**YOR19 Conference 22 – 24 Sept 2015**

**Conference Aston Meeting Suites – Birmingham**

**Abstracts by Stream**

**A YOUNG OR GUIDE TO ..**



**Organiser: Victoria Forman**

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| 22/09/2015 : 16:00 : Room 3 Stafford Rm 2 | Code: YOR19A1509 |

**Practical tips for carrying out facilitated simulation modelling**

**Dr Antuela Tako** *(Loughborough University)*

This talk provides a number of hints and tips, which analysts interested in practicing facilitated modelling could find useful. The main aspects considered are: the art of facilitation, team roles, group size and workshop organisation. While I will share some suggestions and advice based on my experience of undertaking facilitated modelling with PartiSim, the audience is also welcome to share their thoughts and ideas.

What is the nature of your talk?: Very practical
Does your talk require prior knowledge of the subject area?: A little
Is your talk accessible and relevant to Practitioners?: Highly

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| 22/09/2015 : 16:30 : Room 3 Stafford Rm 2 | Code: YOR19A1469 |

**A Young OR guide to .... working with open source mapping data**

**Dr Neil Urquhart** *(Edinburgh Napier University)*

Vehicle scheduling and routing problems have long interested OR practitioners. For many years problems such as the Traveling Salesman or Vehicle Routing with Time Windows have been examined using abstract instances based on the shortest distance between points. This talk will quickly demonstrate the use of Open StreetMap data and tools such as GraphHopper and the Transport for London API to show how practitioners can very quickly create real-world problem instances.

What is the nature of your talk?: Very practical
Does your talk require prior knowledge of the subject area?: Some
Is your talk accessible and relevant to Practitioners?: Highly

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| 22/09/2015 : 17:00 : Room 3 Stafford Rm 2 | Code: YOR19A1577 |

**A Young OR Guide to the OR Society**
**Mr Gavin Blackett** and **Mrs Louise Allison** *(The OR Society)*
This talk will introduce the work of the Society and discuss how you can enhance your career prospects with its services.

What is the nature of your talk?: Very practical
Does your talk require prior knowledge of the subject area?: None
Is your talk accessible and relevant to Practitioners?: Highly

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| 22/09/2015 : 17:30 : Room 3 Stafford Rm 2 | Code: YOR19A1474 |

**A YoungOR guide to… Optimisation**

**Mr Oscar Rodrigues-Espindola**, **Dr Pavel Albores** and **Dr Christopher Brewster** *(Aston University)*

Among the broad set of techniques available on Operational Research, optimisation is a very suitable method for a large number of applications. Being one of the most widely recognized techniques, the purpose is to find the optimal combination of different values to maximise/minimise a mathematical function. Therefore, this method is able to evaluate several options to obtain the best value according to the performance measure selected. The potential of optimisation has taken many researchers to develop applications on fields such as business management, industry, energy, engineering, supply chain management, scheduling, environmental management, forest management, agricultural management, airport management, among others. This presentation will provide the attendant with the basic concepts and ideas behind optimisation, focusing on the use of linear programming and the display of some applications. Also some of the main classifications and features of different types of optimisation will be introduced. The purpose is to understand the value of optimisation, identify the main components underpinning the development of optimisation models and to show the process for the design of optimisation models. Finally, understanding the output of optimisation models and the solution methods commonly used the attendant will acquire understanding about the world of optimisation and possible future application.

What is the nature of your talk?: Theoretical
Does your talk require prior knowledge of the subject area?: None
Is your talk accessible and relevant to Practitioners?: Relevant

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| 24/09/2015 : 09:30 : Room 2 Stafford Rm 1 | Code: YOR19A1571 |

**The best thing The OR Society has done in years’ - one member's take on Pro Bono O.R.**

**Mrs Felicity McLeister** *(The OR Society)*

Providing Pro Bono O.R. to third sector organisations is an idea that has been around The OR Society for quite a while. A pilot project was started in 2011 and the interest it generated let to a formal Pro Bono O.R. imitative being set up by The OR Society in September 2013. Since then Pro Bono O.R. has received over 120 enquires, has completed 20 projects and is currently working with a further 21 organisations (as of July 2015). This session will provide details about Pro Bono O.R., talk briefly about some of the case studies, provide an overview of the experience from both a volunteer and organisational perspective and provide further information about how you can get involved. Skilled volunteering is on the rise and Pro Bono O.R. gives O.R. practitioners and academics the opportunity to put their skills to good use. Feedback has shown both the volunteers and the recipient organisations benefit greatly from the whole experience.

What is the nature of your talk?: Practical
Does your talk require prior knowledge of the subject area?: None
Is your talk accessible and relevant to Practitioners?: Very

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| 24/09/2015 : 10:00 : Room 2 Stafford Rm 1 | Code: YOR19A1579 |

**Have your say: developing the OR Society's new website**

**Mrs Louise Allison** and **Mr Navin Mair** *(The OR Society)*

The OR Society's website, www.theorsociety.com, allows members to access their benefits, update their profile, find out about what's going on, book events and training, apply for accreditation, etc. The website is an important aspect of how the Society engages with members and therefore it's important that it meets the needs of members. With this in mind, the Society feels that it is time to develop a new website that will better serve its members. In order to develop a new website we need to know what the requirements are, therefore, we need your input to help shape how the new website will look and function. This will be an interactive session where you can tell us what you like/dislike about the current website and what you'd like from the new one. What features of other websites work well and do you personally use? This will be an opportunity to share thoughts and ideas, and discuss issues.

What is the nature of your talk?: Practical

Does your talk require prior knowledge of the subject area?: None

Is your talk accessible and relevant to Practitioners?: Very

**ANALYTICS**



**Organiser: Michael Mortenson**

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| 22/09/2015 : 13:30 : Room 1 Steelhouse LT  | Code: YOR19A1468 |

**Digital Analytics: You're Doing it All Wrong**

**Mr Michael Mortenson** *(University of Loughborough)*

Digital analytics, the practice of finding meaning in web data and optimising digital marketing, is a field of much growth. However, its central premises will be shown to have some significant issues. As alternative, this talk will present a new area of research that seeks to combine a range of OR and analytical techniques to better identify the sources of traffic, elements of web design, and website content that are generating value for the business. These techniques include Bayesian modelling, data envelopment analysis (DEA), sentiment analysis and topic models. The talk will conclude with some suggestions on the future developments of the research, and some reflections on the possible contributions OR can make to the digital

analytics field.

What is the nature of your talk?: Practical
Does your talk require prior knowledge of the subject area?: A little
Is your talk accessible and relevant to Practitioners?: Very

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| 22/09/2015 : 14:00 : Room 1 Steelhouse LT | Code: YOR19A1467 |

**An adapted version of the Concept Development Assessment Game**

**Mrs Jennie Gozzi** and **Dr Karl Skoog** *(Swedish Defence Research Agency)*

The CDAG is a qualitative analytical method used for assessing concepts or conceptual documents. Areas of application include evaluation of applicability, assessment of completeness and exploration of options of development of a concept. The method enables combining brainstorming with simulation and the challenge of red teaming in war games and focuses on intellectual challenge and discussions. We have adapted this method and used it in a table-top discussion regarding the development and establishment a Swedish-Finnish Naval Task Group (SFNTG). SFNTG has previously been discussed in Swedish-Finnish navy to navy discussions and a vision for the task group has been agreed upon. In short the adapted version was set up to give perspectives from two cooperating teams rather than having two opposing teams as in a traditional war game. Furthermore, the confrontation and challenge phase was changed into a more open discussion and the documentation phase was simplified. The TTD did successfully investigate the utility and feasibility of the vision of the SFNTG and identified challenge areas using the adapted version of CDAG as method. As SFNTG was a premature concept before the TTD we show that this method also is suitable for development of concepts in early phases.

What is the nature of your talk?: Practical
Does your talk require prior knowledge of the subject area?: None
Is your talk accessible and relevant to Practitioners?: Very

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| 22/09/2015 : 14:30 : Room 1 Steelhouse LT | Code: YOR19A1495 |

**Creating young offenders’ typologies using cluster analysis and analysing the impact of childhood involvement in the family justice system on the offending behaviour of young**

**people through data matching techniques.**

**Ms Radka Kozarova** and **Ms Robyn Smith** *(Ministry of Justice)*

The Criminal Careers Analysis team is a part of the Youth Justice Analytical Programme within the Ministry of Justice. The team focuses on analysis of young offenders (aged 10-17), in terms of their characteristics and their offending behaviour over time (i.e. number of offences committed, seriousness, type of offences, re-offending rates, etc.). A better understanding of the drivers of youth crime will help the Ministry of Justice and the Youth Justice Board to more effectively predict future demand, allocate resources and target interventions. We have performed a cluster analysis to create potential young offender typologies, which enables us to identify different patterns of offending behaviour among young people. We present the results of a cluster analysis, explaining offending behaviour of specific groups, their characteristics and the methodology used. As part of the project, we looked at the risk factors associated with the onset of offending. Evidence suggests that family background can impact on how likely a young person is to offend. We have run a data matching exercise looking at the proportion of young people who went through family justice proceedings who also appear in the Police National Computer (a database of police-recorded offending). We then linked matched individuals to our young offenders’ typologies to better understand the relationship between a young person’s involvement in the family courts and patterns in offending behaviour. We present the data matching technique used, outline some of the difficulties encountered, and explain how these issues were overcome. We will briefly describe how this project feeds into the wider Data Linking initiative and what further steps we intend to undertake.

What is the nature of your talk?: Practical
Does your talk require prior knowledge of the subject area?: None
Is your talk accessible and relevant to Practitioners?: Very

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| 22/09/2015 : 15:00 : Room 1 Steelhouse LT | Code: YOR19A1526 |

**From Sankey to Swanky- Innovative ways of conveying large sets of data to your customer**

**Miss Katharine Etheridge** *(Dstl)*

A primary goal of data visualisation is to communicate information clearly and efficiently through graphical means. Effective visualisations, therefore, aid users in analysing data and evidence. Across Government there is a push to provide customers with options, enabling them to make informed, evidence based decisions. This increasingly means providing customers with tools and interactive dashboards rather than a pre-defined set of selected cuts of data. This presentation will provide examples of interactive tools to demonstrate how to maintain the balance of providing opportunity for your customer to explore the data, and guidance to enable them to draw valid conclusions. Data visualisation is both an art and a science. Visualisations do not need to look dull to be functional. To convey ideas effectively, both aesthetic form and functionality need to go hand in hand. Innovative visualisations can be useful to force your audience to take a fresh view on a familiar set of data, as opposed to searching for pre- supposed answers in more conventional graph types. The challenge comes in ensuring that the analyst does not end up with beautiful data visualisations which fail to serve their main purpose - to communicate information. This presentation will include examples of more innovative visualisations which will provide an insight into the vast array of visualisation forms that are at analysts’ disposal.

What is the nature of your talk?: A mix

Does your talk require prior knowledge of the subject area?: None

Is your talk accessible and relevant to Practitioners?: Relevant

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| 22/09/2015 : 16:00 : Room 1 Steelhouse LT | Code: YOR19A1573 |

**Leveraging Transactional Data - Improving The Performance of Credit Risk Scorecards**

**Ms Emily Verdon** *(FICO)*

Traditional regression scorecards are developed to make credit risk lending decision decisions, whilst such models do tend to contain some transactional characteristics, these characteristics are largely derived by expert judgement. Recent advances in data storage and retrieval technologies have led to a widespread proliferation of massive data warehouses containing vast amounts of transactional data. The transaction data table is by far the largest and most under-utilised source of predictive information. This is due largely to the fact that the useful predictive pattern are embedded across a variable number of rows associated with each customer or account, while most analytic models and techniques require variables that represent information in a single row. This session will present how the Data Spiders module in FICO's Model Builder, allows analytic team to access sophisticated technology to bypass the manual process of brainstorming, coding, testing and evaluating predictive summaries of transactional data. The session will also highlight potential uplift in model performance, from leveraging the transactional data, and how such results are presented. The Data Spiders technology takes advantage of cutting-edge generic algorithm techniques to search a vast space of potential aggregations to identify the optimised predictive variable library. The process begins with a population of randomly generated transaction summaries that is evaluated for performance and then evolves into improved generations through evolutionary operations, such as fitness proportionate selection, cross-over and random mutation.

What is the nature of your talk?: Very practical

Does your talk require prior knowledge of the subject area?: A little

Is your talk accessible and relevant to Practitioners?: Highly

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| 23/09/2015 : 09:30 : Room 2 Stafford Rm 1 | Code: YOR19A1574 |

**Decision Modelling & Optimisation - Optimising Decisions For Profit & Success**

**Mr Ben Archer** and **Ms Anne d'Elboux** *(FICO)*

Pricing in retail banking is both an art and a science, it requires tools that help banks attract and retain the right customers while maximising revenue and margins. Pricing managers need instant access to market feedback combined with the ability to immediately develop optimal strategies and get them to market. Decision modelling and optimisation improves business performance by expanding the application of analytics beyond predictions to decisions, while balancing complex business objectives and accounting for uncertainties. It is a precise, data-guided methodology that combines advanced decision analytics, state-of-the-art optimisation, visualisation, simulation, and strategy design, as well as strategy and domain expertise. Decision modelling software empowers business users to create, maintain and control business policies and procedures throughout their operational systems without programming or specialized development packages. These solutions accelerate customer connectivity through ease of integration with analytics, including optimization and simulation. This session will show how the decision modelling and optimisation approach has been used to help clients make better lending decisions, and improve customer profitability. The solution puts price optimisation tools into the hands of decision makers to help make better decisions across a number of different decision areas, origination decisions; per-approved limits, and collections.

What is the nature of your talk?: Very practical

Does your talk require prior knowledge of the subject area?: A little

Is your talk accessible and relevant to Practitioners?: Highly

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| 23/09/2015 : 10:00 : Room 2 Stafford Rm 1 | Code: YOR19A1580 |

**McLaren Applied Technologies: Driving Performance through Innovation**

**Dr Angelico Fetta** *(McLaren Applied Technologies)*

McLaren Applied Technologies works with pioneers in industry, exploiting techniques and methodologies developed in Formula 1 to create novel solutions to complex real-world problems. Analytics is one of the most significant areas of growth at McLaren, with an expanding pipeline of projects from sectors such as healthcare, finance, energy and transport. This presentation offers an introduction to McLaren Applied Technologies, discussing a selection of the decision-support and real-time predictive modelling tools developed.

What is the nature of your talk?: Practical

Does your talk require prior knowledge of the subject area?: None

Is your talk accessible and relevant to Practitioners?: Highly

**CONSULTANCY**



**Organiser: Kuangyi Liu**

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| 23/09/2015 : 09:30 : Room 6 White Hall Rm 3 | Code: YOR19A1562 |

**Big Data, Hadoop and Operational Research**

**Dr Shivam Desai** *(Capgemini)*

In today’s digitally driven world, the challenge for all organisations is to harness the power of big data and analytics to improve their customer experience, operational efficiency and profitability. The volume of data is growing exponentially. As a result, the rate at which data is being produced is far exceeding our traditional ability to extract value from it. New technologies such as Hadoop are helping to address this problem. Hadoop is an open-source software framework written in Java for distributed storage and distributed processing of very large data sets. The session will cover a case study where Capgemini implemented such a solution to help one of our clients use Operational Research techniques with big data. We will also cover the wider project experience in the Business Analytics team at Capgemini consulting.

