

From the Editor

## Good News From Far and Wide

We have just come from a huge gathering of OR professionals in Rome. The record attendance in this EURO-INFORMS joint conference brings to us the good news that OR is alive and well all over the world!

You will also get this feeling as you read about and grasp the organization skills that went into the Paris, Rome, St. Petersburg, Florence, Karelia, Erice, Medan conferences, and more so as you reflect on the breadth of theory and practice they encompass. Turning the pages to the OR Impact section detailing how an OR model helped underpin the remarkable growth of a company and then on to the Tutorial discussing a novel approach to obstacles in solving an OR problem, one appreciates that nothing can take the place of OR!



▲ OR in East and West

On the other hand, will OR be subsumed by Analytics? Read our Feature which explains the INFORMS perspective, defining Analytics as “the scientific process of transforming data into insight for making better decisions.” Our Book Review, on the other hand, starts with the dictionary definition of a quant as “an expert at analyzing and managing quantitative data”. Going through both these articles may leave you wondering whether you are now a quant doing Analytics.

“Given the analytics trend, what initiatives will equip students as they join the work force?” is a question that the public and private sectors have grappled with and responded to with a collaborative approach in the Philippines. In nearby Indonesia meanwhile, a conference on OR was organized by a core group that had been very active in organizing streams and attending various IFORS and EURO conferences. The country does not yet have a national OR society, but it is hoped that with the assistance of IFORS

and EURO, they will be able to organize one. IFORS and EURO representatives were on hand this September to give this support at the conference in Medan, the largest city in the largest island of Sumatra.

The new IFORS Administrative Committee in its first eight months in office has accomplished a lot. This issue covers some of them, including the good news from the IFORS journal, ITOR. The Developing Countries Committee hit the ground running with the completion of the ICORD EWG Workshop in Rome and with the IFORS Prize in full swing. IFORS presence through its Distinguished Lecture program was again one of the Rome conference highlights.

In the meantime, IFORS News continues to strive to cover international OR events, people and organizations, so that we may continue to share with one another the good news about OR. However, doing this job well requires a

greater network than what we currently have. National societies have been asked to assign their IFORS correspondents with the first batch of volunteers shown in the table. They join regional representatives who had been busy helping out with IFORS News for the past years: Degang Liu (APORS), Annibal Parracho (ALIO) and Willi Weber (EURO).

We are still waiting for the other societies to appoint their representatives, who will be the eyes and ears of the IFORS News in their respective localities. Receiving these names will certainly be additional good news!

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

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# Supporting OR Journals in the Asia-Pacific Region

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Academic journals serve as platforms for researchers to share their scientific findings and to learn from their peers. In particular, OR journals play an important role in promoting OR researches, disseminating new findings and putting OR theories and methodologies to work in the real world.

Rapid economic development in Asia-Pacific brings new challenges that will keep fueling OR researches in the region - a trend, which unfortunately, has not been fully appreciated by the western scholars. Globalization has fueled rapid and drastic changes in the economies within the Asia-Pacific region, particularly, those of China and India. It is here where changes have brought about new and more challenging optimization and decision making problems in energy, transportation, telecommunication, financial engineering, urban planning, health care, environmental pollution, natural resource consumption, transnational logistics, to name a few. In general, traditional theories and methodologies of operational research and management science are no longer adequate given the complexity and depth of these problems. Solving these problems requires a good understanding of their underlying background and inherent nature, requiring the development of new theories, methodologies and modeling approaches.



With socio-economic changes enriching OR work in Asia-Pacific, an increase in OR publications in the region is expected. More OR journals are needed to contain these papers that address new and upcoming problems relevant to the region's new dynamics.

However, compared with North America and Europe, there are currently very few international academic journals on OR in the Asia-Pacific region. The Association of Asia-Pacific Operational Research Societies (APORS) has only one official academic journal, *Asia-Pacific Journal of Operational Research*. A couple of

national OR societies in the region have their own journals, such as *Journal of the Operations Research Society of Japan*, *Australian Society for Operations Research Bulletin*, *the Philippine Journal of Operations Research*, and the newly launched *Journal of the Operations Research Society of China*.

Apart from quantity, quality is an issue that has to be considered. At the moment, most OR journals in Asia-Pacific region are not of the high standard expected for several reasons. First, most OR journals in Asia-Pacific region are very young, relative to famous international journals in the west. Second, it has been hard for the less known OR journals in Asia-Pacific region to attract submissions from western scholars. Third, researchers from Asia-Pacific region prefer to submit their work to western academic journals rather than to their local journals owing to evaluation systems that favor publications in the more recognized western journals.

With Asia-Pacific becoming an increasingly significant contributor to global economic growth and dynamics, more attention should be paid to the region's OR problems and OR development. More OR academic journals of better quality are no doubt of strategic importance.

I am very grateful to many western scientists who have been supporting OR journals in Asia-Pacific region. In particular, I would like to take this opportunity to thank those who agreed to serve on the editorial board of the newly launched *Journal of the Operations Society of China*. As the list is long, I will mention only a few of them, including the former IFORS president, Professor Dominique de Werra; General secretary of International Mathematics Union, Professor Martin Groetschel; and Professor Yinyu Ye of Stanford University, who is an INFORMS John von Neumann Theory Prize winner.



I hope that more and more OR scholars from the west would help the OR journals in Asia-Pacific region. You could show your support in many ways. First, you could submit papers to OR journals from Asia-Pacific region, or encourage your colleagues to do so. Secondly, you could join the editorial boards of these journals. Thirdly, you could recommend our journal to libraries. Your support will be much appreciated.

It is clear that the OR journals from Asia-Pacific region still have a long way to go to catch up with the top OR journals in the world. But I am certain that with the international community lending a helping hand to their colleagues from the Asia-Pacific region, we will get there in time. 

## New Trends Follow ITOR Indexation

IFORS journal *International Transactions in Operational Research* (ITOR) Editor Celso Ribeiro, in his annual report to the IFORS AC, announced that the ISI indexation of ITOR has brought an increase in the number of submissions by 55% in August 2011 when it was indexed. The release of its inaugural (June 2012) impact factor of 0.648 brought an additional increase of 60%, bringing 2013 forecasted submissions to 338. It was noted that there was a dramatic increase in the number of submissions from China since indexation.

Out of 61 countries, India, USA, Brazil and Iran lead in the number of article submissions for the period 2007 to 2013. Ranking countries by accepted articles yields a different list, with USA, Brazil, France, Portugal and Canada on top.

Though it has fully recovered from a small decline in submissions and papers published in 2011, the increase will be felt two years after, e.g., increases in 2012 will be reflected in the number of articles and pages printed in 2014. Publication statistics show an average time to first decision at 62 days, while the annual page budget has steadily increased from 768 (in 2007) to 1176 (in 2013). >>



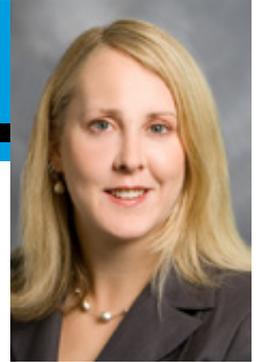


>> In terms of on-line access, 2012 saw a 30% increase in readership: 46,939 downloads in 2012 compared to 36,133 in 2011. The most downloaded paper (2519 times) in 2012 is Rais & Viana's "Operations Research in Healthcare: A Survey", vol. 18. Interestingly, six out of the ten most downloaded papers are tutorials or surveys that appeared in the first (double) issue of last year's volume, leading the editor to conclude that surveys and tutorials are critical for the success of our, and for that matter, any journal.

Ribeiro also welcomed 7 new editorial board members and announced that another six new associate editors from Austria, Brazil, China, France and USA will be invited next year. This will bring the 2014 editorial board to 47 members coming from 20 countries. He also reported on six special issues being prepared, covering: ALIO/EURO, MCDM, DSS, Matheuristics, Cutting & Packing, HM. 

## Analytics - Embracing the Trend

Anne Robinson, INFORMS President



It is a rare event these days to open a business publication, walk through an airport or even participate in a C-level meeting and NOT see or hear reference to analytics. Recognized as the currency of business, analytics are empowering decision-making at new levels. A trend that started with CIOs is spreading throughout the C-Suite – Everyone wants ANALYTICS! "Big Data" has even become common lexicon around the board room.

Companies are also beginning to understand that the old days of analytics being simply sql queries and parameterized reporting is not going to differentiate them amongst their competitors. Basic analytics have become table stakes. To find the true intelligence in their business, organizations need to go beyond the basics and harness the essence and insight in their data.

What exactly do we mean when we say analytics? INFORMS' official definition is:

*Analytics, the scientific process of transforming data into insight for making better decisions*

Within analytics, three categories have become the standard nomenclature:

- **Descriptive Analytics** refers to analytical capabilities that characterize what is happening now. This dimension of analytics typically refers to preparing and analyzing historical data (using techniques like data modeling, visualization, and regression analysis)
- **Predictive Analytics** describes what will happen. These analytics predict future probabilities and trends (data mining and predictive modeling)
- **Prescriptive Analytics** evaluates and determines new and different ways to operate to achieve a specific objective (optimization and simulation)

The trends in analytics are undeniable. A simple Google search will show the steady increase in interest in analytical capabilities from all over the world.

Employment opportunities for experts in this area will also prosper. Indeed.com, an online global jobsite, has experienced an increase of over 15,000% in analytics related job postings between 2011 and 2012. Examining the growing demand for analytics professionals in the U.S. and the dearth of trained people in the field, McKinsey & Company predicts that demand for deep analytical talent in the U.S. could be 50-60% greater than its supply by 2018. Gartner estimates that only one third of the 4.4 million data scientist roles available worldwide will be filled by 2015.

What does this mean for Operations Research professionals? How do we embrace this trend? These were the exact questions INFORMS wanted to answer. In 2010, INFORMS engaged CapGemini, a leading global consulting company, to understand the market trends around analytics, the relationship between analytics and operations research, and which potential products and services relevant to the analytics community are missing today.

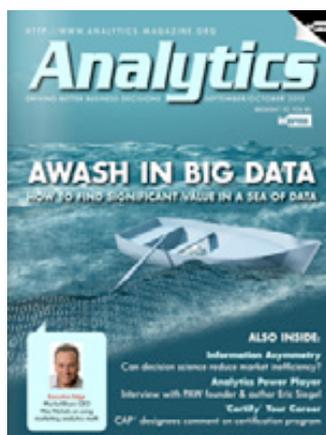
The eight week study resulted in many insightful findings. One of the most interesting takeaways was around the perception of O.R. Operations research was seen as a toolbox to solve specific problems, whereas analytics was a capability core to the business. Analytics was accepted as part of an organizational culture and part of "business as usual." Analytics was perceived as enabling business value in addition to academic integrity delivered by operations researchers.

The study also revealed a great demand for analytics talent (as we subsequently learned from other organizations). As Operations Research professionals, it is our responsibility to link the demand for expertise in translating data into insight with the skills and capabilities within our field.

At INFORMS we are driving this in a number of different ways. Our flagship magazine, Analytics, continues to deliver articles on relevant operations research techniques and success stories. The online publication has witnessed a steady increase in subscriptions and viewership of the articles. The Executive Edge column is written by executives for executives, and presents relevant topics and experiences from that perspective.

Academia is also responding to the analytics trend. University academic programs where traditional operations research classes were taught are creating, rebranding, or expanding their offerings to include analytics courses and degrees. The most seasoned programs in the US are North Carolina State University's and Northwestern University's Masters in Analytics programs.

In response to the findings by CapGemini, INFORMS is now offering a Certified Analytics Professional (CAP<sup>®</sup>) certification. The CAP certifies knowledge of the end-to-end application of the analytics process. It was created to ensure quality within our profession, develop standards, identify individuals with appropriate breadth of knowledge, ensure continued competency, all within a neutral environment (software & vendor agnostic). (For more information go to: <https://www.informs.org/Certification-Continuing-Ed/Analytics-Certification>)



Additionally, INFORMS expanded its services to include continuing education courses. Initial topics were chosen based on requests from members as well as external trends. The first two courses being offered in-person this year are “Data Exploration & Visualization” and “Essential Skills for Analytics Professionals.” They were developed with inputs from experts in these specific domains and in adult education to ensure interest and alignment for more seasoned learners. The expectation is that they will be offered globally and eventually online.

