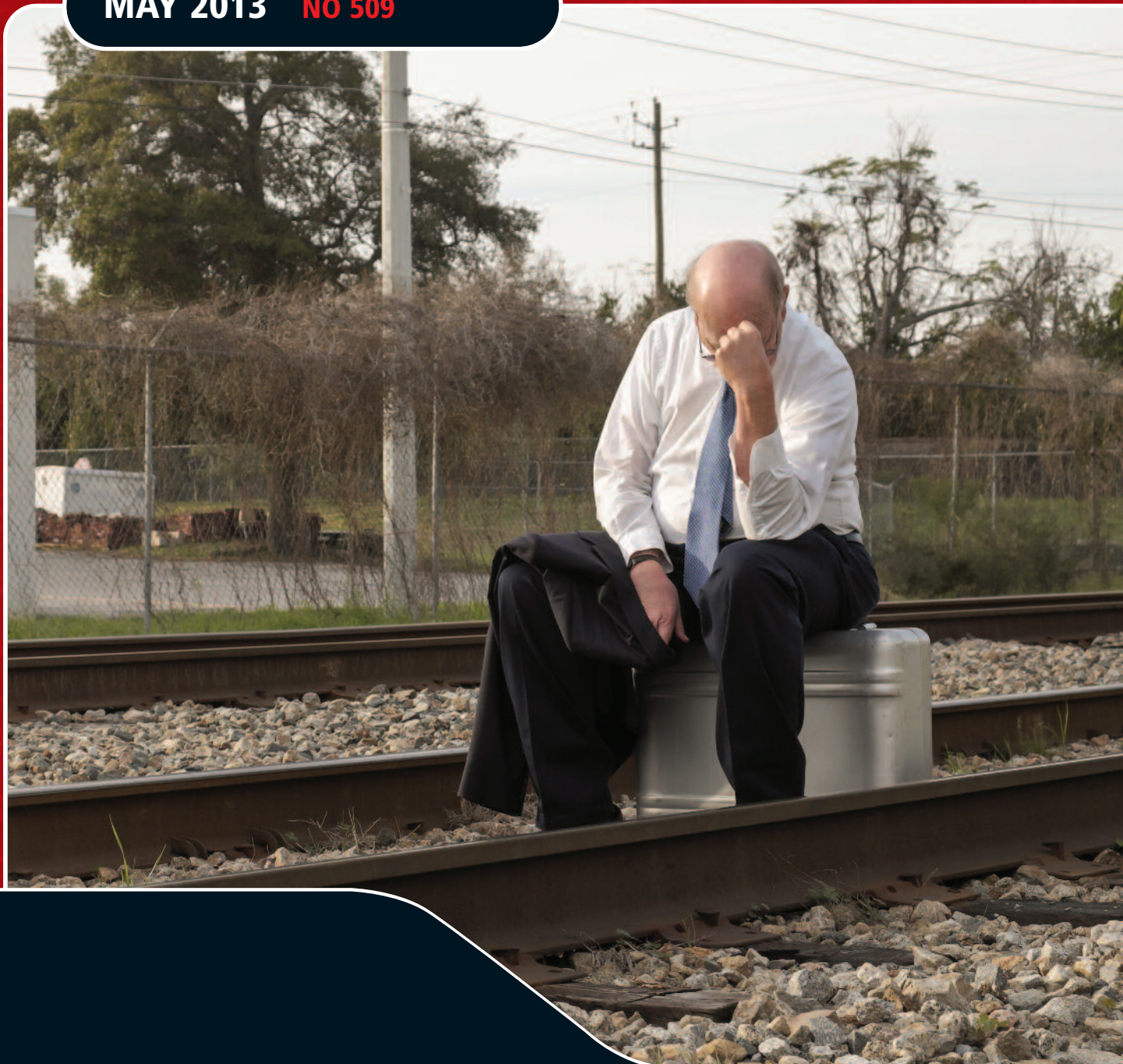


THE SCIENCE OF BETTER AT THE HEART OF ANALYTICS

# INSIDE O.R.

MAY 2013 NO 509



## TSP FINDS SHORTEST ROUTE TO FAME

:: INSIDE THIS MONTH :: :: :: ::

SIR HENRY TIZARD PART 10

YONGOR18 – A FIRST IMPRESSION

SYSTEMS THINKING TO SUPPORT POLICY MAKING

HOW ACCURATE CAN PREDICTIONS BE?



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## EDITORIAL

JOHN CROCKER

### Luckily, the article on how to win the Grand National will be too late for you to waste your money this year.

I would suggest that this is a classic case of where data analysis without any understanding can lead to some bad decisions. In this case, it is unlikely that many people would have suffered particularly badly – anyone who bets very large sums on the National is either too rich for their own good or should seek medical advice. Of the three tipped, Seabass came 13th, Tatenen was a faller at fence 12 and by a remarkable coincidence Teaforthree came in 3rd at 10-1 so you may just have broken even depending on what bets you made. Curiously, five out of the first six had names comprising two words and hence according to William Hartson, very unlikely to win.

In many cases, the consequences of bad analysis are a lot more serious. There are several teenagers in Wales suffering badly from measles at this very time. When they should have been vaccinated as young children, there was a 'scare' resulting from bad analysis of data which incorrectly found a link between autism and the MMR vaccine with the result that many parents considered the potential risk of side effects to out-weigh the potential benefit of vaccine and, as a result, withdrew their consent from having their children vaccinated. Although the paper and author responsible has been discredited, conspiracy theory has taken hold making it far more difficult to convince parents of the safety of the vaccine. Maybe the severity of this latest out-break of the virus will make more see sense.

The media love a good story and, alas, very few journalists are scientists. There is also the 'Why let the facts get in the way of a good story' sentiment. Complementary medicine, or quackery, to give it a more apt name is very largely based on believing there are connections when there is no real evidence to support this. No matter how many scientific trials are carried out or refereed papers are published discrediting homeopathy, chiropractic, reflexology or whatever, people will still pay good money in the hope that there might be some truth in it. Something that really annoys me is that

when our local surgery was moved to new premises, they somehow found room to include 'surgeries' for all of these charlatans. I accept they are not breaking the law and have every right to extort money from gullible people – what I object to is that such practices should be given credibility by those who should know better.

The main point I wish to make is that people are extremely good at finding correlations. The majority, if not all, religions depend on it. Someone falls ill, the witch-doctor does his magic, the person recovers therefore whatever the witch-doctor did must have cured the patient. Suppose the patient dies then clearly this was because the patient lacked faith; either way, the witch-doctor is exonerated and his standing is reinforced. Nothing anyone says or the witch-doctor does will convince his followers that he is a charlatan. For some reason, humans are 'wired' to believe.

There is, of course, a corollary to this. Breeders of race horses who expect their horses to one day compete in the National may decide to give them names which 'maximize' their chances of winning. This could result in there being a lot more horses which have high Hartson scores. If every horse competing in the National had a name which scored maximum Hartson points then assuming at least one of them made it to the finishing line, this would obviously re-enforce Hartson's argument – a case of self-fulfilling forecasts.

Apparently, 2013 is the year of Statistics – to celebrate this event the RSS/ASA magazine *Significance* is available to anyone free of charge – all you have to do is follow the link [www.significancemagazine.org/view/SigAppnew.html](http://www.significancemagazine.org/view/SigAppnew.html)

Please note that the capitalisation in tthe address is, ahem, significant.

<OR>

## CONFERENCE NEWS

<b>EVENT:</b>	KIM2013 Conference	<b>DATE:</b>	4 – 5 June 2013	<b>VENUE:</b>	Forest of Arden Hotel, Meriden
<b>EVENT:</b>	Advanced Analytics + Big Data	<b>DATE:</b>	12 June 2013	<b>VENUE:</b>	IET, London
<b>EVENT:</b>	IMSIO5 2013	<b>DATE:</b>	3 - 4 July 2013	<b>VENUE:</b>	University of Salford
<b>EVENT:</b>	OR55 Annual Conference	<b>DATE:</b>	3 – 5 September 2013	<b>VENUE:</b>	University of Exeter
<b>EVENT:</b>	Blackett Lecture	<b>DATE:</b>	28 November 2013	<b>VENUE:</b>	Royal Society, London





# INTRODUCING THE KIM2013 CONFERENCE PAPERS

ROCHELLE SASSMAN



*Forest of Arden Hotel & Country Club, Meriden, CV7 7HR, UK.*

The Knowledge and Information Management Conference (KIM) will be held on 4-5 JUNE 2013 at the Forest of Arden Hotel & Country Club, Meriden. This is a superb opportunity for people from all industry sectors to meet and exchange views, to build strong relationships and on-going dialogues as well as facilitating interested parties to showcase their work.

Knowledge management has become a key process in understanding organisations and their use of resources when considering goods and services, to improve quality. For large organisations, knowledge management may be seen as an intra-organisation activity, but sustaining quality for small-to-medium enterprises may require inter-organisational cooperation. The different quality and knowledge management issues faced by different sectors and differently sized organisations, and how these are addressed in practice and in theory, will help to make this a very interesting conference.

This conference attracted papers from all over the world, from countries as far as Venezuela, Taiwan, Hong Kong, India, Gambia, Pakistan, Mexico, Russia, Thailand and countries in the European Union.

Our team of reviewers, international experts from academic and industry, reviewed the papers and final admissions for the conference proceedings were received on the 12<sup>th</sup> April 2013.

The papers for publication in the conference proceedings cover different areas of knowledge management in the fields of academia, healthcare, aviation management to name a few.

On the opposite page is a brief analysis of papers which have already been peer-reviewed:

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KM Area	Title of Full Paper
<b>Decision Making</b>	<p>Social Influence in Online Purchase Decisions: A Social Power Theory Perspective</p> <p>Rethinking knowledge hierarchies - bridging the gulf between theory and practice: the case of Frankfurt airport's billing department</p> <p>Dynamic Analysis Exploitation Capability</p> <p>Multi-Criteria Interval Valued Intuitionistic Fuzzy Decision Making Using A New Score Function</p> <p>Do We Have Time for KM? An SME Perspective</p>
<b>KM Frameworks</b>	<p>A Topological Approach to Knowledge Management and Development in a Company</p> <p>Resource Indicator of Knowledge Differentiation</p> <p>The MinK Framework: Developing Metrics for the Measurement of Individual Knowledge</p> <p>Personal Knowledge Development in Online Learning: A Model for Measuring Externalisation, Combination and Internalisation</p>
<b>KM Systems</b>	<p>The early warning concept in the system supporting knowledge management in Polish mechanical engineering industry enterprises</p> <p>Traditional Knowledge as a Factor of Socio-Economic Development of Aboriginal Nations of Siberia</p> <p>The concept of Knowledge Object Management System as a tool reducing the knowledge deficit in the functioning of machine-building industry enterprises</p> <p>Improving Customer Relationships through Business Intelligence</p> <p>A Quality Assessment Framework for KMS Software Reflections on Conducting a Systematic Literature Review</p> <p>The management of patient information in Polish health care system</p> <p>Towards a Quality Assessment Framework for KMS Software: A Mapping Study</p>
<b>Knowledge Maps</b>	<p>Knowledge Diffusion via AUTomated Organizational CARTography [AUTOCART]</p> <p>Using Self Organizing Maps for Sentiment Analysis</p>
<b>Knowledge Sharing</b>	<p>What have we learned so far? The development and application of organisational learning narratives</p> <p>Analysing the effect of Commitment-based Human Resource Practices, Technology and Competition on Web Knowledge Exchange in SMEs</p> <p>Testing the Tacit Knowledge Barriers in Franchising: Are the barriers really distinct?</p> <p>Toward a Sustainable Quality of University Research: Knowledge Sharing and Leadership</p> <p>An Analysis Of Localisation Context In Practice-Oriented Knowledge Transfer</p> <p>Agile Knowledge Management: A survey of Indian perceptions</p>
<b>Organisational Learning</b>	<p>Coach Education – Developing International Discipline of Knowledge</p> <p>Women And Computer Education In West Africa: The Situation Report</p> <p>A Multiple-Case Study in a Stochastic Demand Industry to Sustain Autopoietic Property of Knowledge Agent</p> <p>Feature selection and classification on learning attributes analysis</p>
<b>Quality Management</b>	<p>Compliance Patterns and Quality Management System (QMS) Framework to ensure Billing Compliance</p> <p>Knowledge management for sustainable quality in construction. Preliminary findings from the Venezuelan case</p> <p>The quality of doctoral degree awarding: the perspective of self-regulation mode</p>
<b>Supply Chain Management</b>	<p>Balancing Push and Pull Information Management within the Supply Chain</p>

I look forward to seeing you at KIM2013 in June.

BOOK YOUR PLACE at [www.theorsociety.com/KIM2013](http://www.theorsociety.com/KIM2013)! Click the red box 'Book KIM2013 online'.

# INTERESTED IN... BIG DATA

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 RISK ANALYSIS VISUALISATION  
 PREDICTIVE MODELLING ADVANCED ANALYTICS  
 DATA MINING DATA SCIENCE  
 CUSTOMER INSIGHT FORECASTING

...this is the professional conference for you

## Developments in Analytics and Big Data – Adding Value

**Operational Research – adding value in analytics.** Over the last 75 years, Operational Research (O.R.) professionals have developed mature methodologies to analyse and use data that can **add significant value** in big data analytics. The aim of this event is to show how developments in Analytics are leading to **increased competitive advantage** in these challenging times.

**Chair: Geoff Royston** President, The OR Society

### Confirmed Speakers:



**John Hopes** Lead Partner, Business Modelling, Ernst & Young, Vice President, The OR Society, Chair, Analytics Working Group  
*O.R., Data Science and Analytics: Maximising Value from Big Data*

The O.R. community has a long history of using analytics on big data to add value, including the development of effective methodologies that ensure implementation. There is much potential synergy from collaboration between O.R., Data Science and Analytics, which will be illustrated via case studies.



**Gearóid Madden** Accenture Analytics Innovation Centre, Dublin  
*The use of Analytics in Fraud Detection in the Insurance Sector.*

Gearóid leads the Insurance Team in Accenture's global Centre of Excellence for Fraud & Compliance Analytics. The talk will be illustrated with some case examples



**Colin Shearer** SPSS – data mining pioneer and developer of Clementine software  
*The 'Analytical Revolution': the Industrialisation of Advanced Analytics*

It's a given that the cloud helps businesses of all sizes overcome infrastructure constraints. This is extremely pertinent to the uptake of advanced analytics by a broader range of organizations. Advanced analytics can be the key to better decision making in virtually any area of business.

**Wednesday**

**12 June 2013**

**9am to 5.30pm**

Institution of Engineering & Technology

**Savoy Place**

**London, WC2R 0BL**

**Fee £75+VAT**

**until 1 May then**

**£150+VAT**

**Includes buffet lunch**



**This event is sponsored, and subsidised by, The OR Society**

**For more about this event, and to book online, visit [www.analytics-events.co.uk](http://www.analytics-events.co.uk)**





**Detlef Nauck**, BT - Chief Research Scientist and BT's leading expert in data analytics  
*Predictive Analytics and Proactive Service – their impact on BT and new research developments*

The presentation will cover a number of projects at BT that have used predictive analytics in order to improve service performance and to pre-empt service failures. It will also give a brief overview of their current research programme in autonomics and its relation to big data.



**Fintan Galvin** Founder and CEO, i01 – a leading Open source Consultancy  
*Harnessing Search Engines, Analytics and Semantics for Competitive Advantage*

Analytics and search engines are natural bedfellows as shown by the changing way in which search engines are using user action based Analytics to drive their algorithms in order to get the best answers delivered back to the users. The focus will be on combining three key areas, Search Engines, Analytics and Semantics using open source tools. The session will look at a case, examining how to put these areas together to best effect to gain a competitive advantage and give an insight into the tools that can be used to achieve this.



**Sanjit Atwal** - CEO, Squawka  
*Analysing Premier League Player Value using Big Data*

Football is a global behemoth when it comes to business. English Premier League clubs, especially, receive huge amounts of television revenue on an annual basis and even clubs getting relegated from the top flight will, the following season, receive parachute payments of approximately £12million. But how much analysis actually goes into the expenditures of these clubs when compared to their on-field performance? Squawka has developed its own unique player performance index, which analyses over 14 million on-ball actions in real time to display the performance of each player, enabling managers to compare team/player performance and value for money.



**Aaron Sugarman** Head of Commercial Analytics, TUI UK & Ireland  
*The application of analytics in Tour Operating*

TUI UK and Ireland, which is part of TUI Travel PLC and includes the brands of Thomson and First Choice, takes over 5 million customers on holiday each year. Aaron will give an overview of the application of analytics in different areas including that of yield management, web analytics and customer relationship management and then take a look at the opportunities in the future roadmap.

**Book now online at [www.analytics-events.co.uk](http://www.analytics-events.co.uk)**

**This event is subsidised by the OR Society to ensure excellent value:  
Book and pay by 1 May for the early bird rate of £75+VAT; after 1 May the fee is £150 + VAT**

**The OR Society has recently established an Analytics Network to provide support to all working in Analytics and Big Data.**

**KEEP IN TOUCH WITH WHAT'S NEW IN ANALYTICS**

**BY JOINING THE ANALYTICS NETWORK**

**AT [www.analytics-network.co.uk](http://www.analytics-network.co.uk)**

## OPERATIONAL RESEARCH GOES TO THE MOVIES

**NIGEL CUMMINGS**

Hands up all those who have seen 'A Beautiful Mind'? Now it's time to go to see another movie about maths, intrigue and human relationships.