What is the nature of your talk?: Practical

Does your talk require prior knowledge of the subject area?: None

Is your talk accessible and relevant to Practitioners?: Relevant

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| 23/09/2015 : 10:00 : Room 6 White Hall Rm 3 | Code: YOR19A1527 |

**Quick win through supply chain design**

**Dr Tin Leung** *(LLamasoft EU)*

In recent years, organisations have been trying to reduce their cost in every aspect of their business, in particular, the supply chain operation has become one of the main focus, as it is regarded as one of the low hanging fruit to achieve desire cost reduction. This saving increases in value and become more prominent especially in the multi-international companies, who have expanded their business in the past through acquisitions and market penetrations, as they have a messy and complex supply chain operations. To achieve this, the presenter is going to share his experience in supply chain design and challenges faced with in this kind of projects. In particular, this presentation will base on a consultancy project carried out with a global Petroleum and lubricant company, which has acquired a European company in 2008 but without any supply chain operation change since. The presenter will cover two main themes: the supply chain design, and the consultancy challenges during the project. In addition, the presenter will also share his insights into using commercial tools, such as SupplyChainGuru and Tableau, as well as his learning during his time as a

consultant.

What is the nature of your talk?: Practical

Does your talk require prior knowledge of the subject area?: A little

Is your talk accessible and relevant to Practitioners?: Highly

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| 23/09/2015 : 10:30 : Room 6 White Hall Rm 3 | Code: YOR19A1514 |

**Workforce Planning Modelling at EY, with practical examples of police force capacity**

**planning and roster scheduling in transportation**

**Miss Alexandra Mishenina** and **Mr Joe Wood** *(EY)*

Workforce represents one of the largest costs for most organisations, so being able to plan and manage resources effectively is vital to minimising costs and creating value. We help our clients to identify and allocate the right people, to the right place at the right time to ensure that their business runs effectively. Workforce modelling to support such decision making is complex due to variability in demand drivers (including seasonality), diverse skills sets and the need to respect financial, practical and operational constraints. EY have successfully delivered workforce planning projects for a range of clients in both the public and private sectors, enabling improved strategic, tactical and operational resource management. In this session we will cover two examples in more detail: Capacity Planning in Policing – This project involved building a complex workforce planning model for a police force in the Middle East. The bespoke model analysed demand to calculate staff requirements and generate resource profiles for different functions of the organisation. Roster Scheduling in Transportation – EY developed a roster evaluator tool for a UK airport to measure the suitability of current security staff rosters to satisfy passenger demand. The tool enables the airport to explore the benefits that could be realised by implementing a range of new rosters, as well as analysing the resilience of rosters to future changes in security procedures, passenger volumes and arrival profiles. The presenters are two consultants from the OR team at EY.

What is the nature of your talk?: Practical

Does your talk require prior knowledge of the subject area?: A little

Is your talk accessible and relevant to Practitioners?: Very

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| 23/09/2015 : 11:00 : Room 6 White Hall Rm 3 | Code: YOR19A1558 |

**Using 'Gamification' to improve collaboration and knowledge sharing at EDF Energy**
**Mr Alastair Brown** *(Capgemini)*

Gamification is the use of game thinking to solve problems and motivate and engage employees or customers. The Business Analytics team at Capgemini Consulting recently delivered a successful Gamification project with EDF Energy. Ideas and contributions were crowd-sourced by EDF Energy employees, aimed at saving money and improving the organisation’s performance. The results of the project broke every predefined success criteria. Though not a typical Operational Research technique we will show how Gamification has many similarities to many ‘soft’ OR techniques. We will present what was achieved during the project at EDF Energy and also talk about how Gamification can help in similar situations. We will also talk about what it is like to work in the Business Analytics team at Capgemini Consulting and discuss wider project experience.

What is the nature of your talk?: Practical

Does your talk require prior knowledge of the subject area?: None

Is your talk accessible and relevant to Practitioners?: Relevant

**DATA ENVELOPMENT ANALYSIS**



**Organiser: Konstantinos Petridis**

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| 24/09/2015 : 10:00 : Room 1 Steelhouse LT | Code: YOR19A1503 |

**A Dynamic Framework for Better Queue Management in a large Public Hospital of a**

**Developing Country with no Appointment System: an Application using Data Envelopment Analysis**
**Miss Komal Aqeel Safdar**, **Dr Prasanta Kumar Dey** and **Dr Ali Emrouznejad** *(Aston Business School)*

Queuing is considered as a key efficiency criterion in any service industry, including Healthcare. Despite numerous Healthcare applications, Data Envelopment Analysis (DEA) has not been applied to evaluating queuing systems. Almost all queue management studies are dedicated to improving an existing Appointment System. In developing countries such as Pakistan, there are no appointment systems, resulting in excessive wait times. Additionally overloaded health systems, dearth of resources and cumbersome procedures for patients lead to over-whelming queues. The current study presents a novel application of DEA in evaluating the queuing process of a busy public hospital in Pakistan, where all patients are walk-in. The main aim of this paper is to develop a dynamic framework using DEA, which alerts the hospital management of the moment to moment change in the patient inflow, such that patients have no prior appointments. Among other factors, it was observed that inappropriate allocation of personnel is one of the main factors that affect the queuing situation. Therefore, a flexible framework is proposed which assists the hospital management to quickly determine the efficiency of the system and the required number of personnel at different wait times. Hence, the queuing situation can be controlled pre-emptively, before the queue builds-up excessively. The proposed dynamic framework is easy to implement without any major ‘set-up’ issues. Also, the suggested guideline is generic, and can be implemented in any department in large busy public hospitals of other developing countries, where appointment systems are non-existent, to constantly monitor and improve the rapidly changing queue situation.

What is the nature of your talk?: Practical

Does your talk require prior knowledge of the subject area?: Some

Is your talk accessible and relevant to Practitioners?: Very

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| 24/09/2015 : 10:30 : Room 1 Steelhouse LT | Code: YOR19A1568 |

**DEA/Goal Programming model for Incineration Plants performance in UK**

**Dr Konstantinos Petridis** and **Prof Prasanta Dey** *(Aston University)*

Incineration plants in UK carry out two important tasks: reduction of waste disposed to landfills, and power/heat production from waste incineration distributed to the grid. However, incinerating waste produces, except for desirable outputs like exported power, harmful emissions, too. In this work, a DEA/Goal Programming model is presented to assess the performance of each incineration plant. Data from 22 incineration plants have been collected regarding capacity (waste and power), power exported, annual availability and levels of harmful emissions. The proposed model provides an allocation of the examined incineration plants, by shutting down a plant if it doesn’t meet environmental targets. Additional constraints are considered regarding levels of power exported and annual availability. The model is solved for multiple scenarios regarding the number of incineration plants that will be eventually installed. Results are provided regarding the optimal allocation of each incineration plant and the optimal values of under and over achievement of each environmental target. Additionally, a comparative analysis is conducted on the scores derived from the proposed method and DEA models that handle both desirable and undesirable outputs. No differences between the two rankings are derived by applying statistical analysis.

What is the nature of your talk?: Practical

Does your talk require prior knowledge of the subject area?: Some

Is your talk accessible and relevant to Practitioners?: Very

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| 24/09/2015 : 11:30 : Room 1 Steelhouse LT | Code: YOR19A1504 |

**Assessment of Efficiency among Police Stations in Cagayan de Oro City, Philippines**

**UsingData Envelopment Analysis**

**Dr Rhoda Namoco** and **Mr Alfredo Vicera Jr.** *(Mindanao University of Science and Technology)*
Data envelopment analysis (DEA) is a non-statistical technique which uses a linear programming model for evaluating the performance of decision-making units (DMUs) working under similar conditions and using the same types of inputs to produce the same kind of outputs. In this study, output-oriented DEA Model is used as a tool to evaluate the efficiency of ten police stations in Cagayan de Oro City, Philippines. The number of communication and office equipment, police outposts, administrative police non-commissioned officers, investigative police non-commissioned officers, police personnel, women’s cases investigators, operation vehicles, firearms and investigative equipment; population of police responsibility area, and annual budget were used as inputs, while the number of investigated cases, persons arrested and crime-related cases recorded were used as outputs in this study. Results of the study show that 4 out of the ten police stations considered in this study were found to be less efficient based on the CCR model. Results further provide suggestions for potential improvements for the police stations which were considered less efficient.

What is the nature of your talk?: Practical

Does your talk require prior knowledge of the subject area?: A little

Is your talk accessible and relevant to Practitioners?: Somewhat

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| 24/09/2015 : 12:00 : Room 1 Steelhouse LT | Code: YOR19A1515 |

**Efficiency assessment using Data Envelopment Analysis for Municipal Solid Waste**

**Incinerators in China**

**Dr Konstantinos Petridis** *(Aston Business School)*, **Mr Vinay Dutta Vemula** *(Indian Institute of Technology Kharagpur)* and **Dr Prasanta K Dey** *(Aston Business School)*

In this work an evaluation framework for MSW incinerators is presented. It is evident from the framework that capital investments, material handling capacity and the power generation from the incinerators are highly crucial while developing a MSW treatment facility. Thus a comparison of relative efficiency across MSW incineration facilities in china by using the Data Envelopment Analysis (DEA) is conducted. Also, Comparative statistical analysis between MSW Incineration facilities by looking at the following factors: a) Capital invested, b) Capacity of raw material processed and c) Power generated. DEA is employed to measure the efficiency in each MSW incineration plant. The advantage of this methodology is that it particularly suits for estimating multiple input and multiple output production correspondences. The efficiency calculation can be done appropriate for waste treatment facilities as DEA has gained great popularity in measuring relative efficiency among various business sectors. Observations made on the following will add basis to provide support while evaluating proposals for potential MSW incineration plants because proposing a new plant needs detailed business plan: Material handling capacity, Capital Investment, Net power generation, MSW availability in China, % of MSW currently being processed, Revenue made when selling electricity and stocking MSW. Further to this this study will be able to provide insight into better optimization involving additional treatment and technologies which require investment and may increase the operation cost of incineration plants. Accordingly, the overall performance of an incinerator comprises several dimensions including the efficiencies of waste treatment, electricity production and returns on the invested capital. Thus by providing with an efficiency measure to appraise the performance of incineration plants in China. Further we could explore factors affecting the efficiency of energy conversion in the electricity generation process.

What is the nature of your talk?: Very practical

Does your talk require prior knowledge of the subject area?: A little

Is your talk accessible and relevant to Practitioners?: Highly

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| 24/09/2015 : 12:30 : Room 1 Steelhouse LT | Code: YOR19A1567 |

**Using Data Envelopment Analysis to Identify Best Practice in Delivering Cost-Efficient Good**

**Quality Health Care.**

**Prof Emmanuel Thanassoulis** *(Aston University)*

This talk draws from a project carried out by the authors, using data from the National Health Service (NHS) in England. The aim of the project was to identify and disseminate best practice in terms of delivering cost-efficient good quality health care. The talk will report on the current phase of the project, looking potential savings at inpatient episode level. We have looked at inpatient spells for Chronic Obstructive Pulmonary Disease (COPD) as the unit of analysis. We have analysed 900 episodes pertaining to 500 patients treated at a number of UK hospitals. The analysis sets the length of stay of each spell against the medical condition of the patient and the quality of care received. DEA is used for the analysis in the form of an additive model. The findings suggest there are substantial possible reductions in length of stay which could translate to cost savings. The paper also explores systematic differences in length of stay by providers and by teams within providers.

What is the nature of your talk?: A mix

Does your talk require prior knowledge of the subject area?: Some

Is your talk accessible and relevant to Practitioners?: Relevant

**DEFENCE & SECURITY**



**Organiser: Louise Maynard-Atem**

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| 23/09/2015 : 09:30 : Room 3 Stafford Rm 2 | Code: YOR19A1464 |

**Sense and Sensitivity – a soft solution for hard OR?**

**Dr Cecilia Dahlgren** and **Mr Jan Frelin** *(Swedish Defence Research Agency)*

Analysis methods based on principles of system dynamics have been used in a number of various civil sectors such as business development and planning of urban, environmental, traffic and aid projects. By combining system dynamics with rules of cybernetics, Prof. Vester created the Sensitivity Model – a computerized framework of analytical tools for planning and management of complex systems. In this study we performed a practical and theoretical examination of a variation of Sensitivity Model and assessed its suitability as a tool for military Operational Research in particular. To do this we created an adapted, Excel-based, version of the model and performed a case study of a current conflict situation in Africa. In our analysis of the method we considered aspects such as time and resources required, complexity of execution and the potential for generation of useful results. In our study we identified several O.R.-related application areas where Sensitivity Model could be used as a suitable analysis method. The disadvantages of the method include a relatively high threshold for method learning and competence, time consuming execution and requirement for continuous engagement of all participants. The great benefit of Sensitivity Model is that it helps all stakeholders to understand the system, or problem area, from a larger perspective and to identify their own role in it. The resulting decisions are therefore largely made based on a comprehensive understanding of the system as a whole. Further benefits are the cyclic structure, which enables continuous updating throughout the whole process, and that some of the system tools can be used separetely to perform analysis in a smaller scale for specific needs.

What is the nature of your talk?: A mix

Does your talk require prior knowledge of the subject area?: A little

Is your talk accessible and relevant to Practitioners?: Very

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| 23/09/2015 : 10:00 : Room 3 Stafford Rm 2 | Code: YOR19A1572 |

**Evidence-based Decision Support to Transport Security**

**Miss Karen Chapman** *(Dstl)*

To help combat the threat of terrorism, Dstl provides evidence-based analytical advice across Government to inform decision making on matters of Homeland Security. A significant part of this has been the provision of advice to the Department for Transport (DfT) to inform transport security policy in the Aviation, Land and Maritime environments for over ten years. Operational Research (OR) techniques have been used to assess the impact of making changes to security processes and policies to understand their operational impact. Based on outcomes, potential options can then be taken forward for further investigation if required, or changes in security process implemented directly through policy changes. This presentation will provide a brief overview of the role OR plays in supporting transport security policy decision making within DfT, focusing on two recent examples:

• An assessment of search procedures which involved a combination of computer modelling of an exemplar crowded place, Multi-Criteria Decision Analysis, and Human Factors assessment techniques.

• Guidance on how to best deploy passenger screening equipment in an airport environment in order to optimise its effectiveness. The modelling suite used is varied and includes detailed simulation modelling of the search comb process found at airports. The evidence-based decision support Dstl provides affords DfT and wider Government greater confidence that the implementation of these changes will further enhance the national security of the UK against the threat posed by terrorism.

What is the nature of your talk?: A mix

Does your talk require prior knowledge of the subject area?: None

Is your talk accessible and relevant to Practitioners?: Very

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| 23/09/2015 : 10:30 : Room 3 Stafford Rm 2 | Code: YOR19A1516 |

**Life as an operations analyst in the Swedish Armed Forces**

**Dr Kristofer Hallgren** *(Swedish Defence Research Agency)*

About four months after I started my work as an operations analyst at the Swedish Defence Research Agency I was asked to fill a position at the Armed Forces HQ. In order to prepare for the job I obviously wanted to know more about the typical tasks and problems I would be expected to solve and support. The answer was that there is no such thing as a typical task or problem. Not the answer I expected, but it raised my interest and I accepted the challenge. After almost three years at the C2ISR (Command, Control, Intelligence, Surveillance and Reconnaissance) department at the Armed Forces HQ I now know that there really is no such thing as a typical task, at least not in that department. Instead I would like to present a smorgasbord of some of the different projects I have been involved in. From short and well-defined problems to long-term studies that have kept me busy ever since I started. This includes a technical systems analysis of the Armed Forces Command and Control systems, a requirements analysis of security systems for important infrastructure, development of a space strategy, and concept development for a new national radar chain. Each of them demanded a different approach and new methods to solve the problem at hand. The wide ranging tasks have taught me a lot, not only about different methods but also about the craftsmanship of being an operations analyst. In addition to discussing the approach to these problems I would like to share with you some of the lessons learnt during these first years.