While the University Programs, CAP Certification and Continuing Education speak to the supply of analytics professionals, it is also important for organizations to be able to assess their demand and source necessary analytics talent. As such, INFORMS has created an analytical maturity model that will allow companies to understand their maturity and requirements. Moreover, a professional job market for

analytics talent is now available at the major INFORMS conferences as well as online through a newly relaunched job marketplace, now called the Career Center. It is hoped that all of these efforts will strengthen and enrich our community by connecting the talents and expertise of operations research professionals with the overwhelming demand for analytics skills.

The arrival of analytics is a significant development for the Operations Research field. Analytics is bringing growth to industry, improvement to government, and a realization in the public that math modeling contributes significantly to our lives. The highest advanced analytics level is almost inseparable from the methods that have made O.R. distinct and powerful. All our associations and societies will benefit significantly if we recognize analytics’ prominence and plan for analytics to play an important, and welcome, part in our future. 🌐

## Public-Private Sector Cooperation Results in Analytics Specialization Tracks

*Manila, Philippines* - The Commission on Higher Education (CHED <http://www.ched.gov.ph>) and IBM (<http://www.ibm.com/ph>) announced last May 31, 2013 that specialization tracks on Business Analytics for Information Technology Education (ITE) and the Bachelor of Science in Business Administration (BSBA) Programs are ready for implementation this school year 2013-14. The CHED Memorandum Orders were passed and co-developed in collaboration with IBM, taking into consideration the paradigm shift and growing demands of the local and international business landscapes, and are geared towards helping transform the Philippines to become more globally competitive across all industries.

The growing demand for leaders to make better and faster business decisions makes business analytics and optimization a huge global market opportunity, estimated at about US\$160 billion by 2015. High volume data continues to come from both structured and unstructured sources, including social media. Today, organizations can leverage advanced analytics to address market uncertainty, complexity, volatility, and revenue growth. However, according to Gartner Big Data demand will reach 4.4 million jobs globally by 2015, but only one-third of those jobs will be filled due to a lack of trained skilled professionals globally.

“Recognizing the impending global talent shortage, CHED and IBM, in collaboration with other key higher education stakeholders, sought to address this challenge that we face as a country. These newly approved specialization tracks on business analytics for ITE and BSBA Programs bring us a step closer to preparing our nation to capture and lead in this big global analytics market opportunity,” said Dr. Patricia B. Licuanan, Chairperson of CHED. “We are elated and encouraged that several top notch higher education institutions have already signed up and have committed to implement these analytics electives this coming school year.”

Some of the early adaptors that have already rolled out the new analytics subjects this June include the University of the Philippines - Diliman, Ateneo de Manila University, De La Salle University, Asia Pacific College, University of Santo Tomas, College of St. Benilde, Universidad de Manila, Jose Rizal University, Republic Central Colleges and Araullo University of the PHINMA Education Network.

“Data is quickly becoming the most important natural resource in the world, and companies who have talent with the best skills to help them take advantage of Big Data will have a more promising future. With the right academic development and professional training, the Philippines has the potential to be a leading incubator for advanced business analytics talent globally,” said Mariels Almeda Winhoffer, President and Country General Manager, IBM Philippines.

“CHED’s commitment to developing the world’s future leaders right here in the Philippines, combined with IBM’s global analytics expertise will help ensure that the country is well positioned to be a global center for advanced analytics, where industry leading best practices will be developed and implemented.”

To prepare Filipino talent for the next wave of growth, CHED and IBM forged an agreement in December 2012, to cooperate and develop an analytics education master plan that will enable and position higher education institutions in the country for leadership in analytics. IBM, in collaboration with CHED, proactively consulted with the business



▲ Photo Shows (L-R): Seated -- Mariels Almeda Winhoffer, President and Country General Manager, IBM Philippines and Dr. Patricia B. Licuanan, Chairperson of CHED. Standing -- Dr. Vincent Fabella, President, JRU, Tata Medado, APC, Fred Pascual, UP, Mencu Cueto-Pacana, Dean, School of Management and Information Technology, De La Salle College of St. Benilde, Atty. Carmelita Yadao-Sison, Director, CHED Legal Service

community, tapped institutions that are Centers of Development (CoDs), and Centers of Excellence (CoEs) to develop specialization tracks focusing on business analytics.

IBM and CHED’s vision of a comprehensive education master plan to help capture the huge global potential of the analytics market, took shape in September 2012 when an international team of IBM volunteers worked with the Commission under the IBM Corporate Service Corps (CSC) program. At the end of the month-long assignment, the team provided recommendations to CHED, identifying ways to position the Philippines as an analytics education and technology hub for the region. The IBM CSC program, often called

the corporate version of the “Peace Corps”, was developed to help IBM employees become effective 21st century global leaders and citizens while helping solve complex problems in developing countries like the Philippines. The Corporate Service Corps is a global pro bono IBM initiative launched in 2008 that sends hundreds of IBM’s brightest employees into emerging markets every year. These experts provide small businesses, non-profits, non-governmental organizations, and educational institutions, expertise and professional skills to help improve local conditions and foster job creation. >>



>> The Business Analytics Specialization Tracks use an integrated approach and take into consideration the interrelationships among functional areas of business as well as sensitivity to the economic, social, technological, legal and international environment in which business

must operate. The objective of the program is not simply to impart basic business knowledge, but to instill and nurture important qualities and skills to the students that are essential for future business leadership and organizational success. 🌐

# OR for Development Section



## Perspective from an ICORD Veteran

### Continuing the Tradition of a Workshop on OR for Development

Arabinda Tripathy <tripathy44@rediffmail.com>

The Sapienza University of Rome hosted the Joint ICORD EWG ORD WORKSHOP 2013 from June 27 to 28. The annual ICORD workshop of IFORS is the current format of the ICORD initiative started in 1992. The workshop provides a platform for intense, involved and implementation oriented discussion on issues related to development. In a sense it is the continuation of the theme of ICORD activities which is now being pursued through ORD WORKSHOP with lot more focus on implementation and problem solving.

The workshop format was very effective in achieving the goal. Each presenter was given adequate time for presentation. Two reactors were identified in advance. They were provided with the full paper and were expected to critically react to the paper. In addition, open discussion at the end was also facilitated. An important aspect of the workshop was the tutorial on Problem Structuring Methods by Jonathan Rosenhead and Leroy White.

The developing world was well represented at the workshop with participants from Africa, Asia, South America, New Zealand along with some participants from Europe with interest in the field. The papers presented at the conference covered areas like environment, education, energy, agriculture, food, and health. All the papers dealt with real life development related problems and their management. The techniques used to analyse the problems varied from hard OR tools like Data Envelopment Analysis, Analytical Hierarchy Process, Supply Chain Management to soft OR tools with variants of Problem Structuring Methods. In most of the presentations, a combination of approaches was used to address the issue. A novel part of the workshop was the reaction portion and the discussions that followed the presentation. This reflected the involvement and concern of the participants on these developmental issues. Some of the papers are briefly described below.

The paper by Datta on **An Energy Allocation Model**, focused on a block (collection of villages) level energy planning. The model takes in to account the energy needs and alternatives available to



▲ Development Section Editor A. Tripathy with S. Datta before the start of the workshop.

meet the energy needs. This calls for agreement amongst all the villagers in respect of cropping pattern and pursuing various initiatives of non conventional energy options. The process of developing and implementing the initiatives were discussed.

**Long-term Scenarios for Global Child Mortality: The Role of Food, Water and Energy** by Lucas was an engrossing presentation addressing one of the major health concerns of developing countries. The model with data from developing countries highlighted the factors affecting child mortality and approach to improve the situation. During the discussion the role of female literacy on child mortality was brought into focus with effective participation from the members.

The presentation by Tripathy on **Soft Problems – Hard Impacts: Some Applications** discussed adoption of Soft OR approaches to some problems including one related to the salary of Members of Parliament. The approach to getting a common understanding on the issue by various Political Parties with conflicting ideologies, which resulted in a salary acceptable to all political parties, was discussed. The presentation also included a model illustrating the role of hard and soft OR in problem solving.



▲ Workshop participants take a break for a group picture.



Presentation by Amaya on **Optimization Modeling for Resource Allocation in the Chilean Public Education System** addressed a complex problem situation related to an important area of Education in a developing country context. The presenter highlighted the complex situation and the approach to modelling the same in order to arrive at a solution acceptable by all stake holders. The presentation was followed by a lively discussion indicating the relevance and importance of the problem situation.

Watson made an absorbing presentation on **Developing Decision Support for Foodbank South Africa's Allocation System: A Reflection on Future Research** demonstrating the use of both hard and soft OR to address the issues. The effort was to ensure the minimisation of food wastage due to shelf life and ensure benefit to the needy. The areas of further work were also presented by Watson.

Similarly, all the other papers highlighted critical areas related to development and approaches to address them. Availability of the

papers and provision of reasonable time resulted in meaningful discussions.

The tutorial on Problem Structuring Methods was a great success. All the participants took active part in the tutorial. It allowed the participants to effectively use the tool through a case study. At the end, the participants felt that some more time would have been helpful.

The workshop fulfilled its objective beyond expectation. Areas for improvement include allotting more space for the workshop in order to facilitate some unstructured discussions in small groups and informal interactions; allowing for some flexibility with time to allow extended discussions on certain issues; and allowing more time for the tutorial would have made far greater impact. On the whole, the workshop was highly valuable and served its purpose very well. 🌐

## Perspective from a young OR professional

# A Unique Interdisciplinary Multi-methodology Multi-scale Experience

Laura Lotero <llotero0@unal.edu.co>

Prior to the 26th Euro conference, the International Conference on OR for Development (ICORD), IFORS and the EURO Working Group on OR for Development joined hands to bring to the fore issues on OR for development during a two-day workshop in Rome.

Elise del Rosario, Honora Smith, Giorgo Gallo and Gerhard-Wilhelm Weber in the program committee and Paolo Dell'Olmo and Vanda De Angelis in the local organizing committee ensured that our stay in Rome, the Sapienza University, and most of all, in the workshop, turned into one delightful experience.

The workshop consisted of 17 paper presentations, where for each paper, two reactors were pre-assigned to provide an in-depth feedback of the work. Papers include interesting applications of operational research in development issues such as energy allocation, resource allocation for educational systems, green supply chain management, organic waste recycling in agricultural systems, medical waste allocation, urban mobility planning, child mortality, among others. The paper presented by Robyn Moore related to the case of community operational research in Kapiti, New Zealand and how to reach consensus on water reforms in developing communities was, later in the Euro conference, awarded the EthOR Prize, organized by the EURO Working Group on "Ethics and OR".



▲ Participants listen intently to a presentation.



▲ Laura Lotero (extreme right) shown discussing with organizer E. del Rosario, DC Chair Sue Merchant and organizer W. Weber during the last day farewell cocktails.

We had the pleasure and fortune of having among us researchers from the five continents of the globe! People from India, Chile, Philippines, France, UK, Colombia, The Netherlands, Tunisia, Estonia, New Zealand, Indonesia, Brazil, South Africa, Germany, Bratislava and Russia came together and shared their different perspectives and their use of Operations Research towards the common objective of development.

In addition to the excellent paper presentations, Jonathan Rosenhead and Leroy White guided a half-day tutorial on Problem Structuring Methods (PSM) as an alternative method for undertaking wicked problems, which are more prevalent in the developing world. The idea was to show that some problems that are frequently found in developmental situations and that are commonly seen as "not OR problems" can be approached by PSMs. The "Too Many Voices" exercise was based on a real case in India and the methodology we used and discussed was the Strategic Options Development and Analysis (SODA).

