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IFORS NEWS

International Federation of Operational Research Societies

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EDITORIAL

IFORS: Past and Future

Mike Trick <trick@cmu.edu>

On January 1, 2016, it will be my honor to become the 21st President of the International Federation of Operational Research Societies.

In a sense, I have known about IFORS even before I decided that I wanted to work in this area. When I took my first course in linear programming, my father asked whether I knew of Sir Charles Goodeve. I was to learn that Sir Charles was a leader in using operational research techniques for anti-submarine warfare in World War II, and later played a significant role in introducing OR methods in industry.

My father knew of Sir Charles since he grew up in the same 1000 person town, Stonewall, as my mother and father. Sir Charles was the founding President of IFORS. Stonewall has had an unusual impact on our field!

IFORS was founded as an umbrella organization to unite the various national societies. IFORS conferences provided an opportunity for the entire world of operational research to come together every three years. Travel was difficult: meeting yearly or more was not possible, but every three years the world of operational research got together.

IFORS developed more programs to unite the world. *International Abstracts in Operational Research* made it possible for work published in small, national journals to be known throughout the world. *International Transactions in Operational Research* provided a nation-independent publication outlet. IFORS has sent researchers around the globe to learn and cross-pollinate research efforts. Our Distinguished Lecturers and Tutorial Lecturers assure that research is spread throughout the geographic regions. IFORS has helped developing countries create an operational research structure, and has supported nascent societies as they try to grow.

For 56 years of existence, IFORS has been an important force for the internationalization of Operational Research.

The world has changed tremendously in those 56 years. Traveling to international conferences is easy to do. Many conferences attract the international crowd that used to be the hallmark of an IFORS conference. Internet search lets researchers from around the world know immediately of new, relevant work no matter where it is done. Even journals themselves come under question when research mainly happens in easily-available working papers and specialized conference proceedings.

I believe strongly that IFORS can continue to play a critical role in advancing operational research, as well as its trendier near-synonym "analytics", throughout the world and in supporting its members, the national societies. But our programs need to address current needs, not the needs from Sir Charles' day. All of our programs need to be effective at meeting the charge of IFORS: to enhance operational research around the world. That is the challenge over the next years.

The IFORS Administrative Committee and I are interested in your views: What should IFORS be doing to have maximum impact on the world's operational research scene? How can IFORS best support its member societies? How can IFORS be important? Please feel free to email me at trick@cmu.edu , and be sure to follow @ifors_news and @IFORSPresident on twitter for the newest from IFORS.

From the Editor

A Warm Welcome to the New Year and the New Team

Elise del Rosario <elise.del.rosario@stepforward.ph>

As we end 2015, it is heartening to see that OR communities around the world are as active as ever, with recent conferences in Africa (Tunisia), Asia (Indonesia), North America (USA) and South America (Mexico), the major IFORS regions. IFORS itself is now getting ready to welcome a new set of officers representing these regions. They will take the reins for the period 2016-2018. Get to know them better with this issue, even as we hear from the incoming President himself, Mike Trick. And you certainly won't want to miss the excitement of giving your opinion about where the IFORS 2020 Triennial Conference will be, as we print here the summaries of two competing bids from the OR societies of Korea and Turkey. In addition, this issue features under our regular OR Society in Focus – the proponents - the Turkish OR society in this issue, and the Korean national society in the next.

A reminder that IFORS always takes care of early stage-professionals who will become the leaders of tomorrow is a Call for applicants to the ELAVIO Summer School included in this issue. In addition, we read of the account of the Kiev Summer School, which is continuing to experiment with their training formulas!

We end 2015 too on a somber note, given all the tragedies happening on a global scale. We read here of the refugee problem and a proposal for handling this problem using a soft OR methodology that, coincidentally, is covered by our Book Review section. A serious look as well on what low and medium income countries need from the OR discipline is also tackled in our OR for Development Section. It has long been recognized that IFORS has a long history of concern for and involvement in OR for development, as evidenced by an announcement here of ICORD 2016 happening in Mexico, even as ICORD 2015 is yet to happen in Sri Lanka this month, on the heels of an ORD Workshop sponsored during the EURO 2015, also written up here.

A paper presented during the EURO 2015 on collaborative logistics takes center stage in our OR Impact section. In fact, it was presented as part of a stream on case studies, which present an interesting mix of practical experiences of people making OR projects work in various environments. Read about them all in the extensive description, which includes the use of cloud computing for small and medium sized businesses. How to ensure security in a cloud environment? Read about an innovative approach featured in our Tutorial.

I have touched on the articles in this issue, but this would not be complete without my year-end acknowledgement of the people who have tirelessly helped come up with this quarterly IFORS News. They are the section and regional editors, as well as the national society correspondents listed in the Editorial Box. I thank them in the same way I thank you for reading and sharing the articles in our issues. Happy New Year!

From the AC

IFORS Honors ITOR Assistant Editor

As announced by the General Editor Celso Ribeiro during the **International Transactions in Operational Research** (ITOR) Editorial Board meeting held at the EURO 2015 in Glasgow, ITOR's impact factor has improved considerably, from 0.481 in 2013 to 0.977 in 2014. This puts ITOR at 49th out of 81 titles in the ISI's Operations Research and Management Science category, and 113th out of 185 titles in the general Management category. The Impact Factor provides a quantitative index for journal evaluation, being a measure of the frequency with which the "average article" in a journal has been cited in the two years following its publication.

ITOR Editor Celso Ribeiro (l) and IFORS President Nelson Maculan (r) flank ITOR Asst. Editor Simone Martins at plaque presentation ceremony.

ITOR receives submissions from more than 80 countries, showing that it is truly a well-established international journal. The increase in the impact factor was also followed by a substantial increase in the number of paper submissions: from 68 in 2007, to 361 in 2014 and to about 600 (estimate) in 2015. This puts a pressure not only on the whole editorial board, but particularly on the Assistant Editor Simone Martins, who has to filter all submissions to make sure that they comply with technical, non-similarity, non-plagiarism, and editorial quality criteria before they are sent out for refereeing. The Editors also have to follow up closely all the refereeing procedure to ensure a fast and fair publication process. The current refereeing time until the first decision averages less than 4 months.

In line with the IFORS Administrative Committee decision to commend Simone Martins for her dedication, enthusiasm, cooperation and hard work as Assistant Editor of ITOR, IFORS President Nelson Maculan and ITOR General Editor Celso Ribeiro presented Simone with a plaque of appreciation during an informal ceremony held at the Universidade Federal Fluminense, Niterói, Brazil, on October 13, 2015.

Your Choice of Site for IFORS 2020

(Online voting will start December 1, 2015)

Factor	Korea	Turkey
Date	1st Option: June 21(Sun.) – June 26(Fri.), 2020 2nd Option: May 31(Sun.) – June 5(Fri.), 2020	JULY 5-10 2020
Location	Seoul, Korea	Istanbul, Turkey
Local Support	Support from the Korean government and related institutes: • Korea Tourism Organization & Seoul Tourism Organization's Support: Special souvenirs for international meetings participants, cultural programs, Korean traditional performance during gala dinner, and others • Seoul Welcome Kit: Traveler's Guide, a set of Seoul postcards, a coupon book with various discounts at hotels and spas, museums, malls, performances, and restaurants throughout the city • Related institutes and industries' support: Advertising, gifts, and others	The Operational Research Society of Turkey (ORST) and Boğaziçi University fully support the organization of this conference. Boğaziçi University was established in 1863 as Robert College and became a public research university in 1971. The Department of Industrial Engineering was established in 1973 and is one of the most sought after engineering programs in the country and in the region. Boğaziçi University's IE Department (http://www.ie.boun.edu.tr/) organized the 2003 Joint EURO/INFORMS Conference in Istanbul. It is enthusiastically looking forward to hosting the global OR community in Istanbul in 2020.
Strength of OR in the country	KORMS was established in 1976 and the Society comprises 3,600 individual members, 29 special members, 12 group members, and 145 library members in 2015. The Korean Academic Society of Business Administration, Korean Institute of Industrial Engineers, Korean Society of Management Information Systems and other related societies are actively collaborated with KORMS. In particular, more than 1,000 domestic participants made presentations during the KORMS 2015 joint conference.	Participants will benefit from a conference held in Istanbul, interacting with an active OR Community in a growing economy. ORST was established in 1975, and the OR community in Turkey and the region has been growing since then. The worldwide OR community with first degrees from Turkish Universities. ORST is very active and growing as well. ORST regularly organizes its annual national congress, which attracts about 700 participants. Furthermore, the OR/IE community in Turkey and abroad regularly attend EURO, INFORMS and IFORS conferences in growing numbers.
Local Organizing Committee	KORMS President, KORMS President-Elect, KORMS Ex-Presidents, KORMS Vice President-Chapters, KORMS Vice President-Research Activities, KORMS Vice President-Publications, KORMS Vice President-International Activities, KORMS Vice President-Education and Presidents of other major societies.	BOĞAZIÇI IE FACULTY MEMBERS ON THE LOCAL ORGANIZING COMMITTEE: Kuban Altınel*, Necati Aras, Gülay Barbarosoğlu*, Yaman Barlas*, Mustafa Baydoğan, Ümit Bilge*, Taner Bilgiç*, Refik Güllü, Ali Rıza Kaylan*, Gürkan Kumbaroğlu, İlhan Or*, Mahmut Ekşioğlu, Wolfgang Hormann*, Caner Taşkın, Ali Tamer Ünal*, Tınaz Ekim Aşıcı, Aybek Korugan, Hakan Yaşarcan, Gönenç Yücel* *Members of the 2003 Joint EURO/INFORMS Conference Local Organizing Committee
Venue & Accommodation	**Coex Convention & Exhibition Center, Seoul, Korea** Coex is a huge, four-story building complex, not individually separated buildings. If you have multiple presentations and need to go different presentation rooms, you may take an elevator in each in a complex. We can have backup space reserved in case that the number of participants exceeds 3,000. We can also have sufficient rooms for 54 parallel sessions without a hitch. Coex also has big shopping mall (the largest underground shopping mall in Asia), duty-free store, department store, restaurants, aquarium, cinema, hotels, casino, and lots of entertainment places in one roof. • **Accommodations** Seoul is well equipped with excellent hotels of various standards and styles, with a wide range of room rates and superb services.	**Hilton Bomonti Conference Center**, a recently built hotel and congress center with top-class facilities located in the heart of the city. The location of the conference center is also conveniently close to the hotel district of the city, which has a wealth of options for accommodation.

	In addition to the list below, there are more than 150 hotels with approximately 25,000 rooms available in Seoul at present, and it will continue to increase to 210 hotels with 38,000 rooms by 2015. Thanks to the city's efficient transportation system, participants can reach the venue with ease from many parts of the city.	
Venue & Accommodation Accessibility & Transportation	Seoul is a fascinating convention city with easy access from all over the world. 1,400 direct flights are scheduled every week from major cities in every continent to Seoul. About 94 airlines, including active players in the world's three major alliances, are operating in Incheon, resulting in high interlining opportunities for newly inaugurating airlines. • **Convenient Transportation**: Travelers have easy access to Coex of their hotels around the venue via Incheon International Airport, with the option of a non-stop airport limousine bus or taxi around one hour, or the AREX high-speed rail service. Coex also has its own city airport terminal with convenient check-in service to prevent long delays at the airport	Istanbul is easily and affordably accessible from all over the world. Turkish Airlines has direct flights to Istanbul from over 80 international cities, and many other carriers have over 200 direct flights from various cities all over the world. Istanbul Ataturk Airport's International Terminal is the world's gateway to Turkey. The terminal accommodates 20 million passengers annually.
Wow Factor	**Superb ICT Infra**: Based on Korea's superb ICT infra, it will be the smartest place for IFORS 2020. • **Win-Win Partnership**: IFORS 2020 will be an invaluable opportunity to make a difference in the region. It will be a pivotal time to influence when the grounds are laid for an entirely new market. • **Promotion Plan for the Developing Countries**: Invitations to IFORS 2020 will be sent to management scientists in developing countries, which will contribute to expediting their development (expansion of IFORS membership and audience to Asian countries). • **K-Culture and Hospitality**: Korea tradition is rooted in more than 5,000 years of history and culture. Korea and Seoul will impress you with its old tradition and new wave of K-pop, fashion, music, drama, food, dynamic and hospitable people. • **Strong Support from Korean Government and Industries**	We believe it is timely to have an IFORS conference in Istanbul: a city that is located at the crossroads of Europe and Asia. Istanbul is the cultural, industrial, commercial and historical center of Turkey. The city, with its incredibly diverse and rich cultural and historical heritage as well as its beauty, embraces all contradictions: ancient and modern, mystical and earthly. We promise a memorable conference experience in this unique environment

IFORS Officers: New Faces for 2016- 2018

Michael Trick 2016-2018 President
Mike Trick is faculty member at Carnegie Mellon's Tepper School of Business in Pittsburgh, where he also serves as Senior Associate Dean for Faculty and Research. His involvement with OR societies began when he became founding editor of INFORMS Online in 1995. After this, he served as President of INFORMS in 2002. He then served as NORAM Vice President from 2004-2009, generally taking a role in helping select conference locations and aiding local organizers in putting together the IFORS Triennial conferences. Notably, it was during these years that IFORS reached out and held its Triennial conferences in South Africa and in Australia. You can also follow him on twitter @miketrick and his blog at http://mat.tepper.cmu.edu/blog

Luciana Buriol Vice President
Luciana Buriol has Ph.D. by UNICAMP, Brazil, with 15 months of internship in AT&T Labs, USA,followed by a postoctoral stage of 18 months in La Sapienza, Rome. Since 2006 she had been Associate Professor of Computer Science at the Federal University of Rio Grande do Sul (UFRGS), Porto Alegre, Brazil. As President of ALIO in the term 2012-2014, she coordinated efforts across OR societies within the region. Her main research interests are in optimization (problem solving by exact and heuristic methods) and algorithms (algorithm design for mining massive data). Buriol is currently a CNPq (Brazilian National Research Council) Advanced Fellow.