What is the nature of your talk?: Very practical

Does your talk require prior knowledge of the subject area?: A little

Is your talk accessible and relevant to Practitioners?: Very

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| 23/09/2015 : 11:00 : Room 3 Stafford Rm 2 | Code: YOR19A1520 |

**What is the cost of defence?**

**Mr Tommy Lodge** *(Dstl)*

The presentation will cover some of the work undertaken by Dstl in providing independent cost advice to the Ministry of Defence (MOD). It will cover a number of different bespoke tools that have been developed to provide strategic level costs across the whole of the MOD, providing key evidence to support senior decision makers. These tools have been designed to allow rapid turnaround work which is especially important at busy times for MOD such as during a Strategic Defence and Security Review (SDSR). The two main tools that will be covered are; our tri-service costing tool that maps all of the MOD spending to defence outputs; and our affordability tool which assess the long term affordability of the Armed Forces.

What is the nature of your talk?: Practical

Does your talk require prior knowledge of the subject area?: A little

Is your talk accessible and relevant to Practitioners?: Very

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| 24/09/2015 : 11:30 : Room 4 White Hall Rm 1 | Code: YOR19A1529 |

**Addressing the financial implication to the Ministry of Defence of changes to the British**

**Army's Regular / Reserve balance**

**Mr Ashley Smith** *(Defence Science and Technology Laboratory (Dstl))*

With the Ministry of Defence looking to greatly increase the number of Army Reservists available for deployment on operations, whilst reducing the size of its Regular Forces, it is very important that the relative cost of Reserve and Regular Forces is well understood. A team from the Defence Science and Technology Laboratory (Dstl) investigated the cost difference between Regular and Reserve units, in order to understand the comparative cost of training, supporting and deploying Regular and Reserve Forces. The challenges included developing an appropriate and fair cost breakdown for the comparison, as the ways Regulars and Reserves train and are deployed differ greatly; delivering the analysis within a short period of time without compromising on detail and accuracy; and communicating the results at an appropriate level for senior military and civilian audiences. The talk will cover how the team addressed and overcame these challenges, and touch on some of the key lessons learned along the way from the point of view of a MoD analyst early in their career.

What is the nature of your talk?: Very practical

Does your talk require prior knowledge of the subject area?: None

Is your talk accessible and relevant to Practitioners?: Highly

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| 24/09/2015 : 12:00 : Room 4 White Hall Rm 1 | Code: YOR19A1534 |

**Managing Defence Acquisition Growth**

**Mr Ryan Watson** and **Mr David Bangert** *(Polaris Consulting)* and **Mr Neil Davies** *(Defence Economics)*
It is widely recognised that the cost of Defence equipment rises more quickly than the general rate of inflation. Recent work by Defence Economics (formerly DASA-DESA) demonstrated the fact that, in economic terms, Defence capability represents ‘tournament goods’ whereby cost rises to deliver capability greater than that of adversaries. The impact of escalating costs has meant that while repeated Defence Reviews have sought to identify and prioritise the UK’s Defence needs, the planned number of platforms set out in a Review is usually reduced by the time they enter service. Polaris Consulting Limited, working with Neil Davies, former MOD Chief Economist, has studied major Royal Navy acquisitions over the past 50 years, as an exemplar, to interrogate the underlying causes for the frequent reduction in platform numbers, capability or outright project cancellations which have beset the MOD. The work has identified the drivers which have dislocated a large proportion of programmes: including defence inflation, unit acquisition cost escalation, optimism bias and loss of economies of scale. It has built on previous research, assessed approaches taken by other nations and looked at particular case studies to build up a picture of how and why programmes fail to deliver their promised capability. The work has reinforced the need to confront the systemic problems in UK Defence acquisition, and presents suggestions as to where procedures and behaviors should be changed to improve outcomes.

What is the nature of your talk?: A mix

Does your talk require prior knowledge of the subject area?: A little

Is your talk accessible and relevant to Practitioners?: Very

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| 24/09/2015 : 12:30 : Room 4 White Hall Rm 1 | Code: YOR19A1559 |

**Monitoring the Health of the Defence Enterprise**

**Miss Karen Chapman** *(Dstl)*

Whilst methods for organisational performance are widely known and implemented, methods for assessing organisational health are only just emerging but the assessment of organisational health is a growing area of interest. It is recognised as an important source of competitive edge in the private sector, and as an important enabler for resilience and agility in the public sector. This presentation will provide a summary of how Dstl is designing a process to monitor the health of the Defence Enterprise. It will comprise of (i) a review of how health is conceptualised and monitored in other organisations; (ii) a review of how defence currently assesses health and performance; and (iii) an identification of ‘quick wins’ for immediate improvement. The outputs from this work will be used to support the design and implementation of organisational change across the Defence Enterprise.

What is the nature of your talk?: Theoretical

Does your talk require prior knowledge of the subject area?: None

Is your talk accessible and relevant to Practitioners?: Very

**DISASTER MANAGEMENT**



**Organiser: Sara Hasani**

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| 24/09/2015 : 09:30 : Room 3 Stafford Rm 2 | Code: YOR19A1493 |

**Business continuity planning for SMEs in response to natural disasters: A literature review,**

**and future directions**

**Mr Puttipong Anantasopon** *(Brunel University)*

Natural disasters are increasingly imposing the major adverse impacts on businesses, the society, and the environment. All natural disasters can disrupt operations irrespective of the type of organization, and it is hard to predict the time of occurrence, and the level of damage. Not many businesses and in particular, small-medium enterprises (SMEs) can protect themselves, but the business continuity planning (BCP) provides a useful foundation for preparedness and response activities. This research provides a review of business continuity planning literature in the SME context and it aims to find organize the literature review for building crisis plan when responding to natural disasters. All relevance articles in this field are reported and thereafter, the various fields are classified and analysed. This research identifies a number of areas for BCP for SMEs in understanding of response to natural disasters, and how organizational culture, leadership style, and level of resilience affects this response.

What is the nature of your talk?: Practical

Does your talk require prior knowledge of the subject area?: Some

Is your talk accessible and relevant to Practitioners?: Relevant

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| 24/09/2015 : 10:00 : Room 3 Stafford Rm 2 | Code: YOR19A1477 |

**A Time Series Approach for Wave Height Prediction Based on Real-Time Sensor Data.**

**Siobhan Moran, Enda Howley** and **Jim Duggan** *(National University of Ireland)*

In 2014 extreme weather and wave action caused millions of euro worth of damage along the west coast of Ireland. Recent research indicates that the risk of damaging storms along Irelands west coast has increased by 25% as a direct result of human-induced global warming. The primary aim of this research is to design and develop a robust alert based system, capable of predicting wave height for a given time period. This system can deliver many benefits, both for the operational day to day activities and for more extreme scenarios allowing for appropriate precautionary measures to be put in place. On a daily practical level, predictions of wave height will be useful to marine traffic, in planning journeys, routes and berthing windows in port. Our research partners, SmartBay Ireland Ltd., have deployed two buoys off the west and south coast of Ireland. Sensors on the buoys collect – among other parameters - wave and environmental data. In conjunction with tidal and weather data from other sources, this data will be analysed to identify the key indicators for influencing and predicting wave height. The methodology follows the five key steps in forecasting with time series data: problem definition, gathering information, exploratory analysis, choosing and fitting models and using and evaluating a forecasting model. Work to date has involved merging the sensor data sets, conducting exploratory data analysis and forming initial univariate ARIMA models. Future work will involve developing more accurate models and exploring the multivariate perspective. The second challenge of the project involves developing a visualisation system capable of presenting the analysis to key stakeholders through a user-friendly mobile application.

What is the nature of your talk?: Practical

Does your talk require prior knowledge of the subject area?: Some

Is your talk accessible and relevant to Practitioners?: Relevant

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| 24/09/2015 : 10:30 : Room 3 Stafford Rm 2 | Code: YOR19A1483 |

**Nurse Emergency and Disaster Preparedness during Mass Gatherings in public hospitals in**

**Mecca city, Saudi Arabia**

**Mr Fuad Alzahrani** *(King Fisal Hospital in Mecca)*

Background: The city of Mecca in Saudi Arabia has been attracting a large number of Muslim people who come for the pilgrims on a regular basis. This research will examine the emergency preparedness and response of hospital nurses during a mass gathering, namely, Hajj. Since the Hajj is uttered by the astrophysical calendar, which is shorter than the Gregorian monthly calendar, it presents public health strategy planners with a moving objective, demanding stable preparedness. Aims: The aim of this study is to investigate the knowledge and disaster preparedness of the emergency nurses in the emergency departments of all public hospitals in Mecca, Saudi Arabia. Objectives: To investigate the level of awareness and Knowledge of emergency nursing in Mecca city to respond for any case of mass gathering disaster. To develop the roles of emergency nurses and disaster preparedness during mass gathering for the nurses in this city. Research Methods: A cross-sectional survey is proposed to collect data on hospital emergency and disaster preparedness from nurses working in the emergency departments of all hospitals in Mecca, Saudi Arabia. The cross-sectional survey was conducted using a self-administered questionnaire including a combination of structured and open-ended questions. Data analysis: The data collected from the registered nurses was analyzed quantitatively to answer this study's aims. The program SPSS (Statistical Package for Social Scientists) was used in order to analyze the data collected from the field. Results: The results reveal that the participants showed low knowledge levels concerning emergency and disaster preparedness and related issues. However, role understanding was high. Conclusion: This study provides a baseline research for the future of healthcare emergency nurse in mass gathering situations. Also, this study suggests effective strategy required to develop the nurse preparedness during mass gathering disaster.

What is the nature of your talk?: Very practical

Does your talk require prior knowledge of the subject area?: A little

Is your talk accessible and relevant to Practitioners?: Relevant

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| 24/09/2015 : 11:30 : Room 3 Stafford Rm 2 | Code: YOR19A1473 |

**Effective coordination among the agencies for final relief distribution**

**Mrs Priyanka Roy** *(Aston Business School)*, **Dr Pavel Albores** , **Dr Christopher**

**Brewster** and **Dr Chris Owen** *(Aston University)*

Purpose: Last mile relief distribution is the final stage of humanitarian logistics. It refers to the supply of the relief items from local distribution centres to the disaster affected people. In the last mile relief distribution literature, researchers have focused on the use of optimisation techniques for determining the optimal solution, but there is a need to include qualitative factors with those optimisation techniques in order to obtain better predictive results. Among that qualitative techniques, coordination is the most important factor which affect the final relief distribution. In this research coordination among the agencies considers sharing resources among the agencies. The aim of this work is to show that the effectiveness of last mile relief distribution is positively correlated with the degree of coordination. Methodology: There are two stages of the methodology used to achieve the goal. Interviews: The authors conducted interviews with the Indian Government and with South Asian NGOs to identify the critical factors for final relief distribution. After thematic and content analysis of the interviews and the reports, the authors found that coordination is the significant factor which affect the final relief distribution. Model building: Last mile relief distribution in India follows a specific framework described in the Indian Government disaster management handbook. In this research, we modelled this framework using agent-based simulation and investigated the impact of coordination on effectiveness. We define effectiveness as the speed and accuracy with which aid is delivered to affected people. We tested through a simulation modelling whether coordination improves effectiveness. Findings: After analysing the simulation results we found that there is a statistically significant impact in the performance of the model when coordination is included as a factor for the multi-agent system. Also when measuring coordination performance among the increased number of agencies, a significant performance improvement is observed.

What is the nature of your talk?: Practical

Does your talk require prior knowledge of the subject area?: A little

Is your talk accessible and relevant to Practitioners?: Very

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| 24/09/2015 : 12:00 : Room 3 Stafford Rm 2 | Code: YOR19A1462 |

**Evaluation of PREDIS model – a simulation game**

**Mrs Sara Hasani** *(Brunel University)*, **Dr Emel Aktas** *(Canfield University)* and **Dr Ramzi El-Haddadeh**

*(Brunel University)*

The extraordinary conditions of a disaster, induces a phenomena called the proliferation of actors, causing serious problems for disaster response operations. A nobel decision-making platform, PREDIS, is introduced to predict the human impact of a disaster (fatality, injured, homeless) with up to 3% of error. This platform enables the decision makers to estimate the required needs for each disaster and prioritises them based on the disaster type and socio-economics of the affected region/country. To verify this model, a simulation game is designed to replicate a disaster-like situation for a sample group of expert decision makers. To that end a hypothetical case of response is created using a real case scenario of disaster. Using the PREDIS model the impact and the required resources are predicted. A set of 300 randomly created hypothetical partners is provided to the participants. Two sets of decisions and answers by expert and non-expert participants are then compared. Each set contains the decision making scenario before and after using the PREDIS model. The result of the simulation game shows that the PREDIS model enables the user to decide within one hour after the disaster strike using the widely available data at the time of the disaster. It also enables non-expert to decide almost similar to an expert in terms of similarity of the choices and the speed of the decision. Overall, the experts confirmed that in case of prior training they are willing to use PREDIS model in disaster situation and recommend it to the colleagues.

What is the nature of your talk?: Very practical

Does your talk require prior knowledge of the subject area?: Some

Is your talk accessible and relevant to Practitioners?: Highly

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| 24/09/2015 : 12:30 : Room 3 Stafford Rm 2 | Code: YOR19A1463 |

**PREDIS model – A predictive disaster management decision technique**

**Mrs Sara Hasani** *(Brunel University)*, **Dr Emel Aktas** *(Canfield University)* and **Dr Ramzi El-Haddadeh**

*(Brunel University)*

The extraordinary conditions of a disaster requires the mobilization of all available resources. The necessity draws various humanitarian actors with different capabilities into the affected area. This phenomenon, called the proliferation of actors, causes a counter productive effect during the disaster response operation. The aim of this research is to provide a structured review of the partner proliferation problem and suggest alternative courses of action in restructuring the disaster response network. Drawing on the concept of Virtual Organizations, the research concludes that the short-term collaboration is a suitable structure for the response phase. This process requires the careful selection of suitable partners who are compatible with the specific requirements of the disaster situation. Therefore a series of empirical studies are conducted. The first study utilizes the statistical and mathematical predictive techniques including regression analysis , neural network analysis to predict the impact of the disaster. The second study uses the archival data to set a platform for need estimation for the disaster affected population. The third study uses the optimization techniques in combination with a set of 300 hypothetical partners to select the best response candidates. As a result the final PREDIS platform is built upon the historic records of 4252 natural onset disasters since 1980. It is capable to predict the human impact of the disaster (the estimated range of the number of fatality, injured, homeless) up to 3% of error. The PREDIS platform also is capable of estimating the required needs for each disaster. To that end it enables the decision makers to prioritise the needs based on the disaster type and socio-economic characteristics of the affected population.

Using the principles of utility theory the PREDIS platform also renders possible to rank and optimise the desired partner configuration based on the decision maker’s preference.