The workshop was a great opportunity for both junior and senior researchers to come together and share their experiences and expectations on how to tackle the problems of development, being those on developing or developed countries, making the workshop a unique interdisciplinary, multi-methodology, multi-scale experience for all of us who joined the activity for the first time. 🌐



# The IFORS Prize: Continuing to be Relevant



Andres Weintraub <aweintra@dii.uchile.cl>

It was during the IFORS 1987 in Buenos Aires when IFORS instituted the **Third World Prize**. (name used until 1993 when it was changed to **Developing Countries Prize** and eventually taking its current name, **IFORS Prize on OR for Development**.) This competition was motivated by IFORS desire to bring out exemplary work in developing countries and how OR is used to address issues of development.

The IFORS Prize has undergone a lot of changes, which include doubling of prize money and removing the limitation of work to those whose primary authors are from developing countries. This was aimed at providing a greater visibility for the Prize and motivation for the researchers to share their work with the international OR community.

Admittedly, a competition for work in developing countries raises such questions, as "Is there a special kind of OR for developing countries?" It is well-known that the theory, methodologies, algorithms of OR are universal. What can be considered special about developing countries are the types of problems and the implementation challenges.

Others say that the world has changed significantly since 1987. Developing countries have since made advances, as evidenced by the transformation in the last decades of the BRIC countries and alongside them, of the many Latin American and Asian economies. However, it is also safe to say that many of the challenges that existed in 1987 are still present for these developing economies:

- OR role in addressing problems that require using the most of a scarce resource may be given lip service, but largely, continue to be ignored.
- Problems in the areas of: health- in terms of organization and treating major illnesses; food distribution; education - particularly in rural areas; financing schemes; logistics; and infrastructure planning, which can benefit most from OR tools, are rarely solved in this way.
- Less structure in institutions, which lead to weaker decision-making are still commonplace.
- Lack of data, which may come from lack of infrastructure or discipline in collecting these, force decision making with incomplete information.
- Higher uncertainty due to political and economic stability fosters the feeling of futility of long-range planning.
- Lack of infrastructure, such as for telecommunications and computing preclude the use of OR methodologies that may depend on these.

All these aspects create challenges that developed countries face less frequently.

The following list of papers that have won the Prize gives an idea of problems faced in the developing world and how OR had been used successfully to address these.

2011, XIX, Melbourne

First Place: Joao Neiva de Figueiredo and Miguel Angel Marca Barrientos (Bolivia) **A Decision Support Methodology for Increasing School Efficiency in Bolivia's Low-Income Communities**

Runner Up: Angel Luis Udias, David Rios Insua, Javier Cano and Hocine Fellag (Algeria) **Cost Efficient Equitable Water Distribution in Algeria: A Bi-Criteria Fair Division Problem With Network Constraints**

2008, XVIII, Sandton

First Place: Haouari M., Aissaoui N., Berrima K., Sherali H.D. and Mansour F.Z. (Tunisia) **Integrated Aircraft Fleeting and Routing at**

**TunisAir**. Runner Up: Raad D., Sinske A. and van Vuuren J. (South Africa) **Robust Multi-objective Optimization for Water Distribution System Design Using a Meta-Meta-Heuristic**

XVII, 2005, Hawaii

First Place: L. Melgarejo, J. Neiva de Figueiredo and C.E. Fries (Brazil) **A Decision Support Methodology for Increasing Public Investment Efficiency in Brazilian Agrarian Reform**

Runners Up: M. Osman, H. Zaher and D. El-Iraqi (Egypt) **Cultural Heritage Management – a Goal Programming Application**  
Wadilmeluk Yindong Shen and J. Xia (China) **Integrated Bus Transit Scheduling for Beijing Bus Group Based on Regionalized Operation Mode**

M. Negreiros Gomez, A.E. Xavier, N. Maculan, A.F. Sampaio Xavier and P. Michelon (Brazil) **A Framework of Computational Systems and Optimization Models for the Prevention and Combat of Dengue**

XVI, 2002, Edinburgh

First Place: Rafael Epstein, Lysette Henriquez, Jaime Catalan, Gabriel Y. Weintraub, Cristian Martinez (Chile) **A Combinational Auction Improves School Meals in Chile**

Second Place: G. Groves, J Le Roux and Jan H Van Vuuren (South Africa) **Network Service Scheduling and Routing**

XV, 1999, Beijing

First Place: Xikang Chen, Xiaoming Pan, Cuihong Yang (China) **Study of China Grain Output Prediction**

Runners Up: JH Van Vuuren, Werner Grundling (South Africa) **An Active Decision Support System for Optimality in Open Air Reservoir Release Strategies**

Qingzhen Zhao (China) **Application of OR in Agriculture Management in China**

XIV, 1996, Vancouver

First Place: X-S Zhang and J-C Cui (China) **A Project Evaluation System in the State Economic Information System of China: An Operations Research Practice in the Public Sector**

Runners Up: RK Chaturvedi, K Bhattacharya and J Parikh (India) **Transmission Planning for Indian Power Grid: A Mixed Integer Programming Approach**

G Liu, J Xu, C Hi, B Zhou and Q Ren (China) **Operational Research and Economic Development: The Optimization of the Ecological, Economic Development for the Upper Reaches of the Yangtze River (Changjiang)**

XIII, 1993, Lisbon

First Place: Goutam Dutta (India) **A Linear Programming Model for Distribution of Electrical Energy in a Steel Plant**

Runners Up: N.D. Pizzolato (Brazil) **School Location: A Real Application of the P-Median Model**

A. Tripathy (India) **Using OR/MS in Third World Countries: Some Cases from India**

XI, 1987, Buenos Aires

Nicolas Majluf (Chile) **The National Assessment of Education in Chile**

Through the IFORS Prize, the researchers and their work such as those given above are given the proper recognition and encouragement. More importantly, the global audience is made aware of how problems associated with development could be addressed in a competent and creative OR way! 🌐



# IFORS

INTERNATIONAL FEDERATION OF OPERATIONAL RESEARCH SOCIETIES

## Prize for OR in Development

### Third Call for Papers



IFORS is pleased to announce that the Prize will be awarded during the 20th Triennial conference on "The Art of Modeling" to be held in Barcelona, Spain from 13-18 July 2014.

This competition has been held for over 25 years, and recognizes outstanding and relevant OR work carried out in developing countries.

- Awarded at the close of the IFORS Triennial Conference and carries with it a grand prize of US\$ 4,000.00 and a runner-up prize of US\$ 2,000.00
- The finalist papers are automatically considered for publication in the IFORS Publication, International Transactions in Operational Research (ITOR). Publication is contingent upon the usual refereeing process. Authors of these papers agree that the first right to publish their papers lies with ITOR; as such, they will not publish the same until and unless they receive permission to do so by the ITOR editor.

Important details about the competition follow:

#### Topic of paper

- The paper should describe a practical OR application in a developing country, conducted to assist a specific organization in its decision-making process with regard to education, health, and other basic services, water, technology, resource use (physical or financial), infrastructure, agricultural/industrialization, natural resources, or environmental sustainability. It should also contain original features in methodology and/or implementation in developing countries.
- The paper should include some description of: the application's social context, how the project succeeded despite constraints and limited resources, and particularly its impact on the decision making process or on the organization for which it was conducted. Where appropriate, the relevance of the country's state of

development to the study should be addressed. A stress on developmental issues will be an important factor in the judging.

- Papers of a purely technical nature, or those, which have no relevance in the developmental context, will not be considered.

#### Judging Criteria

- Qualifying papers will be evaluated on the following criteria: problem definition, creativity and appropriateness of approach, MS/OR content, stress on developmental issues, innovative methodology, impact of the study, paper organization and structure, and quality of written and (if selected as finalist) oral presentation. Participation of local researchers will also be a judging criterion.

#### Other Information

- Principal authors and presenters of any nationality are welcome. If selected to be among the finalists, the entry will be presented by one of the principal authors during the IFORS Triennial Conference to be held in Barcelona, Spain from 13-18 July 2014.
- Finalists' registration fees will be sponsored by IFORS. For finalists who are nationals of developing countries, a grant for living expenses may be requested but cannot be guaranteed.
- Entry must be submitted using the submission site for the IFORS journal, International Transactions on Operations Research (ITOR)  
<http://mc.manuscriptcentral.com/itor>, indicating in the cover letter that it is intended for this competition. At this point, authors warrant that their paper submissions have not or will be published in another journal. ITOR Editor Celso Ribeiro will forward the papers submitted to the Chair. When the finalists are announced, only finalist papers will be considered as formal submissions to ITOR.
- An international panel of judges chaired by Andres Weintraub, Chile, has been formed and will be announced at the same time as the selection of finalists. 

Further inquiries should be sent directly to the Prize Chair:  
**Prof. Andres Weintraub**  
Professor Department of Industrial Engineering  
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P.O. Box 2777 Santiago, Chile  
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**Last date of submission of the full paper: November 30, 2013**  
**Finalists will be notified by: February 28, 2014**  
**Date of presentation: July 14, 2014**

# EURO-INFORMS 2013 Posts Record Breaking Attendance

Sarah Fores <manager@euro-online.org>



While there was expectation that a joint conference hosted in Italy's beautiful capital city would attract a lot of interest, how this translates to the number of participants was not appreciated until the deadlines approached. The previous EURO-k conference record at 2500 delegates for the 2010 Lisbon conference was surpassed as Figure 1 shows, particularly as the extended deadline approached. By July 1, 3500 delegates were greeted by beautiful weather, an impressive location and an exciting programme with eminent plenary and keynote speakers. The program was the result of collaboration between EURO and INFORMS, two major groups within IFORS.

More than 70 parallel sessions were organised over the three and a half days. One can only be grateful that the organisation of an event of such proportion was left in the very capable hands of Operational Research specialists! Proactive in advertising and organising themed sessions, stream organisers were honoured with a cocktail party hosted by the Sapienza Università di Roma. The theme of the conference programme was *All Roads Lead to OR* and the range of topics presented confirmed the value of OR in so many aspects of day-to-day life.

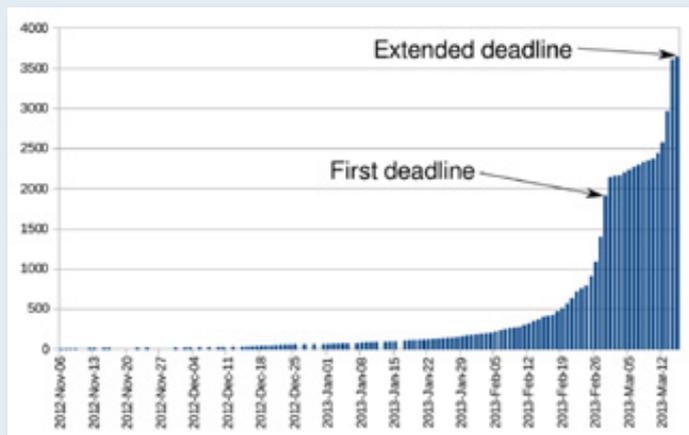


Figure 1: Number of abstract submissions over time

Delegates were officially welcomed on the first day of July at the Opening Session held at the Aula Magna, the Great Hall built between 1933 and 1935 and designed by Marcello Piacentini. The session was introduced by the two programme committee chairs Marc Sevaux (EURO) and David Simchi-Levi (INFORMS). Standing in front of Sironi's 1935 fresco *Italy between the Arts and Sciences*, they thanked the programme committee, the organising committee chaired by Paolo Dell'Olmo, and the professional congress organiser EGA. President of EURO Gerhard Wäscher welcomed INFORMS members to the first joint conference held since 2003, and he thanked the organisers for their hard work in coping with the challenges of such a large conference. For her part, INFORMS President Anne Robinson tackled the importance and future of OR and the special relationship between INFORMS



Organizers welcome participants at the Aula Magna with Sironi's fresco at the background

and EURO in hosting such a conference. Delegates also received a local warm welcome from Anna Sciomachen (AIRO), Luigi Frati (Rector of Sapienza) and Luigia Carlucci Aiello (Dean of the Faculty of Information Engineering, Informatics and Statistics at Sapienza). Sponsors and exhibitors were also thanked for their vital contribution to the event. Following the tradition of EURO-k conferences, awards were announced during the opening and closing sessions. At the opening session, the EURO Distinguished Service Medal award was presented to Theodor Stewart for his contribution to a large number of EURO and IFORS activities over a number of years and for being instrumental in negotiating South Africa's entry into EURO in the early 1990s. The EURO Gold Medal was presented to Panos Pardalos in recognition of his work in global optimization.