Guillermo Durán VP representing ALIO
Guillermo Durán is professor in the University of Buenos Aires and the University of Chile. He is Director (through competitive appointment) of the Calculus Institute at the University of Buenos Aires since December 2011.This is the Applied Math Institute of the University of Buenos Aires. He is an Independent Research Associate at CONICET (National Scientific and Technical Research Council, Buenos Aires, Argentina). His research interests include Graph Theory and Combinatorial Optimization. He has published more than 40 articles in the main international journals related to these areas. He is OR consultant for different public and private organizations in Chile and Argentina.

Ilias Mamat, VP representing APORS
Ilias Mamat is academician, professor and founder dean at the Quest International University Perak, Malaysia Faculty of Business Management & Social Sciences. He is Director of Renesas Semiconductor Penang. He previously was with the University of Technology MARA and Vice President of the National Equity Corporation (Permodalan Nasional Berhad). His major research interests include applying simulation in manufacturing strategies and quantitative analysis in finance, where he has published papers, books, and book reviews. A Chartered Statistician and a Chartered Scientist, he is a Fellow of the Financial Services Institute of Australasia, Australia.

Jacek Blazewicz, VP representing EURO
Jacek Blazewicz is since 1987 Professor and a vice-director (since 1987) of the Institute of Computing Science, Poznan University of Technology. Member of the Polish Academy of Sciences, the Polish Informatics Society and Founding Member of the Polish Bioinformatics Society. A member of editorial boards of 10 international journals, he has edited a series of International Handbooks on Information Systems. He is an active organizer of conferences of which he has co-chaired 35 and a prolific publisher of papers and books. He is a recipient of the EURO Gold Medal, Doctorate Honoris Causa of the University of Siegen, and the Copernicus Prize, among others.

Karla Hoffman, VP representing NORAM
Karla Hoffman is professor in the Department of Systems Engineering and Operations Research in the Volgenau Engineering School, George Mason University where she served as its Chair. She has received multiple research and teaching awards. Her primary research areas are combinatorial optimization, auction theory, and real-time scheduling and routing. She currently consults to the federal government on auctions and to the military and telecommunications industries on scheduling, manpower-planning and capital budgeting. Her research focuses on the development of new algorithms for solving large complex problems arising in industry and government. She served as INFORMS President and IFORS NORAM VP.

Richard Hartl, Treasurer
Richard Hartl has been full professor of production and operations management at the University of Vienna where he was also head of the Department of Business Administration. A Senior Extramural Fellow of the Center for Economic Research (CentER), University of Tilburg, he is associate editor of several top journals and has regularly received teaching awards while obtaining research grants for both theoretical and applied research. He was Austrian Society for OR (OEGOR) President. His main research areas involve the application of OR methods in production, logistics, and transportation.

Conferences

Mexican National Congress Focuses on New OR Trends

Alejandro Alvarado Iniesta <alejandro.alvarado@uacj.mx>

The 4th National Congress of the Mexican Society of Operations Research (IV CSMIO 2015) took place last October 7th to 9th in Juarez, Chihuahua in Mexico with the theme *Operations Research: New Trends and Applications.*

The Congress consisted of 3 plenary talks and 81 technical talks spanning the many disciplines within OR. The plenary talks were presented by: Maxim Ivanov Todorov, of the Universidad de las Americas Puebla, on *Constraint Qualifications In Convex Vector Semi-Infinite Optimization;* Oliver Schütze of CINVESTAV-IPN, on *Pareto Explorer: A Global/Local Exploration Tool For Many Objective Optimization Problems;* and Roberto Ley-Borrás on *Integrated Decision Analysis*. Other papers covered a wide range of OR topics such as Logistics, Metaheuristics, Optimization, Statistics, Mathematical programming.

The scientific portion of the conference was well balanced with the social activities which included a welcome reception and a Gala dinner. The IV CSMIO 2015 attracted 91 participants from different regions of Mexico even as it welcomed participants from Colombia, Chile, Germany and France. IV CSMIO 2015 was a success, judging from the feedback from the participants. The V CSMIO 2016 will be held in Cd. Madero, Tamaulipas in Mexico. Those interested are asked to visit http://smio.weebly.com/ for further information.

Participants benefited from both the scientific and social events.

OR in Indonesia Continues to Take Root

Milagros Baldemor <milagros_baldemor@yahoo.com.ph>, **Esther Nababan** <esther@usu.ac.id>, **Suryati Ngatasi Sitepu** <sitepuati@yahoo.com>, **Gerhard-Wilhelm Weber** <gweber@metu.edu.tr>

The *3rd International Conference on Operational Research (InteriOR 2015)* with the theme *"Initiative to Develop through OR"* was held at the Grand Aston Hotel, Medan, Indonesia on August 21-22, 2015 (http://www.interior2015.info/). The two-day conference attracted over 250 old hands and newbies in Operational Research from around the world, yielding 99 paper presentations. Four parallel sessions featured papers covering topics from business to advances in OR dynamic systems, applications in data mining, decision analysis, game theory, logistics, global optimization, probability and statistics, project management, simulation, social network, transportation model, supply chain management, financial engineering, business analytics, network analysis, sustainable optimization, fuzzy optimization, DEA and stochastic optimization. Plenary talks were given by Kok Lay Teo,Curtin University, Perth, Australia on *Optimal Control Computation for Non-linear Switched Systems;* Li Duan, Chinese University of Hongkong, on *Cardinality Constrained Optimization*; Gerhard-Wilhelm Weber, METU, Ankara,Turkey on *Optimal Control of Stochastic Hybrid Systems;* Zuhaimy Ismail, Universiti Teknilogi, Malaysia, on *Forecasting as a Tool to Decide Better;* and Esther Nababan, University of Sumatera Utara, on *Eco-efficiency of Industrial Park with Ecological Carrying Capacity as a Control Factor.*

Participants pose for the customary group picture.

The participants were warmly welcomed by USU rector Subhilhar, after which a striking of the gong by the acting Mayor of Medan, Syaiful Bahri officially opened the conference. A traditional dance prepared by students in colorful costumes completed the welcome. The presence of an IFORS representative and EURO Conference Adviser Gerhard-Wilhelm Weber was deeply appreciated by the organizers, who, in turn, spared no effort in bringing together international academicians and researchers, OR professionals and enthusiasts within Sumatra to strengthen the newly-established OR Society of Indonesia. It will be remembered that it was in 2013 when IFORS encouraged the leadership of the INTERIOR series of conferences to form an OR Society

All invited speakers had the honor and pleasure of being hosted at the famous Lake Toba, a unique jewel and one of the most beautiful scenic places in the country. The outing gave an opportunity for greater exchange on the state of OR in Medan, Sumatra and Indonesia and on future support of and collaboration with the Indonesian Society.

The conference was jointly organized by the Department of Mathematics, University of Sumatera Utara (USU), Indo Mathematical Society, and the Indonesia Operations Research Association (IORA). The Organizing Committee chaired by Mardiningsih, and the Scientific Committee, with the session chairs, authors, presenters, discussants, paper reviewers and sponsors all did their part in making this conference memorable. The conference provided scientific learning amid a lovely atmosphere made special by the hospitality of everyone and the smiles, in particular, of the young OR people of Indonesia!

The positive experience and the success of the conference made the participants look forward to future conferences like ICORD 2015 which will be held in Sri Lanka and EURO 2016 in Poznan, Poland. InteriOR 2015 was conceptualized by the organizers in celebration of the 50th anniversary of the Department of Mathematics of USU.

A Historic First OR Annual Conference in Tunisia

Jacques Teghem, **Fouad Ben Abdelaziz** <fouad.abdelaziz@gmail.com>

Tunisian Operational Research Society TORS (www.tors-tn.org) organized its first Annual Conference from June 12 to 14th 2015. During the conference, 49 participants from 6 nationalities (Belgium, Canada, France, Germany, Morocco and Tunisia) presented their work. Three international speakers were invited, namely: Fouad Ben Abdelaziz of the NEOMA Business School, France; Jacques Teghem of the Polytechnic Institute of Mons, University of Mons, Belgium and Leandro C. Coelho of the Administration Sciences Faculty, University of Laval Quebec, Canada

Fouad (right) with Tunisian and Moroccan participants.

A best paper award carrying a subsidised participation of the winner to the OR for Development workshop in Glasgow http://ifors.org/ewg-ord/ on July 9-10th,2015 was awarded. The TORS business meeting was also held, where a new set of officers was elected for the term 2015-2017. Youssef Masmoudi turned over the reins to Mohamed Aymen Boujelban. The conference was memorable for the great ambiance but more so because of the seriousness and motivation of all organizers and participants. This Annual meeting was sponsored by EURO and IFORS. TORS is one of the newest IFORS members, accepted only into IFORS in November 2014. The society aims to share, exchange knowledge and promote theoretical developments and applications in the operational research field in Tunisia. The conference covered most areas of Operations Research and decision-making support.

OR Explorers on Historic Grounds

Jim Cochran <jcochran@cab.latech.edu>

The 2015 INFORMS Annual Meeting was held on November 1-4 at the Philadelphia Convention Center. Over 5,000 operations research professionals from academia, industry, and government attended and enjoyed a wide range of the plenary and keynote presentations; panel discussions; tutorials; and oral and poster presentations.

As is tradition with annual INFORMS Conferences, three colloquia targeting the career needs of specific segments of INFORMS members were held on the Friday and Saturday immediately prior to the conference: The *Doctoral Student Colloquium* for current doctoral students 2-3 years from graduation in mind designed to provide guidance on deciding between a career as an academic or as a practitioner and advice on how to deal with issues that arise in a job search and early in one's career; The *New Faculty Colloquium* for early career faculty in mind designed to address the needs of academics at the beginning of their career with topics on writing successful research proposals, building and maintaining a research program, advising students, the importance of professional service, and navigating the tenure process; and The *Teaching Effectiveness Colloquium* for OR educators with sessions on creating, incorporating, and assessing effective teaching techniques in OR courses and curricula. Addressing important issues faced by their target audiences, these three colloquia had always very popular, and 2015 was no exception.

Participants had a hard time choosing among the interesting sessions.

In addition to these colloquia, the Workshop on Data Mining and Analytics was also held throughout the day on Saturday prior to the conference. This very well-attended content specific workshop, which was organized by INFORMS' Data Mining subdivision, was held in recognition of the growing interest in data mining among members of the OR community.

As the conference began in earnest at 8:15 on Sunday morning, it was immediately apparent that General Chair Tamás Terlaky of Lehigh University and the organizing committee had put together a tremendous meeting. After the first round of sessions, the conference moved to a large ballroom for the Official Welcoming Session and a plenary talk by Margaret Brandeau of Stanford University, who spoke on *Creating Impact with Operations Research in Health*.