*Director Timothy Lanzo.*

It is some twelve years since Russell Crowe starred as the mathematician John Nash (and 1994 Economics Nobel laureate). There have been precious few mainstream films that involve either mathematicians or mathematics so it is of some interest to find a newly released film dealing with a group of mathematicians, albeit, fictional ones.

This new addition to the archives called *Travelling Salesman* is a very low budget (made for less than \$10,000) film which apparently took only 2 weeks to produce. *Travelling Salesman* is an intellectual thriller about four mathematicians hired by the U.S. government to solve possibly the most elusive problem in computer science history.

Without giving too much away, the four have found a proof that  $P = NP$  (see elsewhere in this issue) by finding an algorithm that solves the travelling salesman problem. Given that this conjecture is true, then many problems suddenly become almost trivial. Not least of these is the factorisation of very large numbers, the basis of



*Travelling Salesman cast and crew.*

the RSA encryption method used by banks, credit cards and governments. Incidentally, this method of encryption was discovered independently by mathematicians at GCHQ, Cheltenham some time before it became public knowledge but they were, of course, sworn to secrecy so never received any credit for it. It would also appear that Saul Gass, (see obituary in this issue) also did some work in this area but possibly did not appreciate the significance of it at the time.

The story is written and directed by Timothy Lanzo, it premiered at the International House in Philadelphia on Saturday, 16 June, 2012. It is unclear how wide a release it will gain worldwide, low-budget films, after all, tend to go straight to DVD. If it does go straight to DVD, *Travelling Salesman* should be available in Britain fairly soon.

By the way 'A Beautiful Mind', scored 8.1 out of 10 on the Internet movie database (IMDb) index, scores such as this generally means films are pretty well worth watching. *Travelling Salesman* on the other hand, has so far only scored 5.3, which generally means it probably isn't unless you have a particular interest in this area.



## EPSRC FUNDING

**TIM BEDFORD (UNIVERSITY OF STRATHCLYDE), ERC**

My portfolio in the Education and Research Committee covers contacts with the Engineering and Physical Sciences Research Council (EPSRC). Although this is not the only Research Council that funds O.R. research, it is probably the most significant.

People with long memories will recall that a number of academic departments received support from EPSRC for Masters' courses in O.R. This is now pretty much a thing of the past, although some funding is still available through doctoral training grants in order to promote, and prepare students for, doctoral research. The research councils, in general, argued that there was insufficient 'research' in a master degree and therefore funding should be sought elsewhere.

Within the EPSRC portfolio, O.R. is only named explicitly within the Mathematical Sciences portfolio. Here it is called Mathematical Aspects of Operational Research to distinguish it as a subset of O.R. However, O.R. is seen by the staff of EPSRC as a subject which is present in many different portfolios and indeed across different research councils. For O.R. researchers this causes some difficulties but also provides opportunities that other disciplines lack.

Other areas of EPSRC which include some form of O.R. include ICT and Engineering. ICT includes O.R. in Maths of Computing and Artificial Intelligence Technologies. Engineering includes O.R. within its Transport, Operations and Management area.

Although EPSRC still recognises different disciplines, a few years ago, they changed their emphasis to one which was more concerned with 'Challenge themes', which typically are cross- or multi-discipline in nature. At the time, the Government was keen to influence research that would provide short, medium or, to a lesser extent, long term benefit to the UK. Of these, Energy, Healthcare Technologies and Manufacturing the Future are notable cross cutting priorities for which O.R. is important. These areas have substantial funding and operate 'managed calls' (calls for proposals around specific topics). They do not have an associated responsive mode panel attached to them, so whenever a researcher puts in a grant application for one of these thematic priorities, but outside a managed call, the application is sent to a discipline specific panel for ranking. If it is funded then the money may well come wholly or partially from the theme budget rather than e.g. maths.

The fact that there is no funding available for straight O.R., per se, suggests that O.R. researchers will need to collaborate with researchers from other disciplines within a wider research proposal. The proposal will need to be mainly around novel research in the EPS disciplines, with a strong bias towards mathematics (ICT, Engineering, or one of themed areas). There are nice examples of successful collaborative proposals, for example, emerging from Maths and Energy and Maths and Manufacturing calls, that show that O.R. can get funding through the Challenge themes.

Like all research councils, the EPSRC is going through a difficult financial period. Last year it decided that although it would continue to maintain Mathematical Aspects of Operational Research and Maths of Computing, it would reduce funding in Transport, Operations and Management. Statistics and Applied Probability is the only area of maths which is to grow.

At the moment the primary criterion for ranking appears still to be research quality. National importance (which includes capability shaping) is a secondary criterion and in practice would seem to be used to 'tie break' between more-or-less equally good quality proposals.

Like all the research councils, EPSRC is trying to both promote the development of impact from EPSRC funded research, and find good examples of such impact to be able to show the Government. Recently, they awarded Impact Acceleration Awards to approximately 30 different Universities. While the aim of these awards is to stimulate impact from EPSRC funded research, these also provide opportunities to Operational Researchers, whether or not they originally had EPSRC funding, because Operational Research, of any kind, should be able to help other academic colleagues in generating impact from their research.

This year a very large part of total EPSRC funding is going to be devoted to Centres for Doctoral Training, and many academics are currently busy writing proposals. A number of these proposals will touch on Operational Research, and to be successful they will

require the support of colleagues from business. The Centres for Doctoral Training represent a step change in the concentration of research council funding of PhDs. It is therefore important that O.R. is represented within winning bids.

While EPSRC funding is not easy for O.R., a number of changes have occurred which should give O.R. some natural advantages. The first is the emergence, discussed above, of thematic priorities such as Energy, Health and Manufacturing. The second is a wider addition of the criterion of *National Importance* alongside research quality. While research quality is the primary criterion, national importance is a major secondary criterion. EPSRC defines it as follows:

'National Importance is the extent, over the long term, for example 10-50 years, to which the research proposed:

- contributes to, or helps maintain, the health of other research

disciplines contributes to addressing key UK societal challenges, contributes to current or future UK economic success and/or enables future development of key emerging industry(s)

- meets national strategic needs by establishing or maintaining a unique world leading research activity (including areas of niche capability)
- fits with and complements other UK research already funded in the area or related areas, including the relationship to the EPSRC portfolio and our stated strategy set out in 'Our Portfolio'.

Despite the difficult funding environment, or possibly because of it, this should not be a bad time for EPSRC funding of O.R., as long as we are able to engage and collaborate with colleagues from other disciplines. This, in general, will mean being pro-active. Many other areas will either not be aware of the existence of O.R. or if they are, they may not appreciate how it could help them.

<OR>

## MATHEMATICS, STATISTICS AND O.R. FOR ALL: SHARING GOOD PRACTICE IN SERVICE TEACHING IN THE MATHEMATICAL SCIENCES

FRIDAY 17 MAY 2013, UNIVERSITY OF MANCHESTER



For many years, Mathematical Sciences departments and groups have offered service teaching in Mathematics, Statistics and O.R. to students in a range of other disciplines. This event aims to provide an opportunity for staff involved in this work to meet and share good practice in the teaching, learning, assessment and organisation of service teaching. The purpose of the event is to launch the establishment of a community of practice in this area.

The scope of service provision provided by Mathematics, Statistics and O.R. subject specialists is wide ranging. The challenges which can arise are many and include teaching large class, engaging students, contextualising content, the use of appropriate learning technologies and building students' confidence in the use of mathematical and statistical techniques. This event will provide the ideal forum for the discussion of these and other challenges and for

sharing examples of successful practice in this area.

This event is being funded by the Mathematics, Statistics and Operational Research discipline (<http://www.heacademy.ac.uk/disciplines/maths-stats-or>) at the Higher Education Academy (HEA). As such there is no charge for attending this event.

For further information and to book a place please go to [http://www.heacademy.ac.uk/events/detail/2013/17\\_May\\_MSOR\\_Manchester](http://www.heacademy.ac.uk/events/detail/2013/17_May_MSOR_Manchester).

Queries about this event should be emailed to Catherine Redfern ([Catherine.Redfern@heacademy.ac.uk](mailto:Catherine.Redfern@heacademy.ac.uk)).

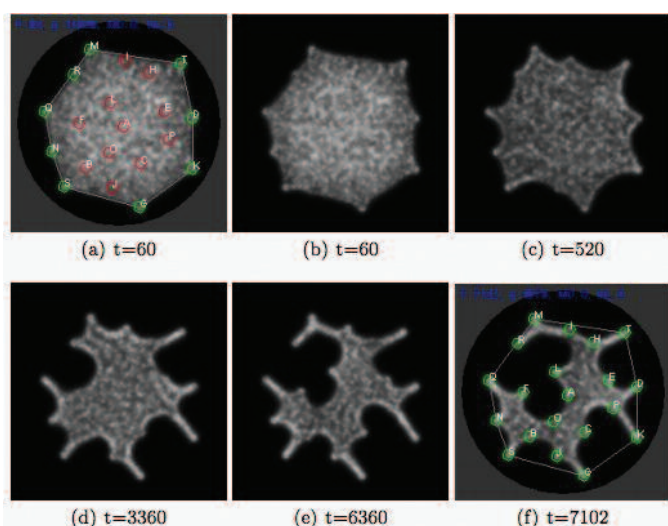
<OR>



## TSP FINDS SHORTEST ROUTE TO FAME

**NIGEL CUMMINGS**

According to an internal email from Pro Vice-Chancellor Paul Olomolaiye, University of West of England (UWE), news of research into the travelling salesman problem (TSP) went 'viral' on 26 March 2013. The research, carried out by Jeff Jones and Andy Adamatzky, Centre for Unconventional Computing, is based on a shrinking 'blob' of material.



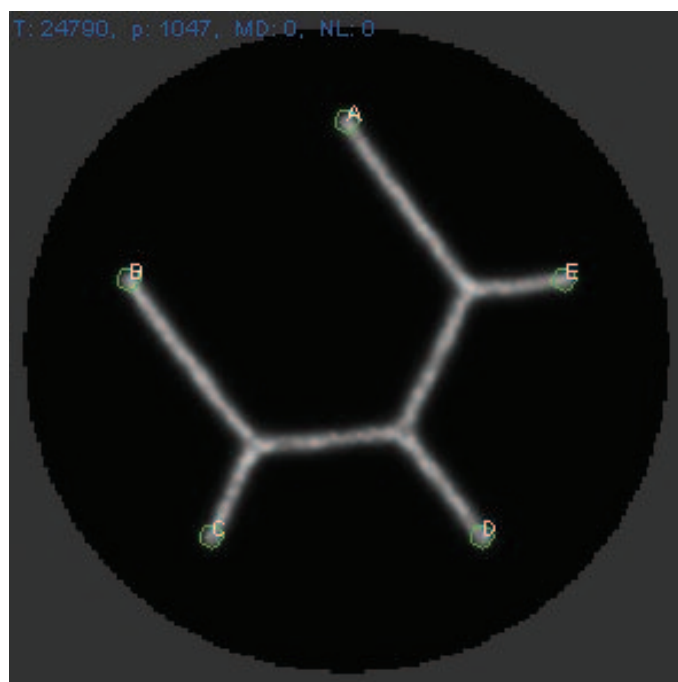
Although the results are interesting, the approach is not particularly new – slime mould was used to help design the optimum track layout for the Tokyo metro many years ago. In that case, the aim was to find the layout which minimised the length of track rather than the one which minimised the distance from A to A via all stations passing through each once and only once. Using this method to solve the TSP means that extra roads have to be added to avoid the need to re-visit certain stations, towns or cities. What is new with this method is the morphological adaptation of the 'blob' to its environment by applying a set of very simple rules to each particle in the way it reacts to others and to the environment.

In the cases looked at by Jones and Adamatzky, they created a map with 20 towns placed randomly within a finite 2-D [Euclidean] space with the proviso that no two towns were within a certain minimum distance of each other (to make sure all were distinct). They set the 'blob' to shrink to the point just before one of the towns became isolated then used the shape of the blob to draw straight lines between the towns so connected. They repeated the experiment six times for each of twenty different layouts. They also calculated the distance of the minimum route – with 20 towns, this is still feasible. (In 2005/6, a TSP involving 85,900 cities was solved although it did take rather a long time and used an enormous number of processors.) In all 120 cases, the blob failed to find the

minimum distance but in six of them (the same 20-town layout) the blob came within 4%. In the least successful case, it was 20% longer than the true minimum. This suggests that this approach could be used to determine a good starting point for an heuristic approach but certainly cannot be relied upon to find the best route.

There are several variants to the TSP. The traditional formulation requires the 'salesman' to visit every town or city once and only once using existing roads in a closed loop (i.e. ending up at the start point). This became idealised by assuming all towns and cities were linked to each other by straight roads. It then got slightly extended such that the route from A to B was not necessarily the same distance as from B to A – this could happen with one-way systems.

From this developed another set of problems that are commonly referred to as vehicle routing problems (VRP). Just as with the TSP, each vehicle is required to visit a certain number of 'towns' or drop-off points but here the restrictions are on the capacity of the vehicle such as a van. Typically, there are two main constraints: volume and weight. Each van can only carry so many kilograms and, of course,



it has finite dimensions. Each drop-off site has an order which will generally be made up into a box or possibly a pallet. The requirement is to minimise the number of vans or trips and the total distance travelled whilst aiming to have all deliveries completed by a certain time and, naturally, complying with the law at all times.

It also mutated into the converse problem in which the aim is to find the minimum length of road/rail/cable which connects all the towns and cities – this is apparently known as a ‘Steiner tree’. The subtle difference here is that it is not the users but the providers of the roads (etc) that are the clients who wish to minimise their expenditure.

Other problems which, with a certain amount of imagination, fit into this category are timetables, set partitioning, number factorization and many more. In most, if not all, cases, the problem is relatively easy to state and for small numbers, the problem is also very easy to solve. The difficulty comes when the number of towns,

students, buses, vans, potential factors, sub-sets or whatever, starts to increase as the size of the solution space increases exponentially i.e. faster than any polynomial and hence becomes one of the class of problems referred to as NP-hard.

Proving, or disproving, that  $P = NP$  is one of the six remaining unsolved Millennium Problems for which the Cray Foundation has offered a prize of one million US dollars. Although soap bubbles, slime mould, ants, bees and soldier crabs have all been used to help find solutions to these problems, as yet none have produced an algorithm that reduces the problem from NP to P although as you will see elsewhere within this issue, there is a film (I believe which was shown at INFORMS 2012 in October) that claims 4 mathematicians working for the US Department of Defence cracked the problem.

&lt;OR&gt;

## ANTOLOGY

JOHN CROCKER

King Solomon said, ‘Go to the ant, consider her ways and be wise.’



In a series of four programmes televised on BBC4, Adam Hart has been investigating what ants can tell us. Unfortunately most of these will have been broadcast before you read this but if this series follows common trends, there is a good chance they will be repeated several times over the coming months even if you do not have one of these magic boxes that allows you to watch programmes whenever you wish.

A study of ants foraging for food some years ago revealed that these small insects are actually very good travelling saleswoman. By laying pheromone trails if they are successful in their search, other ants will know to follow them. As more and more ants follow the path so the pheromone trail intensifies. It has been found that

these paths that the ants lay down are actually the shortest or very close to the shortest routes between the nest and the food source. Simulations using this same principle have been found to be very efficient at solving the travelling salesperson problem.

Southwest Airlines apparently used simulated ants to determine whether passengers would be quicker at boarding an aeroplane if they are pre-allocated seat numbers or allowed to freely choose their seats. The conclusion was that that latter was quicker although it should be pointed out that the ‘ants’ were effectively told to choose the first available seat whereas passengers tend to be rather more perverse. The optimum would be to fill the vacant seats furthest away from the entrance and from window to aisle; that way passengers do not block the seats or aisles but that might force some people to sit next to others to whom they took an instant dislike.

Ants have also inspired a number of other optimising problems such as finding the best route between planets, design of buildings to avoid blocking at exits during emergency evacuations, shortest lengths of cables or wires in micro-circuitry and quicker computer networks. With over 11,000 species to choose from all with potentially different types of behaviour, there are clearly still opportunities to discover other ways in which these fascinating creatures may help us solve some of our more intractable problems.

(Taken from ‘Ant Behaviour’, *Focus: Science and Technology*, April 2013)

&lt;OR&gt;

## SIMULATION WORKSHOP

# THE OR SOCIETY'S 7TH SIMULATION WORKSHOP (SW14)



**HELD IN COOPERATION WITH: THE INFORMS SIMULATION SOCIETY; THE SOCIETY FOR MODELING AND SIMULATION INTERNATIONAL (SCS). 1-2 APRIL 2014, WORCESTERSHIRE, UNITED KINGDOM**

The biennial OR Society Simulation Workshop brings together practitioners and academics working in the field of discrete-event simulation and related fields. It provides an opportunity to exchange ideas on the current and future state-of-the-art in simulation and modelling. The programme consists of a key note presentation, panel discussion and parallel streams. Breaks between sessions and the conference dinner provide an excellent opportunity for networking. The exhibition area includes poster display and some of the latest developments in simulation software tools.

### Location

The Abbey Hotel Golf and Country Club is situated in Worcestershire on a lovely 175-acre estate that once belonged to the now ruined local abbey. It provides an excellent standard of accommodation and conference venue. There are also leisure facilities and a championship standard Golf Course.



