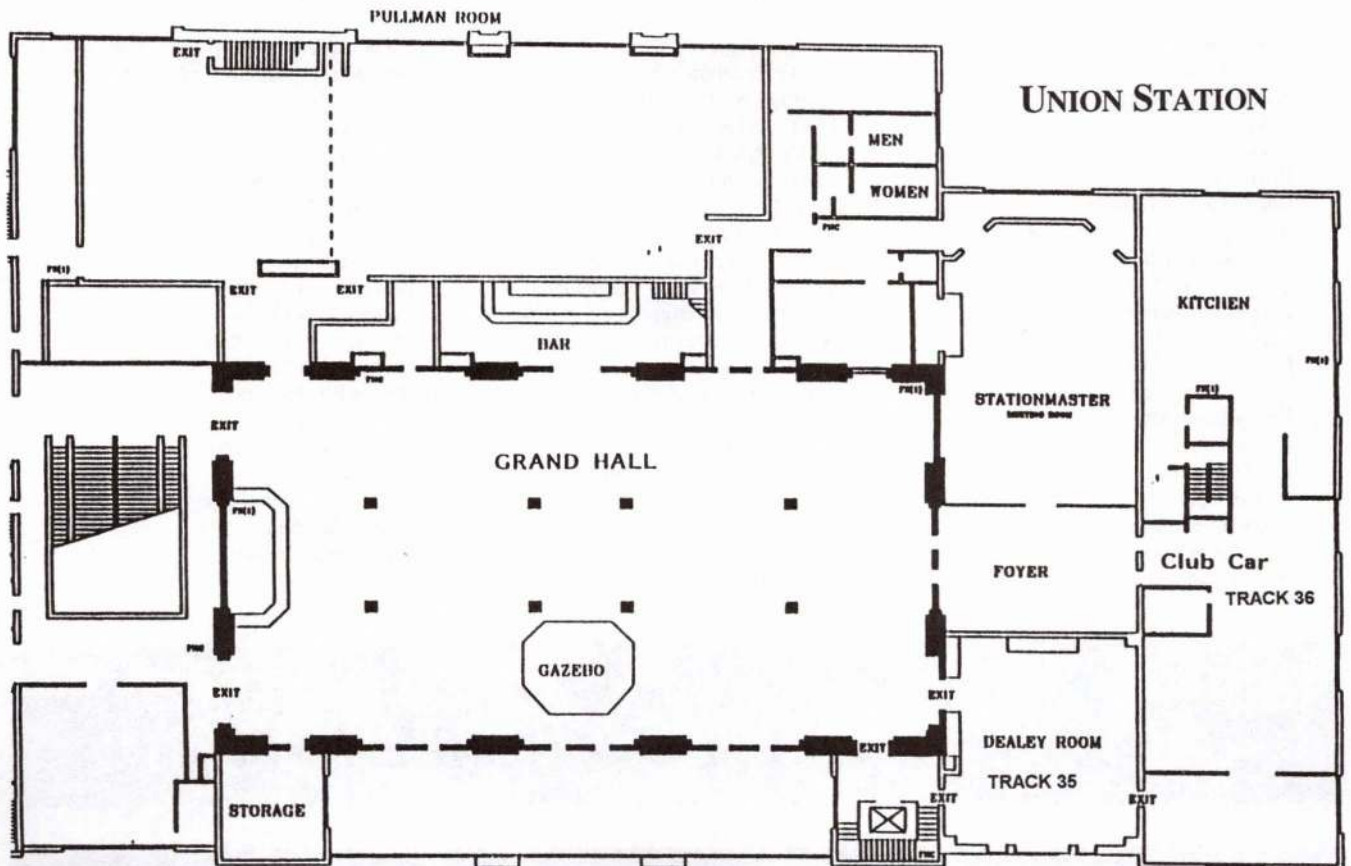
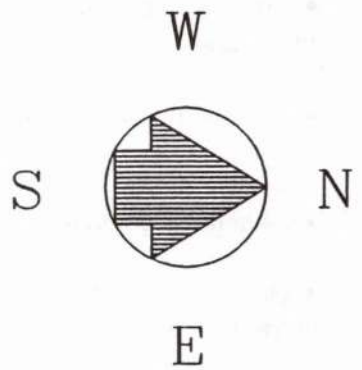
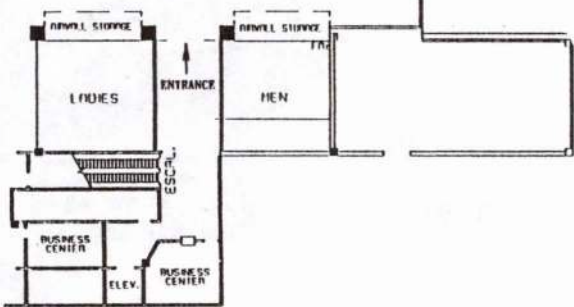


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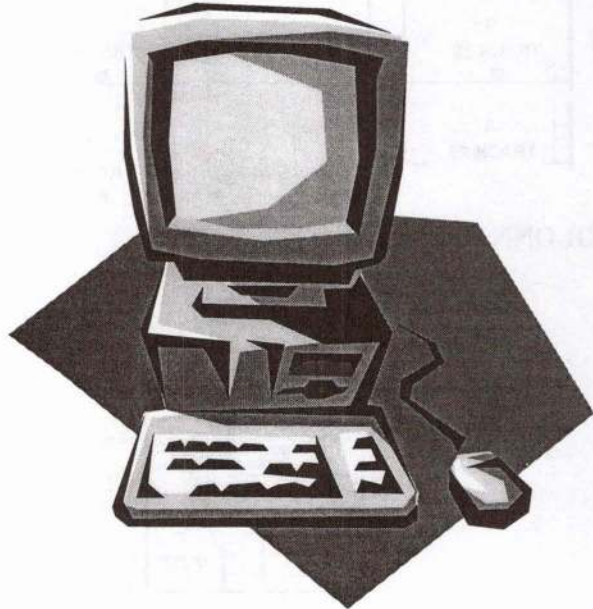


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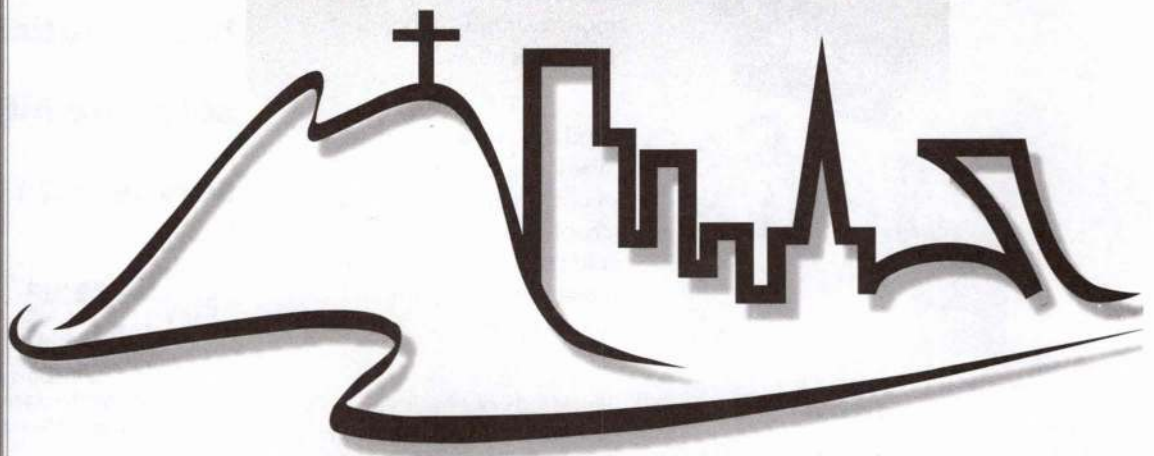
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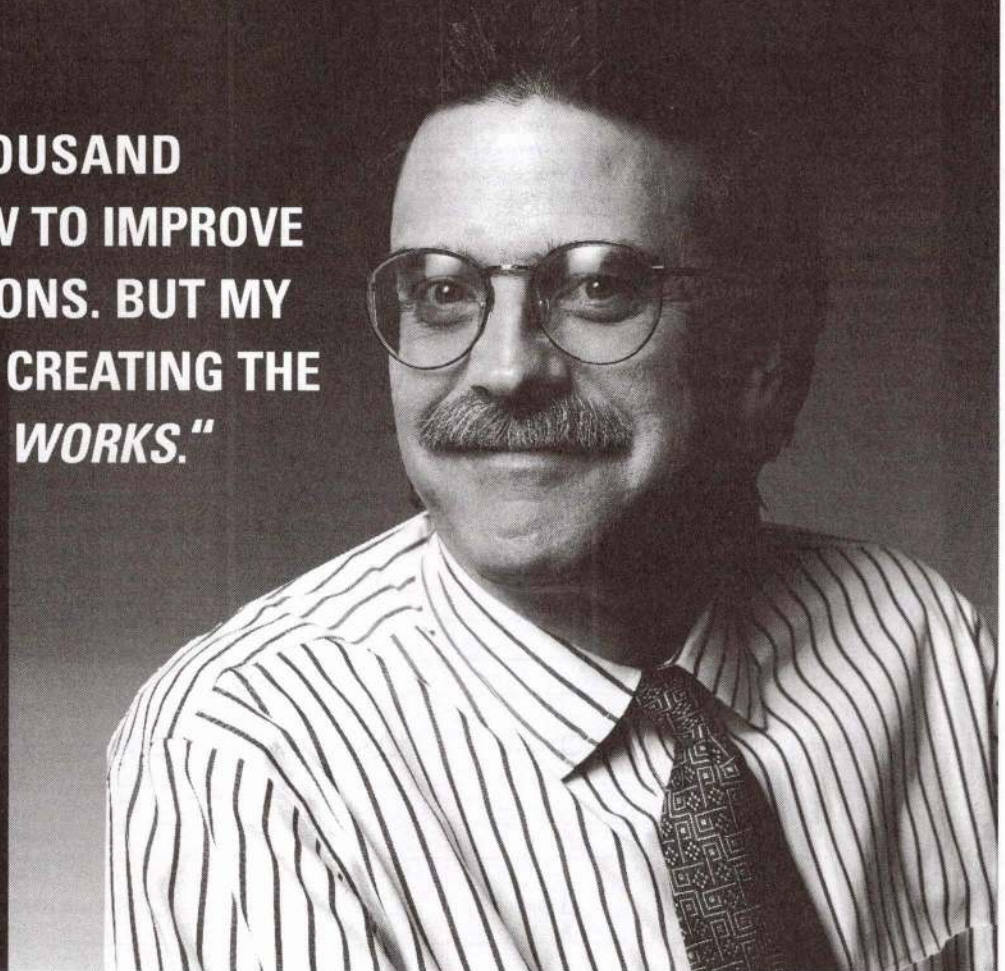
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Track	Room	SA	SB	SD	SE	MA	MC	MD	ME	TA	TB	TC	TD	TE	WA	WB	
		8:45-10:15	10:30-12	2:45-4:15	4:30-6	8-9:30	1-2:30	2:45-4:15	4:30-6	8-9:30	9:45-11:15	1:15-2:45	3-4:30	4:45-6:15	8-9:30	9:45-11:15	
1	Reunion B	OR/MS Applications				Railroad Applications				OR/MS Applications							
2	Reunion C	Airline Tutorials				Applications											
3	Reunion E	Aviation Applications				Facilities Layout											
4	Reunion F	Military Applications															
5	Reunion G	Decision Analysis														Military Apps.	
6	Reunion H	Education															
7	Regency A	Manufacturing & Service Operations Management													Queueing	Flex Mfg	