Each day of the conference featured four rounds of 90 minute sessions as well as plenary and keynote talks. In addition to Professor Brandeau's opening plenary talk, the conference featured the following plenary talks: *Computational Thinking, Inferential Thinking and Big Data* by Michael Jordan of University of California Berkeley; *Understanding and Managing the Complexity of Healthcare* by Bill Rouse of Stevens Institute of Technology; and *Empiricism and Optimization in the World of Big Data* by Alfred Spector of Google (retired).

Exhibits attracted a lot of audience.

Keynote talks included: *Getting more out of a Modern Power Grid: The Role of Mathematical Modeling and Optimization* by Mihai Anitescu of Argonne; *Conic Integer Optimization* by Alper Atamturk of University of California Berkeley; *The Advent of the Intelligent Electronic Health Record* by John Glaser of Cerner; *Optimizing Healthcare and Using Healthcare to Motivate the Development of New Optimization Models, Methods, and Tools* by Sanjay Mehrotra of Northwestern University; *Stochastic Networks: Scaling Limits, Performance Analysis and Optimization* by Kavita Ramanan of Brown University; *Optimization Techniques in Data Analysis* by Steve Wright of University of Wisconsin- Madison.

Panelists on the President's Panel discussed the role of quantitative based decision making when dealing with the challenges universities are facing in the dynamic environment of higher education. These panelists included: Mark C. Reed, President of Saint Joseph's University; Ali A. Houshmand, President of Rowan University; Stephen K. Klasko, President and CEO of Thomas Jefferson University and Jefferson Health System; and John D. Simon, President of Lehigh University.

The conference also featured thirteen 90-minute tutorials on a wide variety of emerging and important topics as follows *Pricing Inspired by Data and Practice* by Georgia Perakis, MIT; *Emergency/ Disaster Preparedness and Response* by Laura McLay, University of Wisconsin-Madison; *Approximations of Queueing Performance for Rapid Systems Design* by Ton Dieker, Columbia University; *Robust Optimization, Risk Ambiguity* by Erick Delage, HEC Montreal and Dan Iancu, Stanford; *Game Theory and Networks* by Asu Ozdaglar, MIT; *Simulation Optimization* by Dave Goldsman, Georgia Tech *Healthcare Systems Engineering* by James Benneyan, Northeastern University; *Demand Response in Power Systems* by Josh Taylor, University of Toronto; *Data Mining/Informatics* by Art Chaovalitwongse, University of Washington; >>

Prize winners all.

>> *Stochastic Optimization* by Guzin Bayraksan, Ohio State University; *Big Data Analytics in Retail, Airline, Insurance, and Risk* by David Simchi-Levi, MIT; *Markov Decision Processes* by Andrew Schaefer, U. Pittsburgh; *Automatic Algorithm Configuration* by Meinolf Sellmann, IBM.

All conference attendees received free access to the *INFORMS 2015 TutORials in Operations Research* online content concurrently with the meeting. This publication comprises chapters written by select presenters of the tutorials offered in Philadelphia.
The workshop *O.R. and Mathematical Analytics for High School Math Teachers* was also held during the conference. The purpose of this workshop, which is organized every year by Ken Chelst of Wayne State University, is to help high school math teachers integrate operations research into their courses and curricula. The workshop, hosted on Tuesday, November 3 by Drexel University's LeBow School of Business, attracted over forty enthusiastic and engaged high school teachers from eastern Pennsylvania who attended hands on and interactive workshops on linear programming, multiple criterion decision making, and working with nonlinear functions. Throughout the workshop, these tools were applied to real problems including selecting a wireless plan, choosing a college to attend, maximizing profitability of a product mix, and reducing time standing in line. Dave Goldsman of Georgia Tech and Jim Cochran have worked for several years with Professor Chelst to give these workshops in conjunction with INFORMS (also given during a workshop in Kathmandu for over forty Nepalese high school teachers immediately prior to the 2014 Conference of the Operations Research Society of Nepal).

Of course, INFORMS awards were given and subdivisions and committees met, and on Tuesday evening a grand reception was held. This reception featured foods for which Philadelphia is famous – cheesesteak sandwiches and soft pretzels. The reception was lively and a lot of fun, with old friends connecting and new friendships made.

You can find out more about the 2015 INFORMS Conference by visiting the conference website. INFORMS Annual Meeting 2016 General Chair Chair Chanaka Edirisinghe of Rensselaer Polytechnic Institute looks forward to welcoming participants to Nashville for the INFORMS Annual Meeting 2016 Nashville on November 13 - 16 2016.

Optimal Decisions and Big Data in Historic Vienna

Kamil Jerzy Mizgier* <kmizgier@ethz.ch> **Gerhard-Wilhelm Weber*** <gweber@metu.edu.tr>

The International Conference on Operations Research - OR 2015 (https://or2015.univie.ac.at/) was held in one of the most beautiful and "livable" cities in the world, Vienna, from the 1st to the 4th of September 2015. Connecting the imperial history with contemporary art and science, Vienna had always been at the forefront of scientific progress, making it a perfect venue for an OR conference with the theme *Optimal Decisions and Big Data*. This joint international conference of the *German (GOR)*, *Swiss (SVOR/ASRO)* and *Austrian (OeGOR) OR Societies* welcomed more than 800 participants from around the world, who were all accommodated in the main building of the *University of Vienna*, which celebrates its 650th anniversary.

The conference began with the plenary talk of *Matteo Fischetti* on the need to simplify models for Big Data. He proposed that the OR community should focus on the prescriptive parts of the analytics process to increase the prominence of OR methods within the broader academic and practitioner communities. The many interesting parallel and semi-plenary sessions added to the success of the conference, such as the presentation of *Stefan Minner* which dealt with novel approaches for data-driven inventory management. The semi plenaries delivered by experts coming from all over the world, as follows: *Margaret Brandeau* (USA), *William Cook* (Canada), *Lars Grüne* (Germany), *Dennis Huisman* (The Netherlands), *Janny Leung* (Hong Kong), *Torsten Möller* (Austria), *András Prekopa* (USA), *Rubén Ruiz García* (Spain), *Daniele Vigo* (Italy) and *David Wozabalm* (Germany) further enhanced knowledge sharing during the event. The closing plenary talk was equally memorable, as Steve L. Scott from Google showed how optimal decisions and big data work together in the real world to produce business-relevant results. Without sacrificing scientific rigor, he presented how to use statistical models to optimize user experience on a multi-computer infrastructure. The conference was split into 27 streams co-organized by members of the three societies.

An equally rich social program complemented the scientific portion of the Conference. It included a Welcome Reception in the yard of the University of Vienna (*Arkadenhof*). The Mayor's Reception at the *Vienna City Hall* not only featured the dinner buffet, but also speeches honoring *András Prekopa's* 86th birthday as well as the achievements of the OC Chair, *Georg*

Pflug, among others. The conference dinner at a typical *Viennese Heuriger* restaurant gave the participants the opportunity to enjoy real Austrian cuisine. In all the events, hospitality shown to all the participants capped the unforgettable atmosphere.

Side events, particulary the exhibition of the *Vienna Circle*, celebrated the importance of interdisciplinary approaches of OR. For instance, the contribution to OR of the great physicist *Ludwig Boltzmann*, considered as one of the founding fathers of the *Vienna Circle*, is still remarkable as reductionist approaches are now needed more than ever.

The Conference was sponsored by IBM, GAMS, Guirobi, AMPL, RISC, Springer and Local Solver. Additionally, Siemens and Inform Software sponsored prizes for MSc. and PhD. Theses. The great role played by GOR and theUniversity of Vienna, along with the Chairs of the Organizing Committee and of the Program Committee, *Georg Pflug* and *Gernot Tragler*, respectively, deserve congratulations for a successful conference attended by a balanced mix of participants from the academe and business.

(*Kamil, was an Erasmus Exchange Student at the Faculty of Physics of the University of Vienna exactly 10 years ago, and it is like coming home, now to be an organizer of the session on *Supply Chain Risk* and as a speaker. He comes from Poland, where EURO 2016 has been set, and where he is serving as a stream co-organizer. *Willi, on the other hand, is all praises for the stream and session organizers, as well as the students and EURO for enabling such a high quality event which led to many new friendships and connections.)

Growing OR with Help from the international Community

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From August 4 to 18, 2015, the International Summer School *"Achievements and Applications of Contemporary Informatics, Mathematics and Physics" (AACIMP)* opened its doors for the tenth time to researchers, practitioners and learners from all over the world. The event was held in Kyiv (Kiev), Ukraine and brought together 44 educators and 101 learners from nearly 20 countries.

On its 10th year, the stream devoted to OR had a specific application focus on *Smart Cities: Operational Research, Energy and Urbanistics*, with a focus on sustainable urban development enabled by analytical methods, ICT tools and emerging technologies, with emphasis on OR mathematical models to improve decision making under uncertainty in business, government and society. The other non-OR streams were: Applied Computer Science, Computational Neuroscience, and 3D printing.

The plenary session on *Business Analytics and Data Science - Opportunities for Ukraine and for the World* given by Oleksandr Romanko (University of Toronto, Canada) provided a brief overview of algorithms and techniques for data analysis including statistics and optimization; examples from finance, risk management, smart city projects were used to illustrate application of business analytics. From this, the OR stream continued on to deal with cases and applications for several key areas of smart cities, including energy, mobility, security, planning and governance, including tools and methods to complete projects.

A big change was that this year, two thirds of the School was devoted to project teamwork. After three days of introductory lectures and seminars, 22 student teams started to work on projects with the help of project supervisors. Four project topics identified within the OR stream were: Smart Career Planning and Skills Development via Personal Analytics; Improvement of Traffic Signaling System Data Management - A Case Study of Kyiv; Economic Performance of Air Solar Collector Technology in Ukraine; Sustainable Campus - Engineering and Financial Model for Improving Energy Efficiency. Resource people were invited to provide the teams with information and relevant data.

Students presented the results of the project work using posters and prototypes - an exercise, which gave them a chance to improve their presentation skills through the valuable feedback from colleagues and advisers. It can be said that the newly introduced project-based learning and multidisciplinary approach proved to be effective, as gathered from students:

I heard about the Summer School from my friends and my supervisor, who was one of the organizers back in 2008. I really wanted to participate, because in addition to new acquaintances, interesting lectures by researchers and experts from around the world and fun social events, an interesting stream "Operational Research, Energy and Urbanistics" was offered. It is directly related to my research, so I knew it would be very useful and would open new opportunities. I learned a lot from the lectures about Operational Research for developing countries by Prof. Gerhard-Wilhelm Weber, as well as the lectures by: Alana Lajoie-O'Malley about Sustainable Campus Project at the University of Winnipeg; Oleksandr Romanko of IBM on Data Analysis; Urs Thomann on Urban Planning; and Benoit Sicre on Energy Efficiency. This year, every student had the opportunity to participate in teamwork on various projects under the supervision of lecturers. And it was a really memorable experience, from which I got a lot of useful skills. Thanks to Summer School my summer this year was unusual, useful and memorable! - Anastasiia Lisogor.

This year, the OR stream was represented by Smart Cities, which made our two weeks of studying less theoretical and more practical. What impressed us most was the big number of experienced lecturers from all over the world. We were excited to work with professor Weber from Turkey as well as with Urs Thomann and Benoit Sicre from Switzerland. Their expertise and enthusiastic lectures enabled us to create new revolutionary solutions for energy efficiency, smart usage of resources using all our skills in OR and analytical techniques. This international cooperation inspired us to make Ukraine smarter and much more efficient. - Darya Botvynko.

The AACIMP team has always highly appreciated cooperation with IFORS and EURO, which have consistently supported the Summer School. This year, IFORS supported the participation of three prominent lecturers from Europe.

The AACIMP Summer School has been a bridge linking Ukrainian young researchers in the field with the international Operational Research community for 10 years. SSA members have been organizing the stream "Initiatives for OR Education" at the EURO/IFORS conferences since 2010. Moreover, the World Data Center for Geoinformatics and Sustainable Development of NTUU "KPI" began cooperation within the "OR for developing countries" initiative.

All course materials and project results are accessible online. http://summerschool.ssa.org.ua. Readers will note that the AACIMP Summer School was established by Student Science Association (SSA) of the National Technical University of Ukraine "Kyiv Polytechnic Institute" (Kyiv, Ukraine). OR grew from lectures in 2006 to a key topic in 2009 through the encouragement provided by Willi Weber.