Abbey Hotel

The hotel is near to Birmingham, which has excellent links through the International Airport and railway services. London is only 1.5 hours away.



Stratford-upon-Avon

Local attractions include Stratford-upon-Avon (Shakespeare's birthplace) and Warwick's Medieval Castle.

### The Programme

The workshop will include plenary sessions, special focus streams, simulation practice sessions and posters. Contributions to the technical programme are sought in the following areas, although papers in any area of discrete-event simulation will be considered.

#### Simulation Modelling Methodology

- Component based simulation
- Collaboration methods
- Distributed simulation
- Web based simulation
- Simulation and the grid
- Simulation and artificial intelligence
- Simulation visualisation

- Simulation software
- Simulation standards
- Human performance modelling
- Agent-based simulation
- Service-oriented simulation
- Conceptual modelling
- Verification and Validation

#### Simulation Analysis Methodology

- Design and analysis of simulation experiments
- Simulation optimisation
- Risk Analysis
- Metamodelling

#### Simulation in Practice

- Simulation in manufacturing
- Simulation in services
- Simulation in defence
- Simulation in healthcare
- Simulation in semiconductor industry
- Simulation practice
- Simulation education
- Energy modelling
- Environmental simulation
- Supply chain and transportation modelling

All submissions will be peer reviewed. Accepted papers will be published in the conference proceedings and will be presented at the conference. Presentations will be given 30 minutes including time for questions and answers.

The **Simulation Practice Stream** provides an opportunity to submit a shorter paper (3 to 5 pages). These papers should either describe a novel application of simulation or provide some insight into how the use of simulation might be improved. Contributions from simulation practitioners are particularly encouraged.

**Posters** of applied or research projects in simulation (1-3 pages), will be displayed during the conference. A poster session is provided where delegates have 1 minute to briefly introduce their work.

#### Timetable and Deadlines

**1 November 2013:** Submit electronically contributed papers not previously published or presented. Submission instructions will be found soon at [www.theorsociety.com](http://www.theorsociety.com) (in the conferences section). Each submission must be a 4-10 page paper (3-5 pages for the Simulation in Practice Stream), including an abstract of less than 150 words.



Submission implies that an author will attend the workshop to present the paper, and all clearance required for publication of the paper will be obtained by 14 February, 2014.

**10 January 2014:** Contributors will be notified whether or not their paper has been accepted.

**14 February 2014:** Authors provide the final manuscript for inclusion in the conference proceedings. These should be in the format required for the conference. Author instructions will be available soon at [www.theorsociety.com](http://www.theorsociety.com) (in the conferences section).

**14 February 2014:** Submit poster title and abstract of 150 words. These should be submitted using the electronic submission form for full contributed papers. Submission implies that an author will register to the conference. Posters abstracts will be published in the conference proceedings and should follow the guidelines for conference papers.

*If you require any further information on paper or poster submission, please contact the programme or poster chairs: Dr Stephan Onggo and Dr Cathal Heavey (Programme) or Dr Thomas Monks (Posters).*

#### Conference Fees Guide

Conference fees include attendance at the conference, meals, refreshments, the conference dinner and the conference proceedings. Accommodation and breakfast is not included.

**Please note that all the figures shown below are a guide only and may be subject to change**

	Early registration (up to 14th February 2014)		Registration (after 14th February 2014)	
	Excl VAT	Inc. VAT	Excl VAT	Inc. VAT
Members	£300	£360	£350	£420
Non-members	£370	£444	£420	£504
Students	£140	£168	£140	£168

*(Members of associated Societies INFORMS and SCS qualify for member's rate)*

#### Organising Committee

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<OR>

## CETL-MSOR CONFERENCE 2013

### The CETL-MSOR 2013 Conference - Next Steps

will be held at Coventry University on 10th and 11th September 2013.



The aim of this conference is to promote, explore and disseminate emerging good practice and research findings in Mathematics, Statistics and O.R. support, teaching, learning and assessment. The conference will appeal to all those teaching Mathematics, Statistics or O.R., whether this is to specialist mathematics students or students studying components of mathematics within their degree programmes.

In November 2012, the CBI published a report entitled *First Steps – the first aspiration of which is 'Better education should be our overriding long-term priority'*. The conference will explore ways in which learning and teaching in Maths, Statistics and O.R. in higher education can contribute to this aspiration within a rapidly changing environment.

The principal themes of the conference will be:

- Employability;
- Meeting the needs of a diverse student population;
- Technology-enhanced learning and teaching;
- The National HE-STEM Programme legacy.

Authors are invited to submit abstracts of no more than 500 words by Monday 2nd June 2013 which explore the themes of the conference. Interesting reports on issues relating to the wider teaching and learning of Mathematics, Statistics and O.R. that do not fit directly with the themes will also be considered.

More information and the abstract submission form is available at <http://www.sigma-network.ac.uk/cetl-msor2013/>

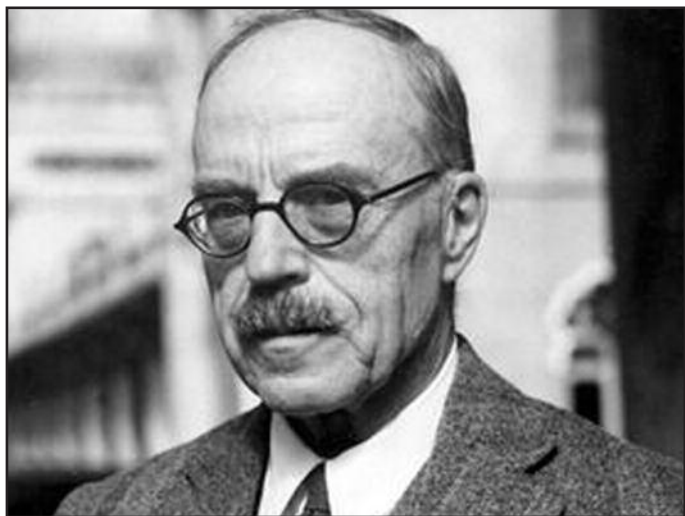
<OR>



## SIR HENRY TIZARD PART 10

**JOHN CROCKER**

In July 1943, Tizard sent in a letter of resignation which was accepted by both Churchill and Cripps (Minister of Aircraft Production) but this was by no means the end of his war effort.



In fact, the first thing he did was to start organising a visit to Australia to give them the benefit of his wisdom. Following a series of delays including returning to Poole following an engine failure, he and his assistant J.E. Adamson finally made it to Montreal just 142 hours after leaving Oxford. 'And what [...] is the use of [...] spending so much time, skill and energy in endeavouring to increase the economic speed of air transport when the really important thing is to stop the waste of time on the ground.'

From Montreal, they flew down to Washington where they met with Charles Lindemann and AVM McNeece Foster. Tizard renewed acquaintances with Vannevar Bush and discussed progress on the atomic bomb. For a number of reasons, communications between the US and UK on R&D had all but ceased but these had now been resolved. Their exchange was 'in the best scientific tradition'. Sometime later Tizard and Bush were together outside Boscombe Down. Tizard told a friend that they were going to go fishing. A couple of days later in London, the friend asked him how the fishing had gone. He replied, smiling, 'Very well! Caught nothing ... but the fishing went very well!'

From Washington they flew to San Francisco and onto Honolulu where they were delayed again. This gave Tizard the opportunity to visit Admiral Nimitz who brought him up to date with the latest advances in radar and the situation in the Pacific while Sir Henry told him about how things were going in the Atlantic and Europe.

From Honolulu, they island hopped in a five-seater, twin-engined,

Martin 'Mariner' from one US base to another all the way to Brisbane (delivering baseball bats en route) finally arriving on 28<sup>th</sup> August. Here they were met by Sir George Julius (Chief of C.S.I.R) and Sir David Rivett who soon had him attending interviews, visits, consultations and meetings with politicians and Service chiefs.

Almost immediately, Tizard discovered a problem of non-coordination. It appeared that Australia was not receiving vital technical and operational information on radar and radio counter-measures. He discovered that the information was, in fact, being sent from the UK but it was going to the Radio-physics Laboratory but going no further because no one there recognised its importance. Tizard, naturally, soon rectified the situation.

There developed a day-by-day two-way communication between Tizard and London with vital information flowing both ways. Every day was filled with meetings. On 23 September, for example, he met with Senior Officers of the RAAF at Victoria Barracks where he hammered out the most efficient way in which an Operational Research Group could be set up within the Force. Prime Minister Curtin asked him to look into aircraft production. His recommendation was that production should concentrate on three types of aircraft all using, if possible, the same engines (instead of six using different engines).

'Too much that is being built today is second-rate, and will have little influence on the defeat of the enemy. To give first-class human material second-rate equipment merely lengthens the war at the cost of valuable life. [...] Is it not obvious that the wholesale destruction of enemy shipping is the best way to shorten the war?'

Tizard's work in Australia had been a success in much the same way as had his work in Canada. He found the political atmosphere much more to his liking than at home. He was also invited to spend six months in India to get their science and research into shape but declined because no one in authority could assure him that his visit would have any effect on foreshortening the war with Japan.

He spent much of the last 18 months of the war prodding and playing devil's advocate. There were few areas into which he did not delve and give the benefit of his wisdom. An example of this was when he gave a speech at the Royal Society Club in February 1944 at which he criticised ICI. Lord Melchett, Deputy Chairman of ICI, was present and complained that his talk was a general attack





# OR55 – EXETER 3-5 SEPTEMBER 2013: CALLS FOR PAPERS

**PHILIP JONES AND DAVID SMITH**

These streams are calling for your papers!

With the number of streams growing, the calls for papers are becoming ever louder! So, now's the time to offer your abstract. All you need to do at this stage is to produce a title and an abstract of up to 300 words maximum. In order to ensure that your abstract appears in the conference handbook given to all delegates, please make sure it's submitted at the OR Society's website **not later than Friday 14 June**.

Papers are normally given within a 30 minute slot. Keynote papers and tutorials / workshops can be an hour long. To make things easy, go to the OR55 Conference page [www.theorsociety.com/OR55](http://www.theorsociety.com/OR55) and you'll see a red 'Submit Title/Abstract' button.

The full list of streams accepted so far is shown below.

## **Analytics**

Catherine Mulligan - [c.mulligan@imperial.ac.uk](mailto:c.mulligan@imperial.ac.uk)

## **Community and Third Sector O.R.**

Martha Vahl - [mvahl@lincoln.ac.uk](mailto:mvahl@lincoln.ac.uk)  
Eliseo L. Vilalta-Perdomo - [evilaltaperdomo@lincoln.ac.uk](mailto:evilaltaperdomo@lincoln.ac.uk)  
Jane Parkin - [janeparkin@gmail.com](mailto:janeparkin@gmail.com)

## **Criminal Justice**

Ian Seath - [ian.seath@improvement-skills.co.uk](mailto:ian.seath@improvement-skills.co.uk)

## **Data Envelopment Analysis – DEA**

Bing Xu - [B.Xu@hw.ac.uk](mailto:B.Xu@hw.ac.uk)

## **Distributed Computing and Simulation**

Andrew Poulter - [ajpoulter@dstl.gov.uk](mailto:ajpoulter@dstl.gov.uk)

## **Energy**

Paul Jennings - [paul.jennings@nnl.co.uk](mailto:paul.jennings@nnl.co.uk)

## **Forecasting**

Fotios Petropoulos - [f.petropoulos@lancaster.ac.uk](mailto:f.petropoulos@lancaster.ac.uk)

## **Green Logistics**

Tolga Bektas - [T.Bektas@soton.ac.uk](mailto:T.Bektas@soton.ac.uk)

## **Healthcare and Social Care Modelling**

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Tillal Eldabi - [tillal.eldabi@brunel.ac.uk](mailto:tillal.eldabi@brunel.ac.uk)

## **Information Systems & Knowledge Management**

Jo Smedley - [jo.smedley@newport.ac.uk](mailto:jo.smedley@newport.ac.uk)

## **Inventory Management, Logistics and Supply Chain**

Babai Mohamed Zied – [Mohamed-Zied.Babai@bem.edu](mailto:Mohamed-Zied.Babai@bem.edu)

## **MCDA**

Alessio Ishizaka - [Alessio.Ishizaka@port.ac.uk](mailto:Alessio.Ishizaka@port.ac.uk)

## **Metaheuristics**

Ender Ozcan - [exo@cs.nott.ac.uk](mailto:exo@cs.nott.ac.uk)  
Andrew Parkes - [ajp@Cs.Nott.AC.UK](mailto:ajp@Cs.Nott.AC.UK)

## **Optimisation**

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## **O.R. Consultancy and Case Studies**

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## **O.R. in Construction**

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## **O.R. in Education**

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## **O.R. in Sport**

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## **Problem Structuring and Soft O.R.**

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## **Scheduling**

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## **Sustainable Supply Chain**

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## **Sponsors and Exhibitors**

**Need more information?** Full details can be found at [www.theorsociety.com/or55](http://www.theorsociety.com/or55) or just contact the sponsorship organiser, Hara Papachristou [hpapachristou@lanner.com](mailto:hpapachristou@lanner.com) to find out more about how you can make the most of these opportunities.

## OR55 IS MAKING AN IMPACT

**RUTH KAUFMAN MAI STREAM LEADER**

Once again we will be running the one day Making an Impact stream: on Wednesday 4th September – focused on meeting practitioner needs.

One of the most popular sessions in previous years has been speed-networking, giving you a chance to find out who is doing what in the loosely-defined, unbounded, enormously varied field of practical O.R., from sophisticated analytics to applied common sense; and providing a good base to build on at all the other networking opportunities later in the day.



*Networking at OR54*

There will be a choice of seminars and workshops including 'technique tasters' or introductions to topics such as Agent Based Modelling, system dynamics, data visualisation and analytics; software demonstrations; discussion of areas of practice including performance measurement, tackling fraud and error, horizon scanning; and more general practice issues such as career development, and ethical dilemmas (the list of is still to be finalised, so if you would like to propose a topic that you would particularly like to see on the list, or indeed if there is a workshop/seminar you would like to run, please get in touch). And there will be a chance for academic experts and practitioners to get together, to share problems and solutions.

The day will also include a conference plenary talk from Mark Dixon, who used his cutting-edge mathematical and statistical expertise to found ATASS, a consultancy specialising in sports analytics and green energy, and the Presidents Medal – three case-studies showcasing successful practical applications.

We have crammed all this into one day in case you can only spare one day away from the office – but for those who want to make more of their journey to Exeter, there is plenty of value to be gained on other days. We're encouraging streams to run tutorials and workshops too. These will be concentrated on Tuesday afternoon. Contact the appropriate Stream Coordinator if you wish to run one. There will also be a case study stream on Thursday.

### WOULD IT HELP YOU TO RAISE YOUR PROFILE WITH O.R. PROFESSIONALS?

Then why not sponsor OR55?

The conference is a great place to meet lots of O.R. academics and practitioners. You can promote your services, speak directly with people and find out more about what they really need.

Perhaps you could make yourself better known as a consultancy in the field. Or maybe you can offer software or other products which will help O.R. analysts solve their problems.

If you exhibit at OR55 you will make contacts and might meet future business partners or employees. If you provide sponsorship of a specific item then your name will be in front everyone.

Whether you exhibit or sponsor, your details will appear on the website, in general conference information and in *Inside O.R.*, the monthly news magazine.

In the last two years there have been over 300 people at the conference. These have been evenly split between academics and practitioners. The conference lasts three days and this year will be in Exeter in September.

### ASSISTED PLACES: OR55, EXETER

#### GAVIN BLACKETT SECRETARY & GEN MGR

The OR Society's annual conference is an important event in delivering its charitable aims as it has the potential to reach a large number of both members and non-members.

Even though the Society aims only to break even in running the Conference, the price of registration and accommodation taken together with travel costs can soon mount up. Practitioners from larger organisations tend to get conference places paid for by their employers, whilst many academics have conference budgets to cover their attendance at events such as this. There are, however, a number of potential attendees for whom the conference costs can represent a significant barrier.

These potential attendees would not only benefit personally from attendance, but the conference itself and the wider O.R. community could gain value. This is where the Society's Assisted Places Scheme comes in.

So, the next step is up to you! Successful applicants will have their registration and accommodation charges fully funded\*, thereby gaining the opportunity to present their work and network with experts in the field.

Applicants are invited to submit a proposal for funding via email to Gavin Blackett, (gavin.blackett@theorsociety.com) before the deadline of 28 June 2013. Successful candidates will be informed of the awards in July.





## **Business Change Officer (2 Posts)**

### **Organisational Development**

### **Headquarters, Wakefield**

### **£26,394 - £30,633 (Progression Scheme)**

West Yorkshire Police are looking to recruit 2 Business Change Officers whose role, as part of a Business Change Team, will be to support the development and delivery of corporate and local transformational change and continuous improvement projects to enable the Force to fulfil its objectives effectively and efficiently.

The ideal candidate will be educated to degree level and will have recognised knowledge, experience and proven ability in the application of appropriate methodologies and the use of relevant information technology, tools, techniques and systems to support project work. Typical experience might comprise of a variety of advanced quantitative methods, modelling, problem structuring, simulation and other analytical techniques within a project environment.

You will be highly numerate with the ability to provide an innovative approach to analysis and a methodical/analytical approach to problem solving. You must also be prepared to travel for business purposes.

These posts are suitable for job share.