Participants from 83 countries then spent the next few days attending some of the 3000+ talks from the scientific programme and forging new collaborations with other participants. For the first time in a EURO-k conference, a thinner abstract book was produced sans the abstracts of the papers. These were contained in a USB flash drive cleverly attached to the name badge lanyard. In addition to a mobile app, delegates were given the option to plan their conference with the new 'My Program' application, which synchronized with their electronic calendars. In addition to the convenience offered to the participants, it allowed the organisers access to statistics on the number of people who have planned to attend each of the sessions. Based on 1415 users, The most popular parallel sessions were related to OR education, which are major areas for both INFORMS and EURO.

Plenary speakers were Hal Varian, George Nemhauser and John Little. Hal Varian presented OR in a very modern world by using Google data for economic predictions. George Nemhauser emphasized the impact of integer programming across a range of applications. John Little, as IFORS Distinguished Lecturer, showed how Little's Law applies to different types of queues. Keynotes on important current aspects of the discipline summarized core messages and offered insights by accomplished speakers.



IFORS President Nelson Maculan (left) presents the IFORS Distinguished Lecture award to John D.C. Little.

As always, the social programme is central to such an event and the social dinner at the Caffé delle Arti adjoining the Galleria Nazionale d'Arte Moderna e Contemporanea was a particular highlight.





▲ Farewell Dinner among the sculptures at the National Gallery of Modern Art, with Paolo Dell'Olmo just below the centrepiece

Old and new friends enjoyed good food and wine in rooms adorned by wonderful paintings and sculptures. There was also a fantastic opportunity for all to browse the collection in the gallery which provided an excellent impression of modern Italian art. Many people also attended Night@Sapienza and enjoyed live music played by MuSa (short for Musica Sapienza) as the sun went down over the Piazzale della Minerva. The volunteer students led by Linda Foster recruited a number of delegates to dance on the steps.

A number of competitions were held, among them, the EthOR Award presented to Robyn Moore. During the closing session, the EURO Doctoral Dissertation Award was presented to Christian Raack and the EURO Excellence in Practice Award was presented to Andreas Brieden, Steffen Borgwardt, and Peter Gritzmann. Finalists for all these awards presented their work before their respective members of the jury in dedicated sessions during the conference. Awards for the best EJOR papers were given to Florian Jaehn, Peter Letmathe, Christian Bierwirth, Frank Meisel, Maria Isabel Gomes Salema, Ana Paula Barbosa-Povoa, and Augusto Q. Novais during the closing

session. All award winners were given the recognition due them with the members of the jury for each competition, gratefully recognized.

Reminders for future conferences were given by: Elena Fernández for the IFORS Barcelona conference in 2014; by Valerie Belton and Tim Bedford for the Glasgow EURO-k conference in 2015. Anne Robinson and Gerhard Wäscher presented gifts to members of the programme committee and organising committee and praised their efforts in making the conference a huge success. This was echoed by Sally Brailsford, EURO Vice President, who also expressed pleasure at having worked with such a committed team. As chair of the closing session, Paolo Dell'Olmo concluded the conference by thanking his colleagues for their tremendous efforts and by inviting the ubiquitous student assistants to the stage. The students received a tremendous applause from the grateful delegates who, at one point or another, have sought them out for guidance on various concerns throughout the conference.



The success of the conference was a product of the exceptional efforts of the programme committee and organising committee, in particular, Marc Sevaux, David Simchi-Levi, Paolo Dell'Olmo, and Giovanni Felici. Gerhard-Wilhelm Weber, advisor to EURO-k conferences had likewise extended his invaluable contribution and limitless enthusiasm for the success of the conference. 🌐

▲ EURO President Gerhard Wäscher (right) presents token of appreciation to advisor to EURO-k conferences Gerhard Wilhelm Weber.



## European Combinatorialists Return to Paris

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DEI "Guglielmo Marconi", University of Bologna

The 26th Annual Meeting of the European Chapter on Combinatorial Optimization (ECCO XXVI) took place in Paris, France, from May 30 to June 1, 2013. Paris is the city where ECCO, a working group of EURO created in 1987 by Catherine Roucairol, Alexander Rinnooy Kan and Dominique de Werra, had its first conference in 1988. Quoting the EURO Bulletin (de Werra, Eur J Oper Res 35, 2, 294-299, 1988):

*The new EURO Working Group ECCO (European Club of Combinatorial Optimization) (Note: 'Club' was changed to 'Chapter' during the meeting) had its first meeting in Paris on January 28 and 29, 1988. Organized in a quite professional style by Catherine Roucairol, chairperson of this working group, the colloquium took place at University of Paris VI (Jussieu) on the 23rd floor of a tower with a 360 degree view of the city (even a rainbow was planned). More than forty combinatorialists attended the sessions during a day and a half. The programme included talks by F. Maffioli, A. Sebo, P. Bortot, G. Gallo, P. Tolla, J. Fonlupt, S. Martello, P. Brucker, J. Clausen, L. Escudero, M. Queyranne, B. Barcia and K. Jornsten.*

The group, which has now more than 1,300 members, was chaired by Catherine Roucairol for the first 10 years, and is now chaired by Silvano Martello. The Advisory Board includes Jacek Blaźewicz, Van-Dat Cung, Alain Hertz, and Paolo Toth.

The ECCO conferences are held on a regular basis (once a year, in Spring) and are devoted to all aspects of combinatorial optimization. They are usually attended by around 100 participants, and nicely



▲ Figure 1: Left to Right: Silvano, Catherine, Dominique. (picture taken by Van Dat)

combine scientific works and exchange of new ideas with an exciting atmosphere. The latest conferences (2000-) were held in Capri, Bonn, Lugano, Molde, Beirut, Minsk, Porto, Cyprus, Dubrovnik, Jerusalem, Malaga, Amsterdam, Antalya, and Paris.

The Scientific and the Organizing Committee of ECCO XXVI were co-chaired by Christophe Picouleau and Bernard Ries. The conference was held at the *Conservatoire National des Arts et Métiers* (CNAM), that kindly offered the participants free access to the *Musée des Arts et Métiers*, a beautiful collection of scientific instruments and inventions (including an original version of the Foucault pendulum and a number of Pascalines).



There were 95 presentations, organized in four parallel streams, and 135 participants. The conference was honored by the attendance of Catherine Roucairol and Dominique de Werra.

Four invited speakers delivered plenary lectures:

- Peter Gritzmann, Geometric Clustering
- Dorit S. Hochbaum, Combinatorial algorithms for the Markov Random Fields problem and implications for ranking, clustering, group decision making and image segmentation;
- Alberto Marchetti-Spaccamela, Combinatorial Optimization Problems in Real Time Scheduling;
- Stéphane Thomassé, Separating Cliques from Stable Sets.

The social program included a welcome cocktail in room salon d'honneur of the conference venue and a guided tour in the Montmartre district to discover workshops, homes and favorite places of many artists such as Renoir, Pissarro, Toulouse Lautrec, Van Gogh, Seurat, Sisley. The Gala Dinner took place at the famous restaurant La Coupole.

Every fourth year the ECCO annual conference is jointly organized with the British International Symposium on Combinatorial Optimization (CO). The next meeting, ECCO XXVII - CO 2014 Joint Conference, organized by Peter Gritzmann, will take place in Munich (Germany) from May 1 to May 3, 2014, see <http://www.ecco2014.ma.tum.de/index.php?id=5&L=1>.



## Revelations from Renaissance Florence

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Florence was the site of the 11th Meeting of the Continuous Optimization Working Group of EURO (EUROPT Workshop) from June 26-28, 2013. From the very first one held in Budapest, Hungary in 2000, EUROPT workshops have been highly appreciated by the international optimization community. About 180 researchers made their way to Florence en route to the main EURO conference EURO-INFORMS 2013 (<http://euro2013.org/>) in Rome. EUROPT is the EURO Working Group on Continuous Optimization (cf.



▲ EUROPT 2013 participants from Brazil, Turkey and Germany pose before the distinctively Florentine panorama (photo courtesy of Miray Hanım (Aslan) Yildirim)

<http://europt.iam.metu.edu.tr/>); it has very close and fruitful ties with many other EURO Working Groups (<http://www.euro-online.org/web/pages/103/working-groups>) and has been instrumental in establishing two others, namely, the EURO WG on Computational Biology, Bioinformatics and Medicine and EURO WG on OR for Development. The focus of the 11th EUROPT Workshop rested especially on advances in continuous optimization. For closer information we refer to the homepage of the workshop: <http://www.europt2013.org/>.

World-leaders in continuous optimization and related areas were present to give outstanding plenary talks. Chih-Jen Lin from the National Taiwan University introduced *Optimization and machine learning*, Marco Locatelli from the Università di Parma talked on *Towards better bounds: The interplay of convex underestimators, branching rules and domain reductions*, and Jacek Gondzio from the University of Edinburgh shared his insights regarding *Inexact search directions and matrix-free methods for large-scale optimization*. Participants from 30 countries from Brazil to Taiwan covered nearly all branches of modern continuous optimization in almost 150 paper presentations. Through the efforts of the conference chairs Fabio Schoen from Università degli Studi di Firenze and Laura Palagi from Sapienza Università di Roma, the lectures touched on the full range of such interests as: equilibrium problems, global optimization, first order methods, multiobjective optimization, derivative-free optimization, nonsmooth optimization, copositive and polynomial optimization, among others.

The incredible backdrop of historic Florence made the social events extra special. The Workshop Dinner took place at Villa Bardini, built in 1641 on a hill that overlooks the Arno River and Florence. Connected to a beautiful garden, the villa houses two permanent exhibitions: Museo Pietro Annigoni, named after a known Italian painter of the 20th century, and Fondazione Roberto Capucci, dedicated to an extraordinary Italian fashion designer. Uphill is the house of Galileo Galilei from 1610 to 1633. Here, he was found

guilty for heresy and condemned to house arrest for life for his book, *Dialogue concerning the World Major Systems* in which he defended the Copernican heliocentric theory against the dogma that the Earth was in the center of the universe. It was significant to be at the place where research independence was put to the test and there reflect on how such independence remains as important then as it is now.

The farewell cocktail took place in the courtyard of Palazzo Strozzi, one of the finest examples of Renaissance architecture. Commissioned by the merchant Filippo Strozzi in 1489, the Palazzo has been Florence's largest temporary exhibition space since the Second World War. This provided the opportunity to visit the current exhibition *The Springtime of the Renaissance. Sculpture and the Arts in Florence 1400-60*. The exhibition illustrates the origin of what is still known today as the "miracle" of the Renaissance in Florence through masterpieces of sculpture and painting. The chefs d'oeuvre of the outstanding Florentine artists Lorenzo Ghiberti and Filippo Brunelleschi, Donatello and Filippo Lippi allowed participants to gain a deep insight into the realm of original Renaissance ideas. It has been interesting to find out during the excursion that Renaissance ideas substantially influenced not only the arts, but also research methodology. Reliance on observation, as well as the combination of reasoning and empirical evidence had their roots at this period and has remained very useful to the modern researcher. Overall, participants of the 11th EUROPT Workshop touched and were touched by the glorious Florentine past.



## THE SEVENTH INTERNATIONAL CONFERENCE ON GAME THEORY AND MANAGEMENT

## Success in St. Petersburg

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Gerhard-Wilhelm Weber <gweber@metu.edu.tr>

VII International Conference on Game Theory and Management <http://www.gsom.spbu.ru/en/gtm2013/> was held at the Graduate School of Management, St. Petersburg University in Russia from June 26-28, 2013. This annual English-speaking conference is a product of the long-term multilateral cooperation between St. Petersburg University (Graduate School of Management and Faculty of Applied Mathematics, Control Processes) and the *Russian Branch of the International Society of Dynamic Games (ISDG)*.