8	Regency B	Manufacturing & Service Operations Management				Inventory Management				Manufacturing							
9	Regency C	Flexible Mfg.		OR Apps. in Semiconductor Mfg.				Location Analysis				Queueing/Inventory					
10	Cascade A	Transportation Science				Transportation Science											
11	Cascade B	Transportation Science															
12	Cotton Bowl	Railroad Applications		Supply Chain Operations				Logistics		SCOpt.		Mgmt.					
13	Sanford	New Product Development															
14	Fowler	Technology Transfer		Finance				Environment		Recoverable Products							
15	Bryan A	Technology Management															
16	Bryan B	Organizational Science				Marketing											
17	Latimer A	Health Applications				Health Care Mgmt.											
18	Latimer B	DEA & Productivity				Quality Mgmt.		Service Ops.		Forecasting							
19	Duncan A	Special Events		Electronic Commerce				Simulation									
20	Duncan B	Information Systems				State-of-the-Art in IS				Telecommunications		Simulation					
21	Brisbane A	Management of Medical Technology															
22	Brisbane B	Workshops		Teacher Program				Operations Management									
23	Executive	Logistics/Supply Chains				Decision Analysis											
24	Directors	Finance		Econ.		Marketing		Management		Strat Plng		Apps.					
25	Colonnade A	Statistics & Reliability				Reliability & Quality Eng.											
26	Colonnade B	Student Affairs				Applied Probability				Global		Programming					
27	Colonnade C	Interface Between AI/OR		Artificial Intelligence		AI/OR Techniques in Project Mgmt. DA		Neural Nets & Machine Learning									
28	Colonnade D	Integer Programming Tutorials				Integer Programming											
29	Colonnade E	Nonlinear Programming		Linear Programming				Stochastic Programming									
30	Colonnade F	Heuristic Methods in Optimization				Scheduling											
31	Colonnade G	Combinatorial Optimization				Optimization											
32	Colonnade H	Computer Science															
33	Colonnade I	Software Demonstrations															
35	Dealey	Scheduling															
36	Club Car	Queueing															
37	Reunion E-F	Beale Keynote SC 1:15 - 2:15pm, Welcoming Session MW 10:00 - 11:00am, Plenary MP 11:00am - 12noon, Plenary TP 11:30am - 12:30pm															
38	Reunion G-H	Edelman Keynote SC 1:15- 2:15pm															