The online application form and role profile may be accessed through the following link [www.westyorkshire.police.uk/recruitment](http://www.westyorkshire.police.uk/recruitment)

**Post reference Number: YSC008**

**Closing date: 2nd June 2013.**

## EVENT ORGANISED IN BREWERY SHOCKER

JOHN HOPES



‘For those who aren’t familiar with it, the Analytics Network is an interactive community, supported by a landing site on the OR Society website.’

Some said we couldn’t organise a network launch in a brewery. But sixty or so of us were there in ‘The Brewery’, Chiswell Street for the first meeting of the OR Society’s Analytics Network, to listen to stimulating talks from Jacqui Taylor and Tony O’Connor.

Admittedly I did struggle a bit with the technology in my opening slot, when my antique laptop subjected the audience to a strobe light show instead of my slides (which on reflection might have been an improvement). But I pressed on, discovering that it is actually possible to speak without the assistance of visual aids. As a bonus, the experience gave me enough evidence to persuade the firm to give me a new computer.

For those who aren’t familiar with it, the Analytics Network is an interactive community, supported by a landing site on the OR Society website. It organises meetings on analytics topics of interest and provides, via the website, the OR Society and INFORMS analytics publications, details of meetings and events, videos of talks on analytics, discussion groups and access to the OR Society document repository. It is a new concept for the Society, being more than just a special interest group. It is planned that, as it draws in more members of the wider analytics community, it will identify and respond to the professional needs of that community and hence attract even more to join.

During the launch event I joked that volunteers for the Analytics Network committee should form a queue at the end of the formal part of the evening, expecting that everyone would head off for a drink instead. But, rather pleasingly, by the end of the evening I did have more than enough enthusiasts to take the Network forward. And the good news was that these included members of the analytics community who had not previously been involved with the OR Society.

This is just the latest step in the Society’s ongoing analytics initiative. Coming up are the next OR Society one day analytics event on 12 June featuring speakers from Accenture, SPSS, BT, TUI and elsewhere, and OR Society representation at major analytics conferences being organised by others (the Predictive Analytics Innovation Summit on 30 April and Big Data Analytics on 20 June).

For me, the talks at the launch event demonstrated both the opportunities and the threats presented to the O.R. community by the current boom in analytics and ‘big data’. As Tony O’Connor highlighted, O.R. has over 75 years of experience in building up a body of knowledge, techniques and skills in the quantitative, statistical and structural analysis of business data. This is an extremely powerful resource that can be deployed to add value in the world of big data. In particular, O.R. can add value in structuring the problem, in analysing decisions through the use of O.R. techniques, and in ensuring that wider ramifications are considered in changes to system design.



What Jacqui Taylor's talk emphasised, however, was that the world is changing fast and that O.R. needs to keep pace with that change. In particular, the world of big data, the Cloud, virtual organisations, unstructured data and social media is giving rise to a whole new set of management problems to be solved. We have the 75 years of O.R. experience, but are we bringing it to bear on these new challenges?

One of the latest trends is the emergence of the term 'data scientist' and I noticed that Jacqui described herself and her colleagues in this way. Tom Davenport and D.J. Patil have in the Harvard Business Review famously described Data Scientist as the sexiest job of the 21<sup>st</sup> Century (I really must change the job title on my business card). And if data science is defined as being a combination of mathematics, statistics, advanced computing, visualisation, hacker mindset, domain expertise, data engineering and scientific method, then where on earth will these sexy people be found? Well, at first glance it looks as if O.R. is as good a hunting ground as any. But, searching through various articles on the subject, I have yet to find one that suggests recruiting such super humans from the world of O.R. Instead the usual suggestion is that scientists with strong programming skills would be the best source of such skills.

And, unfortunately, we have been here before. Back in the 1980s and 90s when first the banks and then the hedge funds began injecting some serious mathematical muscle into the analysis of risk and complex securities they could well have concluded that the best

source of such quantitative skills was the world of O.R. But they didn't, instead hiring PhDs in mathematics, the natural sciences or engineering who would conduct their own research into modelling techniques. The fact that they ended up using techniques that ranged from simulation to stochastic programming just serves to emphasise the scale of the opportunity that O.R. missed.

The same thing happened to a large extent in the late 90s / early noughties when the leading companies in the digital economy were seeking quantitative skills to develop search engines and other optimising algorithms for websites. So we certainly shouldn't be complacent that the world of data science will naturally come to the same conclusion as us about where to find the necessary skills.

I am more optimistic this time, though, as there are already so many O.R.-trained people working in the broad analytics space, whether in credit scoring, web or customer analytics, or in consulting. Many O.R. groups have already changed their name to something featuring analytics, and no doubt some will evolve into Data Science departments. In addition, some University O.R. departments are offering courses in analytics. In order to ensure that O.R. remains relevant in this space, though, I think it is important that it places enough emphasis on the core skills of statistics, mathematics and programming. If we have those basics in place the additional value that O.R. brings will become a significant differentiator.

&lt;OR&gt;

## FIFTH EUROPEAN CONFERENCE ON INTELLIGENT MANAGEMENT SYSTEMS IN OPERATIONS

SUNIL VADERA AND KHAIRY KOBACY

IMSI05 3-4 July 2013 - Book online at [www.theorsociety.com/IMSI02013](http://www.theorsociety.com/IMSI02013)

We have an excellent schedule of papers included in the programme for the fifth Intelligent Management Systems conference coming up in July.

Plenary speaker, Professor Qiang Shen will open the conference with his talk on the 'Feature Selection in Intelligent Information Systems'. His talk will be followed by a Review Paper given by the Chairs of IMSIO, Sunil Vadera and Khairy Kobbacy, called a 'Review of AI applications in Operations: 2009-2013'. Various talks on topics of interest then follow and the current list of paper titles and their authors are shown below. (Please note, these may be subject to change) :-

### Production/Manufacturing

- *An intelligent method to support joint production management in a cluster*, Anna Ławrynowicz
- *Hybrid Multi-Objective Genetic Algorithm for Integrated Conflict-Free Automated Guided Vehicle (AGV) Routing*, U. A. Umar, M. K. A. Ariffin, N. Ismail, Tang. S. H.

### Methodologies / General

- *Knowledge Structure Mapping Design by Evolution*, John Gordon
- *Women and computer education in Africa: where we are*, Ikechukwu Ifeanyi Ezy

### Data Mining

- *Learning a Grammar for SMART objectives using Inductive Logic*

*Programming*, Darah Aqel, Sunil Vadera

- *Recognition of Control Chart Concurrent Patterns using NeuroEvolution*, Funlade T. Sunmola

- *Latent Dirichlet Markov Allocation for Sentiment Analysis*, Ayoub Bagheri, Mohamad Saraae

- *A meta-learner for cost effective induction*, Samar A. Shilbayeh and Sunil Vadera

- *Aspect Detection with Unsupervised Modeling*, Ayoub Bagheri, Mohamad Saraae

### Supply Chains/ Healthcare

- *Supplier selection using different metric functions*, S.E. Omosigho and Dickson E. A. Omorogbe

- *Value Chain Management: An Illustration using Variability Mapping and Decision Frontier Analysis*, Michael Pearson

### Maintenance

- *Development and validation of rule-based GAMM for preventive maintenance program evaluation*, Luis Barberáa, Adolfo Crespoa, Khairy Kobbacy

- *Criticality analysis for maintenance purposes. A study for complex in-service engineering assets*, Adolfo Crespo Márquez, Pedro Moreu de León, Antonio Sola Rosique

- *Modeling and analysis of the failure process for cost effective maintenance scheduling of MV XLPE cables*, B. M. Alkali, M. Qatan C. Zhou and M. Farrag

&lt;OR&gt;



## YOUNGOR 18 CONGRATULATIONS!

### HILARY WILKES

Congratulations to everyone who was involved in organising, speaking and contributing in any way to a very successful YoungOR 18 conference in Exeter this April. The winners of the prizes are as follows:-

The **Elsie Cropper Shield** for the Best Paper at the YoungOR 18 conference, as voted for by their peers



**Winner:** Gary Preece, *Government Operational Research Service (GORS)*

**Paper:** Improving communication effectiveness in the police through viable system modelling (VSM).

**Stream:** Criminal Justice

The **DEA Stream Prize**, as sponsored by Banxia Software, for the best presentation in the stream .



**Winner:** Sadia Farooq, *Warwick Business School*

**Paper:** Investigating the Efficiency of Microfinance Institutions: A DEA Approach

**Stream:** Data Envelopment Analysis (DEA)

The **Soft Methods Stream Prize**, as sponsored by Banxia Software, for the best presentation in the stream.



**Winner:** Kai-Simon Goetzmann, *Technical University, Berlin.*

**Paper:** Reference Point Methods and Approximation of Pareto Sets

**Stream:** Soft Methods

< OR >

## WHERE ARE THEY NOW?

The following members on the Society's mailing list have recently had their mail returned to the Membership section, presumably because they have changed their address.

Would any member who is currently in touch with them please ask them to email [Carol.Smith@theorsociety.com](mailto:Carol.Smith@theorsociety.com) advising us of their current whereabouts so that we can update our database and return to a speedy and efficient service.

Gowtham Bharatwaj Srinivasan      Kent

< OR >



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- **Impact Explorer™** - a voting, ranking and matrix assessment tool. Groups use radio based handsets coupled with the Impact Explorer software to register their opinions or cast votes on the subject being discussed. The system supports up to 250 participants. Cost depends on the handsets being used. Prices start from as low as 31 GBP + VAT per handset. Handsets can be purchased in any quantity. Accompanying software license starts from £395 + VAT. System requires both hardware and software.
- **Interwrite™ Response** - a classroom response system. Using radio frequency or infra-red handsets, students respond to questions presented in PowerPoint, the internal question editor, or to impromptu questions asked verbally. The system can support thousands of students. Cost depends on the handsets being used. Prices start from as low as 31 GBP + VAT per handset. Accompanying software is included with the receiver kit, cost depends on the system being used. Discounts available for volume purchases of handsets.

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## NEW CHAIR FOR CMS

**GAVIN BLACKETT, SECRETARY & GENERAL MANAGER**



Professor Sir Adrian Smith FRS, Vice-Chancellor of the University of London is to be the new Chair of the Council for the Mathematical Sciences (CMS).

It is anticipated that he will take up the post in September 2013, succeeding Professor Frank Kelly CBE FRS (University of Cambridge).

In approaching Sir Adrian, the five CMS societies recognised the contribution that he had made to the sciences, in particular the mathematical sciences, during his time in the university sector and Westminster, and that his appointment would be of huge benefit to the mathematical sciences community. Over the past three years, under the leadership of Professor Frank Kelly, the CMS has become the one body recognised by government as representing mathematical sciences and with which national policymakers now regularly engage. CMS speaks with one clear voice on issues affecting the current and future health of the discipline and with Sir Adrian at its head will continue to build on recent success to meet the challenges of the future. The five CMS societies are delighted that he has accepted the role.

Sir Adrian has a wealth of experience both in higher education and government. He was Chair of Statistics and Head of the Department of Mathematics at Imperial College London, and also Professor of

Statistics and Head of the Department of Mathematics at Nottingham University. He was Principal of Queen Mary, University of London, for 10 years – during this time he was also Deputy Vice-Chancellor of the University of London. Sir Adrian joined the Department for Innovation, Universities and Skills (later to become the Department for Business, Innovation and Skills) in 2008 as Director General, Science and Research, becoming Director General, Knowledge and Innovation in 2010. He became Vice Chancellor of the University of London in September 2012.

Sir Adrian is also a past President of the Royal Statistical Society; he was elected a Fellow of the Royal Society in 2001 and received his knighthood in 2011.

Professor Frank Kelly CBE, FRS and Chair of CMS said, 'Sir Adrian Smith's work on Bayesian methods has influenced developments across a wide range of the mathematical sciences, and he has deep experience of the workings of government. I and the five Societies are very pleased indeed to welcome Sir Adrian as the next Chair of CMS'.

<OR>

## PICTORIAL KNOWLEDGE

**IAN MITCHELL**

The health of the OR Society depends on its members.

The April issue of Inside O.R. had several stories that reminded me of the importance of the members as contributors of knowledge rather than subscriptions. Mike Wright described the Archive of the OR Society. Nigel Cummings described the Wall Street Journal review of Steven Boudiansky's book 'Blackett's War' whilst John Crocker's OR-30 recalled meeting KD Tocher.

The first object of the Society is the advancement of knowledge by fostering, promoting and furthering interest in Operational Research. Members of the Society are the major sources: In both academia and practice. What they do defines what O.R. is. Capturing and communicating their actions preserves and expands the value of their work.

The appearance of the new book 'Blackett's War' is cause for celebration as it spreads knowledge of Blackett's O.R. to a broader audience beyond the OR Society or indeed INFORMS, the American equivalent. Knowledge of O.R. takes many forms. Mike Wright mentioned the tapes and 16mm films held by the archive. The latter include two 45 minute BBC2 programmes entitled 'Basis for Decision'.

I have just had the chance to see these as DVDs after a process of

recovery that started with a conversation with Richard Fitzgerald at the O.R. Unit at the Department of Business Innovation and Skills almost three years ago. The BBC now have copies of the programmes lost to them for many years and the OR Society has the chance to see O.R. as it was in 1964.

The two programmes are presented by Pat Rivett. 'Cutting the Queue' and 'Playing It Through' show leading lights of O.R., including KD Tocher and Ronnie Shephard as well as the technology and the cultural attitudes of the time. The programmes complement other sources such as Journals and books. This combination of sources is a unique benefit of the OR Society.

There is a third episode 'The Human Factor' but sadly that was not with the two cans of 16mm film – if anyone can suggest where this is please let the Society know.

Basis for Decision records a high point of O.R. and focuses on the practice of O.R. in real situations. The O.R. models of ports in Wales really did act as the basis for decisions on their design and operation. It would be great to gather sufficient material to attract similar coverage today.

<OR>





## The OR Society

### O.R. Pro Bono Scheme Co-ordinator

An opportunity has arisen for an enthusiastic graduate to join the Operational Research Society's small headquarters team in Birmingham. The Society is seeking an enthusiastic, proactive individual to establish an exciting new initiative: O.R. Pro Bono. The post-holder will build on an existing pilot scheme in order to establish a sustainable, thriving programme of voluntary O.R. support to the third sector. This is a part time (60%) post.

Duties will include: building relationships with potential partners, identifying potential users of the service and volunteers, matching volunteers to projects, monitoring projects, developing marketing materials and promoting the service, developing a sustainable business model and standard processes.

Initially, the post is for a fixed term of one year, but if the appointee successfully develops the role and if funding is obtained, it is possible that consideration will be given to its extension.

Salary will be in the range £22,000 - £25,000 (pro rata) depending on experience.

Applications should consist of a CV **not exceeding two pages**, together with a covering letter of **not more than one page**, which should explain the reason for your interest and the qualities you feel make you an ideal candidate. They should be submitted **by email only**, to [gavin.blackett@theorsociety.com](mailto:gavin.blackett@theorsociety.com).

The closing date is **Friday 10th May 2013**

[www.TheORSociety.com](http://www.TheORSociety.com)  
[www.LearnAboutOR.com](http://www.LearnAboutOR.com)

## UNIVERSITY OF WARWICK MORSE SOCIETY 'WHAT IS O.R?' EVENT

**ADWAYE RAMBOJUN, EVENTS COORDINATOR, UNIVERSITY OF WARWICK**

On Monday 4 March 2013, the MORSE Society invited Dr. Thanos Alifantis, who is the Head of Evaluation and Econometrics at HMRC, as well as a member of The OR Society; and Professor Juergen Branke, professor of Operational Research and Systems for the ORMS Group at Warwick Business school to give a talk on the career prospects in the field of Operational Research to students on the MORSE course.



*Dr Thanos Alifantis*

The evening started at seven o'clock with a clip from The OR Society's 'What is O.R?' DVD. It showed the use of O.R. in different industries and contained testimonials from operational researchers. The clip set the tone for the rest of the evening by capturing the attention of the students who until then had little knowledge of the wide use of O.R.

Dr. Thanos Alifantis started his presentation by highlighting what led him to choose O.R. as a career. He then moved on to talking about how the MORSE degree is ideal for those interested in working in O.R. According to him, being exposed to such a wide variety of disciplines is an advantage to operational researchers who always have to apply their techniques to different fields. He then moved on to explain how O.R. was getting more and more



*Professor Juergen Branke*

used in econometrics. He supported his arguments by showing how he had worked in the field of economics as an operational researcher. Finally, Dr Alifantis presented a case study about a project he was involved in when he worked for a railway company.

The evening would not have been complete without a representative from the prestigious Operational Research and Management Science Group at Warwick Business School. Professor Branke started his presentation by talking about what is being done in the ORMS Group and how MORSE students make perfect PhD candidates for the ORMS group. His claim is that they get enough exposure to a wide range of topics while being introduced to the rigors of Applied Mathematics, which then requires little preparation for the transition to post graduate studies. Next, Professor Branke presented a few slides about projects that some students in the ORMS group had done. The students were amazed by the extent to which the projects actually solved real life problems. He then finished by showing how O.R. is used in optimisation problems within the WBS and throughout the University.



Iain - third year MORSE student



Khilan – third year MORSE student

Also, during the event, two third year year MORSE students gave short presentations. Iain demonstrated linear programming on the board using a simple two variable problem. This stimulated the curiosity of many in the audience, which consisted of many first years who had not yet started their first O.R. module.