Call for Applicants for IFORS scholarship to the XX ALIO Summer SCHOOL (ELAVIO 2016)

Cali Colombia, May 9th – 13th

IFORS is offering one scholarship to the ELAVIO 2016. IFORS will cover the participant's airfare from his/her country (subject to a maximum limit) while ELAVIO organizers will provide meals and accommodation during the dates of the school.

Applicants must:

- have done work in the fields of interest of the School;
- be at an early stage of her/his career;
- present unpublished work and answer questions in English;
- be highly recommended by the adviser/supervisor of her/his work;
- file a report on the outcome of the activity and its benefits.

Candidates satisfying the requirements are encouraged to submit their curriculum vitae, a two-page abstract of the work to be presented, and a recommendation letter by the adviser by **December 7th, 2015 to IFORS Vice President for ALIO Lorena Pradenas**, lpradena@udec.cl. The selected applicant will be notified by February 15th, 2015. Candidates from developing countries will have an advantage in the selection.

ABOUT ELAVIO 2016

The Latin American Association of Operations Research Societies (ALIO) is pleased to announce that the Summer School in Operations Research for Young Scholars (ELAVIO) for 2016 will take place in the city of Cali, Colombia, from May 9 -13, 2016. Hosting the event are Universidad del Valle and the Pontificia Universidad Javeriana (Department of Civil and Industrial Engineering), co-organized by the Universidad de Medellín and the Universidad de Antioquia. ELAVIO is a school promoted by ALIO (Latin-American Association of Operations Research) and supported by IFORS (International Federation of Operational Research Societies. ELAVIO 2016 venue is *Casa Santa Maria de los Farallones Foundation* (better known as *Casa de las Palmas*), a convention center for personal development managed by the Pontificia Universidad Javeriana of Cali.

ELAVIO aims to stimulate participation of and collaboration among young researchers and graduate students, expose them to updates in various research areas through short courses and plenary talks, and provide them a venue to discuss ongoing projects. Previous editions of the school are noted for providing excellent fellowship environments that strengthen contacts among members of research groups from different countries

Topics of interest for the school include, but are not limited to:

- Combinatorial optimization and polyhedral theory; linear, nonlinear and integer programming;
- Metaheuristics and its applications;
- Discrete, continuous and agent based simulation, stochastic processes and probabilistic models; and
- Applications of operational research to problem solving in the areas of sustainability, health care, logistics, agroindustry, engineering, telecommunications, finance and production, big data, among others.

Additional information may be found at: http://paginasweb.univalle.edu.co/~elavio2016/
Please note that half of the courses and talks of invited speakers will be given in Spanish (with English slides).

OR for Development Section

The International Conference on OR for Development 2016 (ICORD 2016) (ifors.org/icord2016) will be held on June 9-10 2016 at the facilities of Instituto Tecnologico Autonomo de Mexico (ITAM) in Mexico City.

The theme of ICORD 2016 is "Constructing pathways to advanced societies through OR". Envisioning advanced societies as organized social groups that pursue higher standards of quality of life, OR may play an important role in decision making for the development of more efficient policies regarding sustainability, healthcare, energy, mobility, education, etc.

ICORD 2016 aims to attract researchers to present their contribution for constructing the pathways to advanced societies through OR methods.

Call for Papers

Authors with papers that fit the scope of ICORD 2016 are encouraged to participate. The papers must present a problem or element that is representative of the context of developing countries.

Extended abstracts (no less than 1,500 words) will be accepted, though full papers are preferred.

Submission system is now available via the conference website: ifors.org/icord2016/call-for-papers

Speakers

Rafael Epstein
Professor at Universidad de Chile; Co-recipient of the Franz Edelman Award 1998 (Operations optimization of forest companies in Chile); Co-recipient of the IFORS - OR for Development Prize Competition 2002 (Combinatorial auctions improves schools meals in Chile); Associated Editor of the Naval Research Logistics journal

Andres L. Medaglia
Professor at Universidad de los Andes (Colombia); Co-recipient of the EURO Award for the Best EJOR (Review) Paper in 2015; Co-recipient of the First Prize in the 2011 INFORMS Railway Application Section Problem Solving Competition; Liaison for the Americas in the Transportation Science & Logistics Society (TSL) – INFORMS

Important Dates
Deadline for paper submission: January 31, 2016.
Notification of acceptance: March 1, 2016.
Early registration: April 1, 2016.
Conference date: June 9-10, 2016.

Organizing Committee

Program Chairs:
David Muñoz Negron
Elise del Rosario

Conference Chairs
Adrian Ramirez Nafarrate
Luis A. Moncayo Martinez

Operational Research and Development; "Real World" Insights from Health O.R.?

Geoff Royston <geoff.royston@gmail.com>

Operational research is contributing to improving global health, one of the grand development challenges for humanity for the 21st century, but has potential to contribute much more , .

While the last two centuries have seen unprecedented improvements in human health, disease remains a major global burden – and falls unequally. Life expectancy around the globe varies by a factor of 2, child mortality by a factor of 20 and maternal mortality by a factor of 100. Most of the UN Millennium Goals were focused on health, and significant progress has been made on some, for example child mortality. Further progress will come not only from increased funding, new discoveries and innovative treatments but also from making best use of existing knowledge and resources, so operational research should have a major contribution to make.

O.R. approaches can inform a range of archetypal global health design and delivery issues - identifying problems, choosing and introducing interventions, scaling them up and integrating them into wider health systems and can help, through monitoring and evaluation, to develop a learning cycle for further improvement. The O.R. community has indeed contributed to developing health care in low & middle-income countries (LMICs), for example:

- Through O.R., a system dynamic model of polio management showed that eradication was a better intervention to choose than control - work that won the INFORMS 2014 Edelman award .
- An O.R. simulation model for capacity planning at HIV clinics showed how the demand on public sector physicians for HIV services in Rwanda could be reduced by four-fifths .
- A recent O.R. study assessing the pharmaceutical distribution chain in Zambia showed that current inventory control policies for sub-Saharan Africa do not adequately allow for common situations involving seasonality in demand and interruptions in road access to facilities, and showed how supply chain redesign should increase drug availability and reduce inventory costs.

However, to fully realize this potential, various issues need to be addressed. Success factors for health operational research in LMICs have been identified more than once , and (as for successful O.R. anywhere) include flexible approaches, practical relevance, local partnership and so on. One major gap is support and funding - few international organizations allocate much of their health research funds to O.R., for example only 3% of funding from the US National Institutes of Health is for research on delivery and use. Another gap is methodological - LMIC health projects denoted as "operational research" are often limited to descriptive surveys and field studies with little or no modelling (for example standard O.R. tools and techniques are *not even mentioned* in current guidance on operations research from a consortium of leading international organisations in global health !), revealing a disturbing disconnection between the main body of researchers in global health and the O.R. community. Researchers on healthcare in LMICs need support from O.R. professionals to help draw on a broader range of analytical methods and to combine field work with analysis and modelling, to avoid on one hand the risk of "methodology lite" fieldwork with lack of rigour and on the other hand, of over-sophisticated technique with lack of practical relevance.

A full O.R. approach will involve considering the use of an appropriate array of tools ranging from traditional "hard" quantitative methods to qualitative "soft" approaches that do not need large amounts of data or computing. Systems approaches seem particularly relevant in the development area see e.g. 9, 10. These can of course be qualitative (soft systems) or quantitative (system dynamics); systems mapping can form a bridge between the two and is often a good starting point, and keeping analysis as simple and visual as possible allows key findings to be absorbed more easily.

But perhaps the key gap for LMICs lies in scarcity of research skills and capacity at individual and institutional level. Nearly all investigations have highlighted the importance of capacity strengthening and mentoring of researchers in the relevant countries. So building operational research skills and capacities ***within LMICs*** is perhaps the single most important challenge – in health and in other areas. Hopefully this something – in health or more generally – where IFORS could expand its existing support for O.R. in Development by, for instance, doing more to foster partnerships between appropriate institutions in the developed and developing worlds, or to sponsor training for those in LMICs, or otherwise.

Finally, a more general point. I have argued before that O.R. , to live up to its byname as "the science of better", must entail more than a traditional "decision physics" approach, and needs particularly to embrace problem structuring, behavioural modelling, and design thinking to be an a*rticulated systems improvement science for the "real world"* . That should help ensure that O.R. engages with the world as it is – where situations can be uncertain, complex and changing, where it's often not known what will work best, or at all, where human factors are important and decision-makers are busy and not always highly numerate. These conditions will apply as much if not more in LMICs, so a "real world" approach to their problems will be essential if O.R. is to fulfill its global potential.

T*his article is based on a presentation to the EURO/IFORS workshop on O.R. for development, held in Glasgow, July 8-10 2015. The presentation slides are available at* http://ifors.org/web/wp-content/uploads/2015/07/OR-for-Development-Workshop-9-July-2015-Geoff-Royston-pdf-of-slides.pdf

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A second look at Uplifting Living Conditions

Nina Kajiji <nina@nkd-group.com>, **Gordon Dash** <ghdash@uri.edu>, **Gerhard-Wilhelm Weber** <gweber@metu.edu.tr>

"OR: Uplifting Living Conditions" was the theme of the OR for Development Workshop held on July 9-10th, 2015 at the University of Strathclyde in Glasgow, Scotland. With this report, we provide some basic information and interesting details about this event, on how we perceived it, its meaning and potential future impact. The Workshop was jointly sponsored by the EURO Working Group – OR for Development (EWG-ORD) and the IFORS, and offered in conjunction with the EURO 2015; the premier European conference for Operational Research and Management Science.

In developed and developing countries, deficiencies in planning, policy execution and institutional life have contributed very much to the problems which we face today, including hunger, poverty, pollution, massive wealth divide, migration streams and related tragedies, poor education, inadequate health services, inadequate disaster response, access to government services. Equipped with the methodologies that are necessary to alleviate these challenges, many Operational Researchers have worked in these fields. A glance at the literature (cf., e.g., http://ifors.org/developing_countries/index.php?title=Main_Page) including entries and winners of the *IFORS Prize for OR in Development* (http://ifors.org/web/ifors-prize-for-or-in-development/) shows that a lot of contributions have been done in OR for Development. In fact, both *IFORS*, with its *IFORS Developing Countries OR Resources Website* (http://ifors.org/developing_countries/index.php?title=Main_Page), and *EURO* (https://www.euro-online.org/) with its *EURO Working Group on OR for Development* (EWG ORD; https://www.euro-online.org/web/ewg/29/or-for-development-ewg-ord), have contributed richly, bringing about meaningful initiatives on OR for Developing Countries in the past few years.

EWG ORD - IFORS Workshop on OR for Development was held before the *EURO 2015* (http://www.euro2015.org/) as a satellite event, with most of the participants of the Workshop contributing actively to the streams related with other EURO Working Groups, e.g., *EWG "Ethics* and *OR" and its EthOR Award* project. This workshop aimed to bring together members of our European and worldwide OR community who have utilized OR tools to address problems in education, health (e.g., epidemics), basic public services, water management, technology, use and reuse of resources, infrastructure, agriculture, industries, environmental sustainability, energy sector, unabated population growth and climate change. *EWG ORD - IFORS Workshop on OR for Development*, was characterized by a special format of the talks, their thorough introduction and constructive feedback mechanism. There were feature presentations by the participants of their papers – each of them selected in a careful reviewing process. All participants were given all the accepted papers in advance, so that they had enough time to study the others' papers. Ample time was provided for a discussion of each of the presentations (see http://ifors.org/ewg-ord/#sthash.m3ltnlk5.dpuf).

Geoff Royston delivers the keynote, summary of which is presented as a feature in this section.

This workshop was prepared with attention to details, by *Soheil Davari, Sue Merchant, Andres F. Osorio, Elise del Rosario, Honora Smith* and *Gerhard-Wilhelm (Willi) Weber*. The welcoming remark of Honora Smith (EWG ORD managing board member and Past Chair) was followed by the opening talk of *Sue Merchant* (IFORS Vice President at large and Chair, *Developing Countries Committee* at *IFORS,* and committee member of the *IFORS Developing Countries OR Resources Website*). The keynote speech was presented by *Geoff Royston*, former head of strategic analysis and Operational Research in the Department of Health for England and Past President of The Operational Research Society of the UK. This keynote speech offered some very insightful comments and solutions that have been implemented by the Department to solve some known and existing real-world health OR issues. *Geoff Royston* also challenged the OR community to draw on a broader range of analytical methods including the use of "Big Data" analytics to address the growing need for better health in developing countries.