What is the nature of your talk?: A mix

Does your talk require prior knowledge of the subject area?: Quite a lot

Is your talk accessible and relevant to Practitioners?: Relevant

**ENERGY AND CLIMATE CHANGE**

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**Organisers: Anthony Collins, Jonathan Tecwyn, Bevan Freake, Avishek Banerjee**

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| 22/09/2015 : 14:00 : Room 5 White Hall Rm 2 | Code: YOR19A1480 |

**Using energy systems models to explore the challenge of decarbonising the global economy**

**Mr Ajay Gambhir** *(Imperial College London)*

The AVOIDing dangerous climate change research programme funded by the UK Government includes an in-depth assessment of the feasibility of decarbonising the global economy in line with meeting a range of long term temperature goals. This has necessitated the use of energy systems models, which represent the linkages between the drivers of demand for energy across all major economic sectors, and how that energy is supplied, from mining and extraction to transformation and distribution. The use and analysis of such models can give vital insights into the potential technology transitions that could occur over the coming century, as well as their associated costs. These transitions can then be compared to historical precedents and other benchmarks to establish their real-world viability. This presentation will summarise the insights gained from the AVOID energy system modelling exercises over the last 18 months, with a view to explaining the key conclusions and how they have been determined. In summary, achieving a deep decarbonisation of the world economy in line with a long-term target to limit global warming to 2 degrees C above pre-industrial levels remains feasible, but will necessitate a range of rapid technology transitions which will require a strong global effort across all sectors and technologies. Delaying global action will add significant costs and risks that the target cannot be achieved. Future patterns of low-carbon technology and energy transitions are in many cases in line with historical precedents, but certain transitions, such as the rapid phasing out of certain fossil fuels, will require careful planning in terms of managing stranded assets.

What is the nature of your talk?: Practical

Does your talk require prior knowledge of the subject area?: Some

Is your talk accessible and relevant to Practitioners?: Highly

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| 22/09/2015 : 14:30 : Room 5 White Hall Rm 2 | Code: YOR19A1510 |

**Forecasting the Electrical Demand of a Naval Base and its Warships**

**Mr Ben Ludford** *(CORDA)*

There is a limited amount of electricity available to Portsmouth Naval Base and there may be a significantly increased demand in the future. The reason being the arrival of the largest ships ever built for the Royal Navy. Namely, the two new Queen Elizabeth Class aircraft carriers, ships that are only slightly shorter in length than the height of the Shard. To a lesser extent, the increase is also down to the arrival of other new ships such as the Type 26 Global Combat Ship. All these modern ships are larger and more power hungry than those they replace. If the limit for its supply were breached, there would be problems, not just for BAE Systems (who run the base) and the Royal Navy, but also the city of Portsmouth who share the limited supply. They are therefore all paying close attention to the future electrical demand of the base. A joint team from CORDA and BAE Systems Energy Solutions and Services have constructed a forecasting tool that estimates the peak electrical demand in different scenarios. We have used the forecast to develop an understanding of the future demand and to start to assess the risk of exceeding the supply. This will ensure the design and implementation of the right solutions to meet this demand effectively and efficiently. This talk will cover some of the nuances of the construction of a tool for forecasting the electrical energy requirements of Portsmouth Naval Base, and some detail of the results obtained. It will answer questions like, when is peak demand on a docked naval ship, and what is the cause? And when will there be a risk to demand exceeding supply, not just on the naval base but also on the Island of Portsea, where Portsmouth sits?

What is the nature of your talk?: Practical

Does your talk require prior knowledge of the subject area?: None

Is your talk accessible and relevant to Practitioners?: Highly

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| 22/09/2015 : 15:00 : Room 5 White Hall Rm 2 | Code: YOR19A1497 |

**Modelling to help drive global greenhouse gas emissions reduction targets: workings and**

**inputs of the Global Carbon Finance (GLOCAF) model**

**Mr Duncan Gray** and **Mr Tim Johnston** *(DECC)*

A key objective of the Department of Energy and Climate Change (DECC) is to help drive global ambition to reduce future greenhouse gas emissions. The UK plays an important role in negotiations within the EU and within the United Nations framework. Two DECC Operational Researchers help provide evidence used to support these negotiations and associated policy developments. Some of this evidence comes from the Global Carbon Finance (GLOCAF) model. GLOCAF is an in-house Excel VBA model which finds the lowest global cost options for achieving different sets of international targets. GLOCAF calculates the most cost-effective way for countries to meet their commitments by using an iterative process which finds the carbon price at which the demand of abatement equals supply in each carbon market. It models 24 countries or regions that together have global coverage and 28 sectors which cover emission producing activities (such as agriculture, power, transport and deforestation). This presentation will look at how GLOCAF works and explain two key inputs: business as usual emissions projections; and marginal abatement cost curves. This is the first of two linked GLOCAF presentations, but it does stand alone.

What is the nature of your talk?: A mix

Does your talk require prior knowledge of the subject area?: None

Is your talk accessible and relevant to Practitioners?: Somewhat

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| 22/09/2015 : 16:00 : Room 5 White Hall Rm 2 | Code: YOR19A1499 |

**Modelling to help drive global greenhouse gas emission reduction targets: assumptions and**

**utputs of the Global Carbon Finance (GLOCAF) model**

**Mr Duncan Gray** and **Mr Tim Johnston** *(DECC)*

This presentation builds on the earlier GLOCAF presentation, though it does stand alone. Key assumptions used in modelled scenarios will be discussed, such as country-level emission reduction targets and the future role of international carbon markets. Scenario assumptions are typically set by DECC International Climate Change analysts following discussions with relevant policy leads. Other assumptions required include the coverage or scope of carbon markets and their efficiency; and how much international climate finance is available and how it is allocated. GLOCAF outputs will be used to look at the potential benefits of using international carbon markets and why it might be considered ‘fair’ for a country to take on a target beyond what it intends to do itself. How these outputs are used to support international negotiations, such as the UK’s position at the UN Conference of Parties meeting in Paris this December, and future DECC international policy developments will also discussed.

What is the nature of your talk?: A mix

Does your talk require prior knowledge of the subject area?: None

Is your talk accessible and relevant to Practitioners?: Somewhat

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| 23/09/2015 : 09:30 : Room 5 White Hall Rm 2 | Code: YOR19A1484 |

**Exploring Optimal Pathways for Reducing Emissions - a DECC/UCL joint adventure.**

**Ms Birgit Fais** *(University College London)*, **Mr Bevan Freake** and **Mr Jonathan Tecwyn**

*(Department of Energy and Climate Change)*

The Climate Change Act established a target for the UK to reduce its emissions by at least 80% from 1990 levels by 2050. This target represents an appropriate UK contribution to global emission reductions consistent with limiting global temperature rise to as little as possible above 2°C. To ensure that regular progress is made towards this long-term target, the Act also established a system of five-yearly carbon budgets to serve as stepping stones on the way.   DECC are using the UCL-developed UK TIMES model to explore potential future energy systems and crucially whether the level of emissions for the 5th Carbon Budget (2028-32) recommended by the Committee on Climate Change in December 2015 can be affordably reached. UK TIMES is a least-cost linear optimization model for the whole UK energy system which identifies the system that meets energy needs with the lowest cost, subject to conditions such as building and resource limitations. This allows the exploration of cost-effective reductions to emissions.   This presentation will outline the development of whole system energy modelling at UCL, discuss interesting future energy scenarios, cover the joys (and perils) of a large-scale optimisation model and advise on convincing policy stakeholders of the value of the approach.

What is the nature of your talk?: A mix

Does your talk require prior knowledge of the subject area?: None

Is your talk accessible and relevant to Practitioners?: Very

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| 23/09/2015 : 10:30 : Room 5 White Hall Rm 2 | Code: YOR19A1466 |

**Upside Energy – Using Open Innovation for Portfolio Optimisation**

**Dr Graham Oakes** *(Upside Energy)*

Upside Energy is building a platform to aggregate energy stored in uninterruptible power supplies (UPS), solar PV arrays, electric vehicles, domestic heating systems, etc. It will then use this energy to provide balancing services to grid operators, distribution network operators and energy suppliers. By allowing households and small businesses to access payments for demand response, currently restricted to large commercial and industrial energy users, we can create a significant energy storage facility that can be used to reduce energy costs, lower greenhouse gas emissions, and improve reliability of the grid. Success of this platform depends critically on development of effective algorithms to: a) Predict what will happen on the grid over time windows of 6-24 hours, and then b) Manage our portfolio of storage assets so as to deliver maximum benefits to both the grid and the owners of the UPS, PV arrays, etc. We have chosen to develop these algorithms through open innovation. We will open up our data and compute facilities to researchers, support them to develop useful algorithms, and then provide a route for them to monetise these algorithms through a suitable licensing model. This paper will outline the problems we are trying to solve, both in grid prediction and in portfolio optimisation. It will describe the open innovation platform we are building (with funding from the Department of Energy & Climate Change’s Energy Entrepreneurs Fund) to share data and compute facilities with researchers. And it will discuss the model we are developing to share the benefits of these algorithms with their developers.

What is the nature of your talk?: Practical

Does your talk require prior knowledge of the subject area?: None

Is your talk accessible and relevant to Practitioners?: Relevant

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| 23/09/2015 : 11:00 : Room 5 White Hall Rm 2 | Code: YOR19A1479 |

**Using Soft Systems Methodology to underpin a large scale evaluation**

**Ms Amy Coleman** *(Department of Energy and Climate Change)*

When I was appointed as the evaluator for the Electricity Demand Reduction pilot scheme I was presented with a pile of out-dated policy papers, cryptic ministerial submissions, and a fractious policy team pulling in different directions. To get up to speed on the policy areas, I facilitated a workshop by drawing a rich picture. The workshop helped me and the evaluation contractors get a broader understanding of the wider context and policy aims but also had a number of other benefits. Most notably refocussing the policy team on the objectives they are working towards which contributed to a simplification in their decision making process. Since that workshop I’ve applied Soft Systems Methodology over and over again. It has enabled me to agree a clear statement of policy intents, which the contractors can evaluate against. This clarification has enabled the evaluators to write more impactful research reports which have had more influence over the decisions being made. I am currently using it to clarify the fundamental policy mechanism which I will use to critique the contractors preparation for assessing the additional impact contributed by the policy. In this presentation I will share the lessons about applying Soft System Methodology which I have learnt along the way.

What is the nature of your talk?: Very practical

Does your talk require prior knowledge of the subject area?: None

Is your talk accessible and relevant to Practitioners?: Highly

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| 23/09/2015 : 14:00 : Room 5 White Hall Rm 2 | Code: YOR19A1560 |

**KEYNOTE: Optimising future local energy systems through the itheca project**

**Dr Jim Scott** *(Aston University)*

There is an increasing need to decentralise energy provision in the UK to be able to sustain greater energy demands, reduced capacity in the network and aging centralised infrastructure. The UK has a large number of potential localised generators in the form of combined heat and power (CHP) engines, deployed in a range of commercial, industrial and residential applications. The distributed generators however suffer low utilisation, with an average load factor of 43.5% nationally, especially with the utilisation of recoverable heat. If decentralised energy systems are to play a significant role in the UK, it is necessary to address their current problems in control and integration to other energy sectors, such as the built environment and transport. Intelligent control and optimisation of multi-functional energy systems has the ability to solve these issues. Research has demonstrated many possible theoretical approaches to efficiently controlling systems but this knowledge is rarely if at all adopted by commercial companies in the sector. This creates an excellent opportunity for operational researchers to make a significant practical impact to this growing and important sector. The itheca (intelligent, transport, heating and electrical control agent) project aims to practically address these challenges by commercially demonstrating the benefits of a multi-functional energy system utilising an intelligent control agent. The project is still in the early stages but there have been valuable lessons learnt from collaborating with leading companies in the electricity, heating and cooling, electric vehicle storage and demand side grid response sectors. This keynote presentation will be our opportunity to discuss the project’s aims and objectives in more detail, the wider market issues and possible solutions to localised energy systems and the wider opportunities for operational research.

What is the nature of your talk?: Practical

Does your talk require prior knowledge of the subject area?: A little

Is your talk accessible and relevant to Practitioners?: Highly

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| 23/09/2015 : 14:30 : Room 5 White Hall Rm 2 | Code: YOR19A1539 |

**Modelling Hinkley Point C**

**Mr Andrew Stothart** *(EDF Energy)*

EDF Energy’s Hinkley Point C project is a planned 3.3GW nuclear power station in Somerset. The first nuclear power plant to be built in the UK for over 25 years, it will be capable of providing power to 5 million homes over a 60 year lifetime, contributing to security of supply and the decarbonisation of electricity generation in the UK. The project company will be party to a Contract for Difference for the power it generates as well as a debt guarantee from HM Treasury subject to certain conditions. EDF Energy’s Corporate Finance department have built and developed the Hinkley Point C financial model in-house. The excel-based model encompasses the entirety of the project through construction, operations, and decommissioning. Elements modelled include the revenues arising from the Contract for Difference, the contributions required under the decommissioning programme, and intricate financing mechanics. The model has been used by various stakeholders for purposes including forecasting project returns, performing credit analysis and establishing value for money. This presentation will explore the workings of certain elements of the model, the challenges associated with modelling such a large, complex project, and the uses the model has been put to over the development of the project to date.

What is the nature of your talk?: A mix

Does your talk require prior knowledge of the subject area?: None

Is your talk accessible and relevant to Practitioners?: Relevant

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| 24/09/2015 : 09:30 : Room 5 White Hall Rm 2 | Code: YOR19A1500 |

**Interactive session: an insight into Domestic Policy development using the bespoke National Household Model**

**Dr Kieran Ingram** *(Department of Energy and Climate Change)* and **Ms Phoebe Zhang** *(Department of*

*nergy and Climate Change)*

DECC and CSE (Centre for Sustainable Energy) have been developing the National Household Model for the last couple of years – a bespoke Java-based microsimulation model which simulates domestic energy policies. The entire GB housing stock is described in detail and functionality is being developed to simulate policies as diverse as the Energy Company Obligation, Green Deal, Renewable Heat Incentive, Smart Meters and Feed-In Tariffs, as well as evolving the stock to reflect processes such as houses being built and demolished. The model has an ambitious remit: to simulate DECC’s entire suite of domestic policies and answer blue-sky questions using just one tool. Scenarios are being developed for continual policy development, but also for long term aims such as carbon budget path setting. This interactive tutorial session will give you an introduction to how the model works and train you to develop and run your own domestic energy policies. You will be given a whistle-stop tour of the Policy development process and will compete to see who can come up with the most cost-effective policy. Attendees are encouraged to bring their own laptops to develop and run scenarios if possible.

What is the nature of your talk?: Very practical

Does your talk require prior knowledge of the subject area?: None

Is your talk accessible and relevant to Practitioners?: Relevant

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| 24/09/2015 : 10:30 : Room 5 White Hall Rm 2 | Code: YOR19A1481 |

**New Build, New Opportunity**

**Mr Anthony Collins** *(National Nuclear Laboratory)*

Work has begun on preparing the ground at EDF Energy’s Hinckley Point C site and companies such as NuGeneration and Horizon Nuclear Power are showing interest in other potential locations across the country. The arrival of this Nuclear Renaissance will bring fresh challenges to the industry in areas as diverse as the routing of new power networks to the logistics of their construction and consequently there is plenty of potential for Operational Research to be used. The National Nuclear Laboratory (NNL) plays an important role in the Nuclear Industry both globally and nationally and has a remit to provide independent advice to the UK Government on nuclear matters. For many years the use of Operational Research in the NNL has predominantly been focussed on the back end of the fuel cycle (reprocessing, waste management & decommissioning). However with the prospective building of new Nuclear Power Stations it is the NNL’s obligation to adapt to these changes in the industry. This presentation will focus on the prospective differences in the use of Operational Research between reprocessing, waste management & decommissioning and New Build and what the potential new opportunities will be. Be this adapting established Operational Research techniques or finding new ways to optimise the industry.