Khilan talked about his experience doing O.R. modules. He claimed that they are the modules that are the closest to real life problems. He explained how his simulation project was about solving an actual problem that the campus was experiencing and how the

campus team took into account the recommendations that stemmed from the project.

The evening ended at around nine o'clock. As is customary at MORSE Society talks, everyone met in the Zeeman Building lobby ('The Street') for some light refreshments and drinks. This was an opportunity for students to talk to the speakers. In the end we received a lot of positive feedback from attendees whose awareness of the vastness of O.R. increased greatly.

&lt;OR&gt;

## NEWS OF MEMBERS

### The Society welcomes the following new members,

DARYL BARKER, Hampshire; WIJENDRA GUNATHILAKE, Stoke on trent; EMMA HICKMAN, Hants; MARIA KOPEC, Reading; MATTHEW LAVERTY, Kent; JONATHAN LOVELESS, Hants; ADAM MORAN, Birmingham; BENJAMIN RANDALL, Hants; STEPHEN REMDE, West Yorkshire; RICHARD ROWLANDS, Berkshire;

### and Reinstated members,

ALASTAIR BROWN, London; JILL GLEN, Renfrewshire; WIJENDRA GUNATHILAKE, Stoke On Trent; XIAO HUANG, Leeds; ANASTASIA MITROMARA, London; SHAMIM RAHMAN, Middlesex;

### and the following student members,

ADONIS IGBINADOLOR, Middlesex; ASMULIARDI MULUK, Devon; GEETHA SIVARAMAN, India;

### Total Membership

2358

### NEW ACCREDITEES

The Society is pleased to announce that the Accreditation Panel has admitted the following members to the categories shown. These members are now entitled to use post-nominal letters as indicated: -

### Admit to the category of Candidate Associate (CANDORS)

David WILLIAMS

Philip MAYBANK

&lt;OR&gt;



# IS LOSING YOUR HAIR MORE THAN JUST A HEADACHE!

**NIGEL CUMMINGS AND JOHN CROCKER**

Danish scientist Francisco Roque and his colleagues at Technical University of Denmark have discovered hidden linkages between health problems that were believed to be unrelated, such as migraines and hair loss, or glaucoma and a hunched back.



Surprised? Well these connections have been established in Dr Roque's study via text mining and analysis of patient records in administration department at Naval Medical Centre San Diego. The work done seems to prove the point that increased use of data mining and text analysis on electronic medical records (EMRs) can assist efforts to uncover trends in health, disease, and treatment response.

Even in 2013 a significant chunk of information about patients remains stored as text, unusable by conventional data-mining methods. This semi-structured or unstructured data includes clinical notes, test results and other important documentation. To take full advantage of such data and provide the best possible service to patients clinicians will need to utilise both data- and text-mining techniques.

Text and data mining have much in common; underlying each is the assumption that knowledge lies buried in a scattered mass of information. Data mining largely relies on statistical methods to uncover trends in structured data, whereas text-mining techniques seek to make sense of information that is unstructured, such as a

doctor's note on a patient's chart.

Much of the available clinical data is captured and stored in narrative form as a result of transcription of dictations, direct entry by providers, or use of speech-recognition applications (none of which are 100% accurate). This 'free-text' form is convenient to express concepts and events, but difficult to search, and analyse.

The application of text mining however, can help code such data for analysis. Text mining normally requires a pre-processing phase such as spell-checking, sentence splitting, and word sense disambiguation. Contextual features like negation, temporality, and subject identification may also be considered in the analysis in order to gain the most accurate interpretation of the extracted information.

Text-mining techniques including pattern matching and complete text-processing methods are based on rules or statistical analysis and machine learning. These can be used to extract significant themes, concepts or detect hidden relationships buried in large 'free-text' clinical data. The information can then be linked to concepts in standard terminologies and coded in a way that can then be explored with traditional data-mining techniques.

Finding correlations in data is, of course, only part of the task. Television detectives may not believe in coincidences but the real world is full of them; after all, it is coincidences upon which a good many 'old wives' tales' are based and once pointed out, we are very good at seeing connections that do not really exist. There are an awful lot of men around who are balding but have never suffered a migraine and similarly, no doubt, many sufferers of migraines who have not lost any hair. How many times have you seen a car of the same make and colour as your newly acquired one? There is an extremely good reason why clinical trials are conducted under double-blind conditions – can we be sure that data-mining is just as rigorous and unbiased?

## YOUNGOR18 – A FIRST IMPRESSION

JOHN CROCKER

Although you no longer have to be young to attend the 'Young OR', it is expected that you will at least be 'young to OR' i.e. have less than ten years experience in an O.R.-related position.



Alas, as readers of this publication will know only too well, I fail miserably on both counts so how come I am writing about this event. One of the many joys of being the Editor is that I get to attend a certain number of conferences each year free of charge and, as I have never been to a YOUNGOR conference (I was even too old when the first one was held in 1979) I thought this would be a good opportunity to find out more about it.

Exeter in the spring, especially the Streatham campus, is normally glorious. The campus is actually a large open-air botanical garden and much of the year is a mass of colour. Although there were a few gardenias, daffodils and primroses, the exceptionally long, cold winter has meant most of the flowering shrubs are still dormant. Fortunately, the same could not be said for the delegates of this conference.

There were around 100 delegates of whom roughly 75% were practitioners. This was based on a show of hands at the opening plenary session presented by President Geoff Royston (who did the counting). By my very rough reckoning, there was a fairly even split between the sexes – half male, half female and the other half indeterminate. While on the subject of statistics, there were also just under 100 papers split among seventeen streams interspersed by three plenary sessions and several workshops.

The Chair of the Organising Committee, Antuela Tako brought us all to order at 9:30 and introduced Geoff, who you may be surprised to learn, also does not meet the criteria. As President, Geoff quite naturally is very concerned about the future of O.R. in general and

the OR Society in particular and, as he pointed out, the audience represents a good cross-section of the next generation of leaders in this profession so should have a vested interest in ensuring the survival and development of both. 'Operational Research' as a term first came on the scenes around 75 years ago – Sir Henry Tizard was probably the first person to coin the term. The OR Club was formed shortly after WWII in 1947/8 so is around 65 years old and was the forerunner of the OR Society.

Geoff was keen to find out what those present thought were the most important issues facing the OR Society in the next seven years (or so) and, in respect to these issues, which way the audience felt they should be developed. To this aim, he asked everyone to write down three issues and give extremes for each. From these, the ten most popular were selected and put up on flip-chart sheets around the walls of the dining room. Everyone was also given a strip of 13 red sticky dots and asked to place these on the flip-charts (as many on each as they wished) somewhere along the line connecting the two extremes. As an example, one issue was 'Methodology' and its two extremes were 'Quantitative' (on the left) and 'Qualitative' (on the right). As it turned out, the majority of dots for this one sat on a vertical line half-way between the two (indicating, of course, that most believed these were equally important).

A very rough and somewhat premature analysis indicates that the OR Society should increase its visibility, aimed at no group in particular, be more extrovert and concentrate on developing a more pragmatic and practical image covering both hard and soft O.R. using the latest methods and technologies. We should also start teaching O.R. at an early age and spread our horizons to incorporate other burgeoning groups such as Analytics. This was the state of play towards the end of the afternoon of the first day. It could, of course, all change by the end of the third and final day of the conference so it will be interesting to see the final results also taking into account the weightings as defined by the position of the dots along the line.

Judging by the enthusiasm of those present and the standard of the small sample of presentations to which I was able to attend, O.R. is certainly not dead nor does it look like dying in the near future. Geoff's survey will certainly give the Board something to think about and the committees plenty to do.



# ARTIFICIAL INTELLIGENCE TO MAKE COMMERCIAL SENSE

**NIGEL CUMMINGS**

Advances in AI and analytics could result in the creation of successful business products with little human intervention.



Many reports which have appeared in the popular and scientific press over the past few years regarding IBM's Watson supercomputer, a device that utilises artificial intelligence, a device seemingly imbued with the ability to beat humans at many tasks.

Watson hit the news originally when it was applied to game shows and in particular the popular American show 'Jeopardy'. During gameplay the supercomputer consistently outwitted human opponents both in speed and accuracy of delivery of the correct answers- its performance went a long way to proving that artificial intelligence could be useful in a real-world.

Going beyond the world of gaming though, the implications of using artificially intelligent supercomputer applications to complete tasks, which would normally require collective human intelligences is now very much a possibility.

New Watson artificial intelligence projects are in development — some on the cusp of commercialisation, others still research initiatives — all however, are at the leading edge of a much larger business for IBM and other technology companies. That market involves helping corporations, government agencies and science laboratories (for example) to find useful insights in the rising flood of data from many sources — web pages, social network messages, sensor signals, medical images, patent filings, social network activity, location data from mobile phones and others.

Advances in several computing technologies have effectively opened up this 'big data' market, and a key one of the technologies under development is the software that AI. It is no secret that IBM has been investing in AI and the big data market for years, it seems

to fit in well with their analytics business which it claims has over 10,000 customers and is expected to gross \$16 billion by 2015.

Watson projects are not yet big money-makers, but they probably will be soon. The projects, according to Frank Gens, Chief Analyst for IDC, infer that IBM now has the advanced technology needed and industry expertise to do things other suppliers cannot. The new Watson offerings could affect all of us as they are services that future users will be able to tap into through a smartphone or tablet computer.

Supercomputer powered AI applications could make a significant impact in developing new business too. John Baldoni, Senior Vice-President for Technology and Science at GlaxoSmithKline, recently got in touch with IBM after seeing the terrific speed with which Watson sifted out so many wrong answers.

Sifting out wrong answers is a huge and costly challenge in drug discovery. The failure rate for new chemical compounds is high. Improving the odds of finding new drugs could increase profits and quality of life for human kind. In fact Baldoni thinks the application of AI combined with vast computing power could be key to developing safe new drugs quickly and economically.

To test this theory, Glaxo and IBM researchers recently put Watson through a test run. They fed it all the literature on malaria, known anti-malarial drugs and other chemical compounds associated with malaria treatment. Watson correctly identified known anti-malarial drugs and suggested 15 other compounds as potential drugs to combat malaria. The two companies are now discussing other projects. 'It doesn't just answer questions; it encourages you to think more widely,' said Catherine E. Peishoff, Vice-President for Computational and Structural Chemistry at Glaxo. 'It essentially says, 'Look over here, and think about this.' That's one of the







exciting things about this technology.'

Watson can cook too, well it can develop new recipes for the food industry. A Watson application was recently used to develop a breakfast pastry, called a 'Spanish crescent'. The new pastry was the result of collaboration between Watson's software developers and James Briscione, a Chef Instructor at the Institute of Culinary Education in Manhattan.

Researchers watched and talked to Briscione as he worked, selecting ingredients and building dishes, and used this data to create what can be described as an artificially intelligent virtual chef with a sound economic head for developing potentially

commercially successful new food products! Watson was able to assimilate data about how the chef developed new products and to sift through combinations of around 20,000 recipes, data on the chemistry of food ingredients and ratings of flavours people like in categories like 'olfactory pleasantness'. The resultant breakfast pastry inspired by Spanish cuisine was a concoction of cocoa, saffron, black pepper, almonds and honey - but no butter!

Watson is also being used in a number of health care projects where its massively parallel processing power is of particular value.

<OR>

## BOOM TIME AHEAD FOR HIGH END ANALYTICS PROFESSIONALS

**NIGEL CUMMINGS**

According to the Harvard Business Review, the 21st century's sexiest job is the data scientist.

It suggested that such employees were 'a hybrid of data hacker, analyst, communicator and trusted adviser', but therein lies a problem; this combination of skills is extremely rare.

Many businesses are trying to recruit data analysts now that company managers recognise the benefits that big data can bring, but they are struggling to find people with the right skills.

The rush to use big data seems almost inexorable. A survey of 600 companies in the US and UK conducted in 2012 by Accenture, the management consultancy, found that two-thirds had appointed a senior figure to lead data management and analytics in the past 18 months. Even among companies that had not made such an executive appointment, 71% expected to do so in the near future.

Recruitment consultants are entering a boom time looking for data professionals because there has never been a greater demand for data analytics specialists. Cititec, which specialises in the information technology sector and has offices in London and Amsterdam, said that in the first six weeks of 2013, they received as many big data requests as they had done for the previous six months in 2012.

According to Brian McCarthy, executive director of Accenture's financial services, analytics practice in North America, 'Global demand across the industry means there is a massive shortage of data analytics skills, especially in the US and the UK'. He also says, 'Graduates with the right kinds of backgrounds for data scientist - computer science, statistics, machine learning - are coming out of the universities, but they are not coming out in sufficient numbers.'

According to Accenture many companies are turning to contractors

- nearly six out of 10 companies report turning to external analysts and consultants - but they are still unable to find the people they need. The shortfall means that IT contractors who are experienced data architects or business analysts can command between £500 and £650 a day in the UK. This could be good news for O.R. and analytics graduates who are at the most highly qualified end of the profession, as PhD-level data scientists can now attract salaries of £95,000.

Accenture have published a report called 'Analytics in Action: Breakthroughs and Barriers on the Journey to ROI'. See: <http://www.accenture.com/us-en/Pages/insight-analytics-action-summary.aspx> for more details.

The report forecasts that in the US and UK alone, jobs demanding advanced knowledge in science, technology, engineering and mathematics (STEM) will grow five times as fast as jobs in other occupations by 2018, and four times faster than jobs in information-intensive industries such as financial services. It seems that from 2013 onwards analytics and O.R will be the careers to be in for high returns!

The report also says that emerging economies are producing STEM talent in greater numbers than developing economies, but it is not enough to meet likely demand across the globe. A survey conducted last year by Accenture's Institute for High Performance looked at demand for analytics experience in the US, China, India, UK, Japan, Brazil and Singapore. It found that by 2015, with the exception of China, all of these countries would be facing a net shortage of qualified PhD graduates.

<OR>

## ADVANCED ANALYTICS TO EASE SUPPLY CHAIN WORRIES

**NIGEL CUMMINGS**

IBM has announced a predictive analytics system that averts supply chain disruption.



As part of their bid for worldwide domination in the field of analytics, IBM seems to be releasing new products for a new analytics markets at a fast and furious rate somewhat helped by their acquisitive policy.

The latest analytics product from their analytics arm is a predictive analytics solution designed to identify and root out problems that could lead to failure in supply chains.

Their Predictive Asset Optimisation (PAO) solution features IBM's predictive analytics software and business consulting services, it is said to be able to harness 'big data' from instrumented assets, identify irregularities in manufacturing processes, spot product irregularities and forecast a range of asset performance risks before a problem arises.

PAO utilises big data to uncover manufacturing and distribution risks and intervene before any asset disruptions might occur. The goal of PAO is to operate, maintain and manage assets throughout their lifecycle and reduce the expenses typically associated with such processes. POA is thought to be particularly useful to companies who have endured a high frequency of critical unpredicted machine failures.

Asset downtime, especially, if unplanned, is a massively expensive issue for organisations and according to IBM, the related unscheduled maintenance costs can range from three to ten times the cost of scheduled maintenance.

Decision making today will inevitably be based on the analysis of data and increasingly on the ability to apply analytics to massive data sets to extract very precise business insights. Companies realising this, and taking on board analytics at the earliest opportunity are likely to gain considerable competitive advantage through improved business efficiency and hence create new levels

of value for their customers.

IBM's PAO offering is said to be multi-adaptable across any industry in which some form of supply chain is utilised. PAO gathers facts on equipment performance, supply levels and supply volumes and anticipates potential failures in their manufacturing systems, supply chains and distribution networks before something goes wrong.

According to engineering estimates, in the U.S. alone there is a need to spend \$2.2 trillion over the next five years just to bring national infrastructures up-to-date. This includes improvements to roads, bridges, water supply, sewers, electrical grids, telecommunications and more. Understanding the data about those systems, and generated by those systems, has never been more urgent.

IBM claim that their PAO system could significantly reduce these costs

<OR>





## BITING BACK AT THE BOOKIES WITH MATHEMATICS!

**NIGEL CUMMINGS**

There have been many attempts to apply mathematics to horse racing – will this latest prove any more successful than its predecessors?



*Seabass and jockey Katie Walsh*

William Hartson, a 65 year old Cambridge University mathematician has come up with what he thinks is a sure-fire way to predict the winner of the Grand National. If successful his method could be applied to any number of races around the world – and his work could end up leaving most bookmakers with a financial headache – well maybe!

Combining sporting interests with scientific analysis to gain dividends is probably something many of wish we had the time to do. If Mr Hartson found the time, if his efforts come to fruit, we all may consider setting a little time aside for analysis of the 'Sport of Kings'. Apparently after analysing the names and ages of all of the National's previous winners this mathematician claims to have worked out a formula to pick the next champion – and this year he decided the winner would be a horse called Seabass.

By the time you read this article, the Grand National will have passed for 2013, but if his prediction was correct, and Seabass was indeed the winner, it may now be the time to consider his particular thread of sports analysis for picking out future winners.

Mr Hartson made his prediction after concluding that winners were most likely to have a name of one word consisting of eight or ten letters and beginning with the letter S, R, M or C. He also found that the winning horse was most likely to be aged nine or 10.

Seabass, an Irish 10-year-old, seemed to fit Mr Hartson's criterion well, apart from having a name falling short by one letter from Mr Hartson's ideal. Even so it scored 13 out of a possible 16 on Mr Hartson's scale, which he devised by analysing the name, first letter, number of words in the name and age of all 40 horses lining up in this year's race.