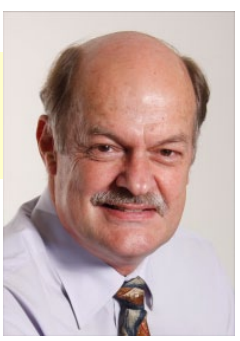
One of the major advantages of the EURO Working Group workshops is the in-depth discussion that ensues among the researchers and reactors. This workshop was no exception, and particularly enriching in this case was the wide range of topics, including: traditional OR applications that emphasized development issues as it pertained to optimum allocation in forestry, improving service quality in hospitals, supply chain management, novel approaches to investigating issues on uplifting living conditions by incorporating data or models from geo-informatics, neuroscience, and non-parametric statistics.
Some other highlights were two very interesting and useful tutorials. The first was on *Multicriteria Mapping Tool* (http://www.multicriteriamapping.com/). This tool is developed by the University of Sussex, UK. The second was on the use of simulation software, *Simula8* (http://simul8.com/).

Special thanks to organizers for truly making sure that all administrative and scientific aspects of the workshop met the highest standards, even as the process drew in and trained young OR workers in organizing, conducting and leading such an event. Of course, the participants representing ten countries across five continents made this workshop a great success.

Book Review

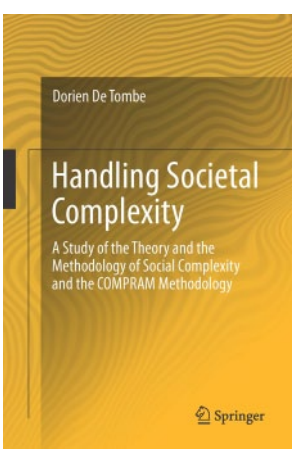
OR: From Problem Solving to Problem Handling

Hans W. Ittmann, University of Johannesburg <hittmann01@gmail.com>



Handling Societal Complexity – A Study of the Theory and the Methodology of Societal Complexity and the COMPRAM Methodology by Dorien DeTombe, 2015. Springer-Verlag, Berlin. pp. 551, ISBN: 978-3-662-43917-6, EURO 129.99 (Hardcover) and ISBN: 978-3-662-43917-3, EURO 107.09 (e-book).

Society worldwide is almost continuously confronted with disasters, complex issues and problems. Terrorist attacks, refugees from Syria and Africa, global warming, HIV/Aids or the world financial crises are just a few examples of complex societal problems. The recent terrorist attacks in Paris have devastating effects not only on society but also on humanity as a whole. All of these are clearly very difficult problems. The framework for handling such societal complexity falls within the ambit of Soft OR. Complex societal problems are by nature almost impossible to solve and therefore the emphasis is on handling or addressing them. This book outlines the theory and methodology of societal complexity and proposes the COMPRAM Methodology (COMplex PRoblem HAndling Methodology).



The book consists of two parts, with the first part laying the groundwork for the eventual introduction of the methodology. The second part takes the reader through several examples where the methodology is applied. Within the first seven chapters, the theoretical foundation is outlined and described in great detail. The COMPRAM methodology is then introduced and explained. The focus in the second part of the book, comprising of the last seven chapters, is on examples of methodology applications in health care, sustainable development, and terrorism, to name a few. In each of these diverse problem areas, different aspects of the methodology are illustrated and emphasized.

In the first part, boundaries of complex problems addressed using the problem handling process is set. In chapters three and four, the methodological theory of societal complexity is developed almost from first principles in a logical and extensive manner. For example, a general definition of a problem is developed: "*something is called a problem when there are discrepancies between the actual or (near) future situation and the desired future situation and/or there is a lack of knowledge, and/or a lack of relevant data and/or a lack of data*". Every aspect related to a problem is discussed and this logically leads to problem handling with all the related issues. From this, a definition is provided for a complex societal problem, which is characterised as: a real-life problem, having a large and often different impact on different groups of society, is undefined or ill-defined, lacking in data and knowledge, concerns many different domains, with many actors/players involved, provokes emotions, is unique and never been handled before. Human problem handling is the topic of chapter four. Aspects addressed here, among others, are the problem handling cycle, problem development and model conceptualisation, a wide variety of problem solving methods, possible interventions emanating from the results, and scenarios with their limitations.

Chapter five illustrates how computers, with a focus on Group Decision Support Systems (GDDS), has and could assist in the process. A real-life example using GDSS is presented, showing the importance of a methodology for handing complex problems. The next chapter goes into the different aspects required from the methodology, culminating in an exhaustive list of 26 conditions which should be considered, included or discussed in supporting the problem handling process. Each of these is briefly stated with a short accompanying outline of what it entails. Chapter seven is devoted to the COMPRAM methodology which is a framework giving guidelines, suggestions and heuristics on how to approach complex societal problems. It consists of six steps, namely, the analysis, problem description by neutral content experts, analysis and description of the problem by different teams of actors, identification of interventions by experts and actors, anticipation of the societal reactions, implementation of the interventions and evaluation of the changes.

In most of the second part of the book, chapters eight to fourteen, examples of the use of the Compram Methodology are discussed in what the author calls "the domain of global safety". Examples include healthcare, economics, climate change, terrorism, large city problems, large technological projects and floods. The credit crisis is likewise presented as a hypothetical application. The time period and geographical area is chosen indicating boundaries of the problem. Issues considered include: the unequal distribution of wealth and power, capitalism and democracy, corruption, illegal activities and tolerance, the credit crisis of 2008 and the various actors involved, the role of business banks, the role of private equity funds and hedge funds, and worldwide financial systems. Given all the background, information and aspects of the problem, the methodology is illustrated.

The issue of implementation of interventions as well as ethical aspects, validation and testing of the methodology are addressed and illustrated in chapter thirteen. The final chapter shows how the outcomes could be used for policy formulation and policy making. A final summary is also provided.

This book is thoroughly researched and provides an in-depth understanding of the multi-disciplinary, multi-actor, multi-level and often also multi-continental approach presented and how it takes into account emotional aspects of a complex societal problem. The author makes it clear that these problems require different approaches and that, in the majority of cases, these are impossible to solve. Nevertheless OR problem solvers, including researchers, lecturers and students, can benefit immensely from an exposure to a problem handling methodology that, if applied properly, has the potential to reduce conflicts, save money and ultimately, even save lives.

Feature

Political Foresight and Societal Complexity Research on the Refugee Issue

A Feature on the Methodology of Societal Complexity for Governments

Ulrike Reisach <ulrike.reisach@hs-neu-ulm.de>, **Neu-Ulm University of Applied Sciences**

The current refugee issue in Europe is a typical example of a complex societal problem. In this case, humanitarian, political, social and economic factors are inextricably woven together in a complex net-worked world of multiple and partially competing interests of stakeholders. The issues at stake are "strategic" and as such, need an interdisciplinary approach. All sciences and societal groups, including businesses, want to understand the current challenges in order to ensure a successful integration of millions of new arrivals in Europe.

Unfortunately, there is no algorithm which optimizes the refugee streams and the logistics of resources needed, nor is there a master plan of integration for a world government, much less a savior who would take all this in his/her hands and lead the way which would satisfy all the needs of the people involved, from asylum seekers to helpers, from local to national citizens, administrations and governments. Such is the pattern of societal complexity: no easy solutions, multiple and often contradicting interests, no accurate forecast or calculability of future developments.

While no real solution can be offered for problems with a high degree of complexity, a methodology shows promise of providing a valuable instrument for governments and organizations in search of: new directions, new approaches for handling crises before they occur, and communication strategies with multiple and sometimes emotional stakeholders. This is the Complex Societal Problem Handling Methodology (COMPRAM*), which prescribes an 6-step plan. Below are suggestions for the problem at hand:

1. Knowledge
Increasing the knowledge, e.g. using a simulation model including several scenarios of future *refugees/migration streams and directions to be expected; regular gathering of forecasts from experts, think tanks and social media; widening the scope of potential ideas and contributors through the creation of a platform for an idea competition.*

2. Power
Analysis and description of the problem by a team of neutral content experts; analysis of their respective power; *strategic analysis of (mega-) trends in various countries, analysis of consequences for the local people and of potential impacts on neighboring countries through experts from various backgrounds (to avoid blind spots, biases and self-interest).*

School sports hall in Bavaria, Southern Germany, with beds for 209 refugees. Most of the sports halls are full here since the Southern part of Germany is on the main migration route for people coming from South and East.

3. Mutual Agreement
Analysis and description of the problem by different teams of actors; discussions of possibilities; agreement on interventions; *migration can be a motor for economic growth if the integration is successful; therefore people and shelters have to be prepared, the distribution, registration and acknowledgement process speeded up, incentive systems and learning material has to be developed. A European alignment of laws and procedures should be found, local laws may have to be adapted, administrative structures might have to become more flexible. An open discussion of such kind of suggestions should not be restricted to the usual bodies, but rather to different interest groups and representatives of the regions: they know the local challenges and can more clearly see potential developments, political, societal, financial risks of the interventions. Additionally, platforms for a competition for the best ideas can be established.*

4. Societal Reactions
Anticipation of the societal reactions; discussion of mutually accepted interventions; *communication is necessary to critically reflect the objectives, plans, and measures.*

This is an opportunity to integrate all stakeholders. Decision makers can use megatrends such as migration to put the relevant priorities on top of the agenda, to explain strategic moves and relate them to short-term/long term goals, responsibility and reputation considerations.

5. Implementation
The implementation takes time and has to be monitored steadily to assess the various steps and their realization and consequences.

6. Evaluation
The evaluation of changes includes information on success of the interventions and lessons learned. *Often there is a lack of explicit analysis of shortcomings in decision making and results - at least they are seldom published because politicians want to be re-elected and tend to sell everything as a success. It is also difficult to measure whether the outcomes are attributable to the strategic decision-making or to other factors and changes that took place. But the usefulness of regional or institutional initiatives can be assessed through a benchmarking process which allows best practice sharing and mutual learning.*

The task will not be easy but with the broader view and knowledge about the arguments of opponent stakeholders, an open and forward-looking approach and discussion can help foster a critical reflection on current policies with regard to future trends. Governments and organizations can use this model to systematically develop scenarios, foster stakeholder inclusion, channel the debate about interventions and strategies, learn from each other and be better prepared for the handling of the existing and further upcoming issues.

**DeTombe, Dorien: Handling Societal Complexity. A Study of the Theory of the Methodology of Societal Complexity and the COMPRAM Methodology, Springer 2015, ISBN 978-3-662-43916-6*

Further information: www.hs-neu-ulm.de/en/ulrike-reisach/ and www.ulrike-reisach.eu/en/

OR IMPACT

Articles demonstrating direct benefits from implementing OR studies

Section Editors: Sue Merchant <suemerchant@hotmail.com>, **John Ranyard** <jranyard@cix.co.uk>

Collaborative Logistics in the Forestry Sector*

Mikael Rönnqvist <mikael.ronnqvist@gmc.ulaval.ca> **UniversitéLaval, Québec, Canada**

The author worked with Skogforsk, the Swedish Forestry Research Institute, to develop models that minimise the cost of transporting timber – a major industry in Sweden - from the forest to the end user. The resultant Decision Support System, FlowOpt, has been used by many European forestry companies to evaluate performance and identify improvements. Hakan Alexandersson, Logistics Manager, Stora Enso Bioenergy in Sweden, reports significant savings from using FlowOpt to plan timber supply to a paper manufacturing plant and also for biomass transportation. FlowOpt was also used to support emergency logistics re-planning after the Gudrun storm hit Southern Sweden, felling some 70 million cubic metres of forest, almost a year's annual harvest for the whole of Sweden. This decision support system was awarded the EURO Excellence in Practice Award in 2012.Whilst individual companies can use FlowOpt to reduce their transport costs, further savings can be made through collaborative logistics involving several companies.