What is the nature of your talk?: Practical

Does your talk require prior knowledge of the subject area?: A little

Is your talk accessible and relevant to Practitioners?: Very

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| 24/09/2015 : 11:30 : Room 5 White Hall Rm 2 | Code: YOR19A1537 |

**Current and future challenges of weather and climate modelling**

**Dr Matthew Mizielinski**, **Dr Robert Dunn** and **Dr Nick Dunstone** *(Met Office)*

The vulnerability of population across the globe to weather and climate events is increasing both due to population growth and changes in weather and climate patterns. To meet the needs of society the weather and climate community provide forecasts, projections and advice for use by a wide variety of stakeholders from the general public to the renewables and reinsurance industries, and government departments. In this talk we will introduce the concepts and components used in the construction of a weather and climate model, and outline some of the current and future challenges faced by the Met Office, and our UK collaborators, in (a) developing weather and climate simulations suitable for producing forecasts and predictions on time scales from days to seasons, decades and centuries (b) extracting scientific value from the vast quantities of data produced by weather and climate models.

What is the nature of your talk?: Practical

Does your talk require prior knowledge of the subject area?: None

Is your talk accessible and relevant to Practitioners?: Somewhat

**HEALTH**



**Organiser: Matthew Mildred**

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| 22/09/2015 : 13:30 : Room 6 White Hall Rm 3 | Code: YOR19A1491 |

**The application of analytic hierarchy process to the prioritisation of pharmaceutical field-force job requests**

**Mr Matthew Mildred** *(Boehringer Ingelheim Ltd, Bracknell)* and **Miss Trang Ngo** *(University of Warwick)*
The pharmaceutical industry and the National Health Service (NHS) rely heavily on the interactions of the pharmaceutical field-force with commissioners and prescribers to increase the awareness of innovative therapies, and to bring about prescribing for patients most in need of treatment. Given the finite resources within the pharmaceutical industry, the field-force often has to compete for resources to best meet the needs of NHS customers. The aim of this study was to understand the goals of stakeholders within a given pharmaceutical company, and to develop a framework to prioritise the fulfilment of field-force job requests to better meet customers’ needs with respect to these goals. This paper presents how analytic hierarchy process (AHP) was used to construct a hierarchy of the decision problem in the form of a value tree, including how the relative importance of each job request was evaluated against a set of criteria. The paper describes how criteria for evaluating job requests were elicited from stakeholders and how the weights of each criterion were established through pairwise comparison whilst ensuring logical consistency. The computer model, which was developed in Excel to prioritise field-force job requests using the elicited information and the value tree, is also presented. Job requests were scored against a number of criteria and were ranked according to their overall scores. AHP provided a suitable framework for prioritising business activities given multiple complex characteristics and resource constraints. In a similar manner, this method could also be used by health service professionals to prioritise commissioning and prescribing.

What is the nature of your talk?: Very practical

Does your talk require prior knowledge of the subject area?: None

Is your talk accessible and relevant to Practitioners?: Highly

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| 22/09/2015 : 14:00 : Room 6 White Hall Rm 3 | Code: YOR19A1505 |

**Discrete Event Simulation using Phase-type distributions – an Application to Emergency Medical Care.**

**Miss Laura M. Boyle** and **Prof Adele H. Marshall** *(Queen's University Belfast)*

Hospital Accident and Emergency (A&E) services play a central role in ensuring the efficient delivery of healthcare across the world. The National Health Service (NHS) in the UK have a government mandate that their A&E units should see a minimum of 95% of patients within four hours of arrival. Emergency departments, however, are consistently failing to meet this aim. In June 2015, NHS England bypassed its 100th consecutive week of under-performance. The problem of long waits has been attributed to a growing demand for urgent care and increasingly stretched resources. Patient length of stay (LoS) in hospital is considered a reliable means of measuring the consumption of hospital resources. This research proposes a new method for modelling patient flow in A&E departments, by integrating the discrete conditional phase-type (DC-Ph) model with discrete event simulation (DES) techniques, both of which have previously been used separately for this purpose with relative success. The DC-Ph model consists of a process component conditioned on a causal network; the causal network employs a data mining approach to identify groups of patients with homogeneous LoS characteristics, then modelling the resulting groups using Coxian phase-type distributions which represent the LoS process as the time until absorption of a finite Markov chain in continuous time, where the stochastic process begins in a transient state and there is a single absorbing state. DES models the dynamic evolution of systems over time, where changes in system state occur at discrete time points and provides opportunity for flexible experimentation with operational strategies in the system. The new discrete event simulation technique learns the underlying processes from the LoS data, and supports scenario experimentation for A&E, providing a powerful tool for hospital management. Preliminary results of an application of the approach to local data from a Belfast A&E department will be presented.

What is the nature of your talk?: A mix

Does your talk require prior knowledge of the subject area?: Some

Is your talk accessible and relevant to Practitioners?: Highly

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| 22/09/2015 : 14:30 : Room 6 White Hall Rm 3 | Code: YOR19A1502 |

**Capacity Planning in Speciality Care Clinics with Monte Carlo Simulation**

**Miss Xing Xie** and **Dr Navid Izady** *(University of Southampton)*

Specialty clinics provide specialized and complex care to patients referred from various sources. Due to the complex nature of specialty clinics, such as the existence of routine and urgent demand streams, ever increasing referrals, limited resources, patients' no-shows and cancellations by both patients and hospitals, large backlogs of appointments and consequently long waiting times threaten the efficiency and profitability of the healthcare delivery in specialty clinics as well as patients' satisfaction. In this study, focusing on the first outpatient visit, we aim to provide generic capacity planning models of the appointment system using Monte Carlo Simulation to assist the healthcare professionals to understand current issues and possible future trend. We aim to find the optimal capacity needed to achieve a given target taking into account of no-shows, cancellation and the referrals. The Monte Carlo Simulation is implemented using both stationary approach with empirical distribution and non-stationary approach with innovations state space density forecast. The innovations state space models, which underlie the exponential smoothing methods, enable automatic best model selection from 30 exponential smoothing methods and the extended density forecast reveals the complete insights about future referrals. We expect our models could be improved by future works listed in the end of this study.

What is the nature of your talk?: Practical

Does your talk require prior knowledge of the subject area?: Some

Is your talk accessible and relevant to Practitioners?: Highly

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| 22/09/2015 : 15:00 : Room 6 White Hall Rm 3 | Code: YOR19A1552 |

**Robust Counterpart Optimisation of Operating Theatre Schedules**

**Miss Elizabeth Rowse** *(Cardiff University)*

A major factor contributing to the high number of cancelled operations in hospitals is the unavailability of beds on hospital wards for post-operative recovery. By modelling the impact of the operating theatre timetable, the Master Surgery Schedule (MSS), on the demand for beds and vice versa, an MSS can be produced that results in a reduced number of cancelled operations, while also levelling the demand for beds throughout the week. In this work, a set partitioning formulation has been developed to assign surgical specialties to operating theatres, and constraints on the demand for post-operative beds are also incorporated. A robust counterpart optimisation approach is further investigated in order to address the stochastic nature of the downstream bed requirements. Simulation of the resulting MSS’s is performed in order to measure their robustness. This research is funded by the University Hospital of Wales; illustrative results from applying our methods to this large teaching hospital will be presented.

What is the nature of your talk?: A mix

Does your talk require prior knowledge of the subject area?: Some

Is your talk accessible and relevant to Practitioners?: Somewhat

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| 22/09/2015 : 16:00 : Room 6 White Hall Rm 3 | Code: YOR19A1498 |

**Modelling overall survival in the economic evaluation of oncology treatments**

**Mr Hamish Lunagaria** *(University of York)* and **Mr Matt Watkins** *(Boehringer Ingelheim Ltd, Bracknell)*
Background: Survival is one of the most important clinical outcomes to assess the health and cost effectiveness of oncology interventions. The National Institute of Health and Care Excellence (NICE) require the time-horizon of a cost-effectiveness analysis to be long enough to capture differences in costs and health outcomes between interventions. This often requires extrapolation of survival data to gain long-term projections from trial data. A range of different methods for extrapolating survival data can be seen in Health Technology Appraisal (HTA) submissions to NICE, with varying levels of acceptance. To date there is no consensus view on the best methodology for performing such extrapolation. Objectives: The objective of this study was to evaluate survival modelling within NICE HTA of oncology treatments, and to compare the current survival modelling literature with the survival modelling methodology used by the manufacturer, the Evidence Review Group (ERG) and that preferred by the Appraisal Committee. Methods: Review, the methodology used in NICE oncology HTAs and the conclusions drawn by the ERG and Appraisal Committee. Additionally, review the literature around survival modelling, and compare and contrast the most up-to-date ideas with the methodology used in the NICE HTAs. Results: A number of NICE oncology HTAs were identified, for which the submissions, ERG reports and final appraisal determinations were reviewed. In addition, the current literature around survival modelling methodology was considered, and methods used in HTA submissions compared with views in the literature. Conclusions: A variety of survival modelling methodologies are available when preparing a cost-effectiveness model, and there is continuing debate about which is optimal. It is clear that details of the methodology used should be tailored to each individual case. However, further work is needed to provide a consensus view on the steps to follow when building an oncology cost-effectiveness model for a NICE HTA.

What is the nature of your talk?: A mix

Does your talk require prior knowledge of the subject area?: Some

Is your talk accessible and relevant to Practitioners?: Very

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| 22/09/2015 : 16:30 : Room 6 White Hall Rm 3 | Code: YOR19A1542 |

**Work System Redesign to Reduce Unnecessary Use of Antibiotics in Nursing Homes: A Mixed-**

**methods Study**

**Mr Edmond Ramly, Dr Mozhdeh Bahrinian, Dr Chris Crnich** and **Dr James Ford** *(University of*

*Wisconsin-Madison)* and **Dr David A Nace** *(University of Pittsburgh)*

Inappropriate antibiotic use in nursing homes (NH) is common. We designed a complex intervention with 3 loci of control: pre-prescribing communication, post-prescribing review, and organizational monitoring. In preparation for implementation, we developed and pilot-tested a communication tool to enhance pre-prescribing decision-making. A work-systems analysis in a 90-bed facility and focus groups with administrators and nurses informed 3 iterations to develop the tool. The tool was implemented for 6 weeks. We assessed nurse satisfaction through surveys and interviews. A revised version was implemented for 6 more weeks. Chart reviews provided data on antibiotics started during both pilot phases and 6 weeks prior. Detailed audits (Weeks 1-2, 7-8), provided information about resident changes in condition (CICs) and tool utilization. The pre-pilot work-systems analysis indicated that no criteria or systematic procedures were in place for identifying resident change-in-condition (CIC) or to communicate assessment findings to providers. The pre-prescribing tool we developed standardized the types of information nurses collected during their assessment of the resident experiencing a CIC. The tool also included an embedded decision-support tool to facilitate identification of low-risk change-in-condition with prompts to discourage urinary testing and antibiotics in residents who satisfied low-risk criteria. The tool was streamlined over two iterations and nurse interviews identified a clear preference for final tool versus earlier versions as well as other documentation tools in use prior to the study. Antibiotics were prescribed 13 times before and 6 times after tool use began (19 prescriptions in 12 weeks). Audits identified 38 CICs. Tool utilization occurred in 10 (26%) of CICs. In-depth review found that tool non-use was appropriate in 25% of CICs. This pilot suggests that reducing antibiotic prescriptions using multi-disciplinary communication tools is feasible.

The mixed-methods design provided insight into the context and mechanisms of antibiotic stewardship, in addition to its outcomes.

What is the nature of your talk?: Very practical

Does your talk require prior knowledge of the subject area?: None

Is your talk accessible and relevant to Practitioners?: Highly

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| 23/09/2015 : 14:00 : Room 6 White Hall Rm 3 | Code: YOR19A1486 |

**KEYNOTE: #Vom: Using Tweets to predict rises in Norovirus lab reports and informing an**

**early intervention to reduce them**

**Mr Callum Staff** *(Food Standards Agency)*

This presentation details a practical account of how social media, namely Twitter, data has been used to form the basis of a predictive model. The model will be an early warning tool for rises in Norovirus cases, thus allowing a pre-emptive intervention to be enacted in order to reduce the impact of the virus. The model itself is a logistic regression model. It uses the fortnightly changes in volumes of Tweets containing words relating to Norovirus symptoms to predict whether or not a significant rise in Norovirus cases will occur. The model has been developed for use as an early warning tool through the use of a Receiver Operating Characteristic Curve, in order to maximise the number of accurate predictions made during the early part of the Norovirus season (November to March) and identifies roughly 70% of actual significant rises. Although there are also false-positives, these tend to be during periods when we have a high certainty that Norovirus spikes would be unlikely, so for the purposes of this application are not an overly large problem. Separate to the model itself, the presentation discusses how the Twitter keywords were narrowed from over 100 suggested words and phrases during a brainstorming exercise (anything from #vom to every single spelling of diarrhoea) to 10 workable groups of word volumes correlated to lab report volumes, through a principal component analysis. The work here exemplifies how OR can be combined with the work of other teams within an organisation to provide a novel yet applicable solution.

What is the nature of your talk?: Very practical

Does your talk require prior knowledge of the subject area?: A little

Is your talk accessible and relevant to Practitioners?: Very

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| 24/09/2015 : 09:30 : Room 6 White Hall Rm 3 | Code: YOR19A1471 |

**The Concept of Process-Oriented Healthcare Delivery Model and its Effects on Emergency**

**are Delivery Performance: any lesson to or from the NHS?**

**Mr Ganye Kwah Driscole** *(University of Southampton)*

Accident and Emergency departments (A&E) are parts of the healthcare system designed to response rapidly and provide emergency treatment to people who unexpected fall seriously sick or are involved in a serious accident (NHS England, 2014). In England, any patient seeking healthcare that is considered not very serious is expected to access it from non-emergency departments such as their General practitioners (GP), Walk in centres (WIC), telephone services such as NHS direct, or 111 visit other centres such as urgent care centre, minor injury units and a host of others that emerge time and again (NHS England, 2013; 2014). The essence for this has been to provide a robust and organised process oriented healthcare delivery model easily accessed by both patients and healthcare professionals. However, evidence on the ground has not shown that this design has improved healthcare delivery organisation or processes as expected. Just as in other parts of the developed world, the A&E department in England has been shown to be struggling with increased demand for A&E healthcare, much of which has been defined as non-emergent cases which does not warrant A&E treatment (Freeman et al., 1999; Coleman et al., 2001; McHale et al., 2013; Cowling et al., 2014). Specifically, between 2009 and 2014, there was 6% increase in the demand for A&E healthcare in England (Health and Social Care Information Centre, 2014). Given the negative effects of such increase demand such as over-crowing, pressure on resources, capacity constraints, increased costs, poor outcomes and a generally bad impression about the healthcare system (Agarwal et al., 2012; Wiler et al., 2013), this study is therefore interested in investigating evidence of the existence of process culture in the delivery of A&E healthcare in the NHS.