He then awarded each horse a maximum of four points for each of these criteria, depending on how similar they were to past winners from the event's 174-year history. For example, a horse whose name is eight or ten letters long – the most successful in the history of the race – would be awarded four points. But a horse with nine or twelve letters – historically less successfully – would be awarded just one point.

Second on his scale was Tatenen, a nine-year-old which made its debut at the National last year – it also scored 13 on the 'Hartson Index', but it was not as consistent across all four areas, while Teaforthree came out third with 12 points.

Mr Hartson, by the way is no 'flash in the pan', he is a well-known academician and author of a number of books on arithmetical coincidences and statistics. For this year's Grand National he said: 'Seabass is the only horse with consistently high scores across all four criteria. It begins with S, is a one-word name, aged ten years and has seven letters, which is only slightly short of the preferred eight. Tatenen scored an impressive 13/16 while Teaforthree scored 12/16 and shouldn't be ruled out – but their scoring pattern is less consistent.'

(Ed. With just two days to go before the race, favourite is 'On His Own', 7-1; followed by 'Seabass' at 10-1. 'Tatenen' is way down at 66-1 but 'Teaforthree' is in the top ten at 14-1. Based on name only, 'Tarquinius' might be worth a flutter at '100-1'.)



## HOW ACCURATE CAN PREDICTIONS BE?

NIGEL CUMMINGS AND JOHN CROCKER

The answer could be very accurate indeed, so long as predictive analytics is involved...



In 1988 a reporter called Nicole Yorkin working for the Los Angeles Times, asked a team of futurologist's what life would be like in 2013. The question resulted in a number of predictions, some of which were remarkably accurate. A large number of respondents believed that in 2013 motorists would routinely use electronic navigation or mapping systems to assist them with their journeys – that prediction was quite accurate.

Many over-estimated the advances in robotics within the home, believing that by now many of us would be employing robots to carry out many of our daily needs. By contrast, none of the respondents foresaw the advances in mobile technology although many of them predicted quite accurately that systems like the Internet would be available to all and electronic mail would be in use which could allow people to send text images and even video material to each other. Another prediction which proved to be accurate was that by 2013 our children would have access to cheap but fully programmable credit card sized computers – this actually became fact with the launch of the Raspberry PI microcomputer in 2012 – a remarkable learning tool for programming and computer education costing less than £20. None predicted that data mining and analytics would be routinely used to enhance business processes. Data mining at that time was still relatively in its infancy, and the term 'analytics' was unknown!

In short, the futurologists fairly accurately predicted the development of existing technology, over-predicted our ability to

develop popular science fiction gadgets and pretty much failed to think of any new ideas. To be fair, if any of them did have any new ideas, they would have been foolish to include them in their predictions unless they had already patented them.

Now, what would a similar group say if asked the same question about life in 2038? Perhaps the first major difference would be that today it would not be necessary to find individuals to ask. Today, the first thing we would do would be to use one of the many search engines to interrogate the Internet. What I really wanted to ask was what would be the future of analytics – I did not intend this query to be an ambitious one, predicting 25 years in the future could after all, be seen by many as somewhat ambitious. Instead I narrowed my search for answers to predictions about where analytics would be by the year 2020.

It did not take very long to find considerable input about the future of analytics from business professionals making a name for themselves by publishing blogs and reports on the Internet. One report which stuck out was a piece written by Erich Siegal for the website Big Think.

By 2020 Analytics will almost certainly have eliminated car theft. The car will know enough about you to know when it is you in the driving seat. It will not let you drive the car if you are not insured for this vehicle. Your navigator will be able to perform real-time re-routing taking into account the current state of the traffic and how much charge you have left in the batteries. Although it may be capable of driving the vehicle itself, it will let you think you are in control and will only step in if you get too close to the vehicle in front or there is insufficient width for you to get through. As a price for a lower insurance premium, it will also control your speed keeping you within the limits which may be adjusted dynamically according to the time of day and the density of the traffic. Road signs may well have been eliminated from the side of the road – the ubiquitous satnav having made them redundant.

Other areas where analytics will affect our lives include menu selection. Your friendly kitchen knows what is in stock and what your preferences are so will offer you a choice of menus taking into account any special dietary needs. It will also check whether there are any items which are nearing their use by date and advise you accordingly. It may even play you a video of what to do at each stage. As you put packets and jars back, so your 'kitchen' will record what you have used and hence whether it is time to replace anything. It will draw up a list and check the prices at the supermarkets in your area.

It is hard to know what else your mobile phone will do. I would



expect that it will have replaced your flexible friend and act as a debit/credit card for whatever accounts you have. It will be able to tell you exactly how much you have, or haven't, got in each account including how much is already committed via standing orders and direct debits. I suspect it will also be able to communicate with your home entertainment system whose remote control will have been replaced by voice recognition and a sensor which allows you to sit in your armchair and use your hands and fingers to do the same on the large screen as you can on the phone or iPad.

There will be services similar to 'Moonpig' which will allow you to choose not just cards but gifts, have them wrapped, personalised

and delivered the next day anywhere in the world all from your armchair having, of course, been reminded that it is your wife's birthday tomorrow. It will also remind you what you bought her previous years.

AI, robotics, fusion-power and endless leisure time will all still be just ten years away!

Predictive analytics it seems, will be affecting our lives substantially in our future, so much so in fact, we'll all be lost without it! Tomorrow after all, is just a day away!

&lt;OR&gt;

## THE IOR LEGACY – SOME ADDITIONS TO THE ARCHIVES

JOHN FRIEND

A snowy Easter break at home in the Pennine foothills has enabled me to add another batch of files to the public record of the legacy of the Institute for O.R. in this 50th anniversary year.

Most of the files now added to the document repository on the Society's website record the various ways in which the new thinking pioneered through IOR has continued to be applied and extended worldwide since its demise as an organisational unit in the 1980s.

Among the new additions, you will find one of the first accounts of a strategic choice workshop in international development based on a collaboration with Brazilian associates to explore strategic options for sustainable development in an island just off the coast of Pernambuco state. This gave rise to requests to draft guidelines on approaches to training in strategic choice [1986], and on the management of strategic choice workshops [1988].

A project at the Lincoln School of Management, supported by the European Social Fund, was designed to develop new skills among managers of small businesses in a developing county's rural food industries. A presentation file [2001] describes the outcomes of trials in mutual consulting methods and in the use of problem structuring software in support of follow-up consulting visits.

Some further experiences in the front line of international development were presented in a short report by Alberto Franco and Mike Cushman [2005] of the inaugural meeting at Warwick of the Society's new special interest group in Problem Structuring Methods. Here, two visiting consultants from Caracas, Elisenda Vila and Ana Maria Benaiges, reported on their impressive use of strategic choice methods both with the national cabinet and with local communities. Their full PowerPoint presentations on that occasion can be accessed via the Special Interest Group section of the Society's website.

There is a PowerPoint presentation which contrasts pressing issues

of regional water management in Venezuela in 2000 and in New Zealand in 2009 two very different geographical and political settings. The presentation was given at the 2011 conference of the International Society for the Systems Sciences in Hull.

The first of two early IOR documents on the website include the section of a report in 1966 by John Stringer, Mike Luck and Brian Smith on *decision-making and adaptation to change in hospital management*. That pioneer project, commissioned by the then Ministry of Health, was to lead on to a wider programme of projects in health and social services management in England, Scotland and elsewhere addressing tough decisions on such issues as the establishment of an intensive care unit; the commissioning of an outpatient department; the development of regional staffing policies; and the allocation of minor capital funds.

The second is a presentation made at the OR Society 1967 Conference, (by coincidence also held in Exeter). This reported the new thinking that was then emerging from our early Nuffield Foundation project 'Policy Research for Local Government'. This was the first paper to present the emergent body of so-called soft O.R. that has since become widely taught and applied under the name of the Strategic Choice Approach.

There are a few further documents still to be added to the record. However those deposited so far should give an idea of the practical as well as the theoretical advances of the last 50 years, and the opportunities for younger generations in O.R. and other fields to continue building on them in the future.

&lt;OR&gt;

# SAUL GASS, PIONEER IN OPERATIONS RESEARCH

GRAHAM RAND, LANCASTER UNIVERSITY

Saul Gass [1926-2013]



Saul Irving Gass, OR Society member and esteemed operational researcher, died on 17 March 2013 in his home in Potomac, Maryland, after a courageous battle with cancer. Born on 28 February 1926 in Chelsea, Massachusetts, to Russian parents - they had emigrated as teenagers around 1914 - he graduated in 1943 from high school.

Soon after he turned 18, Saul was inducted into the Army (17 March 1944) at Fort Devens, Massachusetts. Meanwhile, he managed to complete a full freshman year of engineering at Northeastern University. He trained as a machine gunner with the newly formed 65<sup>th</sup> Infantry Division, which in January 1945 left New York City for Le Havre, before, as part of General Patton's Third Army, moving into action on 17 March 1945, crossing through southern Germany and into Austria. Saul's unit stopped at the west bank of the Enns River, where they were on V-E Day, 8 May 1945, making them the US Army unit that had gone the furthest east.

After his military discharge on 23 May 1946, Saul planned to marry Trudy Candler, whose family had moved to Los Angeles. Saul and Trudy married there on 30 June 1946 and returned to Boston to live with Saul's parents. Ronald was born on 3 June 1951, and Joyce on 22 June 1955. Trudy was a wonderful companion to Saul, frequently accompanying him to O.R. conferences, and became a friend to many of Saul's O.R. friends.

Saul re-enrolled at Northeastern, but transferred to Boston University in January 1947, from where he graduated with a B.S. in education (major in mathematics) in June 1949 and an M.A. in mathematics in August 1949. He began his career as a mathematician in November 1949 for the Aberdeen Bombing Mission, U.S. Air Force, before transferring to Air Force headquarters. There, in the Directorate of Management Analysis, he joined Project SCOOP, where George Dantzig was chief mathematician. The main objective of Project SCOOP was to plan the requirements for Air Force programs, which involved constructing a time-phased plan of requirements of materials for supporting a specific war scenario. The name Linear Programming arose from these programs.

In the Mathematical Formulation Branch, Saul worked on the formulation of Air Force problems and helped develop and test new procedures for solving the resulting LPs. The National Bureau of Standards built, with SCOOP funds, the Standards Eastern Automatic Computer (SEAC). Early computational tests on the SEAC demonstrated the effectiveness of the simplex method. Project SCOOP also installed the second production unit of the UNIVAC computer in April 1952—it was formally turned over to the U.S. Air Force in June 1952. The UNIVAC's simplex code, which Saul helped to check, could solve problems of dimensions 250x500.

Saul left Project SCOOP in May 1955 to join IBM as an Applied

Science Representative to help the salesmen sell and install the new IBM computers designed for either commercial or scientific computation. Saul attended the standard three-week sales training class where he learned commercial applications and sang songs from the IBM songbook! Saul briefly left IBM in 1959 to join the Washington, D.C. consulting services company, Corporation for Economic and Industrial Research (CEIR), as Director of Operations Research. CEIR was one of the first companies to provide computer-based O.R. consultation services; they had purchased an IBM 650 magnetic drum memory computer and an IBM 709 computer, both of which Saul helped to install.

Saul rejoined IBM the following year to work on the expanding U.S. space program for which IBM was a major subcontractor and became manager of the simulation group of IBM's portion of the National Aeronautics and Space Administration's (NASA) Project Mercury Man-in-Space Program, responsible for the development of real-time simulation procedures used to validate the computational and data flow equipment system that IBM developed for Project Mercury. IBM had to develop the analysis and required computer programs, run computer centres and operate an engineering, and communications subsystem that enabled the NASA flight controllers to monitor all phases of a Project Mercury mission. On 1 May 1961, Saul was appointed project manager of IBM's total Project Mercury program. Saul went to Cape Canaveral to observe all the manned orbital missions, including John Glenn's liftoff on 20 February 1962, the first U.S. manned orbital flight.

IBM's space activities relocated to Houston, but Saul, not wishing to move there, applied for a two-year leave of absence under IBM's resident graduate fellowship program, choosing University of California (UC), Berkeley for his doctoral studies, to reconnect with George Dantzig, who had joined UC in 1960. Saul started his Berkeley studies in 1963 as a student in the Industrial Engineering and Operations Research Department. Because he had a substantial background in LP, Saul was not allowed to take Dantzig's LP course for credit; but he did audit the course. Some of his classmates felt uneasy when they found out that Saul had already published *Linear Programming: Methods and Applications* in 1958!

Saul's dissertation was based on a large-scale LP model for a production-inventory application at Esso. Saul devised a decomposition approach working with the dual variables to exploit the block structure of the individual stages and named the resulting algorithm the dualplex method. Saul received his Ph.D. in Engineering Science in September 1965.

When Saul returned to IBM in the summer of 1965 as manager of Federal Civil Programs, responsible for urban problem contracts and consulting, he applied O.R. to urban problems as a full-time member



of the Science and Technology Task Force of the President's Commission on Law Enforcement, created by Lyndon Johnson in 1965. To augment the work of a Commission mainly comprised of lawyers and sociologists, a task force, led by Alfred Blumstein (Ph.D. in O.R.) was formed at the Institute for Defense Analyses to bring scientific thinking to bear on crime. AI recruited Saul to join his staff in 1966. Saul was responsible for developing the task force's approach to how science and technology could best serve police operations.

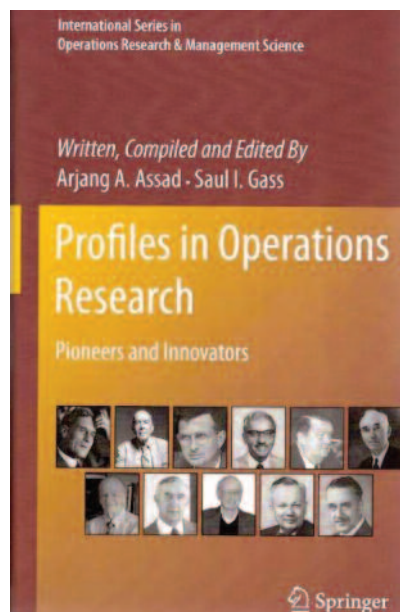
Saul left IBM in 1969 to help form the consulting firm World Systems Laboratories, Inc. as Senior VP, but, economic conditions in 1970 forced the company to close. Saul then joined Mathematica, Inc., an O.R. and economics consulting firm, as director of its Washington, D.C. area office, where he managed mainly public sector projects.

Saul joined Maryland's College of Business and Management in September 1975 as professor and chair of the management science and statistics department with the task of building a high-quality O.R. department. Saul was to spend the next 26 years at the university. He had 'found a home'. He was honoured by the university as a Distinguished Scholar-Teacher and was the Dean's Lifetime Achievement Professor.

Saul contributed hugely to O.R. methodology in two areas. Saul made significant contributions to optimization through his algorithmic procedure for solving a parametric linear-programming problem, resulting from studying production smoothing, through studies of degeneracy and the related problem of cycling, and through investigations of the equivalence of a zero-sum two-person game and the linear-programming problem. The second area concerned decision-aiding methods. Saul co-authored several papers that dealt with the problem of how to select an efficient (Pareto) optimal solution and he, with Tamas Rapcsák, proposed a different method for deriving the vector of weights (or priorities) of the Analytic Hierarchy Process (AHP). Saul used AHP in several new applications.

Throughout his career, a substantial part of Saul's efforts went into expositions of O.R. Saul's *Linear Programming: Methods and Applications* (1958), was the first text on LP. The first edition was translated into Russian in 1961, the first book on the subject in the Russian language, and into several other languages, again being the first LP text in those languages. The fifth edition (1985) was almost 2.5 times the length of the first. His next most widely known publication is *An Illustrated Guide to Linear Programming* (1970). Saul, with Carl Harris, edited the *Encyclopedia of Operations Research and Management Science*, the first of its kind (1996). The second edition was published in 2001, a year after Carl's sudden death.

In his historical writings, Saul chronicled the achievements of pioneers of O.R., via many papers and two books, *An Annotated Timeline of Operations Research: An Informal History* (2004) and *Profiles in Operations Research: pioneers and Innovators* (2011), both co-authored with Arjang Assad. It is in these endeavours that most of my professional collaboration with Saul took place. In my role as the organiser of the IFORS' Operational Research Hall of Fame, Saul gave invaluable help, suggesting possible citation



authors, and contributing three citations himself. His contributions, as would be expected, were interesting and delivered on time. In return, I made some contributions to his projects. From my perspective, this particular Anglo-American relationship was very special.

Saul served as the 25<sup>th</sup> president of Operations Research Society of America (ORSA) in 1976 and was awarded the Kimball Medal for distinguished service to ORSA and the profession

(1991). He was made a Fellow of the Institute for Operations Research and the Management Sciences (INFORMS) (2002) and was the recipient of the INFORMS Expository Writing Award (1997). In 1996, he received the Jacinto Steinhart Memorial Award of the INFORMS Military Applications Society for outstanding contributions to military operations research. He served as President of Omega Rho, the international operations research honor society (1985-1986); as vice-president for international activities of INFORMS, and as vice-president of the International Federation of Operational Research Societies.

This reflection on Saul's rich life is inadequate and indebted to Arjang Assad's profile of Saul in *Profiles in Operations Research* (Springer, 2011, pp. 547-575). Please see that for a more detailed account.