Collaborative logistics can take place at several levels, from the exchange of information (weak) to building relationships for the joint planning and execution of operations (strong) but all involve trust among the collaborating companies. The chosen partners need to agree on the objectives and scope of the collaboration, the responsibilities of each partner and how the benefits will be shared (see Fig 1). The technical issue for collaborating in timber transportation is to find an approach that is likely to achieve maximum savings and then to determine how costs should be allocated to the participants in an equitable and acceptable way. Previous research (Guajardo et al.; 2015) covering collaborations involving up to 50 companies (but mostly 2-5) showed that up to 40% cost savings could be achieved. In this case, an initial analysis of just two timber companies sharing supply and demand, showed that significant savings could be achieved through shared transportation, which is illustrated in Figure 2.

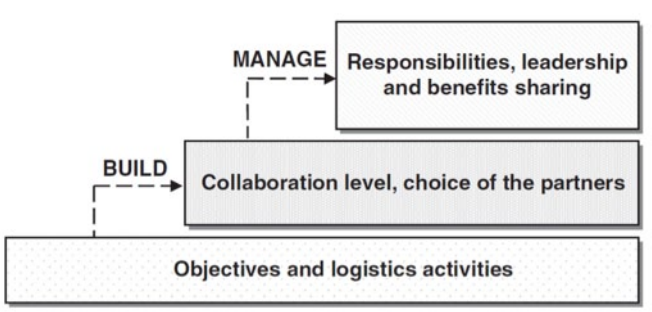


Fig 1 Building and managing logistics collaborations

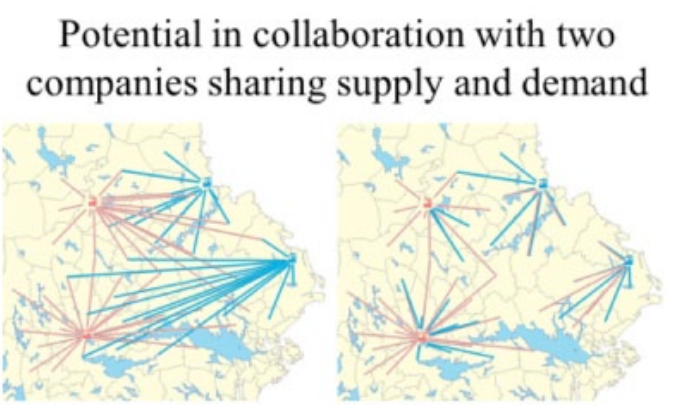


Fig 2 Potential from collaboration between two companies sharing supply and demand

The research then progressed to a case study involving 8 participating timber companies in southern Sweden, which was designed to demonstrate the potential benefits (Frisk et al.; 2010). The problem involved 4842 supply points, 310 demand points and 5053 constraints and was solved using an optimisation model (see reference 1), >>

** presented in the OR Case Studies stream at EURO 2015*

>> which demonstrated that 14% cost savings could be achieved, as shown in Table 1. The next stage was to allocate the cost savings among the participating companies. The simplest allocation is by volume transported, which means that the biggest companies get the biggest savings. However, this may result in some companies being obliged to pay (negative saving) to the coalition as their operational area is very compact and more efficient than the average company in the coalition. Thus two alternative approaches were investigated using a game theoretic approach, one involving 'Shapley' values which is based on the marginal savings when companies are included or not in all potential coalitions and the other an equal profit method (EPM). The latter is based on minimizing the deviation in savings (or profit) between all pairs of companies while having a stable solution (in a game theoretic model). The results (savings for each company) are shown in Table 2, Fig 3 shows the difference between a solution where each company plans separately and one where they collaborate The results also showed that the cost savings increased as the number of participants increased – see Fig 4

opt1: direct flows (individual) opt3: direct flows (collaboration)
opt2: backhaul flows (individual) opt4: backhaul flows (collaboration)

Company	Real	opt 1	opt 2	opt 3	opt 4
Company 1	3,894	3,778	3,640		
Company 2	15,757	14,859	14,684		
Company 3	4,828	4,742	4,703		
Company 4	2,103	2,067	2,043		
Company 5	10,704	10,340	10,153		
Company 6	5,084	4,959	4,826		
Company 7	1,934	1,884	1,877		
Company 8	0,333	0,333	0,332		
All				39,253	38,315
Total	44,637	42,963	42,257	39,253	38,315
Savings (%)	0,00	3,75	5,33	12,06	14,16

Table 1 Optimum supply costs (SEK, thousands) without (Real) and with collaboration and backhauling

The case study also revealed that some practicalities need to be overcome in order to motivate collaboration, including the trust involved in sharing sensitive information, the business model used and the necessity for neutral (and trusted) leadership in order to coordinate all the activities involved (Audy et al.; 2012). After this study, three of the initial eight companies agreed to continue the collaboration but with some extra conditions. An important one was to ensure a minimum level of supply from each company to its own mills. Another was to guarantee that all sharing was mutual, that is, each pair of companies exchanges the same volumes for each log type. The three companies are now jointly planning transportation every month with savings in the range 5-15%. Jan Fryk, Managing Director, Skogforst, says "the use of FlowOpt by our collaborating companies has been a vital contribution to logistics planning in the forestry sector".

Company	Volume	Shapley	EPM
1	9.0	5.1	6.7
2	9.7	9.0	8.8
3	11.2	13.5	8.8
4	4.3	8.6	8.8
5	0.2	5.7	8.8
6	19.9	9.2	8.8
7	13.2	15.8	8.8
8	14.0	6.9	8.8

Table 2 Percentage savings for each company using different allocation methods

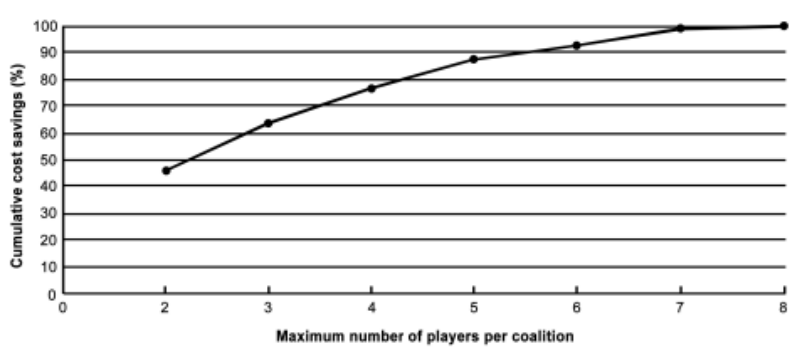


Fig 4 (cumulative savings versus number of participants)

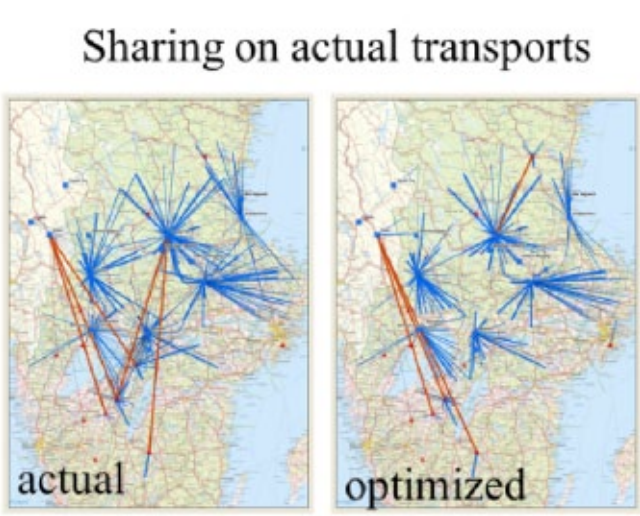


Fig 3 Difference between plans based on actual separate planning and one based on collaboration – 8 Collaborators

This impressive work has demonstrated that collaborative planning leads not only to lower costs for the companies involved but also to significantly reduced emissions caused by transportation, thus helping to address climate change.

References:

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Celebrating the Breadth of OR In Practice

Stream organisers John Ranyard <jranyard@cix.co.uk> **Sue Merchant** <suemerchant@hotmail.com>

Introduction

At the EURO conference in July 2015, OR practitioners from a range of different countries and backgrounds came together to showcase a wide variety of OR work in the *Case studies in OR and Analytics stream*. The papers are described below, grouped by topic. We are most grateful to all our speakers for making the sessions interesting and to all the members of the audience who joined in with enthusiastic questions and comments.

John Ranyard set the scene by using his previously reported survey of OR practice worldwide as a platform to investigate **the changing scope of OR and the divide between OR research and OR practice.** He concluded that the gap between theoretical developments, applications & methods used in organisations continues but that INFORMS and the UK OR Society are doing much to help, such as the 'Science of Better' initiative and 'Making an Impact' conference streams. The scope of OR is being extended by the use of Problem Structuring Methods, though mainly in the UK, but critical challenges remain before more widespread adoption can be achieved. In addition, Business Analytics, which overlaps with OR and has attained a high profile in recent years, presents challenges which need to be addressed.

Speakers in the rest of the stream (from Canada, Germany, the Philippines, Portugal and the UK) then demonstrated that OR practice is indeed alive and well!

Public Sector

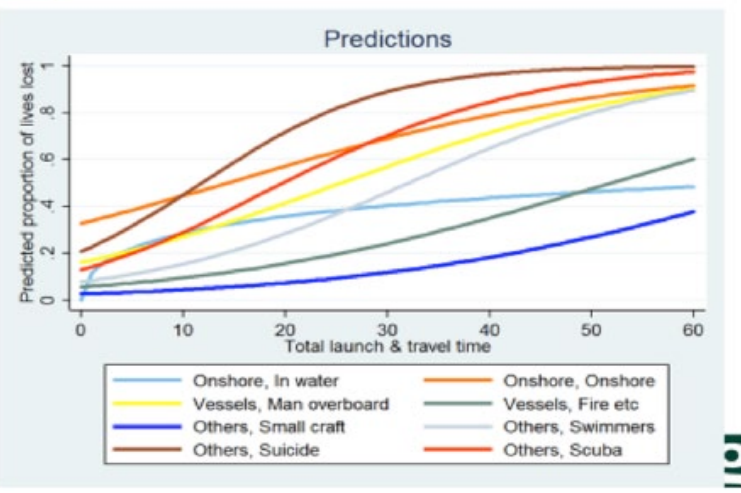
Martin Rahman and Gail Mawdsley from West Yorkshire Police, UK, described how many separately operated **UK police aircraft services** had been rationalised into one central resource. A simulation model was used to estimate the level of coverage that could be achieved with different numbers of aircraft operating from available bases, resulting in savings of 14% in operational costs.

Andrew Cooper from ORH Ltd, UK, described a study for a **regional Fire Brigade** to determine the number of pumps it should hold and at which stations. An optimisation model was developed to identify options for station configuration and appliance deployment, followed by simulation to predict the implications for risk cover and response times. A preferred option (155 pumps situated at 102 stations) was identified and enabled the fire brigade to make major cost savings.

John Mobbs, also from ORH Ltd, described a study he and Tom Boness undertook for the **East of England ambulance service** to understand gaps in provision for key performance targets, such as response times for seriously ill patients, and then determine how to bring the service up to a specified level. A discrete event simulation model was developed and used to identify improvements by rearranging resource deployments, altering shift timings and simplifying dispatch protocols. The model was handed over to the client to support future planning activities.

Joe Breen, Cath Reynolds and Russell Hocken, Royal National Lifeboat Institution, UK, and Michael Wright, Greenstreet Bergman Ltd, UK, had collaborated on a fascinating project to improve the **RNLI's response service** by identifying and quantifying the factors that impact survival rates in serious incidents attended by lifeboats. Their stepwise multivariate logistic regression model had identified key factors affecting the outcome of RNLI services, such as wind, the type of incident, sea water temperature, visibility and response time, thus enabling improved resource usage.

Paul Hewson from Plymouth University, UK, described how he had **audited the government's national police funding formula** on behalf of The Rural Services Partnership, who were anxious to establish that rural regions were not disadvantaged by the formula. He used simple O.R. testing methods to try to find flaws in the way the formula worked. It is commonly believed that around 80% of spreadsheets contain errors but that with careful design (e.g. using software quality processes; using ranging and simulation) many of these can be avoided.