What is the nature of your talk?: A mix

Does your talk require prior knowledge of the subject area?: None

Is your talk accessible and relevant to Practitioners?: Relevant

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| 24/09/2015 : 10:00 : Room 6 White Hall Rm 3 | Code: YOR19A1512 |

**Dissecting the UK Military Medical Chain**

**Mr Michael Hartley** *(Dstl)* and **Miss Laura Brudenell** *(Dstl)*

For every activity the UK Armed Forces undertake, a critical supporting function is the ability to provide medical treatment to the deployed force. The Defence Science and Technology Laboratory (Dstl) undertakes OR on behalf of the UK Ministry of Defence (MoD), to inform planning to provide all deployed personnel with adequate medical care during operations and exercises. Dstl provides analytical support to current operations, involving medical analysis of operational-critical data in tight timeframes, for example in support of the Ebola crisis in West Africa. Medical OR is undertaken using a variety of methods, ranging from simple spreadsheet analysis to simulation models, in order to estimate both Battle Casualties (BC) and Disease and Non-Battle Injury (DNBI) patients. The analysis makes use of several types of data. Historical data is used for detailed analysis of BC and DNBI rates, which can inform medical planning and doctrine developed by senior MoD decision makers. Hypothetical scenarios used for military planning allow the effectiveness of a scenario’s medical plans to be studied and to identify issues with current, planned and future-funded medical capabilities. Medical capability audits are undertaken regularly with input from experts including military personnel, to highlight gaps in the planned medical capability and procurement decisions, and to support future balance of investment. Medical analysis, through expert judgment, historical analysis or modelling, is undertaken to provide evidence based assessment of medical treatment requirements, including aspects such as casualty evacuation, deployed hospital capacities and transfers between an operational theatre and the UK. This presentation will provide an overview of the OR undertaken by Dstl, to evaluate the UK MoD capability to provide medical treatment to the UK Armed forces. A case study on the work done by Dstl in support of the Ebola crisis in West Africa will also be presented.

What is the nature of your talk?: Practical

Does your talk require prior knowledge of the subject area?: None

Is your talk accessible and relevant to Practitioners?: Relevant

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| 24/09/2015 : 10:30 : Room 6 White Hall Rm 3 | Code: YOR19A1561 |

**Applied Evidential Reasoning in Prognostic Rules for Asthma Control Stages in Children: A**

**ase Study in Manchester**

**Miss Huaying Zhu**, **Prof Jian-bo Yang** and **Prof Dong-ling Xu** and *(University of Manchester)*

The UK has highest death rate from asthma in Europe, but it is difficult to distinguish wheezing and asthma for children and it is vague to identify asthma control stages in current official guideline of asthma managements. Since not every patient has all records, the database contains a large proportion of missing values. Here, six pieces of evidence are chosen and only two patients have all these six records. They lead to comparatively limited powers and quite low accuracies of decision tree analysis, logistic regression, artificial neural network, Bayes’ rule and support vector machine. Evidential reasoning (ER) rule is chosen to learn prognostic rules for asthma control stage because instead of treating individual patient as one case, it is based probabilistic inference on hypothesis space. The results present asthma control stages with all possible combinations of evidence. Hence, it could help new patients to identify their asthma control stages and receive corresponding treatments, whilst existing patients could realise which stages they are on and then monitor their stage-changing.

What is the nature of your talk?: Practical

Does your talk require prior knowledge of the subject area?: A little

Is your talk accessible and relevant to Practitioners?: Relevant

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| 24/09/2015 : 11:30 : Room 6 White Hall Rm 3 | Code: YOR19A1545 |

**Work System Redesign to Adapt a Hypertension Protocol for Specialty Clinics**

**Mr Edmond Ramly** and **Dr Christie Bartels** *(University of Wisconsin-Madison)*

Despite routine measurement by staff, we reported that specialists discussed elevated blood pressures (BP) in <1/3 of visits. We aimed to engage clinic staff in work system redesign (WSR) to develop and implement a BP protocol adapted to specialty care. We report WSR results of under the work system domains: people, tools, organization, environment, and tasks. Our multidisciplinary team engaged clinic staff in WSR. Three 1-hour focus groups appraised pre-visit rooming workflows and our proposed electronic health record (EHR) tools. Staff participated in a 45-min group session on BP, and one-on-one 15-min EHR training sessions. We monitored fidelity through EHR data and provided monthly individual audit feedback. These brief sessions focused on goal-setting and staff-driven problem-solving. Three later focus groups offered us evaluative feedback and suggestions for improvements. We also administered a retrospective anonymous 15 item staff questionnaire after pilot testing. Over 90% of staff participated in focus groups. Content analysis of the focus groups informed the development and implementation of WSR interventions (Table 1). The WSR included training (people), protocol and workflows adapted to specialty care (organization, tasks), a customized EHR alert for elevated BP and EHR follow-up order set (technology), and supportive physical cues like a desktop patient brochure linking rheumatologic conditions and heart risk (environment). Four monthly audit/feedback sessions with 10 regular staff identified barriers and solutions. All staff met progressively higher goals and achievement (2% to 75% re-measurement and 0 to 20/month follow-up orders). In evaluative focus groups staff voiced satisfaction and suggested pragmatic changes including BP re-measurement cue cards and EHR alert revisions. Questionnaires showed improved self-efficacy post-intervention (2.5 to 4 on 5-point Likert). Collaborative WSR resulted in successful modification and implementation of a BP protocol for specialty care. Results suggest sound intervention feasibility including improved staff self-efficacy and improved BP re-measurement and follow up orders.

What is the nature of your talk?: Very practical

Does your talk require prior knowledge of the subject area?: None

Is your talk accessible and relevant to Practitioners?: Highly

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| 24/09/2015 : 12:00 : Room 6 White Hall Rm 3 | Code: YOR19A1544 |

**Interactive Planning to Benchmark Assisted Living Facilities Quality**

**Mr Edmond Ramly** *(University of Wisconsin-Madison)*

Assisted living facilities in the US lack systems to measure and improve quality of care and patient satisfaction like those used by hospitals and nursing homes. Reasons include heterogeneity of populations and services provided, absence of federal regulations, and limited use of electronic health records. A learning and adaptation support system was developed (wcceal.chsra.wisc.edu) using interactive planning with a public-private circular organization. A performance measurement system for participating facilities was developed and implemented, consisting of an annual patient satisfaction survey and a quarterly facility survey about quality improvement structure, process, and outcomes. Open-ended questions were used to complement the quantitative benchmark data. In 2013, the patient survey was taken by 3444 of 5817 patients in 180 facilities, and the facility survey was taken by 274 facilities, resulting in 1918 responses to 7 questions. Content analysis was used to code the patient text responses by pre-defined topic and by attitude (positive or negative). In descending order of mentions (# mentions, % negative): meals and dining (375 mentions, 88% negative), overall (355, 1%), staff (331, 53%), activities (203, 84%), environment (196, 57%), health management/care (193, 47%), rights (69, 88%). Proposed survey modifications address key negative responses (30%). Content analysis was used to code the facility text responses. 222 codes were identified inductively. Deliverables included, histograms, pie charts, and tables, as well as a detailed conceptual framework synthesizing the results, and 53 proposed quantitative survey questions. The current state of assisted living quality improvement reflects diverse structures and processes to define, measure, and improve quality and terminologies to describe them. This analysis contributed a quantified conceptual framework and proposed survey modifications expected to support gathering more relevant quantitative data, increasing systematic understanding of assisted living quality, and shortening data analysis time to be able to provide more timely and responsive feedback to facilities.

What is the nature of your talk?: Very practical

Does your talk require prior knowledge of the subject area?: None

Is your talk accessible and relevant to Practitioners?: Highly

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| 24/09/2015 : 12:30 : Room 6 White Hall Rm 3 | Code: YOR19A1482 |

**Health improvement in horses using simple budget impact analysis**

**Mr Nikco Hau** and **Mr Sam Mettam** *(Boehringer Ingelheim Limited)*

Introduction: Pituitary Pars Intermedia Dysfunction (PPID) is a common problem affecting the endocrine system in horses. The disease can cause laminitis, a painful condition in the feet and hooves. Diagnosis is based on a simple blood test and effective treatment is available. However, there is a lack of awareness of the disease and therefore many horses remain undiagnosed and at risk of developing this painful condition. The aim of the project is to encourage more testing and improve health outcomes of horses with PPID. Method: Budget impact analysis is widely used in human health care, but rarely in animal health. In this project, a budget impact model was developed to incentivise PPID treatment in horses by veterinary practices. Practices were sponsored to carry out initial tests. This allowed data collection in horse population in order to obtain disease prevalence and the number of horses that can be treated. Results: The budget impact analysis encouraged more vets to test horses. There was great detection rate which led to increase in treatment and better health outcomes in horses with PPID. This project has shown that animal health improvement is achievable in the business environment of privately owned practices. Conclusion: Budget impact analysis can be utilised in animal health. It has been shown in this project to improve health outcomes in horses and has positive impacts to the owners, veterinary practices and the manufacturer.

What is the nature of your talk?: Practical

Does your talk require prior knowledge of the subject area?: None

Is your talk accessible and relevant to Practitioners?: Relevant

**METAHEURISTICS**



**Organiser: Neil Urquhart**

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| 24/09/2015 : 10:30 : Room 2 Stafford Rm 1 | Code: YOR19A1575 |

**Designing Metaheuristics: How Does This Influence Applicability?**

**Miss Alina Patelli**, **Dr Nelly Bencomo,** **Dr Aniko Ekart** , **Dr Harry Goldingay** and **Dr Peter Lewis**

*(Aston University)*

Metaheuristics are powerful, high level methods meant to generate or select, out of a given set, the one heuristic (stochastic tool) best suited to solve a (decision making, optimisation, modelling, etc.) problem. The research literature provides substantial proof of the efficiency of metaheuristics as (automated) analytical tools applied to problems of increased complexity, where the available data is incomplete and/or noisy and an acceptable solution has to be found in a finite time horizon. This situates metaheuristics well within the scope of the broader field of operational research. Within ALICE (Aston Lab for Intelligent Collectives Engineering), we are interested in many facets of metaheuristics and their applications, ranging from autonomous systems, intelligent agents and smart homes to semantic technologies and computational intelligence. We find that hybrid metaheuristics are of particular usefulness, given that they harness the power of several search algorithms throughout the optimisation process. For the successful application of hybrid metaheuristics (especially in safety critical domains), the manager (i.e., the component deciding which search method to apply at a given stage of the optimisation process) requires some level of access to the inner state (model) of each search procedure (e.g., how solutions are generated and evaluated) as well as to the problem domain itself (information about nonlinearity, noise, multidimensionality/complexity, etc.). In our most recent work, we have analysed the impact that that level of access has on the coupling between different metaheuristic components (the manager, searchers, evaluators, etc.). This effort has produced a new design pattern proposition for metaheuristics, where the evaluation of potential solutions is based on utility metrics, aimed to provide a comparable measure for solutions generated by entirely distinct heuristics (such as hill climbing and evolutionary algorithms), in a way that decreases coupling between their inner state and the manager.

What is the nature of your talk?: Theoretical

Does your talk require prior knowledge of the subject area?: A little

Is your talk accessible and relevant to Practitioners?: Relevant

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| 24/09/2015 : 11:30 : Room 2 Stafford Rm 1 | Code: YOR19A1555 |

**Using Iterated Greedy Local Search with Simulation to Solve the Vehicle Routing Problem**

**with Stochastic Demand.**

**Mr Abdulwahab Almutairi**, **Prof Dylan Jones**, **Prof Angel Juan**, **Banfsheh Khosravi** and **Dr**

**Jamila Ouelhadj** *(Portsmouth University )*

We consider the Vehicle Routing Problem with Stochastic Demand (VRPSD) in which customers’ demands are stochastic. We propose to model and solve the VRPSD by developing a robust optimisation model with a sim-heuristic solution method that allow us to minimise the transportation cost while satisfying all demands in a given bounded uncertainty set. The sim-heuristic algorithm combines Monte-Carlo Simulation with randomised Clarke and Wright heuristic in order to efficiently solve the VRPSD combinatorial optimisation problem. Computational experiments have been conducted on benchmark problems from the literature. The results validate the efficiency of the robust optimisation model with the sim-heuristic solution method in generating very good quality solutions compared to those in the literature.

What is the nature of your talk?: A mix

Does your talk require prior knowledge of the subject area?: Some

Is your talk accessible and relevant to Practitioners?: Somewhat

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| 24/09/2015 : 12:00 : Room 2 Stafford Rm 1 | Code: YOR19A1540 |

**Weights Distribution and Instance Hardness: A Study of Number Partitioning and Knapsack Problems**
**Miss Khulood Alyahya** and **Prof Jonathan Rowe** *(University of Birmingham)*

In our work we try to answer the following research question: Given a problem instance can we decide what is the most suitable move operator to use with iterated local search? We study two NP-hard problems: number partitioning problem (NPP) and the 0-1 knapsack problem (KP). Both problems have many practical applications such as multiprocessor scheduling, public key encryption, inventory allocation, stock cutting, and combinatorial auctions. We empirically analyse the problem’s search space in connection with a neighbourhood structure defined by a move operator over it. The two move operators studied are the 1-bit flip (H1) operator, and the move operator that flips either one or two bits (H1+2). We randomly generate instances with weights drawn form different distributions, unlike most existing studies where instances have uniformly drawn weights. We found that the instance difficulty varies between the different distributions and that each move operator significantly outperforms the other on particular distributions. The next question that arises naturally is: Given an instance of KP or NPP with unknown weights distribution, what is the best search operator to use? We found that the coefficient of variation of the weights (CV), which can be easily computed by dividing the standard deviation over the mean, captures the variation in instance difficulty between the different distributions. We show how the CV can be used to guide the selection of the best move operator for a given instance. We, also, propose a formula to estimate the average number of local optima when using the H1 move operator based only on the problem size and the CV.

What is the nature of your talk?: A mix

Does your talk require prior knowledge of the subject area?: Some

Is your talk accessible and relevant to Practitioners?: Relevant

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| 24/09/2015 : 12:30 : Room 2 Stafford Rm 1 | Code: YOR19A1532 |

**A new Artificial immune system for multi-objective optimization**

**Mr Ayush Joshi**, **Prof Jonathan Rowe** and **Dr Christine Zarges** *(University of Birmingham)*

In this presentation we present a new artificial immune system designed by taking inspiration from cutting edge research in immunology which we use to solve multi-objective optimization problems. The new algorithm, called the germinal centre artificial immune system (GC-AIS) incorporates desirable features from the immune system such as inherent parallelism, dynamic population and memory. Based on experimental comparison with a simple evolutionary optimiser we show that the GC-AIS performs better on the set-cover problem which has applications in location, distribution and scheduling problems. The GC-AIS requires relatively few parameters and uses less communication effort but suffered from the problem of population explosion. We proposed a variant of GC-AIS to mitigate this issue of population explosion and compared the variant with the state of the art MOEA, NSGA-II on the multi-objective knapsack problem which has real world applications in budgeting and resource allocation. Based on our results we show that the GC-AIS variant performs better than NSGA-II for this problem. Finally, learning is a key component of the immune system which we are interested in investigating. We present some experimental results where we have shown the benefits and drawbacks of incorporating memory when trying to solve the set-cover problem in a dynamic scenario. By incorporating simple memory techniques we are investigating the performance of GC-AIS and will present ongoing experiments where we are trying to answer questions like when is using memory useful?
What is the nature of your talk?: Practical

Does your talk require prior knowledge of the subject area?: Some

Is your talk accessible and relevant to Practitioners?: Relevant

**MULTIPLE CRITERIA DECISION ANALYSIS (MCDA)**



**Organiser: Shane O Meachair**

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| 22/09/2015 : 16:30 : Room 5 White Hall Rm 2 | Code: YOR19A1548 |

**Applying Multiple Criteria Decision Analysis (MCDA) in the context of HTA: a case study on**

**metastatic colorectal cancer with multiple stakeholders**

**Mr Aris Angelis**, **Dr Panos Kanavos** and **Dr Gilberto Montibeller** *(London School of Economics and*

*Political Science)*

Objective The objective is to apply in practice an MCDA framework for the value assessment of a set of therapeutic options for metastatic colorectal cancer (mCRC) through an HTA simulation exercise with the participation of all relevant stakeholders in England. The drugs assessed are aflibercept in combination with FOLFIRI, cetuximab monotherapy, and panitumumab monotherapy. Methods Using MCDA principles, past research outcomes and the clinical and economic literature, a mCRC-specific value tree was constructed incorporating the values concerned as criteria. Overall 9 attributes were included in the analysis, the different drugs were scored against the criteria through the development of value functions, weights were assigned to the criteria using a swing weighting method, scores and weights were combined using an additive aggregation approach, and sensitivity analysis of the results was conducted. All stages were informed through the participation of 13 stakeholders (including health care professionals, methodology experts and patients) at a decision conference workshop. Results Value parameters considered spanned the dimensions of therapeutic impact, safety profile, innovation level and socioeconomic impact. Overall value scores were produced reflecting the performance of the drugs against the criteria while considering their relative importance. Cetuximab produced the highest overall value score, followed by panitumumab and then by aflibercept in combination with FOLFIRI. Hypothetical payer’s resource allocation decisions on the coverage of the drugs were made based on “value for money” grounds through the use of “cost-per-unit of value” that was derived by incorporating purchasing costs. Conclusion MCDA possesses the prerequisites of a value based assessment methodological framework. The multiplicity of criteria that can be incorporated to assess value, the weights that can be applied to the criteria, and the stakeholders’ involvement across every stage, all of which are fully transparent, provides a unique combination of broadness, resilience and inclusiveness making it an ideal decision making tool.