At the OR Society's annual conference held in Bangor, Wales in 1990, Saul gave the opening address on 'The many faces of O.R.'. The Welsh members present were probably not too impressed when the Chairman welcomed him to England! Saul was a very special 'face of O.R.'

<OR>



(L. to R.): Rudy Lamone, Arjang Assad, Saul, Alan Goldman at Saul's 80<sup>th</sup> birthday symposium, February 25, 2006, University of Maryland, College Park.

## SYSTEMS THINKING TO SUPPORT POLICY MAKING

COLIN ELWOOD

This was the theme of a recent one day workshop sponsored by the Government O.R. Service (GORS) as part of a wider initiative with the Government Science and Engineering (GSE), organised and hosted by the Department for Environment, Food and Rural Affairs (Defra), to make connections, share experiences and raise awareness.

Around 80 experts and interested professionals from government, academia and the private sector gathered in London to exchange insights and ideas for best practice. Thanks are due to Maria Angulo, Piers Horner and David Cope for masterminding the event, and to the many speakers who gave generously of their time and knowledge.

David Cope (Defra) set the scene by asserting that an interconnected world needs Systems Thinking, but the scale of the challenge is such that we need to significantly increase our capability, especially in government. This is an opportunity for the O.R. and Systems Thinking community.

David Lane (Henley Business School) began his keynote session with a reminder that 'Systems Thinking' embraces a wide range of methods for articulating problems and developing policies in complex, dynamic situations. He went on to introduce one of the most powerful, System Dynamics, which can be used both as a qualitative mapping tool to understand the underlying causal mechanisms that drive system behaviour, and to formulate quantitative simulation models to explore the impact of alternative policies. He illustrated the approach with two practical applications: the first explored the unintended consequences of past policies on the child protection sector; the second modelled the spread of *Clostridium difficile* in a hospital.

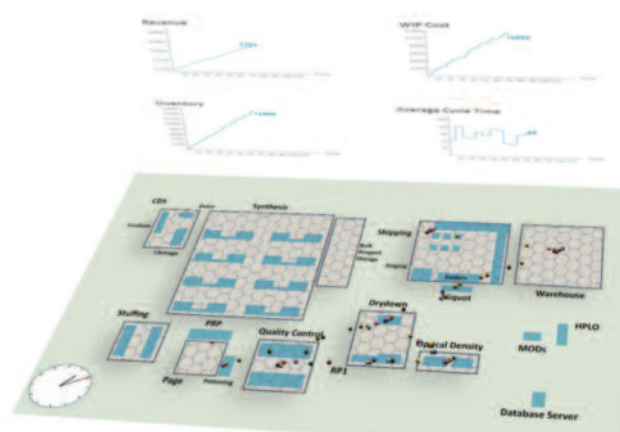
Jeff Johnson (Open University) contended that policy is too often decided by trial and error, and that a more scientific approach was needed. He outlined the EU's Global Systems Dynamics and Policy project, and invited anyone interested to join this research community.

Peter Baudains (UCL) outlined two examples of agent based simulation, showing how the structure of social networks can influence macro behaviour as much as individual agent's decision rules. When London Underground ran late-night trains during the 2012 Olympics, commuters rapidly adjusted their journey times to take advantage, and the Mayor's public warnings to avoid unnecessary journeys had a much bigger impact than expected, due to positive (word of mouth) feedback. This illustrates the difficulty of selecting optimal policy interventions in complex, social systems.

The Silsoe Whole Farm Model, now maintained by Cranfield University, uses linear programming to determine the optimal cropping, labour and machinery schedule on a farm. David Parsons

has embedded this within a macro supply and demand model to explore the future pattern of UK agricultural land use under different economic, social and climatic scenarios, and to model farmers' likely responses to different policies. One surprising finding was that more intensive use of less land for agriculture *increases* bio-diversity – assuming that unused land is left wild, not developed!

George Danner (Torus Business Web) made a strong case for using animated visualisations to bring simulation models to life. Using a hypothetical anthrax outbreak, a pharmaceutical manufacturing plant and an airline's refuelling pattern as examples, he demonstrated how modern technology and best practices in visualisation can help modelling teams communicate more effectively with policy makers, giving them a deeper understanding and greater confidence in results and recommendations.



*Visualisation of simulated pharmaceutical manufacturing plant*

The next two speakers were also experienced practitioners with many tips to share. Sion Cave & David Exelby (Decision Analysis Services) cited one of the main benefits of the systems approach as enabling diverse stakeholders to establish a common language and a coherent, shared mental model of an otherwise intractable situation.



Katie Gronow (Department for Transport) outlined three example applications at the Department for Transport and associated Government Departments, and drew out some useful lessons: systems thinking methods provide much needed structure, help to engage stakeholders, and can be fun, but it is often hard to reach consensus, and the model that emerges from any workshop is only as good as the participants' collective knowledge and judgement – so choose them with care!

In most cases, it is best to not to overwhelm workshop participants with systems jargon, process or theory. As Simon Bell put it, the methodology should be *quiet*, or unobtrusive. That said, it is sometimes useful to consider how a group performed when attempting to apply a given Systems Thinking methodology. The 'Triple Task' method, developed at the Open University, provides a framework to structure the problem, assess the group dynamic from outside, and reflect on the experience from within.

Maria Angulo (Defra) and a team from University of Bristol (Mike Yearworth), Sustain (Rachel Freeman), Ventana Systems (Lee Jones) and WRAP (Tom Quedsted) outlined progress to date on the project that inspired this event. The aim is to build capability to apply qualitative Systems Thinking and quantitative System Dynamics modelling to support policy making at Defra, through two case studies. The first is looking at waste prevention through material flows, and is using causal loop diagrams to identify promising policy levers. The second focuses on the recycling of plastic packaging, using Vensim.

Returning to the theme of infectious disease, Darren Holland and Abdul Khaled (Food Standards Agency) described a System Dynamics model of the spread of the Norovirus, developed by David Lane (Henley Business School). The interaction of the different routes of infection is not well understood, and data is sparse, so the model will be used to test whether reducing the food borne element is likely to have a material effect on overall cases and, if so, where interventions are most likely to have the biggest impact. Sensitivity analysis has helped identify key areas for further research by estimating the potential impact of uncertain inputs and assumptions.

Sarah Culkin (Department of Health) described a successful pilot project to design a system for re-validating doctors at a large teaching hospital. She used Soft Systems Methodology to understand the complex interactions and different stakeholder perspectives surrounding a doctor's fitness to practise, how this could be assessed, and what information could be cost effectively assembled to support this.

The final speaker, Nigel Gilbert (CRESS, University of Surrey) outlined the Evolution and Resilience of Industrial Ecosystems (ERIE) research project, the modelling approaches used, and issues that have arisen. The aim is to develop and apply complexity science to social and economic systems, using computational tools to assist policy makers.

### Brainstorming on real issues

After a short break for refreshment, delegates broke into syndicates to work on one of three live policy issues submitted by colleagues. The objective was to briefly explore the issue, identify likely challenges and suggest one or more Systems Thinking approaches.

Groups 1&4 considered the impact of better information systems and how to measure their relative value in terms of reducing risk.

Groups 2&5 discussed ways to measure the benefits of multiple projects aimed at improving customer experience and/or operational efficiency, where impacts are interdependent and benefits overlap.

Groups 3&6 looked at how faster broadband might impact people's lives, and how this might translate into quantitative benefits (economic, social and environmental).

### Conclusion

Having reflected on the day, here are the insights that struck me as most useful:

- Qualitative models are good for describing complex systems and how they work, reaching a shared understanding and getting buy-in, but they can only *suggest* places to intervene.
- Rich pictures are a quick and easy way to start, and can lead stakeholders to reveal important concerns they would not otherwise voice.
- Building quantitative models takes more effort, but tells you much more about how effective interventions are likely to be, and what *won't* work.
- Always build a qualitative model before attempting to quantify.
- Interview stakeholders individually, and bring a straw man to the first group modelling workshop – this helps you identify the right participants, stay one step ahead – and it saves time.
- Building and running a model to get useful insights and recommendations is only half the battle – you still need to sell the story to the decision maker.
- Pictures (or better animations) may illustrate the story, but policy makers need the explanation in (non technical) words too.

### Further information

If you would like further information on any of the examples or methods above, follow the links embedded in this article. If you'd like to participate in future events, please contact Maria Angulo or, if you work in the Civil Service, you can apply to join the GORS/GSE systems thinking group on LinkedIn by emailing GSE@bis.gov.uk.

### About the author

Colin Elwood is an independent consultant specialising in predictive modelling and analytics, and chairman of the JIGSAW network.



## Events Worldwide

The Events Worldwide listing appears in print quarterly. To see the full listing go to:

[www.theorsociety.com/Pages/NonSociety/NSEvents.aspx](http://www.theorsociety.com/Pages/NonSociety/NSEvents.aspx)

## JOURNALS & SPECIAL ISSUE CALL FOR PAPERS

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For further questions contact the Guest Editor, Fuzhan Nasiri, at [f.nasiri@ucl.ac.uk](mailto:f.nasiri@ucl.ac.uk)

**Abstract:** Infrastructures are facilities and services that support the functioning of human societies. Examples are utility networks (such as water, wastewater, gas, electricity, and communications), transportation systems (such as airports, railroads, roads, and bridges), public buildings (municipal buildings and hospitals), and social venues (such as sports and entertainment facilities). Capital intensity, network complexity, and criticality of services provided are among the main attributes of infrastructure systems. Infrastructure management is emerging as a top global priority in the 21st century due to a growing stock of aged infrastructure facilities and an increasing demand for infrastructure services resulted from a highly urbanized population.

#### IMPORTANT DATES

The closing date for submissions is: **1st May 2013**

### Final Call for Book Chapter: Business Performance Management Further information at

**Abstract:** International Conference on Business Performance Measurement and Management (ICBPMM) took place in Lima during September 11th to 13th, 2012. The book, entitled '*Business Performance Management*' is scheduled to be published in July 2013. However, the publication in this volume is not limited to the contributions presented in ICBPMM 2012. We would like to invite other scholars all around the globe to submit an extended abstract, followed by complete paper to be published in the above edited book.

#### Important Dates

Extended Abstract Submission: Immediate  
Authors Notifications: As soon as possible  
Full Papers Submission: 15 March 2013  
Review Report: 1 April 2013  
Final Paper Submission: 15 June 2013  
Publication Date: July/August 2013

### CALL FOR PAPERS/SPECIAL ISSUE : VeRoLog 2013

**Abstract:** The second meeting of the EURO Working Group on Vehicle Routing and Logistics Optimization (VeRoLog) will take place at the University of Southampton, UK, from 7–10 July 2013. Researchers, practitioners and students are welcome to participate and present their research. Abstracts can be submitted through the website

<https://www.ocs.soton.ac.uk/index.php/verolog/verolog2013> either using the LaTeX or the Microsoft Word template (maximum length one page).

#### Important Dates:

Extended paper submission deadline: 11 March 2013

Notification of paper acceptance: 1 April 2013

Early registration deadline: 29 April 2013

Conference: 7-10 July 2013

Anyone wanting to organize a stream or a session should contact Tolga Bekta ([t.bektas@soton.ac.uk](mailto:t.bektas@soton.ac.uk)).

#### Call for Papers:

### Journal of Simulation Special Issue on Simulation for Sustainable Healthcare

[http://www.palgrave-journals.com/jos/jos\\_cfp\\_sush.pdf](http://www.palgrave-journals.com/jos/jos_cfp_sush.pdf)

**Abstract:** The Journal of Simulation (JOS), an official journal of The UK Operational Research Society, aims to publish methodological and technological advances in the application of simulation modelling-related theory and practice. JOS publishes material in a wide range of domains, including manufacturing, service, defence and healthcare, as it seeks to interest and provoke discussion within the wider simulation community. JOS has recently been accepted by Thomson Reuters for indexing and inclusion in the Science Citation Index (SCI). JOS will publish a special issue on simulation for achieving sustainable development in healthcare.

The special issue editors invite contributions in conceptual, methodological and technical advances to modelling for sustainability in healthcare. Studies that have applied M&S for practical problem solving and have considered the TBL of sustainability are also welcome. The review process will be the same as that used by the journal. Topics suitable for this special issue include, but are not limited to, the following:

- Cross-domain review of literature pertaining to M&S for sustainability, with the objective of furthering sustainable healthcare simulation.
- Conceptual models and frameworks to guide the development of models for sustainable healthcare. Empirical validation of the same.
- Methodological aspects pertaining to modelling for sustainability, for example, the use of hybrid simulation models that incorporate both productivity and sustainability-related criterion.
- Studies that report on the application of simulation for sustainable dementia care, sustainable care for the elderly, among others.
- Sustainable healthcare supply chains.
- Studies that increase awareness of sustainable healthcare through use of Serious Games in a teaching environment.

#### Important Dates:

Submission deadline: 1 July, 2013

Publish the special issue : 2014



# Professional development opportunities for 2013

## Approved courses in O.R. and Analytics

### STAKEHOLDERS ENGAGEMENT

**25-26 April, Birmingham**  
**£1,100 + VAT** for OR Society members  
**Hands on course**

**Course provider:**  
 Hickling & Muller Interactive Process

Gain an understanding of the underlying principles of interactive working, why we work the way we do and when interactive working is appropriate. Appreciate the concept of a 'spectrum of participation' and how to define the degree of influence stakeholders have in the process. Use a toolbox of design tools.

Learn how to apply the underlying principles and practical tools which are widely used in the field of stakeholder engagement; Find out how to avoid and reduce conflict and improve engagement with clients, build dialogue, consensus, collaboration and partnership. Benefit from practical training and hands-on experience in the design and management of all kinds of interactive processes

### HOW TO DYNAMICALLY DESIGN SUPPLY CHAINS

**30 April - 1 May, Birmingham**  
**£1,030 + VAT** for OR Society members;  
**Hands on course**

**Course provider:**  
 Stephen Disney

**NEW FOR 2013**

The bullwhip effect is pervasive in industry and reduces factory profits by up to 30%. This can be eliminated by careful design of forecasting and replenishment rules. In global supply chains with long lead-times the bullwhip problem is a bigger problem still. Supply chains can be designed to balance the inventory / capacity / service trade-off.

Learn about the impact of the bullwhip effect on financial performance; Get to know how the 'Order Up To' policy generates bullwhip and how it can be re-designed so as to avoid bullwhip; Understand how to forecast demand for managing inventory and bullwhip, how to set capacity levels to minimise the costs involved in meeting a variable demand pattern and set safety stock levels to minimise costs and meet target service levels.

### DESIGNING PERFORMANCE MEASUREMENT SYSTEMS USING ANALYTICS

**8 May, Birmingham**  
**£490 + VAT** for OR Society members

**Course provider:** Martin Kunc

This is an introductory course to Balanced Scorecard strategy maps – the latest tool in performance management systems. You'll learn how the model converts plans, resources and capabilities into tangible outcomes like financial performance and customer satisfaction.

Follow the evolution from financial measures to strategy maps; Identify the issues surrounding the design of strategy maps and learn how to build them. Identify the linkages between measures analysing data and simulation. Generate feasible and balanced targets for measures

### INTRODUCTION TO SYSTEM DYNAMICS AND STRATEGIC MODELLING

**14-15 May, Birmingham**  
**£1,090 + VAT** for OR Society members  
**Hands on course**

**Course provider:** John Morecroft

This course is an authoritative introduction to qualitative strategic modelling and simulation based on the powerful concepts from the field of system dynamics proven and tested in successful MBA and executive courses at London Business School. Delegates will learn how to use feedback systems to make sense of puzzling dynamics in business and society.

Learn about causal loop diagramming to decipher interdependencies. Experience dynamic complexity by the use of gaming simulation. Explore the relationship between business performance and underlying feedback structure. Improve business performance by using simulators to rehearse strategic plans

### PERFORMANCE MANAGEMENT WITH DEA

**21 May, Birmingham**  
**£555 + VAT** for OR Society members  
**Hands on course**

**Course providers:**  
 Ali Emrouznejad and Emmanuel Thanassoulis

This course is ideal for anyone interested in assessing the relative performance of organisational units such as regional offices, bank branches, sales outlets, hospitals or schools. You'll get an introduction to the recent developments in DEA including weights restrictions, assessment under variables, returns to scale and target setting and undertake illustrative assessments using advanced features of the Performance Improvement Management Software (PIM-DEA).

Learn about new methods in efficiency and productivity; Understand principles behind the non-parametric performance measurement. Get hands-on experience of the PIM-DEA software from the developers; See how to apply DEA techniques to your own workplace

### DECISION AND RISK ANALYSIS

**29 May, Birmingham**  
**£590 + VAT** for OR Society members;  
**Hands on course**

**Course provider:**  
 Jian-bo Yang and Dong Ling Xu

The course will teach you how to model, analyse and manage the effects of various types of uncertainty that co-exist in decision problems. We introduce a new and advanced approach to Multiple Criteria Decision Analysis (MCDA) under uncertainty and provide hands-on experience of the latest MCDA software tools.

Acquire up to date knowledge in decision sciences and MCDA. Enhance your decision making skills under uncertainty in your workplace; Learn to save time, increase accuracy and consistency in decision making and communications

**To book online, visit [www.theorsociety.com](http://www.theorsociety.com)  
 or call Jennie Phelps on 0121 234 7818**





Nightingale's graphical representation of the causes of mortality during the Crimean War. It will demonstrate how these were used by Nightingale and others to show that preventable diseases contributed to the army's high mortality rate and how the use of this data led to dramatic changes to nursing practices in Army hospitals.