The aim of the conference series is to develop a linkage between fundamental researches in the field of game theory and up-to-date scientific ideas in management and Operational Research. This linkage has resulted in scientific awards and prizes in last two decades. Nobel Prize winners *John Nash*, *John Harsanyi*, *Reinhard Selten*, *Robert Aumann* and *Roger Myerson* have previously taken part in the Conference. It is significant that in 2012 the Nobel Prize in Economic Sciences was awarded to outstanding experts in game theory and applications, *Lloyd Shapley* and *Alvin Roth*.

GTM 2013 featured plenary talks by: *Finn Kydland* (Nobel Prize in Economic Sciences, 2004, University of California, Santa Barbara, USA) **On dynamic games**; *Burkhard Monien* (Paderborn University, Germany) **The complexity of computing equilibria**; *Bernard De Meyer* (Université Paris 1, Panthéon-Sorbonne, France) **Risk aversion and price dynamics on the stock market**; and *Leon Petrosyan* (St. Petersburg University, Russia) **Time-consistent and strategically supported cooperation in dynamic games**.



▲ Invited speaker Finn Kydland (left) shares a light moment with organizer Leon Petrosyan

From the 131 papers sent by 190 authors from 26 countries, the International Program Committee selected 112 presentations for the Conference. The final program included 4 plenary and 76 specialized sessions with 101 scientists

from 21 countries. Foreign authors accounted for more than half of the presentations. The collection of conference presentations will be published with the title *Contributions to Game Theory and Management, vol. VII*.

While the conference was a venue for specialists to exchange their insights and assessments, young researchers who presented their



▲ Organizers and guests celebrate their collaboration and friendship with scenic St. Petersburg in the background.

research learned a lot from outstanding experts who generously gave their comments and ideas for the extension their work.

The *Russian delegation* of the conference was represented by scientific schools of Vladivostok, Moscow, Ekaterinburg, Novosibirsk, Petrozavodsk, Rostov-On-Don, St. Petersburg, Saratov and Chita. With more than 20 speakers participating in this conference series at least 5 times, the conference, and St. Petersburg University in particular, is proving its leadership in the field of game theory and its applications in management and OR.

Since several colleagues of the organizers and main presenters at *GTM 2013* were also Stream Organizers and participants at *EURO-INFORMS 2013* in Rome, the conference provided an excellent opportunity for deeper discussions and extended collaboration among those present and the rest of the European and international OR community.

The social events which enabled the participants to get to know each other better was started on the first day with a *get-together party* held in the beautiful hall of St. Petersburg University's Graduate School of Management. The organizers and the key speakers talked about the history of the conference and the relationship between the specialists in game theory and in management all over the world. Toasts were offered to the organizers and the continuation of the tradition of the meeting series.

A walk along the *Neva River* to *Younost*, where the *conference dinner* was held, followed the last session of the conference. Here, the foreign specialists shared their impressions about the beauty of St. Petersburg and the big role that the conference plays in the field. Another successful conference has passed and the tradition continues with GTM 2014 to be held in St. Petersburg from June 25-27, 2014. 🌐



## IFORS Commends InteriOR 2013 for Rallying Indonesian OR Community

Esther Nababan <esther@usu.ac.id> (University of Sumatera Utara, Medan, Indonesia)

Gerhard-Wilhelm Weber <gweber@metu.edu.tr> (IAM, METU, Ankara, Turkey)

The highly-successful *2nd International Conference on Operations Research (InteriOR 2013)* <http://www.interior2013.org/> was held August 26-27, 2013, in Medan, North Sumatera, Indonesia. Jointly organized by the *Department of Mathematics*, University of Sumatera Utara, and Indo Mathematical Society, the two-day meeting attracted over 315 old hands and newbies in Operations Research from around the world yielding 99 paper presentations.

Welcome remarks by the *University of Sumatera Utara* vice rector of academic affairs *Zulkifli Nasution* and a speech followed by a striking of the gong by the Mayor of Medan officially opened the conference.

This was followed by a traditional dance featuring a lot of color, grace and a distinctively Indonesian welcome.

A highlight of the Opening Ceremony is the presentation of the **International Federation of Operational Research Societies (IFORS)** appreciation for the efforts of the organizers in bringing together the OR professionals and enthusiasts within Sumatra, thus paving the way for the organization of an OR society for Indonesia. In line with the IFORS objective of encouraging the formation of national OR societies, IFORS also provided registration support for ten local participants to the conference. The Certificate of Appreciation was received by the founder of InterIOR conference series, Herman Mawengkang from the IFORS representative in the conference, past IFORS President Elise del Rosario. Joining IFORS in this event is **Association of European Operational Research Societies (EURO)** President, Gerhard Wascher. He expressed EURO's gratitude to the local movers who have actively participated in relatively high numbers during the previous EURO and IFORS conferences: *EURO 2010* in Lisbon, Portugal, *IFORS 2011* in Melbourne, Australia, *EURO 1012* in Vilnius, Lithuania, and *EURO-INFORMS 2013* in Rome, Italy.



▲ Del Rosario presents IFORS certificate to Mawengkang while Filar, Weber and Wascher look on.

The theme of this year's conference, *OR for Industry, Environment and Society* allowed researchers and practitioners to review state-of-the-art literature in OR as well as present scientific results which were particularly relevant to solving real-life problems in industry, environment, and society. The conference provided the venue for researchers, lecturers, educators and students to exchange ideas, communicate and discuss research findings and new advances in all areas of modern OR. High-quality contributed papers were presented, covering all aspects ranging from business to advances in OR dynamics, applications in Management, Finance, Economics, Biology, Environment, Development and Education. The Conference Proceedings will be available in book and CD ROM format.

Keynote talks were given during the morning plenary sessions. Gerhard Wascher (President of EURO; University of Magdeburg, Germany) presented *"Manual Order Picking Systems - Planning Issues and Solutions Approaches"*. He showed how Operations Research enables to strong improvements in industrial and warehouse processes by illustrating increased efficiency in picking processes with the use of OR. *Gerhard-Wilhelm Weber* (METU, Ankara, Turkey; EURO conference advisor) started his talk on *"Advances in OR, Optimization and Control of Stochastic Dynamics - Applications in Finance, Economics,*



▲ One of the packed parallel session venues

*Biology and Environment"* by stressing that time-continuous systems need to be generalized by both phenomenon of impulsiveness and a piecewise, or "hybrid" structure. Applying this insight, he showed how OR can be more useful in the future.

*Jerzy A. Filar* (Flinders University, Adelaide, Australia) spoke on *"The Hamiltonian Cycle Problem and Markov Decision Process"*, where he introduced the corresponding traditional field of combinatorial optimization and then presented recent breakthroughs achieved by his international OR research team. *Elise del Rosario* (past President, IFORS) gave an overview on *"OR: Applications for all Aspects of Business"*. The attendees were enthusiastic as seen from the responses and questions to the presenter, who let the audience benefit from her managerial experiences in a leading international company from neighboring country of the Philippines.

All invited speakers had the honor and pleasure of having been taken by their hosts to the famous *Lake Toba*, four hours by car from Medan. *Lake Toba* is a unique jewel in being both one of the most scenic places in Indonesia as well as the cradle of the *Batak* people of central North Sumatra. The outing gave an opportunity for greater exchange on the state of Operational Research in Medan, Sumatra and Indonesia. Sincere interest from the representatives of the international OR family characterized the discussions on future support and collaboration along the lines of propagating OR in Indonesia.

Chosen by the organizers, these delegates were awarded the IFORS registration support: Putra Jaya Bahtera Bangun and Irmeilyana (Sriwijaya University, Palembang); Siti Rusdiana and Intan Syahrini (Syiah Kuala University, Banda Aceh); Tiryono Ruby and Notiragayu (University of Lampung, Lampung); Ihsan Riyadhi (Padjadjaran University, Bandung); Mardiana Irawaty (Sekolah Tinggi Teknik Adisutjipto, Yogyakarta); Effendi (Andalas University, Padang) and Sudradjat Supian (Padjadjaran University, Bandung).

The Organizing Committee chaired by Tulus Tulusjp, the Scientific Committee, with the session chairs, authors, presenters, discussants, paper reviewers and sponsors all did their part in making this conference possible and memorable.. The conference provided scientific learning amid a lovely atmosphere made special by the hospitality of everyone and the smiles on particularly, the young OR people of Indonesia! 🌐



## Networking and Games in White Nights

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The annual international workshop *Networking Games and Management (NGM-2013)* <http://mathem.krc.karelia.ru/event.php?id=184&plang=rand>. was held

June 23-25, 2013 at a recreation camp in *Urozero* on the shore of one of the cleanest lakes in Europe. With nature as a backdrop, participants gathered to discuss the latest trends and advances of game-theoretic methods applied to networking and management problems.

The plenary talks were given by *Leon A. Petrosyan* (St. Petersburg State University), *Burkhard Monien* (Paderborn University, Germany), *Alexander A. Vasin* (Lomonosov Moscow State University), *Alexander Kononenko* (Dorodnicyn Computing Centre, Russian Academy of Sciences, Moscow) and *Vladimir V. Mazalov* (Karelian Research Center of the Russian Academy of Sciences).



Many researches are being carried out to assist in the development of distributed systems for computing and data storage, such as grids and clouds. In these fields, many challenges arise concerning, but not limited to: fair resource allocation, resource sharing, work scheduling, load balancing, giving a strong motivation to find game-theoretic solutions. *V. Mazalov*

introduced the problem for a model of the cloud computing market in his plenary talk. *A. Rumyantsev, E. Ivashko* and *I. Chernov* presented works on optimizing job workflow in desktop grids.

A whole workshop section was devoted to problems of modeling social networks. Being a significant means of information sharing, they give rise to many urgent challenges. The talks in the section covered some probabilistic and game-theoretic models and solutions that illustrate the variety of their applications, from website structure (*A. Pechnikov, D. Chernobrovkin*) to propagation of forest fires (*Yu. Pavlov, M. Leri*). The participants also presented works on other important topics from OR on game theory, control theory and queuing systems.



▲ Participants shown enjoying nature in Karelia (photo courtesy of Alexander Bekarev and Evgeny Ivashko).

Apart from the main program, discussion developed in friendly talks outside, alongside the beautiful forest lake, accompanied by swallows and warblers. Participants met several times to discuss in depth each others' work and to outline prospective joint research topics. With some organizers and main speakers also performing the roles of stream organizers

and participants at the *EURO-INFORMS 2013* in Rome, discussions continued beyond the Russian borders in terms of deepening cooperation and friendship with other European, and with the international OR community, in general.

The local Organizing Committee consisted of the members of the *Institute of Applied Mathematical Research of Karelian Research Center of Russian Academy of Sciences* (<http://mathem.krc.karelia.ru/>) with its head, *Vladimir Mazalov*, taking the lead. The participants gratefully acknowledged their efforts at bringing Karelian nature with its unforgettable "white nights" to be part of a very fruitful scientific exchange. 🌍

## Linking Theory with Applications in Nonlinear Optimization

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The workshop *Nonlinear Optimization: A bridge from theory to applications* <http://www.dis.uniroma1.it/~erice2013/> is an international conference which took place in Erice, Sicily, Italy at the Ettore Majorana Foundation and Centre for Scientific Culture (EMFCSC). Held from June 10 to 17 2013, the conference featured 38 contributed and 14 invited lectures.



▲ Participants ranging from -new to the field to the highly respected names-learned a lot from each other.

Mathematics, EMCS, Erice, Italy) and *Massimo Roma* (University of Rome, Italy). They invited 14 professors belonging to different universities around the world who have recognized research experience on the topics of the conference, to deliver a lecture. They also chose a wide variety of innovative proposals as contributed lectures.

This conference was the 59th workshop of the *International School of Mathematics "G. Stampacchia"*, and 7th workshop devoted to the field of Nonlinear Optimization. Its main goal was to review and discuss recent advances and promising research trends in Nonlinear Optimization.