What is the nature of your talk?: Practical

Does your talk require prior knowledge of the subject area?: A little

Is your talk accessible and relevant to Practitioners?: Relevant

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| 22/09/2015 : 17:00 : Room 5 White Hall Rm 2 | Code: YOR19A1576 |

**Uncertainty in Multi-Criteria Decision Analysis**

**Mr Shane Ó Meachair** *(Trinity College Dublin)*

Introduction To explore methods of handling data, parameter, and model uncertainty in Multi-Criteria Decision Analysis (MCDA) models. Methods Stochastic sampling methods and approximate computation are used to quantify uncertainty in MCDA models. The methods were applied to datasets of past decisions to estimate model parameters in a preference disaggregation setting. Pilot studies were also conducted to assess feedback given in future decisions. Results MCDA methods which account for uncertainty can give useful feedback to decision makers (DMs). Stochastic preference disaggregation methods give information about factors which influenced previous decisions. These methods also inform current decisions by giving DM’s information on how model assumptions affect the current decision, and the sensitivity of the results to model structure and parameter values. Conclusions MCDA methods which account for uncertainty give important information to decision makers regarding past and future decisions.

What is the nature of your talk?: A mix

Does your talk require prior knowledge of the subject area?: Some

Is your talk accessible and relevant to Practitioners?: Very

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| 22/09/2015 : 17:30 : Room 5 White Hall Rm 2 | Code: YOR19A1517 |

**Police officer dynamic positioning for effective incident response and community presence**

**Miss Johanna Leigh**, **Dr Sarah Dunnett** and **Dr Isa Jackson** *(Loughborough University)*

The UK Police Forces are currently facing funding cuts due to the countries present state of austerity. With these cuts it is vital resources are utilised to their highest possible efficiency. One area where this is of utmost importance is incident response as a timely response is imperative to ensuring the public’s safety. To increase the efficiency of incident response the officers should be positioned to give the best possible area coverage; taking into account where other officers are and what areas can be reached within the recommended response times. This positioning problem is more complex than ambulance positioning as the police must also be visible to the public to assist in deterring crime and increase the public’s feeling of safety. In this work areas where it would be effective to have an officer presence are identified by hot spot analysis using Kernel estimation with historical incident data. This identifies problem areas which have high levels of incidents, which can be deterred by the presence of an officer, such as anti-social behaviour, theft and robbery. These hotspots are also time and day dependent. It has been proven by West Midlands Police that directed patrols to hotspot locations can deter crime. This research takes directed patrol routes a step further and incorporates this method of patrolling into the dynamic positioning of police officers for efficient patrolling and officer response. This is all performed using a computer program designed in MATLAB to advise officers on the patrol route which will be the most efficient use of their limited time. If implemented the benefits of dynamic patrol routing are a decrease in incident response times and decrease in incident levels in hotspot areas. This work has benefited from the collaboration with Leicestershire Police Force.

What is the nature of your talk?: A mix

Does your talk require prior knowledge of the subject area?: None

Is your talk accessible and relevant to Practitioners?: Relevant

**OPTIMISATION**

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**Organisers: Oscar Rodriguez-Espindola and Kostas Petridis**

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| 22/09/2015 : 13:30 : Room 4 White Hall Rm 1 | Code: YOR19A1494 |

**KEYNOTE: Pricing optimization advances and opportunities in the airline industry**

**Mr Michael Benborhoum** *(British Airways)*

The presenter introduces several modern pricing concepts used in the airline industry, then leads a discussion on a pricing optimization case study and further research opportunities. In the proposed case study, a generic airline formulates a pricing optimization problem as a nonlinear program with the objective of maximizing revenue for a given route. The motivation is to propose a novel practitioner's approach to pricing optimization compared to more traditional empirical settings in the industry. The model incorporates discrete pricing points as decision variables and several key business rules as constraints. The problem is solved using the generalized reduced gradient algorithm for optimizing nonlinear programs. A numerical application example highlights a 3.8% revenue improvement, or several million dollars of incremental revenue, relative to the case where one considers only inventory decisions. The program calculates an optimal solution within a second, allowing one to perform various what-if scenarios and ultimately bring further automation to the pricing decision process. Finally, the presenter discusses further academic research that extends the potential benefit of pricing optimization in the airline industry. In particular, one might want to apply pricing optimization techniques to complex interconnected route networks whilst adopting a more tailored customer-centric approach. In the last two decades, innovation in pricing decision support systems has not developed as extensively as in other revenue management areas. Therefore this offers exciting opportunities for further practical research and application in the industry. Although analytical models and concepts are included, this presentation is mostly practical, inspired by the presenter's industry experience as a pricing lead and operational research consultant for a major airline. This work does not reveal any specific British Airways' practices or data; views in this presentation are the author's own based on general industry concepts and public literature.

What is the nature of your talk?: Practical

Does your talk require prior knowledge of the subject area?: Some

Is your talk accessible and relevant to Practitioners?: Very

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| 22/09/2015 : 14:30 : Room 4 White Hall Rm 1 | Code: YOR19A1475 |

**Disaster preparedness and response from a multi-organisational perspective**

**Mr Oscar Rodrigues-Espindola**, **Dr Pavel Albores** and **Dr Christopher Brewster** *(Aston University)*

The elevated number of disasters globally combined with high marginalization and vulnerability levels in many countries are stressing the importance of efficient and effective disaster management. Disasters are extraordinary situations that require significant logistical deployment to transport equipment and humanitarian goods in order to help and provide relief to victims. Therefore, the field of emergency logistics is acquiring a crucial role aiming to provide adequate care and support for people affected by catastrophic situations; dealing with a large number of stakeholders, scarcity of resources and high stakes. Given the challenges posed by disaster management for decision-making, Operational Research has proven to be a valuable support to address several of the logistical activities. Considering the geographical nature of floods, the use of Geographical Information Systems (GIS) can provide interesting insights to include in the decision-making process. Hence, this research introduces a combination of GIS with multi-objective optimization to develop a system for disaster management, considering multi-organisation collaboration for the location and operation of emergency facilities, along with the pre-positioning of relief commodities and decisions related to distribution after the disaster. Using multi-objective optimisation a preparedness and response optimisation models were designed incorporating measures of cost and the level of service provided to victims in location decisions, moving away from the general trend of physical performance measures. To assess the performance of the system, a case study based on the flooding at the city of Acapulco, Mexico in 2013 was analysed. The results obtained showed some of the problems yielded by poor disaster management in the past and exhibited the advantages of the inclusion of the GIS and multi-agency collaboration, along with the use of multiple criteria for effective and efficient disaster management.

What is the nature of your talk?: A mix

Does your talk require prior knowledge of the subject area?: Some

Is your talk accessible and relevant to Practitioners?: Relevant

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| 22/09/2015 : 15:00 : Room 4 White Hall Rm 1 | Code: YOR19A1581 |

**Optimal staff allocation for local police force**

**Miss Hanjing Zhang**, **Dr Sarah Dunnett**, **Dr Lisa Jackson**, **Prof Jiyin Liu** and **Dr Antuela Tako** *(Loughborough University)*

Due to the squeeze on public expenditure, local police forces have been faced to cut their budgets since 2010. These reductions provide a great impetus for investigations on more effective allocation of staff, especially the patrol officers in the immediate response service system. Patrol officer workforce management is a complex and serious problem because poor staffing has substantial impacts on operations cost, service quality and public safety. It is often seen as a process consisting of three sequential phases which are identification of demand for staff, staff roster scheduling and roster assignment. This project details the complexities and constraints of the patrol officers’ work pattern. The aim is to provide a general framework for workforce management in the service system. Queuing theory as the theoretical basis is applied for the system initialisation. Discrete optimisation via simulation is incorporated to guide the improvement of the stochastic system performance, especially to determine the staff levels based on the numbers of incidents requiring immediate responses. A branch and price algorithm is proposed to generate high quality rosters which not only meet the demand for the patrol officers but also take the officers' working preferences into account. The trade-off among system performance, staff availability and roster quality will be discussed based on the experimental results.

What is the nature of your talk?: Theoretical

Does your talk require prior knowledge of the subject area?: Some

Is your talk accessible and relevant to Practitioners?: Very

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| 22/09/2015 : 16:00 : Room 4 White Hall Rm 1 | Code: YOR19A1566 |

**Batch Optimisation**

**Mr Nikolas Stockbroekx** and **Dr Emel Aktas** *(Cranfield School of Management)*

Coordinated lot-sizing problems are common in supply chain management and are often applicable to certain manufacturing, transportation and procurement contexts where products in the same family share a joint setup cost. Lot-sizing problems help to decide when and how much needs to be replenished (both through procurement and/or production) in order to minimise the sum of setup costs and inventory holding costs. In this research, a variant of the coordinated uncapacitated lot-sizing problem with dynamic demand is developed that represents the unique case of a UK company from the process industry. Products of the same family can be produced simultaneously in the same vessel and in several work centres. Each work centre has a different capacity (volume of the vessels) and setup costs depend on the work centre. Specific routings determine which work centres are available for each product family. Product families consist of products with different tin sizes hence the total requirement needs to be converted into litres and kilograms. Moreover, production quantities need to respect the norms (such as mass constraints) imposed by the available work centres. The outcome is a mixed integer linear programming formulation which is solved in IBM CPLEX. The problem is solved for each product family which takes on average 2 minutes. The results not only help to decide which vessels to use but also give an indication of which vessel sizes should be acquired in the future.

What is the nature of your talk?: A mix

Does your talk require prior knowledge of the subject area?: A little

Is your talk accessible and relevant to Practitioners?: Relevant

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| 22/09/2015 : 16:30 : Room 4 White Hall Rm 1 | Code: YOR19A1524 |

**A first-order multigrid method for convex optimization**

**Mrs Sudaba Mohammed** and **Mr Michal Kocvara** *(University of Birmingham)*

The aim of this talk is to design an efficient multigrid method for constrained convex optimization problems arising from discretization of some underlying infinite dimensional problems. Due to problem dependency of this approach, we only consider bound constraints with (possibly) a linear equality constraint. As our aim is to target large-scale problems, we want to avoid computation of second derivatives of the objective function, thus excluding Newton like methods. We propose a smoothing operator that only uses first-order information and study the computational efficiency of the resulting method.

What is the nature of your talk?: Practical

Does your talk require prior knowledge of the subject area?: Some

Is your talk accessible and relevant to Practitioners?: Relevant

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| 23/09/2015 : 14:00 : Room 3 Stafford Rm 2 | Code: YOR19A1549 |

**KEYNOTE: Multiple Optimisation methods for marine renewable energy**

**Dr Dylan Jones** *(University of Portsmouth)*

This seminar will detail the author’s work developing multiple objective optimisation models for the logistics of the offshore wind industry. The seminar will first provide an overview of multi-objective situations arising in this sector including supply chain optimisation, port-choice, installation scheduling, and maintenance scheduling models. Two specific models will then be presented. The first model is concerned with location analysis of UK Round 3 wind farm sites. An extended goal programming model will be built that considers socio-economic, technical, and environmental objectives. A weight sensitivity analysis method is applied and the results described. Overall conclusions regarding the use of quantitative models for decision support in the offshore wind industry will be drawn. The second model uses compromise programming to scheduling vessels during the construction phase of the offshore wind farm. The model considers the bi-objective cost-time trade-offs. The solution algorithms developed and results obtained will be described. Finally, the seminar will close with observations about the use of optimisation in the marine renewable energy and other developing sectors.

What is the nature of your talk?: A mix

Does your talk require prior knowledge of the subject area?: A little

Is your talk accessible and relevant to Practitioners?: Relevant

**OR & STRATEGY**



**Organiser: Diogo Quintas**

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| 22/09/2015 : 13:30 : Room 3 Stafford Rm 2 | Code: YOR19A1511 |

**Engineering Manpower Modelling Application**

**Miss Samantha Wyss** *(CORDA)*

Headquarters Air Command must ensure sufficient Aircraft Engineering Personnel at a Suitably Qualified and Experienced Personnel (SQEP) level are available, through the Aviation Duty Holders, to maintain Airworthiness of a range of frontline and training aircraft types. This requires careful management of human capability, in terms of manpower, to ensure future needs are anticipated and accounted for. Coupled with this a robust understanding of the impact of future decisions/changes to approach on personnel numbers and type is required to inform senior decision makers. Air Command required a simple yet robust and efficient engineering manpower spreadsheet model, which would allow them to explore the impact of decisions on maintenance personnel levels, for example in a deployment situation, and how this would affect their ability to complete the required flying output. On the reverse, the model also needed to be able to show the required manning levels to achieve a flying task in order to assist with planning. The model has been designed in such a way that it is flexible and can be transferred to any organisation that has maintenance elements. This paper will present the approach of the study and how the model can be utilised to provide decision support, aid strategic decisions, and drive operational improvements.

What is the nature of your talk?: Theoretical

Does your talk require prior knowledge of the subject area?: A little

Is your talk accessible and relevant to Practitioners?: Somewhat

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| 22/09/2015 : 14:00 : Room 3 Stafford Rm 2 | Code: YOR19A1551 |

**Application of OR Methods in Cooperative Game Theory and a Proof of the Eurozone**

**Information**
**Mr Yupei Zhong** *(University of Southampton)*

This paper gives an outline of cooperative game theory in the perspective of economics and how operational research tools, including linear programming and dynamic programming, are applied in this domain. Then, it uses the currency composition of official foreign exchange reserve (COFER) as key indicator and proves that the formation of Eurozone is the equilibrium of cooperation gaming. As there is few academic literature employing cooperative game theory to analyse Euro issues, this paper provides an original and applicable framework to study the Euro questions. At last, it simply simulates the possible payoffs of coalition between three main parties in current general elections of the United Kingdom and predict the Conservative would win without cooperation.