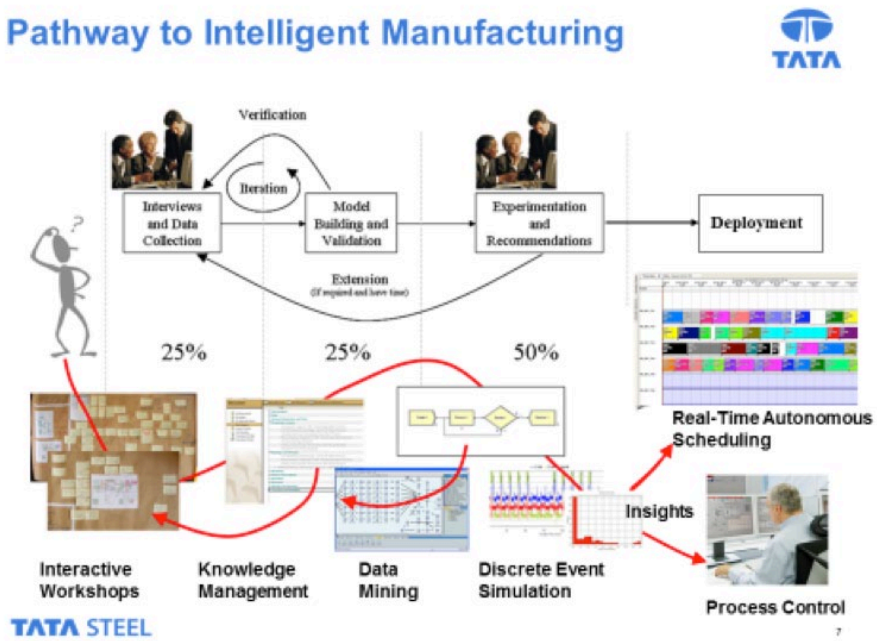


Project to improve RNLI's response service

Production/Logistics

Steve Thornton of TATA Steel, UK, described a case study using an Autonomous Systems Development Tool to Automate Scheduling of a Batch Heat Treatment Plant. Initial workshops and data analysis enabled hard and soft objectives to be agreed and then the development tool plus an associated algorithm were used to balance softer objectives relating to delivery, reliability, energy consumption and utilisation. An extended period of evaluation confirmed the value of the tool but also highlighted the continued importance of human tacit knowledge.

Martin Dahman (Asolvo, GmbH) and Stephan Westphal (Clausthal University), Germany, described the use of a **Long-Term Planning Model for Industrial Alumina Production.** Several successive production steps enable basic materials and preliminary products to be processed to produce diverse final products. As any of these steps can be processed on different machines with different capacities, many options in production scheduling and machine assignment are possible. An LP-based planning procedure was developed to produce an optimal production schedule spanning up to five years and to identify machine capacity bottlenecks. A graphical evaluation system is enabling the new approach to be tested by the client, so far with promising results.



Incorporating hard and soft objectives in scheduling a batch heat treatment plant.

João Alves and colleagues' (University of Porto, Portugal) study into **Reducing Warehouse Picking Travel Times using OR** was reported in the September issue and Mikael Rönnqvist's (Université Laval, Québec, Canada) work on **How to Use Collaborative Logistics** is reported in this issue.

Human aspects of OR

Elise del Rosario, Philippines, summarised her experience of **Getting OR Applied** via a whistle stop tour through a number of most interesting studies she had undertaken in her career from rationalising Philippine owned brewery facilities in China to the optimisation of energy generating facilities in the Luzon island grid in the Philippines (both using a mixed integer programming model). Elise stressed how important it was to have a project champion in the client organisation to help ensure implementation.

David Lowe and colleagues, DSTL and Mike Yearmouth, University of Bristol, UK, designed a method for **Assessing UK Ministry of Defence's acquisition system**, using Stafford Beer's Viable Systems Model. The method was tested with stakeholders drawn from across the MoD and provided a powerful framework. David reflected that: data collection should not be under-estimated; methods are not always scalable; inter-organisational friction can restrict progress; data protection is crucial; and the client/consultant boundary needs management. The team is now moving on to improve the model and to focus on defining and measuring the health of the whole enterprise.

Ian Seed, Cogentus UK, worked with the US Department of Energy to help **prioritise 140 R&D projects to support nuclear clean-up**, using MCDA. He said that it had been very hard to identify objectives despite there being a mission and vision in place, so it was necessary to run through a strategy development session with the Lead Team. Lessons learned included: experts aren't experts on things outside their expertise; scores are a matter of opinion, not fact; workshops are subject to group-think; peer review and data validation are important; use expert workshops to investigate the data but not to 'score'; more people generally means 'more difficult'!

Liam Hastie, Simul8, UK, described **how Simulation and Cloud Based Computing can bring Optimisation to small and medium enterprises** via a collaboration project with a small company that produces die cutting tools. The aim was to optimise its output to meet demand but much computing power is needed to do this using simulation. The key is to link the simulation model to the cloud so as to achieve faster processing times. Future development of the cloud is unclear – will it offer new approaches, like running processor intensive analysis via mobile phones? Watch this space!

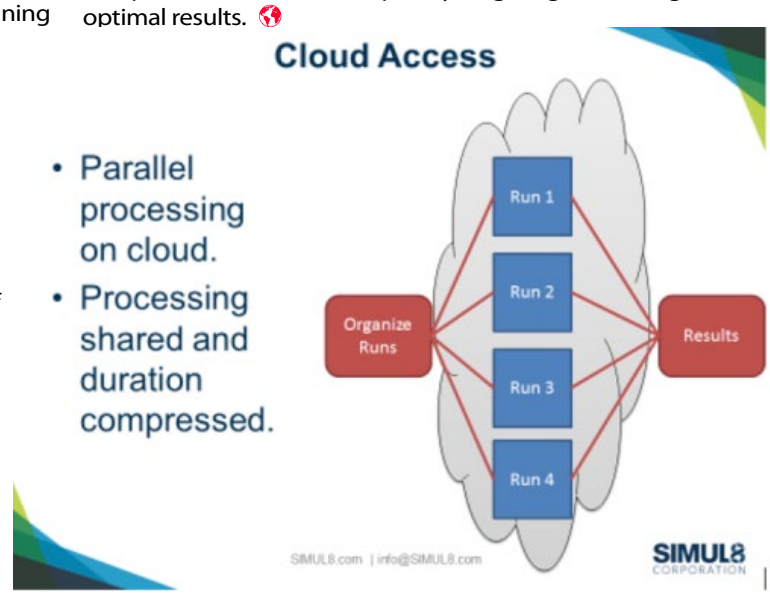
Analytics

Martin Slaughter, Hartley McMaster Ltd, UK, showed how the **most profitable opening hours for Vodafone UK's 300+ stores** could be determined. Large data sets measuring footfall in stores and sales profiles were used to correlate customer arrival patterns with sales activity and to develop tools to identify revised store trading hours. The store hours of virtually all shops were altered in line with the model recommendations. The trading performance was reviewed 12 months later and trading performance had improved as predicted.

John Albiston described how TATA Steel UK is gaining better insights into the flow of material through various steel making activities by using **process mining.** His group had used the 'massive open online courses' (MOOCs) on process mining from Eindhoven University to help them carry out a pilot project, which is enabling a greater understanding of the process variabilities and leading to improved overall performance.

Colin Stewart of Caversham Analytics, UK, explained that the aim of his work was to **develop a postcode- based mortality risk model for insurers** offering life and pension products. Much open source data was accessed to ensure that the model was of the required accuracy, and potential users collaborated in the design and testing of the final product, which will now be marketed. Having the right team in place was seen as essential for providing credibility to potential users.

Finally Paul Edkins, DecisionLab, UK, addressed: **when should a power company's assets be replaced/refurbished so as to minimise the risk of failure?** A mixed-integer LP model was developed to minimise the risk of failure, subject to budget constraints, and provided acceptable results for subsets of the asset portfolio but computational times for the full asset portfolio proved to be excessive. Moreover, it was difficult to incorporate some of the practicalities and beliefs of the asset managers. Thus a rule-based heuristic is being investigated as being more acceptable to the client, hopefully to give 'good enough' if not optimal results.



Bringing optimization to small and medium enterprises via cloud based computing.

Crypto Cloud Computing: Economical and Financial Aspects With Cooperative Game Theory*

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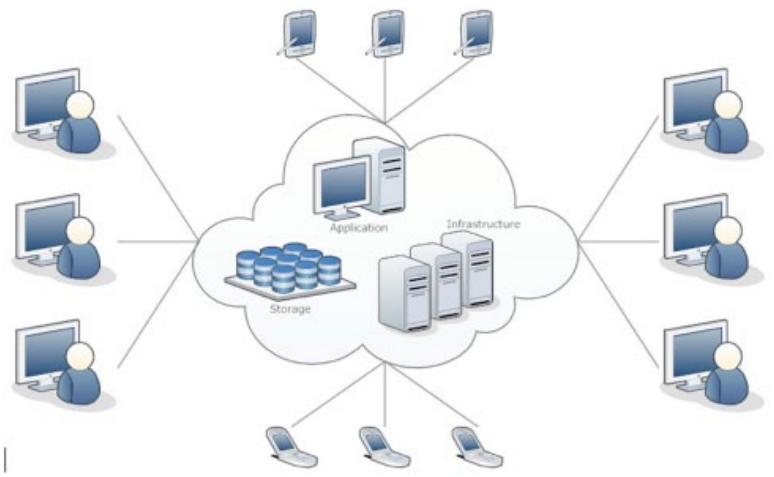
What is the Cloud and Cloud Computing?

Cloud Computing refers to a process of sharing resources to optimize performance i.e., using a network of computers to store and process information in place of a single machine. Various services such as storage, applications, and servers are delivered through the internet. Storing something in the cloud means storing it in a physical space. Depending on the cloud storage service used, that data rests with a company like Apple, Google, Microsoft or IBM which stores the files remotely and provides the user with access on demand for typically, a monthly fee.



Cloud Computing is a trend which has continued to grow because of the following advantages it offers:

- reduced hardware and maintenance cost by operating at high efficiency with optimum utilization;
- global accessibility;
- highly automated processes without concern for software upgrades;
- on-demand manipulation and configuration of applications;
- software installation unnecessary to manipulate cloud application;
- availability of online development and deployment tools, programming runtime environment;
- provision of a platform-independent access to any type of client;
- no interaction with cloud service provider required; and
- reliability stemming from a load balancing capability.

Advances in networking technology and an increase in the need for computing resources have prompted many organizations to outsource their storage and computing needs. This new economic and computing model is commonly referred to as Cloud Computing and includes various types of services such as: Infrastructure as a Service (IaaS), where a customer makes use of a service provider's computing, storage or networking infrastructure; Platform as a Service (PaaS), where a customer leverages the provider's resources to run custom applications; and Software as a Service (SaaS), where customers use software that is run on the provider's infrastructure (Kamara & Lauter, 2010).

Cloud services can be deployed in four ways depending upon the customer's requirements as public, private, community and hybrid clouds (Bhadauria et al., 2011). **Public** cloud infrastructure is provided to many customers and is managed by a third party. Multiple enterprises can work on the infrastructure provided at the same time. Users can dynamically provision resources through the internet from an off-site service provider. Wastage of resources is checked as the user pays for whatever is used. **Private** cloud infrastructure, made available only to a specific customer and managed either by the organization itself or by a third party service provider, uses the concept of virtualization of machines, and is a proprietary network. **Community** cloud infrastructure is shared by several organizations for a shared cause and may be managed by the users or a third party service provider. A composition of two or more cloud deployment models, linked in a way that data transfer takes place between them without affecting each other constitutes a **hybrid** cloud (Bhadauria et al., 2011; Grossman, 2009).

Cloud Computing presents an increasingly popular model for businesses in the financial services industry. Banks, stock brokerages, money management firms and other financial entities are attracted to the cost savings that cloud infrastructures can provide (Intel, 2003). Cloud Computing comes with its share of challenges, in terms of security, data privacy, compliance, availability, and lack of standards. These challenges are highlighted more in a regulated and security-sensitive environment, such as financial services. A financial services firm that relies heavily on information technology enabled services can benefit from Cloud Computing (Garg, 2011).

Cooperative Game Theory

Game Theory is a mathematical theory dealing with models of conflict and cooperation. It has many interactions with economics and with other areas such as Operational Research and social sciences (Gök et al., 2010). *Game theory* analyses situations in which at least two decision makers (players) are involved. Cooperative Game theory deals with coalitions which coordinate actions and pool winnings of its players. A Cooperative Game is a game where groups of players try to enforce cooperative behaviour, hence the game is a competition between coalitions of players, rather than between individual players (Branzei et al., 2008). The main problem in Cooperative *Game Theory is how to divide the rewards or costs among the members of the formed coalitions* (Gök et al., 2010).