In accordance with the theme, applications were given emphasis. A close and fruitful relation with Operational Research was evident in the topics covered, such as: constrained and unconstrained nonlinear optimization, mixed integer nonlinear programming, global optimization, derivative-free methods, nonsmooth optimization, nonlinear complementarity problems, variational inequalities, equilibrium problems, game theory, bilevel optimization, optimization and machine learning and applications in engineering, economics, biology and other sciences. In fact, many of the organizers, members of their scientific schools, and participants have in various ways, been active supporters of the *EURO-INFORMS 2013* in Rome. The Scientific and Organizing Committee consisted of *Gianni Di Pillo* (University of Rome, Italy), *Franco Giannessi* (International School of

The invited lecturers were: **Alfio Borzi** (University of Wurzburg, Germany): *A Fokker-Planck Strategy for the Optimal Control of Stochastic Processes*, **Vladimir F. Demyanov** (University of St. Petersburg, Russia): *Constructive optimality conditions in nonsmooth optimization*, **Daniela di Serafino** (II Università di Napoli, Italy): *On preconditioning in large-scale optimization: updating techniques for sequences of linear systems*, **Francisco Facchinei** (SAPIENZA Università di Roma, Italy): *Complex Variational Inequalities and Applications*, **David Y. Gao** (University of Ballarat, Australia): *Canonical Duality Theory: a Bridge from Mathematical Optimization to Real-World Applications*, **Manlio Gaudioso** (Università della Calabria, Italy): *Nonsmooth Optimization Techniques in Practical Optimization Problems*, **Tom Luo** (University of Minnesota, USA): *On the Linear Convergence of the Alternating Direction Method of Multipliers*, **Kaisa Miettinen** (University of Jyväskylä, Finland): *Experiences of Interactive Multiobjective Optimization and Some Engineering Applications*, **Laura Palagi** (SAPIENZA Università di Roma, Italy): *An Exact Algorithm for Nonconvex Quadratic Integer Minimization using Ellipsoidal Relaxations*, **Jong-Shi Pang** (University of Illinois, USA): *Recent Applications of Nash Equilibrium in Engineering Economics*, >>



>> **Stephen Robinson** (University of Wisconsin, USA): *Reduction Methods for Variational Conditions*, **Gesualdo Scutari** (State University of New York at Buffalo, USA): *Parallel Optimization of Large-Scale Multi-Agent Systems*, **Gerhard-Wilhelm Weber** (Middle East Technical University, Turkey): *Recent Advances in Optimization and Optimal Control of Stochastic Dynamics - Applications in Finance, Economics and Life Sciences*, and **Yaxiang Yuan** (Chinese Academy of Science, China): *An Augmented Lagrangian trust region method for equality constrained optimization*. The connection between theoretical nonlinear optimization and real-world applications was emphasized in the talks of *K. Miettinen* on "Experiences of interactive multi-objectives optimization and some engineering applications", *G. Scutari* on "Parallel optimization of large-scale multi-agent systems" and *G.-W. Weber* on "Recent advances in optimization and optimal control of stochastic dynamics - applications in finance, economics and life science". They provided real-life problems, their corresponding mathematical formulation and how these problems can be solved in an efficient way.

The program was well organized and allowed participants attend all sessions and enjoy the city. Related talks were joined in consecutive sessions. Invited and contributed lectures covered all areas of the workshop, thus enabling a complete view of state-of-the-art for Nonlinear Optimization.

Situated atop the beautiful Mount Erice at 750m above sea level, the EMFCSC venue, located in the famous historic town of Erice

provided an appropriate setting for scientific meetings. Most of participants were well-established professors and young post-doc researchers at different universities around the world. This allowed them to discuss their recent work and find common research interests in order to establish further collaborations. It was noted that every night at the social room, participants met to talk, enjoy, and play musical instruments.

Lunch and dinner were at the restaurants around Erice, which made participants gather into groups and visit various restaurants. This way, they enjoyed not only the excellent views but the tasty Italian food as well.

The social program included the gala dinner where participants partook of a typical Sicilian seafood dinner and enjoyed regional music and a dance performance. The archaeological side of Mothia, Marsala and Selinunte was the highlight of the excursion to three of the most important Phoenician, Carthaginian and Greek settlements in the Mediterranean area.

*The support of several organizations made this activity possible: the Italian Ministry of Education, University and Research, the Sicilian Regional Government, DIAG - SAPIENZA - University of Rome (Italy), GNAMPA - Gruppo Nazionale per l'Analisi Matematica, la Probabilità e le loro Applicazioni, Dipartimento di Management - University of Venice "Ca' Foscari" and University of Calabria (Italy).* 🌐

## Stream Tackles Facets of OR Education

**Olga Nazarenko** <onazzaro@gmail.com>, **Kateryna Pereverza** <pereverza.kate@gmail.com>, **Alexis Pasichny** <alexis.pasichny@gmail.com>, **Dmytro Fishman** <dmytrofishman@gmail.com>, **Gerhard-Wilhelm Weber** <gweber@metu.edu.tr>

The stream "Initiatives for OR Education" was held July 3, 2013, during the EURO-INFORMS 2013 at Sapienza University. The main focus of the stream was to exchange experiences about existing initiatives for OR education - to share and systematize common approaches and methods for creating, adopting and developing OR courses in regular and extended education programs. The stream also gave a good opportunity to present and discuss existing and possible future initiatives.

The stream included three sessions as follows: *OR in regular study programs; Additional educational activities for OR; and OR promotion among academia, businesses, governments, etc.* and consisted of 12 abstracts, 11 presentations and 13 speakers from 7 countries.

The session "OR in regular study programs" gathered scientists and practitioners interested in initiatives that exist within classical academic programs. *Alberta Schettino* (AIRO) shared the results of the OR dissemination activities in the Italian secondary school Istituto Tecnico "G. Galilei", Imperia Projects aimed at introducing young students to OR while simultaneously improving their English listening skills. *Fikret Korhan Turan* from the Department of Industrial Engineering, Istanbul Kemerburgaz University, Istanbul, Turkey, presented his team experience at implementing a set of investment projects to improve the university's sustainability performance as a higher education institute. Survey results showed how stakeholders' priorities for a private university changed under low, medium and high financial constraints. *Jo Smedley* from the Centre for Excellence in Learning and Teaching, University of Wales, Newport, United Kingdom, showed how OR soft systems approaches are used in education. Published results show the improvement in the quality of learning abilities with the use of OR soft systems approaches.



▲ One of the well-attended sessions of the stream.

During the session "Additional educational activities for OR", participants presented their experiences with initiatives aimed at spreading and improving knowledge about OR. *Laura Plazola Zamora* from Mexico discussed the experience of teaching a blind student Linear Programming using Excel-Solver. *Olga Nazarenko* from the National Technical University of Ukraine, Kyiv, Ukraine, described a methodology for the development and approval of academic courses through additional educational activities based on the case study of the *Summer School AACIMP* (<http://summerschool.ssa.org.ua/>). *Giuseppe Bruno* from Napoli, Italy, and *Andrea Genovese* from Sheffield, United Kingdom introduced a Summer School project for specialist training in optimization and decision support systems for supply chain management held within the Erasmus Intensive Programme (<http://w2.estgp.pt/docentes/jlmiran/Odss.SC2013/>). *Andrea Aparo* from Sapienza, U. of Rome, Italy, and *Marco Fida* from Politecnico di Milano, Genoa, Italy, presented the framework of the DISD Master Programme that aims at managing analytical methods and stochastically behaving persons in an integrated way.



In the session "OR promotion among academia, businesses, governments, etc.", Wen Ju Ko from the National University of Kaohsiung, Taiwan explained the results of the science and technology policy evolution of Taiwan. Berk Orbay from Bogazici University, Istanbul, Turkey, talked about usage of an adaptive curriculum algorithm for Turkish high school education system. Vassilis Kostoglou from the Department of Informatics, Alexander TEI of Thessaloniki, Greece, suggested a tool for improving vocational orientation and employability of students and young graduates.

Martin Kunc from Warwick Business School, University of Warwick, United Kingdom discussed the results of exploring the impact of OR communities on the practice of economics and social development based on the example of Latin American countries.

Overall, the stream attained its stated objectives. The interested reader is advised to download the abstract book available at <http://euro2013.org/wp-content/uploads/program-euro26.pdf> for further details of the papers presented. 

## EWG on Ethics and OR Gives Award. Bares Initial Findings of Study

Cristóbal Miralles <[cmiralles@omp.upv.es](mailto:cmiralles@omp.upv.es)>

Launched last December, the *EthOR Award* aims to encourage young researchers, as members of the future generation of OR researchers, managers or decision-makers, to develop and implement OR methods for solving contemporary problems with ethical dimensions. The competition took place during the last EURO/INFORMS conference in Rome. From among the 30 Master's Thesis/ PhD Dissertation submitted for the Award, three finalists were selected as follows:

- Yamini Srinivasan with the MT "A game theoretic framework to mitigate unethical behavior in construction projects"
- Robyn Moore with the MT "Reaching consensus on water reforms: a case of Community Operational Research in Kapiti, New Zealand"
- Ruth Carrasco with the DT "A Management Model for Closed-Loop Supply Chains of Reusable Articles"

The jury was composed of Valerie Belton, Luk van Wassenhove, Cathal Brugha, Giorgio Gallo and Fred Wenstøp. These reputed members of the OR community with deep knowledge on the topic listened to the presentations of the finalists, which displayed high quality OR applications where ethical concerns were considered through different approaches. The brilliant finalist presentations made the job difficult for the jury, who finally granted the award to the Master's Thesis of Robyn Moore supervised by Vicky Mabin at the University of Wellington (NZ).

Apart from the financial award, Moore was given the honor of being the plenary speaker at the XVII ELAVIO (Latin-iberoamerican OR Summer School), an event promoted by ALIO and co-financed by IFORS and EURO, which will be held at Universitat Politècnica de València in Spain on September 2013 ([www.elavio2013.blogs.upv.es](http://www.elavio2013.blogs.upv.es)).

es).

### Exploratory Study

At the same time during the EURO conference, the group started an exploratory study on OR and Ethics. A representative sample of OR workers, ranging from scholars who had just finished their Master thesis to experienced professors and OR practitioners were interviewed. This interview yielded some interesting findings.

While some interviewees have dealt with ethical issues throughout their career, others have never thought about them, and a few had not been aware of how much ethics is ingrained in their work. As stated by the literature, the interviews suggest that the role of Ethics in OR depends on the questions researched and also on the method used.

Professionals who are merely working in academia hardly face ethics as part of their work. Those who are implementing solutions and developing them for practice, however, see ethics as an integral part of the field. Finally, a first impression from the interviews suggests that ethical education is very important. Most of the interviewees are able to resolve ethical issues well on an intuitive basis, while some had difficulties discovering them. Moreover, moral integrity seems to be a key character trait in dealing with morally problematic requests from problem owners.

This study is planned to eventually include the whole OR community. 



## CALL FOR FEATURED PAPERS on Operational Research and Ethics



### Guest Editors

**Fred Wenstøp**  
(BI Norwegian Business School)  
**Cristóbal Miralles**  
(Universitat Politècnica de València)  
**Gerhard-Wilhelm Weber**  
(Middle East Technical University)  
**Richard Ormerod**  
(Warwick University)

### Motivation

From its inception, the operational research (OR) community has taken a keen interest in ethics, and ethical questions of values, responsibilities and impacts in relation to OR have been addressed in many papers. At present, ethical dilemmas associated with the impacts that OR has on decision processes, for instance by influencing the conduct of decision makers or by affecting stakeholders or the environment, are recognized as increasingly important for OR professionals. This recognition has motivated special issues on OR and ethics (European Journal of Operational Research, 2004; Omega, 2009; International Transactions in Operational Research, 2010). It is also the reason why the Board of the EURO Working group on OR and Ethics has taken the initiative to invite featured papers for a special section on OR and Ethics which will be published in the EURO Journal on Decision Processes.