Non-members welcome, no charge is made. After the talks, you are welcome to join us and the speaker for a meal. For further information please contact [MidlandsORSociety@live.co.uk](mailto:MidlandsORSociety@live.co.uk)

### NORTH WEST (NWORG)

**CONTACT:** Nathan Proudlove

**EMAIL:** [nathan.proudlove@mbs.ac.uk](mailto:nathan.proudlove@mbs.ac.uk)

### SCOTLAND (ORGS)

**CONTACT:** Kerem Akartunali (Chair)

**EMAIL:** [Kerem.Akartunali@Strath.ac.uk](mailto:Kerem.Akartunali@Strath.ac.uk)

**CONTACT:** Roberto Rossi (Secretary)

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### SOUTHERN OR GROUP (SORG)

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**TEL:** 029 2087 5524 Fax: 029 2087 4199

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### WESTERN (WORDS)

**CONTACT:** Dr Jo Smedley

**TEL:** 01633 432573

**EMAIL:** [jo.smedley@newport.ac.uk](mailto:jo.smedley@newport.ac.uk)

### YORKSHIRE & HUMBERSIDE (YHORG)

**CONTACT:** Stuart Johns.

**TEL:** (0114) 225 3136

**EMAIL:** [s.l.johns@shu.ac.uk](mailto:s.l.johns@shu.ac.uk)

<OR>

## SPECIAL INTEREST GROUPS

### ANALYTICS NETWORK (ANSIG)

**CONTACT:** John Hopes

**EMAIL:** [ANChair@theorsociety.com](mailto:ANChair@theorsociety.com)

**ANSIG NEXT MEETING:** Adding Value In Analytics

**Date/Time:** Wednesday, 12 June 2013 9am – 17.30pm (Buffet lunch and refreshments provided)

**Venue:** Institution of Engineering & Technology, Savoy Place, London, WC2R 0BL

**Speaker:** TBA

**Abstract:** Experience shows that the most successful businesses are those with the clearest picture of what they are doing, and what they need to change or do better.

The vast amounts of data now gathered by organisations, together with the computing power that's available to analyse it, has led to a revolution that's transforming business decision making: Advanced Analytics. Our one-day seminar examines developments in the field of Advanced Analytics – the latest ways of gaining business insight through quantitative analysis to aid the decision-making process.

Further information on this event, including speakers, programme and booking will follow shortly.

To book on event go to:

[https://www.theorsociety.com/Pages/SpecialInterest/AnalyticsNetwork\\_future.aspx](https://www.theorsociety.com/Pages/SpecialInterest/AnalyticsNetwork_future.aspx)

### COMMUNITY OR NETWORK

**CONTACT:** Leroy White

**EMAIL:** [leroy.white@bristol.ac.uk](mailto:leroy.white@bristol.ac.uk)

**TEL:** 0117 954 5683

### COMPLEX SYSTEMS DISCUSSION GROUP

**CONTACT:** Kevin Gilligan

**TEL:** 0208 977 8553

**EMAIL:** [GilliganMauve@geo2.Poptel.org.uk](mailto:GilliganMauve@geo2.Poptel.org.uk)

Group meetings to be held at 12 Noon

Last Friday of the month

The Adelaide, Park Road, Teddington

**Meeting Title :** The Management of Uncertainty

### CRIMINAL JUSTICE

**CONTACT:** Ian Newsome

**TEL. DDI:** 01924 292244 **Extension:** 22244

**EMAIL:** [ian.newsome@westyorkshire.pnn.police.uk](mailto:ian.newsome@westyorkshire.pnn.police.uk)

Criminal Justice Special Interest Group Meeting

**Date/Time:** Monday, 24 June 2013 at 13:30 - 17:00

**Venue:** Home Office, Westminster

**Speaker:** Various see below.

**Abstract:** The programme is being finalised but is likely to include talks from the Ministry of Justice on a topic tbc; Leeds University on analysis/prediction of burglaries and agent based modelling; Cogentus consultants on a US study involving a community based policing system plus an interesting methodology for measuring effectiveness; and ORH consultants on a Canadian location analysis study. (With many thanks to those of you who have kindly volunteered to speak this time).

The event will be at the Home Office in London, location to be confirmed, from 1.30pm to 5pm. As usual, please bring your own refreshments.

Please notify Sue Merchant as soon as possible if you would like to attend as space is likely to be limited. [suemerchant@hotmail.com](mailto:suemerchant@hotmail.com)



## OR-30

John Crocker  
May 1983

Pocklington is a small market town in the East Riding of Yorkshire roughly half way between York (to the northwest and Hull (to the southeast). Pocklington School is a private independent school for pupils aged 11-18. William Wilberforce (1771-1776) is probably its most famous alumnus. What, you might ask, has that to do with O.R., well two of its students Stephen Baker and Michael Anderson submitted a paper entitled 'Pocklington School Tuck Shop' to the '1981 O.R. Competition for Schools'. They won second prize and an abridged version was published in the May 1983 issue of JORS.

The school tuck shop was open for limited periods on six days a week during term times and manned by usually 5-6 servers on each occasion drawn from a team of two staff and nine sixth formers. Following a number of complaints about how long customers had had to wait to be served it was decided to make it the subject of an O.R. project.

An initial survey run over three weeks was taken which looked at service times versus number of servers, distance travelled by servers and sales figures for each item stocked against each of the three service points. From this, it was decided to increase the number of servers to 8 whenever possible, to rearrange the shop layout within the tight constraints present and to give each service point its own petty cash box.

A second survey was taken over one week and the results compared to those from the original survey. These should an increase of around 25% in both the number of customers served and the stock sold. It was recognised that there were a number of factors which might have influenced this increase both positively and negatively. These included new staff, a shorter survey period, a different time of the year and the very fact that the staff were being 'observed'. Taking all of these into account, it was felt that the effort had been successful and worthwhile – even the pupils/customers were happier!

Bernard Taylor III, Arthur Keown and Allen Greenwood from Virginia Polytechnic and State University decided to try using integer goal programming to determine the 'optimum' number of military aircraft that should be purchased. This is a particularly difficult type of problem because there is no one cost function primarily because 'revenue' cannot be measured in monetary units. There is also the problem that each of the different types of aircraft or weapon system is designed to serve different purposes. In addition, the goals and objectives of the government who have to pay for the equipment and of the military who will be using it may not be compatible. Integer goal programming was found to offer a number of advantages over other methods.

As there are several articles on the travelling salesman problem (TSP) in this issue, it seemed only appropriate to have a look at a vehicle scheduling problem (VSP) which, of course, is a very similar problem. The question that J.C. Cooper, Polytechnic of Central London (now University of Westminster) posed was whether it was safe to use the [Euclidean] straight-line distances between points as a proxy for the actual transport costs. The reality is that the roads between points are seldom straight or, indeed, flat. Fuel usage may also be affected by traffic density as will travel times. The conclusion was, for the cases observed, that straight-line distance gave a reasonable approximation but that this may not always be the case.

Baker, S. and M. Anderson, (1983) Pocklington School Tuck Shop, *JORS* 34.5, Pp 375-378 (jors198389a.pdf)  
Taylor III, B.W., A.J. Keown and A.G. Greenwood, (1983) An Integer Goal Programming Model for Determining Military Aircraft Expenditures, *JORS* 34.5, Pp 379-390 (jors198390a.pdf)  
Cooper, J.C., (1983), The Use of Straight-line Distances in Solutions to the Vehicle Scheduling Problem, *JORS* 34.5, Pp 419-424, (jors198394a.pdf)

<OR>

## OR-20

May 1993

NEWS

### Dry meeting ends at closing time

Reports from PW, CORU, ERC, AC, ETC

Report on March Council by Nigel Monk

There's a certain virtuosity needed to be on Council, you might like to know. We, quarter after quarter, year after year (<=n, n dependent on status) strive to bring to bear our full range of skills and experiences as Operational Researchers – net – working, political manoeuvring, 'lies', soft and hard interactions – and still I get lumbered with this newsletter report! Fifteen selfless souls braved a two-page agenda to meet at Dr. Johnson's (dry) meeting

house after denying ourselves the luxurious four star penthouse suite above nearby New Street.

Chris Chapman reported continuing progress with 'The Association of Management Sciences' societies' network proposal, as detailed in earlier newsletter articles. All the societies involved seem very keen but clearly these initiatives take time as representatives report back to their own councils, and so on.

### Very young O.R.

Jim Bryant and Carole Roberts were elected (nay volunteered) onto GPC as Council reps. Jim continues and Carole replaces Jill Edge who has recently borne a very young 'O.R.er'.

The first major item was approval of the 1992 accounts which we



did, sort of. But more interesting is the problem – and the opportunity – these have revealed. It seems that the rises in subscriptions and events prices, increases in the value of stocks and shares, and a reduction in printing costs have all, more or less equally, contributed to a net surplus of £90,000 for the year. The budget predicted a £46,000 loss. This is quiet serious because, as a result, our charitable spending – the result, our charitable spending – the reason why the society enjoys a tax free status (simplistically anyway) – has fallen to a level which the Inland Revenue might regard as unacceptably low. Simply put, if OR Society doesn't spend this money charitably, and soon, we may lose it (and future monies) to the government anyway. How do you fancy paying VAT on your subscription?

### Development of O.R

Clearly, Council has its own ideas but if anyone wishes to nominate an initiative to benefit from this situation they should write to Bob Miles with a (preferably costed) proposal to arrive before the beginning of May. Just to remind you, O.R. charitable aims are the 'Advancement of O.R.' through Educations, Advancement of Knowledge, and Publications. Whether this surplus will be repeated in future years is uncertain. The depressed printing costs, for example, may be permanent due to structural changes or temporary due to the recession leading to excess capacity.

Next up, Jim Bryant spoke to a report from the Community O.R. Unit at Northern College in his capacity as chairman of the Management Committee. The report covered the two years up to September '92. CORU has been forced by funding constraints into retaining only one, full-time member of staff which is clearly undesirable. CORU is primarily core-funded by OR Society and the Cadbury Trust, aiming its work directly at and with client groups such as housing associations, rather than the potentially more lucrative work for charities in general. This is under review and may have to change in the future.

CORU is well established now and quite widely known to potential client groups in the north. The Steve Cook award plus various conferences lend proof to this. However, the amount of written material produced so far was felt to be somewhat low although understandably so. A broad spectrum of publications was encouraged, including material for wider consumption than the usual O.R. audience. Council did, without being mercenary, fund this initiative requiring some return, and it is hoped this report and other material might be of use in publicising O.R. in the continuing 'Marketing of O.R.' initiative.

### Education and Research

Bill Hancock spoke to a report from the Education and research Committee as chairman. Bill gave us a broad outline of ERC's activities which was received without contention. Bill would like to co-opt some extra help onto the committee.

### Regional Grants Raised

Val Belton was co-opted onto Council. Regional grants were increased 25% in line with inflation (!) – since they were last raised. Committee memberships were tidied up. The OR Society archive is to be located at Warwick University at a low cost to the Society.

### Publicity for O.R.

The next proposal concerned 'Publicity for O.R.' as part of the ongoing efforts to raise the awareness of O.R. stemming from Paul Thornton's term as president. Basically, a programme of work for the next 6 months has been suggested by Shelia Hart, a media consultant, Aided part time by Shelia, a task force comprising Richard Nicholls, Bob Miles, John Ranyard and Nigel Monk will oversee and undertake the not inconsiderable work involved. The short-term objectives are to raise the profile of O.R. in a limited way and afterwards to consider the effectiveness of the methods for the longer term. In the longer term, the need to improve the health of the O.R. in general and specifically to increase the usage of O.R. by various categories of potential clients, both new and old.

### Inundated

One aspect worth mentioning which the task force will be examining is that, being widely optimistic, the OR Society offices may be inundated with requests for work and/ or help setting up O.R. departments. With the apparent growth of the 'Lone Ranger' practitioners but with the desire to avoid any formal responsibility to process such requests in order to avoid conflicts of interest, some other mechanism will need to be found and in place for whatever response is elicited. It would be very damaging and unprofessional to be unable to follow-through any interest generated.

### Beale Award

Other articles will detail the programme and report progress. It is intended that visible results will be produced over the summer.

Council were pleased to receive from the Awards Committee the nomination of Jonathan Rosenhead as winner of the first Beale Medal for sustained contribution to the literature of O.R.

Somehow, despite the two page agenda, we managed to finish by 3.00pm. Virtuous? That doesn't even come into it.

<OR>

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**IMPORTANT:** Contributors please note. All contributions must be in four parts as follows (1) headline (approx 6 words); (2) mini-abstract (max 25 words); (3) main body of contribution (max 500 words); (4) keywords. At the editor's discretion, contributions exceeding 500 words will be shortened, serialised or published with the warning Long article. X words. Whenever possible contributions should be submitted electronically as Word files and emailed to [insideor@theorsociety.com](mailto:insideor@theorsociety.com). Illustrations should be attached as JPG, GIF, TIF or files of other common formats. Contributions submitted in hard copy must be posted to The OR Society at the address above, or sent to the Society's fax number, and be clearly marked Inside O.R. All contributions must bear the author's name and address (not necessarily for publication). All contributions accepted by the editor will be published in the print version subject to availability of space. The editor's decision on all contributions is final and no correspondence will be entered into.



**OPTIMISATION & FORECASTING**  
**£30,000 - £45,000 + Benefits**

This leading media business is committed to success through its innovation, vision, passion and, most important, its people. As part of building a world class analytics team, current emphasis is the recruitment of a talented achiever offering proven experience of optimisation, forecasting and related OR activities. Impressive academic credentials, excellent social integration skills and genuine commercial acumen, are also essential attributes. **London, West End**

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**£25,000 - £35,000**

On behalf of this rapidly expanding Marketing Analysis Consultancy we are seeking a high calibre Customer/Marketing Analyst with proven experience of conducting and delivering data analysis (reporting, profiling, segmentation) using SAS. The successful candidate should have a numerate degree, strong SAS and SQL skills and have the ability to add value from day one. Excellent client facing skills are an essential prerequisite, as is a real passion for gaining insight from data. **London**

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**Packages £65,000 - £110,000+**

Premier management consultancy requiring additional professionals, at both principal and managing consultant levels, to join their leading Strategy & Analytics group. Previous experience could include: customer insight, pricing strategy, yield management, data analytics, business intelligence, data mining/modelling or forecasting; underpinned by a demonstrable track record of business development and proven people/project management experience. **Central London based**

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Working for one of most respected brands in the UK, you will be responsible for designing and executing a range of analytical tasks to deliver business insights that will drive revenue growth, reduce business costs and enhance customer satisfaction. You should have an in depth understanding of statistics and predictive modelling (with specific areas of expertise around logistic regression and multiple linear regression) and have experience of using statistical software to produce predictive models. **London**

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**To £50,000 + Benefits**

Joining this new and exciting software development company you will be responsible for analysing large sets of data, implementing sophisticated algorithms and analytical routines to make a real-time impact on their products and working offline to extract insights from the data to drive the company forward. You need to have at least an MSc in Operational Research or Statistics and ideally a relevant PhD to support this. With experience of analysing large data sets you will have used either R, VBA, SQL, SAS, SPSS or Matlab and ideally have basic experience with computer programming (C++ , Python or Java). **Exeter**

**HEAD OF WEB ANALYTICS**  
**c£100,000 + Benefits**

This specialist role is pivotal to the success of the Digital Sales & Marketing function of this global travel brand. The prime remit is the creation of a new analytical team, to successfully deliver online traffic analytics to the business, enabling customer retention, loyalty and optimal sales conversion. The successful candidate will need to offer a strong numerate grounding, coupled with upwards of ten years' demonstrable analytical and management achievement. **Bracknell**

**MOBILE APP. ANALYTICS**  
**c£60,000 + Bonus + Benefits**

Our client, a major online retail brand, is experiencing strong growth in mobile commerce. Working closely with the Director of a newly created team and your EU Partners, you will be delivering business performance analytics, blue sky and deep dive analysis. You will be able to offer 5-8 years modelling and analytics expertise, sound technical capability (SQL, Excel) and the ability to synthesise a compelling argument. **West London**

**PRINCIPAL INSIGHT ANALYSTS—ONLINE**  
**To c£50,000 DOE + Benefits**

At an exciting time of continued growth, these are excellent opportunities to join a recently formed Analytical Team with the focus on providing the business with timely and accurate insights and recommendations to assist in strategic decision making. Highly numerate and commercially aware, you will be of graduate calibre, ideally with a numerate degree, with proven commercially driven insight and analysis experience. Experience in search engine/ Google analytics or direct marketing/email context beneficial. **South Wales**

**PRINCIPAL CONSULTANT—DEFENCE ANALYSIS**  
**To £55,000 DOE + Benefits**

Dynamic consultancy that provide analytical and management consultancy to help government and businesses make better-informed decisions. They are looking to recruit high energy, exceptional Principal Consultants to work across a range of areas covering services based on modelling and operational research techniques. Working closely with clients, you will be involved in a range of business winning and delivery activities so you must be flexible, adaptable and committed to successful delivery. Relevant defence analysis experience essential. **Hampshire**

For an informal discussion in total confidence on any of these positions or the market in general, please contact: Mark Chapman, Teresa Cheeseman, Kate Fuller or Sarah Sambrook. Alternatively visit our website to view our current vacancies.

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