Financial benefits are an important factor when cloud infrastructure is considered to meet processing demand. The Cloud Computing business has a financial aspect defined by a revenue model, pricing mechanism, cost structure, and cost accounting mechanism elements (Jäätmaa, 2010).

Storage services based on public clouds such as Microsoft's Azure storage service and Amazon's S3 provide customers with scalable and dynamic storage. By moving their data to the cloud, customers can avoid the costs of building and maintaining a private storage infrastructure, opting instead to pay a service provider as a function of its needs.

For most customers, this provides several benefits including availability (i.e., being able to access data from anywhere) and reliability (i.e., not having to worry about backups) at a relatively low cost (Kamara & Lauter, 2010).

**presented during the 55th Meeting of the , EURO Working Group on Commodities and Financial Modelling (EWGCFM).*

On account of Cloud Computing adhering to the pay-as-you-go pricing model that determines the cost of services in terms of such metrics as server hour, bandwidth, storage, the minimum cost spanning trees are investigated in this study to provide the financial aspects.

In order to allocate the cost of the minimum cost spanning tree among the players in a fair way, Bird's rule is used to assign the cost of an edge constructed in some iteration of the Prim algorithm to the player which constructs that edge and gets a connection with the source in that same iteration. Then, the Shapley value is defined and axiomatically characterized in different game-theoretic models. The Shapley value (Shapley, 1953) is one of the most interesting single-value solution concepts in Cooperative Game theory. Introduced and characterized for Cooperative Games with transferable utility (TU games) with a finite player set and where coalitions values are real numbers, it has captured much attention being extended in new game theoretic models and widely applied for solving reward/cost sharing problems in OR and economic situations, sociology, computer science, etc. (Gök et al., 2010).

Adressing Security and Privacy Concerns

Although Cloud Computing is a promising innovation with various benefits in the world of computing, it comes with risks, the biggest of which is security and privacy. This has resulted in an increasing trend to store data in encrypted form on cloud storage servers. However, effective retrieval of encrypted data and other operations are difficult to achieve by traditional cryptogram systems. Various cloud service providers adopt different technologies for securing data stored in their cloud such as public key encryption, private key encryption, and homomorphic encryption (Bhadauria et al., 2011; Michalas et al., 2012; Naehrig et al., 2011).

Crypto Cloud Computing is a new secure Cloud Computing architecture. It can provide protection of information security at the system level, inherently integrating encryption and security. The cryptology part of the model refers to Platform as a Service (PaaS) because PaaS aims to protect data, which is especially important in case of storage as a service. In case of congestion, there is the problem of outage from a cloud environment. Thus the need for security against outage is important, the data needs to be encrypted when hosted on a platform for security reasons. Infrastructure as a Service (IaaS) refers to the sharing of hardware resources such as storage, bandwidth, server for executing services, the cost part of the model refers to this service.

Various cloud service providers adopt different technologies to keep the data stored in their cloud safe. This study uses XTR cryptosystem (Lenstra & Verheul, 2000) and proposes a novel public key encryption scheme that provides secure message transmission. The security of the proposed encryption scheme depends on the difficulty of Trace Discrete Logarithm Problem (Trace-DLP). It also has the property of semantic security (Stam & Lenstra, 2001; Giuliani & Gong, 2005).

Proposed Model

Consider a group of financial cloud services, each of which needs to be connected to some source, either directly or via other financial cloud services. This model considers 3 financial cloud services and 1 source as cryptology system. Every possible connection has some (nonnegative) costs associated with it and the problem is how to connect every financial service to the source such that the total joint cost of the created network is minimal. In order to work with real values, the costs of financial cloud services in the cloud are calculated using Amazon cost calculator. From here, pricing and cost accounting mechanisms are obtained. The cryptology system as a source is located in the private cloud for safety reasons, while the financial cloud services are in a public cloud, thus the model runs on a hybrid cloud.

In this model, the cost which is the cost taken for the required proposed encryption algorithm is added to the costs between the financial cloud services and the cryptology system. Thereby,

Amazon Glacier Parameters	FCS1	FCS2	FCS3	FCS1-FCS2	FCS1-FCS3	FCS2-FCS3	FCS1-FCS2-FCS3
Storage (GB)	750	500	10240	150	10990	10740	11490
UPLOAD and RETRIEVAL (request)	1000	500	10	1500	1010	600	1510
Data Retrieved (GB)	20	150	30	170	50	180	200
Retrieved Period (Month)	1	1	1	1	1	1	1
Inter-Region Data Transfer Out (GB/Month)	150	200	3	0	0	0	353
Data Transfer Out (GB/Month)	100	50	35	150	135	85	185
Data Transfer In (GB/Month)	100	75	20	175	120	95	195
Total Cost ($)	18.20	13.43	104.27	15.36	120.76	113.73	135.9

Table 1. Costs of Financial Cloud Services.

the new costs are $18.20+C_C$, $13.43+C_C$, $104.27+C_C$. Thus, the total costs will be calculated for storing the encryption information of other financial cloud services data store. When the financial cloud services are cooperative, decrease or increase in the costs are examined and two different methods (the Bird's rule and the Shapley value) of finding solutions are evaluated.

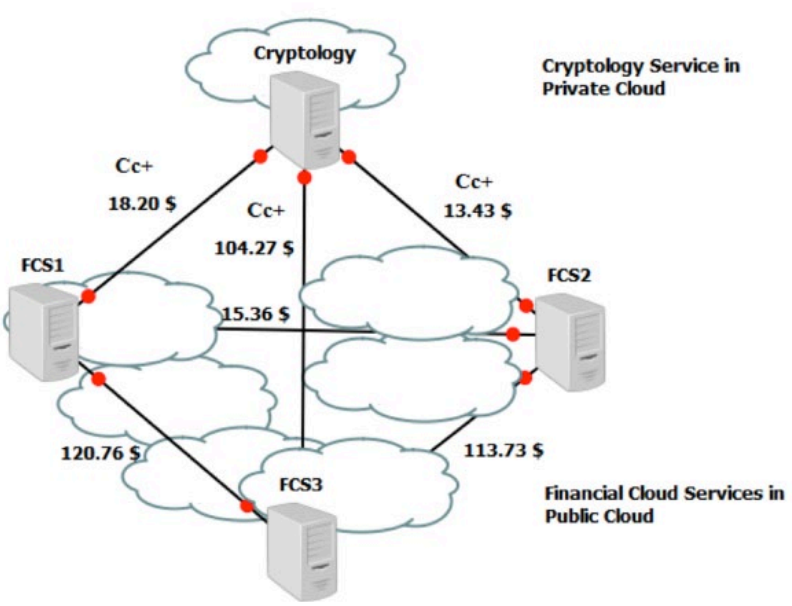


Figure 1. Illustration of Our Model.

The solution with the Bird's rule is (15.36, $13.43+C_C$, 120.76).

The Cooperative Game with the cryptographic costs can be seen below.

$$\hat{c}\{(1)\} = 18.20 + C_c,\ \hat{c}\{(2)\} = 13.43 + C_c,\ \hat{c}\{(3)\} = 104.27 + C_c,$$
$$\hat{c}\{(12)\} = 31,63 + 2 * C_c,\ \hat{c}\{(13)\} = 122.47 + 2 * C_c,$$
$$\hat{c}\{(23)\} = 117.7 + 2 * C_c,\ \hat{c}\{(123)\} = 149.55 + C_c.$$

The Shapley value of this game (22.75,17.98+ C_c / 2,108.82+ C_c / 2).

This study proposes two solution concepts namely: the Bird's rule and the Shapley value. It can be seen that the costs for player 1 and player 2, in the Bird's rule, is lower than the Shapley value. But for the third player, Shapley is a better solution. If is bigger than 23.88, player 1 and 2 prefer the Bird's rule. If is smaller than 23.88 the third player prefers the Shapley value. Hence, the choice of the third player depends on .

Discussion and Conclusion

The research areas of Game Theory, Cryptology and Cloud Computing are both extensively studied fields with many problems and solutions. Yet, the cross-over between them has not been explored. This paper introduces the theory of Crypto Cloud Computing with efficient encryption algorithm.It brings together the concepts of Cloud Computing, Cooperative Game Theory, and Cryptology. Solution concepts from Cooperative Game Theory (the Bird's rule and the Shapley value) are presented, which Show that using the proposed approach in this study, financial services firms can meet the technical challenges of Cloud Computing and build a comprehensive and effective cloud strategy.

References (for lack of space, please contact the authors for the list of references).

OR Society in Focus

"Research on Directed Actions" Flourishing in Turkey

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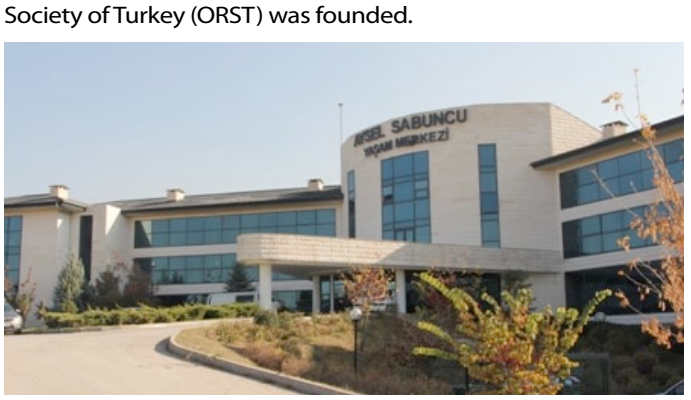
Operations Research first made an appearance in the Turkish scientific and academic circles when the Scientific and Technological Research Council of Turkey (TÜBİTAK- responsible for the funding and coordination of government-supported research) established the Operations Research (OR) unit within its organization in 1965. Later in 1975, Halim Doğrusöz, the first chairperson of this unit, initiated a graduate Operations Research and Statistics program at the Middle East Technical University, Ankara. On March 10 of the same year, the Operational Research Society of Turkey (ORST) was founded.



The Middle East Technical University

Meanwhile Boğaziçi University, Istanbul Technical University and Middle East Technical University founded Departments of Industrial Engineering with strong emphasis on OR. Over the years, OR education had been largely organized under Industrial Engineering departments in Turkey and enjoys a high reputation as a popular profession among university students. As of the end of 2015, there are 75 Industrial Engineering departments (IE) in 75 different universities with an intake of more than 6,000 students a year. Owing to its popularity as a profession, IE departments have attracted and still attract very strong students. Many of these students have pursued graduate degrees and there is a sizeable Turkish community of OR researchers and practitioners outside Turkey.

As part of the effort to introduce and make known the discipline of OR, ORST founders deliberately avoided the use of the literal translation of the word "operations", but invented a new word "Yöneylem" (which is a combination of "direction" and "action" in Turkish). Thus, "Operations Research" has been known as "Yöneylem Araştırması" ("Research on Directed Actions") in the local language. Since its founding, ORST has played a key role in the communication and interaction among Operations Researchers and Industrial Engineers. ORST is currently a well-established society with a total membership of around 1,400 from both the academe and industry. ORST is a full member of EURO (The Association of European Operational Societies) and IFORS (International Federation of Operational Research Societies).

The Society is governed by an executive committee comprised of the president, secretary, treasurer and two members. The executive committee is elected by the general assembly for two-year terms. The board of the current ORST consists of: M. Selim Aktürk, President, from Bilkent University, Cem İyigün, Secretary, Middle East Technical University, Sinan Gürel, Treasurer, Middle East Technical University, Bahar Yetiş Kara, Bilkent University, and Güvenç Şahin, Sabancı University.

The main activity of ORST is the organization of an annual Operational Research and Industrial Engineering (OR/IE) congress. ORST also organizes a bi-annual Doctoral Colloquium for doctoral students with the aim of bringing together doctoral students from all parts of the country to share their research and experiences.

The first national OR/IE congress took place in Istanbul in 1975. The national congress usually takes place in summer and is hosted by one of the universities in Turkey appointed by the society board. In 2015, the 35th congress was organized with more than 700 participants. Although the official language of the congress used to be Turkish, the number of sessions conducted in English has increased with the resultant significant increase in foreign participants.. In addition to plenary speakers, tutorials, contributed and invited sessions, these conferences also feature student paper competitions among new IE graduates as well as an Excellence in Practice award that is given to the best OR/IE application in practice. The congress is recognized as the most important annual event of the society and it is here where society members and the OR community in general learn and share in an academic and a social setting.

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