## Contents

The Guest Editors welcome both empirical and theoretically grounded papers on topics such as:

- Illustrative, ideally cross-disciplinary cases studies that offer insights into what OR can learn from other disciplines facing ethical questions
- Integration of ethical considerations into OR processes based on ethical theories
- Development and adoption of codes of conduct for OR professionals
- Relevant ethical positions, principles and criteria that the philosophical discourse on ethics suggests for OR
- Contributions of OR on the ethical dimensions of contemporary social, environmental and economic problems.

The papers may address topics in any application domain (e.g., energy, engineering, environment, finance, health care, operations management) or approach problems from varied perspectives (e.g., corporate social responsibility).

## Schedule

Prospective authors are invited to submit a full paper to the Editorial Manager system as Original Research (<https://www.editorialmanager.com/ejdp>) with a reference to this Call in the field 'Enter Comments'. The deadline for the submission of full papers is October 31st, 2013. It is envisaged that the special section papers will be published in late 2014 or early 2015. 



## Call for Entries: 2014 Edelman Award

Submit your entry now for the 2014 Franz Edelman Award. INFORMS' top prize for implemented work in OR/MS and analytics rewards outstanding examples of innovative and "game-changing" analytics projects in organizations. A three-page summary is due by October 16, 2013. The 2013 Edelman Award competition will be held at INFORMS 2014 Conference on Business Analytics and Operations Research, March 30-April 1, Boston, Massachusetts, USA. Click here for more information and the application process. Peter Bell, Professor of Management Science at University of Western Ontario, Canada, is 2013-2014 chair of the award committee. 

## OR IMPACT

Articles demonstrating direct benefits from implementing OR studies

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

## Breadth Of Range And Depth Of Stock: Forecasting And Inventory Management At Euro Car Parts Ltd.

Roy Johnston <Johnston@ntlworld.com>, Euro Car Parts Ltd . F.R.

Many companies operating within the supply chain observe an 80:20 or Pareto pattern of sales, i.e., 80% of the sales come from 20% of the products, and of course the converse, namely, 80% of the products generate only 20% of the sales. As a result, these slow selling parts often receive little management time, with some textbooks suggesting a very cavalier attitude to their control. However, this approach is wrong, as illustrated by this case study.

Euro Car Parts Ltd. based in Wembley, UK, (ECP) has rapidly grown to a business with 1900 employees and a turnover approaching £300 million. It is a classic wholesale company, buying car parts from suppliers and selling them to independent garages, service centres and individuals. When the investigation started, ECP had one main warehouse that held a stock of some 56,000 stock keeping units (SKUs). This main warehouse replenishes the stocks of 63 branches nationwide by overnight delivery, with the option to serve urgent orders through dispatches within the day at a higher cost.

The branch network stocks and delivers parts to garages and other businesses, making a total of some 3 million deliveries a year. Any branch will sell only a subset of the 56,000 centrally



 Roy Johnston and Adit Sheth receive the award for the team from ORS President Geoff Royston.

held parts in any year. Some SKUs are associated with popular vehicles or are required as part of regular servicing, and these tend to be sold by every branch. Other slower moving parts may be sold from one or a few branches. Across the company as a whole, the slowest selling SKUs sold on 12 or fewer occasions per year (therefore sourced from at most 12 branches) number 28,000. The aim of the study was to recommend:

- which parts should be stocked at which branch or level in the internal supply chain; and
- how many of each part should be stocked at each location.

It is obvious that parts which sell quickly at a branch should be stocked there, so

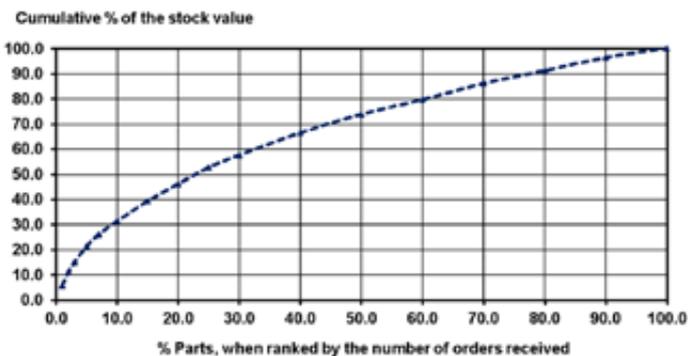
the investigation concentrated on the slower selling parts. These are particularly important for two reasons.

The first can be illustrated by the Pareto pattern from a typical branch in ECP. The 12,500 parts were ranked by the number of orders received for the part. The number of units issued of these parts over the year has been cumulated and plotted as a percentage of the total of the annual issues in figure 1.

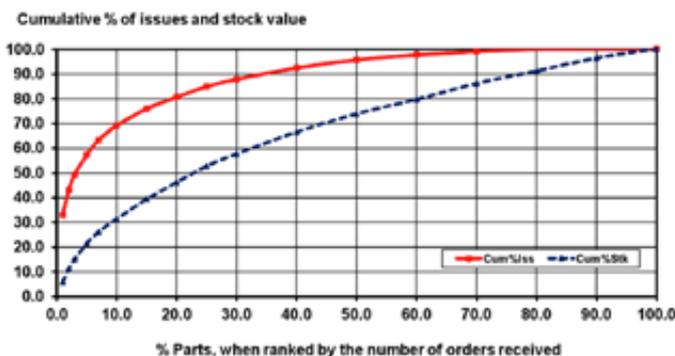




**Figure 1. The Pareto pattern of issues**



**Figure 2. The Pareto pattern of stock holding**



**Figure 3. The Pareto pattern of issues and stock holding**

This illustrates the classic pattern, namely, that 80% of the issues come from the top fastest selling 20% of the parts whilst only 20% of the issues come from slowest selling 80% of the parts in the range stocked. Figure 2 illustrates a dissimilar pattern for the cumulative value of the stock of the ranked parts. Note that 80% of the slower selling SKUs which generate only 20% of the issues comprises over 50% of the total stock investment. Clearly this is not a trivial matter.



The second factor relates to the make-up of a typical customer order. An order is rarely for a single part, but the branch used in the example above averaged 8.4 different SKUs per order, and 40% of all orders included a slow moving part (with twelve or fewer orders within a year). Failure to stock a wide range of parts

results in not being able to complete an order fully and can prevent the repair of a car, constituting very poor service to the ultimate customer.

Good customer service requires both a wide range of parts and a satisfactory stock level for each part. Whilst there is a plethora of literature about setting stock levels by part, this study is the first one that looks at balancing the depth of stock held by part and the breadth of the range of parts. Both are clearly important components of customer service and increasing either factor increases the customer investment and therefore, the operating costs. Having a very high level of stock investment over a small range of parts, or the converse, delivers poor service. This paper demonstrates how to relate the two by employing elementary probability theory. The probability that adding another unit to the stock of a specific part will result in a sale and thus generate the expected value of that sale to the company can be estimated from the forecast demand. Similarly, the probability that adding a new line to a stocking location will result in a sale and its resulting expected value to the company can be assessed. These expected returns should be equal when the stock investment is optimally balanced.



Additionally, it was found that most of the literature on setting stock levels relates to fast selling products when the issues in any period can be well represented by a continuous probability distribution. But this would be a very poor model for the intermittent and irregular demand pattern for slow selling parts. So rules for stock holding of items with a discrete random pattern of demand were devised. It was shown that the Poisson distribution was a very satisfactory representation for the observed pattern of sales.

Converting both theoretical developments into simple rules not only made the system easier to implement, but the many branch managers, who previously always thought (or at least maintained) that their branch was starved of stock could see the fairness and logic of the centrally imposed stock management.

Over a six year period, the company doubled the number of branches and more than tripled its turnover. This was principally achieved by a completely focused management and staff, but the computerised stock system helped underpin this phenomenal growth.

The work is reported in more detail in a paper in the Journal of the Operational Research Society (see reference below) and was awarded the Goodeve Medal in 2012. The judges commended the study and commented that the work demonstrated that theoretical developments could lead to significant benefits in the real world as long as researchers and managers collaborate closely to address the practicalities. [🌐](#)

*F R Johnston, Euro Car Parts Ltd (ECP), E A Shale, University of Warwick, UK, S Kapoor, (ECP), R True (ECP) and A Sheth (ECP): Breadth of range and depth of stock: forecasting and inventory management at Euro Car Parts Ltd. J Opl Res Soc (2011) 62: 433-441*

# TUTORIAL

## Integrating Local Search Techniques Into A Mathematical Programming Solver



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### Introduction

Mixed Integer Linear Programming (MIP) is undoubtedly one of the most powerful tools of Operations Research (OR). Its ease of use appeals to OR professionals: the user models the problem as an integer linear program and the MIP engine solves it by branch & bound & cut. This “model & run” approach, when effective, reduces considerably development and maintenance of optimization software, and other tree search-based technologies like Constraint Programming (CP) are following the way.

Faced with situations such as large-scale nonlinear optimization problems, OR practitioners often find MIP or CP solvers ineffective. They address this problem by implementing local search heuristics. In contrast with tree search techniques, Local Search (LS) involves applying iterative changes (called moves) to improve the objective function. This technique allows operations researchers to obtain good-quality solutions in a reasonable time (in the order of minutes). However, designing and implementing local search algorithms is not straightforward, even with frameworks that have been designed to help the programmer.

The algorithmic layer dedicated to the evaluation of moves is particularly difficult to engineer, because it requires an expertise both in algorithms and computer programming. (see [1] for a survey on the LS paradigm and its applications.)

This observation motivated the development of LocalSolver, a mathematical programming solver based on local search. Started in 2007, the project aims to combine the simplicity of use of a model-and-run solver and the power of local search techniques for combinatorial optimization. It thus enables OR practitioners to focus on the modeling of the problem using a simple formalism, and leave its actual resolution to a solver based on efficient and reliable local search techniques.

### Modeling

LocalSolver includes an innovative math modeling and scripting language for fast prototyping called LSP (Local Search Programming) language. This language is used in our examples although lightweight object-oriented APIs are also available for full integration (C++, Java, .NET). LocalSolver’s modeling language is close to that of classical mathematical programming but its use of a larger set of common mathematical operators makes it more intuitive and easy to learn for OR practitioners. For example the following lines define the model of a knapsack problem with  $n$  objects of given weights and values.

```
function model() {
  for [i in 1..n] x[i] <-

  knapsackWeight <- sum[i in 1..n] (weights[i] * x[i]);
  constraint knapsackWeight <= kn

  knapsackValue <- sum[i in 1..n] (values[i] * x[i]);
  maximize knapsackValue;
}
```

In this basic example, binary decision variables  $x[i]$  are introduced with the `bool()` statement. Then, the weight in the knapsack is introduced as a sum expression and a constraint is set on its value. Finally, the value in the knapsack is defined and set as a maximization objective. Note that

several objective functions could be added, which would be interpreted as a lexicographic objective function. The crucial point here is that nothing more needs to be defined and in particular no neighborhoods are specified. Only this model is given to the solver. The solver is left to apply a local search algorithm made of “general-purpose” moves to work on the abstract combinatorial structure induced by the user model, first for finding a feasible solution and then for iteratively improving this solution. The key principles of these moves will be given in the next section.

Although this simple knapsack example uses only linear expressions, the underlying solving techniques allow the use of highly nonlinear operators including conditional expressions (*if A then B else C* written as  $A ? B : C$ ) or even array lookups (the expression  $A[N]$  coding for the  $N$ th element in array  $A$ ). Table 1 gives the list of available operators.

Table 1. Mathematical operators available in LocalSolver.

Arithmetic	Logical	Relational
sum, min, max	not	==
prod, div, mod	and	!=
log, exp, pow	or	<=
sin, cos, tan	xor	>=
floor, ceil, round	if	<
abs, dist, sqrt	at	>

Introducing logical, arithmetic, or relational operators has two important benefits of being intuitive and efficient in a local search context. With such low-level operators, modeling is easier than with basic MIP syntax, even for beginners (in particular, for those who are not comfortable with computer programming). Besides, the invariants induced by these operators can be exploited by the internal algorithms of the LS solver to speed up local search.

For example, we can consider the P-median problem [2], of selecting a subset  $S$  of  $P$  cities among  $N$ , for instance for locating public facilities, so as to minimize the sum of distances from each city to the closest city in  $S$ . In the model below the use of conditional and min operators allows formulating the model almost as expressed in the above sentence. This simplicity also yields a model focused only on the relevant decision variables, namely the selection or not of each city:  $x[i]$ . After constraining the sum of these variables to equal  $P$ , the `minDistance[i]` from each city  $i$  to the closest city in  $S$  is written as the minimum of distances to other cities, the distance to cities outside of  $S$  being counted as infinite (`InfiniteDistance` can be set to the maximum value in the distance matrix). The objective function is the sum of these `minDistance[i]`.

```
function model() {
  x[1..N] <- bool();
  constraint sum[i in 1..N] (x[i]) == P;

  minDistance[i in 1..N] <- min[j in 1..N]
    (x[j] ? distance[i][j] : InfiniteDistance);

  minimize sum[i in 1..N] (minDistance[i]);
}
```



Here again this definition of the problem is all that the solver needs to find high-quality solutions in seconds (an average gap of 0.6 % on the 40 instances of the OR-Library with a time limit set to 1 minute). In the next section, we will describe the internal mechanisms making this possible.

### Solving

Our approach to autonomous Local Search was guided by the following fundamental principle: the LS solver must work in the same way that an LS practitioner works.



This implies that LocalSolver performs structured moves to maintain the feasibility of solutions at each iteration, whose evaluation is accelerated by exploiting invariants induced by the structure of the model. Components that make the algorithm efficient are:

- An incremental machinery that quickly evaluates the impact of a transformation of the solution;
- Multiple autonomous moves exploiting the combinatorial structure of the model to explore feasible neighborhoods of a solution;
- A global adaptive search strategy guiding the search towards high-quality solutions.

The incremental machinery is based on a representation of the model as a directed acyclic graph (DAG), the roots of which are the decisions and the leaves, the constraints and objectives. The inner nodes of this DAG are the operators listed in Table 1. With this representation, a solution is a complete instantiation of the root variables. Applying moves to the current solution consists of modifying the current values of the decisions (roots) and evaluating constraints and objectives (leaves) by propagating these modifications along the DAG. Designing a highly optimized propagation algorithm allows evaluating millions of moves per minute on real-life models.

The most simple generic move is the change of the value of a decision, for example, changing the value of a  $x[i]$  decision in our P-median example. However, if we want to move from one feasible solution to another, as in most hand-made local search algorithms, more structured moves are required. The solver builds such moves by analyzing the structure of the model. For instance, the cardinality constraint in the P-median problem will be exploited to design moves preserving the number of selected cities and consequently the feasibility of the solution. More generally, following ejection chains or ejections cycles in the constraint hypergraph (Figure 1) yields very powerful moves. In addition to these small neighborhoods, larger neighborhoods can be explored by combining smaller neighborhoods within a

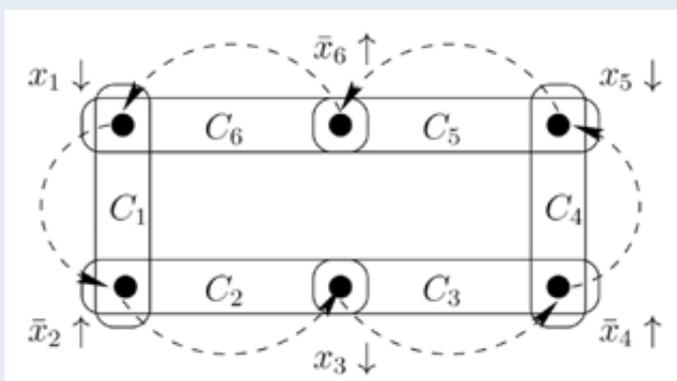


Figure 1. An ejection cycle involving six boolean variables  $x_1, x_3, x_5$  (whose current value is 1) and  $x_2, x_4, x_6$  (whose current value is 0), and six constrained sums  $C_1, \dots, C_6$ . Each variable belongs to two sums (for example,  $x_1$  belongs to  $C_1$  and  $C_6$ ). Now,  $x_1, x_3, x_5$  are decreased while  $x_2, x_4, x_6$  are increased. This move preserves the values of the sums, and thus the feasibility of the constraints.

destroy & repair mechanism. Finally, the identification of special combinatorial structures can trigger the activation of specific neighborhoods. Note that the neighborhoods can be explored almost randomly or by targeting moves with higher probability of success.

The exploration of the search space is distributed on several threads with periodic synchronization. The global diversification of the search is ensured through simulated annealing with reheating and restart mechanisms. Statistics on the performance of the moves are dynamically exploited to improve the overall performance along the search.

### Benchmarks and conclusions

Despite their apparent conceptual simplicity, the principles given in the previous section yield remarkably good results in practice, in particular for large-scale combinatorial optimization problems, which are out-of-scope of state-of-the-art mathematical programming solvers. Even on some of the hardest MIPLIB instances, LocalSolver recently outperformed the best MIP solvers. Another typical example is the car sequencing problem, which consists of scheduling cars along painting and assembly lines subject to sequencing constraints. The solutions obtained by LocalSolver in 10 seconds are far better than the ones obtained by the best MIP solvers after running for 1 day. This ability to tackle large-scale combinatorial problems in a model-and-run fashion was vividly illustrated during the EURO/ROADEF Challenge 2012, which involved the reassignment of processes on Google servers subject to various resources and dependency constraints. Ranked 24th over 82 participating teams, LocalSolver was the sole model-and-run, general-purpose mathematical programming solver to qualify for the final round using a 100-line model, written in one day. More computational results on both academic and industrial problems can be found in [3] or on our website.

In 2012, LocalSolver was mature enough to move from a research project to a commercial product that is now used in various industries around the world, from the maximization of TV advertising revenue in France to the optimization of bakery supply chain in Japan (a nonlinear problem involving 3 million 0-1 decisions!).

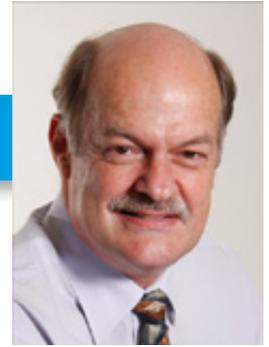


For the end of 2013, the first step toward an all-in-one mathematical programming solver for large-scale mixed-variable non-convex optimization is planned. This new version will offer several new important features from both functional and technical points of view: small-neighborhood moves to optimize over continuous or mixed decisions; exploration of large, exponential-size neighborhoods over 0-1 or mixed decisions using some tree search techniques (for example, rounding heuristics based on linear relaxation); exploration of large neighborhoods over continuous decisions by revisiting successive linear programming techniques for nonlinear programming (based on a simplex algorithm); computation of lower bounds combining constraint propagation and dual linear relaxation. 🌐

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**Keeping Up with the Quants – Your Guide to Understanding + Using Analytics** by Thomas H Davenport and Jinho Kim, 2013. Harvard Business Review Press, Boston, Massachusetts, USA. pp 240, ISBN-10: 142218725X (hardcopy), \$18.69; ISBN-13: 978-1-4221-8725-8 (e-book), \$14.99.

Merriam-Webster defines “quant” as “an expert at analyzing and managing quantitative data.” Although as Operations Researchers, we can exclaim, “that’s us!”, this book is not just for us quants.

A lot has been written recently about the rise of “big data” and how it should be used and analysed to assist and improve managerial judgement and decision making. While there are many people qualified to manage and analyse big data, the lack of know-how in understanding and using data optimally brings an increasing need for those who make decisions to have an understanding and insight into analytical thinking. This is the objective of the book, stated eloquently in the introductory paragraph, as follows: “We live in a world awash with data. Data is proliferating at an astonishing rate – we have more and more data all the time, and much of it was collected in order to improve decisions about some aspect of business, government or society. If we can’t turn that data into better decision making through quantitative analysis, we are both wasting data and possibly creating suboptimal performance. Therefore, our goal in this book is to show how quantitative analysis works – even if you don’t have a quantitative background – and how you can use it to make better decisions.”

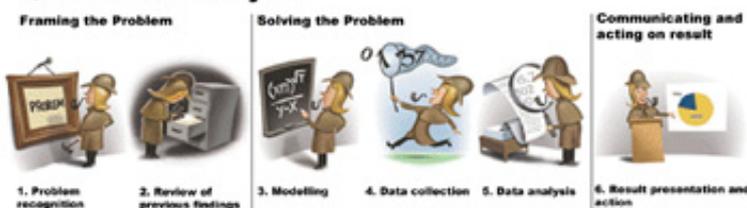
This rise of big data implies that organisations are going to require analysts to do detailed analysis but organisations also need people to make decisions and take actions based on these results. The latter, non-analysts and non-quantitative people, are the intended readers of this book which aims to make them better customers of data.

Credited with “creating”, but maybe more importantly, generalising the use of the term analytics, Thomas H Davenport is a very credible author of a book on a guide to understanding and using analytics. **Keeping up with the Quants** follows two other books he co-authored, namely, **Competing on Analytics** and **Analytics at Work**.

In this book, Davenport and Kim define clearly what they mean by “Analytics” and “Big Data” while tracing the rise of the latter to the exponential increase in computing power and widespread availability of internet and social media. They deal, to a great extent, on the increasing necessity of analytical thinking and the consequent importance of the “informed consumer of Analytics”. Analytically-minded executives who ask the right questions without necessarily becoming expert quants themselves are highlighted throughout the book through a lot of illustrative examples.

The authors present as a framework the three major stages of analytical thinking and the quantitative components within each stage, as follows:

### The Three Stages and Six Steps of Quantitative Analysis



Chapters 2 to 4 are devoted to each of these stages and steps within the stage. Even if slightly different methodologies and terms are used, most Operations Researchers would recognise and feel comfortable with these stages and steps. Framing, or defining the problem, consists of a two-step process of problem recognition and reviewing previous findings. Advice

is provided on conducting these steps while emphasizing their iterative nature. Many examples, even in the chapter on framing the problem, are explained through following the entire process fairly diligently. Focus on the decision maker or manager is consistently kept in the discussion on the analytical process.

The authors show that the second stage, frequently considered to be the core of analytics, is more structured and better defined. This stage, where quants are called in to assist, is covered in detail. Such aspects as: three ways to assign measures to variables; data collection phase with both primary and secondary data; and key statistical concepts and techniques are described. The latter is fairly comprehensive but in the end some of this may be beyond the comprehension of the average decision maker. In many instances, there needs to be a greater differentiation between what is relevant to the quant and to the customer/user of the model.

The final stage, possibly the most crucial stage in any analytic study, is communicating the results and action required. A presentation of the different types of visual analytics and their purposes makes the reader aware of the different ways of presenting results, without losing focus on the importance of communication in any modelling exercise.

An entire chapter is devoted to an area that undoubtedly needs much more emphasis in the operations research world, namely, creativity in quantitative analysis. It is stressed that “the most successful uses of analytics are highly creative, and creativity is an important component of successful analytical approaches to problems”. The four stages of creative analytical thinking are labeled: preparation, immersion, incubation and insight. Chapter 6 outlines how the analytical capabilities required by decision makers can be cultivated or learned. This is presented fairly comprehensively and in an easy-to-understand manner.

The final chapter is devoted to the topic of working with quants. Various relationships that should be in place are clearly spelled out, in particular, what the quantitative analysts should expect of business decision makers and visa-a-versa.

In emphasizing the importance of improving analytical thinking for business people, the book encourages them to learn something about mathematics and statistics, as well as to understand and question assumptions. The quants on the other hand, are enjoined to: learn the business; be interested in the business problem; explain technical language; be willing to develop a relationship; and never make the decision maker feel stupid. A fascinating illustrative example describes the development of a forecasting model for CISCO. A high quality model was required, the success of which depended on the buy-in of management. To ensure implementation, the project team explained statistical techniques in a way that ensured confidence in the model.

Although **Keeping up with the Quants** is aimed mainly at exposing decision makers to analytical thinking, the book has much to share with quants. Davenport and Kim have successfully opened the doors to the magical world of mathematics and quantitative analysis for decision makers through this book. However, as quants, we operations researchers, can benefit as much, if not more, from this book!