What is the nature of your talk?: Theoretical

Does your talk require prior knowledge of the subject area?: Some

Is your talk accessible and relevant to Practitioners?: Relevant

**SIMULATION**



**Organiser: Leanne Smith**

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| 22/09/2015 : 13:30 : Room 2 Stafford Rm 1 | Code: YOR19A1507 |

**KEYNOTE: Is facilitated simulation modelling a rising star?**

**Dr Antuela Tako** *(Loughborough University)*

Facilitated modelling has emerged as a new mode of undertaking simulation studies, where the client and analyst are jointly involved in developing and using simulation models. The aspect of facilitation is not a new concept in the OR field, but facilitated simulation modelling is still in its early stages, with the exception of system dynamics. Facilitation is believed to enhance client involvement, where the analyst and client are jointly involved in a learning process, leading consequently to implementation. In this keynote, I consider the existing practice and approaches to facilitated simulation modelling, drawing on examples from the literature as well as from my own experience. The paper concludes with ideas about how facilitated simulation modelling could evolve in the future.

What is the nature of your talk?: A mix

Does your talk require prior knowledge of the subject area?: A little

Is your talk accessible and relevant to Practitioners?: Highly

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| 22/09/2015 : 14:30 : Room 2 Stafford Rm 1 | Code: YOR19A1465 |

**An agent-based model for the analysis of sourcing and collaboration strategies in supply**

**chains**
**Miss Niniet Indah Arvitrida**, **Prof Stewart Robinson** and**Mrs Antuela Tako** *(Loughborough*

*University)*
This study applies an agent-based modelling approach to investigate how firms’ sourcing and collaboration strategy affects supply chain performance. This is a critical issue in supply chain management practice, particularly in understanding failures in supply chain collaboration. Thus, this work aims to provide knowledge not only about the extent of the influence of the sourcing and collaboration strategy, but also to provide recommendations for designing a supply chain collaboration strategy. The model represents a simplified two-dimensional strategic landscape in which the supply chain operates, representing responsiveness and efficiency. The supply chains that operate within that landscape consist of three agents (suppliers, manufacturers and customers) acting in a two-stage supply chain. Over time the agents form and reform new supply chains in accordance with the rules and parameters of the model. The key experimental factor in this study is the sourcing and collaboration strategy, which is defined as the length of collaboration between a supplier and a manufacturer, and the supplier selection criteria. These variables are simulated in an environment that is subject to complexity and uncertainty in both the upstream market and the downstream market. The upstream market uncertainty is produced by suppliers’ features and the downstream market complexity is represented by manufacturers and customers’ characteristics. The uncertainties in these markets are generated by the boundedly-rational actions of the agents. The responses of this model are supply chain revenue and fill rate, which signify collaboration failure and success. Preliminary results of from the model will be presented.

What is the nature of your talk?: Theoretical

Does your talk require prior knowledge of the subject area?: Quite a lot

Is your talk accessible and relevant to Practitioners?: Relevant

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| 22/09/2015 : 15:00 : Room 2 Stafford Rm 1 | Code: YOR19A1490 |

**Optima predict: evidence-based decision making for emergency services.**

**Dr Leanne Smith** *(The Optima Corporation)*

Emergency services all over the world have to make complex strategic and operational decisions on a daily basis; from where to locate bases, how many resources to deploy and when, to managing ever growing demand and financial pressures. In particular, Emergency Medical Services (EMS) are becoming increasingly aware of the need to understand their population, improve patient outcome and service quality, and make evidence-based decisions a priority in a straining healthcare system. Utilising simulation and optimisation techniques, Optima predict offers a tailored environment for EMS managers, planning teams and analysts to understand the interactions between their resources and performance. The software solution allows the service to explore their system in great detail, also investigating impact of temporal and spatial factors, such as, time-of-day effects, seasonality changes, road-traffic disruptions, shift patterns, demand and deployment. This talk will showcase the Optima predict software, outlining the methodologies used in the solutions and the “what-if” scenario modelling process. Some case studies will also be presented showing significant system improvement potential when utilising simulation techniques for Emergency Medical Services.

What is the nature of your talk?: Practical

Does your talk require prior knowledge of the subject area?: A little

Is your talk accessible and relevant to Practitioners?: Highly

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| 22/09/2015 : 16:00 : Room 2 Stafford Rm 1 | Code: YOR19A1485 |

**Coordinating distributed investment decisions: When being systematically wrong is right**
**Dr Stephan Leitner** *(Alpen-Adria Universität Klagenfurt)*, **Dr Doris A. Behrens** *(Cardiff University)* and

**Dr Alexandra Rausch** *(Alpen-Adria Universität Klagenfurt)*

We analyze the effects of both non-systematic and systematic forecasting errors on the practicality of a multi-stage budget allocation and coordination mechanism related to distributed investment decisions. In particular, we analyze the impact of both non-systematically inaccurate and systematically inaccurate predictions on the coordination of distributed investment decisions. The latter ones are modeled to be due to the overconfidence bias. The predictions of concern pertain to the expected cash outlay necessary to launch and operate an investment project, to the expected cash inflows generated by the project's operation, and to the self-assessment of whether or not the abilities expected to be needed for operation coincide with one's own. We show that within a hierarchical business organization with distributed authorities for decision-making, in some cases being overconfident can mitigate the negative effect of erroneous forecasting compared to being non-systematically wrong. While we can show that a systematic error like over- confidence may increase losses in NPV when it is a question of forecasting initial cash outlays, overconfidence may also be somewhat beneficial in the sense that overconfidence mitigates the unfavorable effects of non-systematic errors when it comes to faulty forecasts of cash inflows and individual abilities to operate investment projects. In these cases, we find that it is less detrimental if man- agers are systematically wrong and overestimate cash inflows and their own abilities to execute an investment project instead of being arbitrarily wrong in forecasting. We can conclude that if errors are made one at a time, a company is better off with its decision-making managers being systematically wrong with regard to confidence than being non-systematically wrong. Moreover, we offer policy advice on efficiently sequencing error correction (if errors do not occur in isolation) so that the performance of the multi-stage coordination system increases in the best possible way.

What is the nature of your talk?: Theoretical

Does your talk require prior knowledge of the subject area?: Some

Is your talk accessible and relevant to Practitioners?: Somewhat

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| 22/09/2015 : 16:30 : Room 2 Stafford Rm 1 | Code: YOR19A1531 |

**The use of Simul8 in Transport Consultancy**

**Miss Grace Francombe** *(Steer Davies Gleave)*

Working in the field of transport consultancy allows exposure to a diverse range of projects across various markets. The questions to be answered, problems to be solved and estimates to be quantified are rarely the same. This presents an opportunity to use and learn different software and methodology rather than simply employing a ‘last time we did it this way’ mentality. Having said this, the default for transport consultants tends to be spreadsheet modelling in Microsoft Excel. Whilst on a graduate programme with Steer Davies Gleave (SDG), an independent transport consultancy, I have twice had the opportunity to promote the use of Simul8 as opposed to conventional spreadsheet modelling methodology when simulating queuing. The context, constraints and strategies of both projects were inherently different; however the objective of assessing the acceptability of queuing time and length ran parallel. SDG’s role on the first project was to understand and advise on the queuing conditions likely to be experienced by volunteers collecting certification before a major stadium event. The number of service channels in the system was fixed therefore the distribution of arrivals, probability of attendees having an issue (i.e. missing documentation) and the physical layout of the centres were factors to be investigated. A second project involved analysing the usage of restrooms on transportation and testing the impact on queuing of various scenarios that tested different levels of provision. A key challenge with this project was reflecting the reality of queuing on transportation in the modelling inputs, for example, many users will wait in their seats for a restroom to become available. Simul8 is a dynamic and visual tool, this proved inherently useful when using the software to demonstrate queuing as a result of different strategies to both internal peers and external clients for these projects.

What is the nature of your talk?: Practical

Does your talk require prior knowledge of the subject area?: None

Is your talk accessible and relevant to Practitioners?: Very

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| 22/09/2015 : 17:00 : Room 2 Stafford Rm 1 | Code: YOR19A1536 |

**Simulation Modelling in the Fire Service: From Service Analysis to Results**

**Mr Andrew Greggan** *(ORH Limited)*

ORH is a management consultancy that uses OR techniques to carry out resource planning studies for emergency services, health authorities, sports bodies and other public sector organisations. ORH’s consultants use sophisticated analytical techniques to develop a comprehensive understanding of the relationship between demand for a service and utilisation of resources. Data obtained from the fire service is combined with external sources, such as travel times, population or socio-demographic data, to provide a detailed quantitative profile of service provision. ORH use bespoke simulation and optimisation models based on OR techniques to improve the cost-effectiveness of a service and to inform forward planning. The approach combines both optimisation and simulation modelling, which enables the assessment of a wide range of options and ensures our clients can respond confidently to the many challenges they face. Fire and rescue services are experiencing changing demands and the need for greater resilience and flexibility, often in the context of significant constraints on finance and resources. Our work with fire services around the world has shown that taking a modelling approach to strategic planning can deliver a robust solution, maintaining or improving risk and response cover while achieving efficiency savings. This presentation focuses on ORH’s use of simulation modelling within the fire service, presenting examples of the inputs and outputs associated with a typical fire service study. Also included is an overview of the bespoke simulation model itself, plus the processes involved in a typical project.

What is the nature of your talk?: Practical

Does your talk require prior knowledge of the subject area?: A little

Is your talk accessible and relevant to Practitioners?: Highly

**STOCHASTIC MODELLING**

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**Organisers: Julie Williams, Geraint Palmer, Jason Young**

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| 23/09/2015 : 09:30 : Room 1 Steelhouse LT | Code: YOR19A1472 |

**Staffing to meet time-dependent and prioritised demands**

**Dr Julie Vile**, **Dr Jonathan Gillard**, **Prof Paul Harper** and **Dr Vincent Knight** *(Cardiff University)*
We review queueing theoretic methods for setting staffing requirements in service systems where customers from two customer classes arrive at a service facility with time-varying arrival rates. Such queueing networks are highly prevalent across the tertiary sector, in services ranging from telephone call centres to Emergency Departments, which are typically evaluated by the proportion of ‘urgent’ and ‘routine’ customers that are responded to within pre-defined response time targets. To date, only approximation methods have been explored to generate staffing requirements for time-dependent dual-class services, but we propose a tractable numerical approach to accurately evaluate system behaviour using mixed discrete-continuous time Markov chains. Our approach is delicate in that it accounts for the behaviour of the system under a number of different rules that may be imposed on staff if they are busy when to leave and involves explicitly calculating delay distributions for two customer classes. Ultimately we embed our methodology in a proposed extension of the Euler method, coined Euler Pri, that can cope with two customer classes. The effectiveness and flexibility of our approach to offer considerably improved staffing functions to traditional approximate methodologies is demonstrated in case studies involving the Welsh Ambulance Service Trust and an Out-of-Hours GP service.

What is the nature of your talk?: A mix

Does your talk require prior knowledge of the subject area?: Some

Is your talk accessible and relevant to Practitioners?: Relevant

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| 23/09/2015 : 10:00 : Room 1 Steelhouse LT | Code: YOR19A1476 |

**Strategic Sensing in Cognitive Radio Networks**

**Mr Ran Snitkovsky** and **Prof Refael Hassin** *(Tel-Aviv University)*

We study a noncooperative multi-player game problem of individual rational users sending data-packets (``customers'' in the terminology of queueing theory) in a Cognitive Radio Network (CRN) with the opportunity of spectrum sensing. The system is composed of two channels (or ``servers''): One unlicensed channel shared freely among all users, and one in which the transmission entails the cost of sensing, and can be denied if the channel is already occupied. It is the users' prerogative to decide whether to use the shared channel or sense, hopefully not encountering a rejection. If a denied customer leaves never to return, the system can be analyzed as two independent subsystems with poissonian stream of arrivals to each one, an M/M/1/1 and an M/M/1, and it can be easily shown that that there exists a unique Nash equilibrium. As opposed to such simple models, in our model customers that are rejected from service after sensing are routed to the shared queue. We model this process as a queueing system comprising of two servers working in parallel, one is an M/M/1/1 loss system and the other is a G/M/1 with heterogeneous arrivals. We compute the transition probabilities and the stationary probabilities of the Markov chain describing the process, analyze the system's capacity and utilization and show, using the technique of Sample Path Analysis, that the Nash equilibrium strategy in the system is well-defined.

What is the nature of your talk?: Theoretical

Does your talk require prior knowledge of the subject area?: Some

Is your talk accessible and relevant to Practitioners?: Relevant

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| 23/09/2015 : 10:30 : Room 1 Steelhouse LT | Code: YOR19A1538 |

**KEYNOTE: Stochastic strategic behaviour: an overview of some applications of game theory**

**to queueing models (and vice versa!)**

**Dr Vincent Knight** *(Cardiff University)*

This talk will give an overview of how stochastic queueing models can be used in conjunction with game theoretic models. This will include talking about markov decision processes, normal form and Stackelberg games as well as routing games. It is hoped that the talk will be of interest to delegates with a background in stochastic modelling but interested in strategic behaviour. As well as discussing the theory, a variety of software packages that allow for the easy use of game theoretic models will be discussed and demoed.

What is the nature of your talk?: Theoretical

Does your talk require prior knowledge of the subject area?: Some

Is your talk accessible and relevant to Practitioners?: Relevant

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| 23/09/2015 : 14:00 : Room 1 Steelhouse LT | Code: YOR19A1488 |

**A reinforcement learning approach to the maintenance planning problem of a large scale**

**ower plant**

**Mr Junchi Tan** *(University of Strathclyde)*

Markov decision processes (MDPs) provide a general framework for maintenance policy optimization problems. But the MDPs problems are usually on large scales and the traditional dynamic programming (DP) falls apart due to two “curses”: curse of modelling -DP methods request to derive the exact values of the transition probabilities, which are often hard to attain with a large state space especially when the transition mechanism is complex; curse of dimensionality- it is also impractical to store these values when states are beyond millions. A simulation-based optimization approach known as Reinforcement Learning (RL), however, can mitigate the two curses to a great extent and deliver ‘near-optimal’ solutions. The so called Q-learning algorithm is a well-known RL method and it is based on value iteration and the Robbins-Monro stochastic approximation scheme. The intuitive main idea of Q-learning is as follows: One learns the optimal actions by mindfully trying actions and updating knowledge, while rambling through the state-space. Rather than computing and storing the transition probabilities, in Q-learning one only needs to store compact-size simulators to generate trajectories. Furthermore, RL can utilize various function approximation methods (e.g. regression, neural networks) to tackle the knowledge storage issue when the size of the state-space is gigantic. Motivated by the maintenance planning problem from a large size plant of Scottish Power, we consider the following industrial environment: A power plant with multiple components and the state of every component is described by both degradation condition and performance. The failure rates of the components are interdependent. Multiple maintenance actions exist with different costs and time scales. In order to assign the limited maintenance resources optimally, we model the sequential decision making problem in the framework of MDPs and solve the gigantic problem by the combination Q-learning and regression functions. The method converges to (near-) optimal results quickly.

What is the nature of your talk?: A mix

Does your talk require prior knowledge of the subject area?: Quite a lot

Is your talk accessible and relevant to Practitioners?: Very

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| 23/09/2015 : 14:30 : Room 1 Steelhouse LT | Code: YOR19A1565 |

**Prison System Modelling: A Comparison of Approaches**

**Miss Ffion Jones** *(Hartley McMaster Limited)* and **Mrs Hannah Neech** *(NOMS)*

The Performance and Analysis Group at the National Offender Management Service are responsible for assessing the impact of policy changes on the use of prison accommodation. The current move to ensure that all prisoners have rehabilitation services in a prison located close to their home has prompted work to ensure that the right amount of accommodation of the right type is available to support current and forecast prisoner numbers and profiles. Two approaches to modelling this have been adopted – a “static model” which looks at the steady state position and a “dynamic simulation model” which considers the transition from the current position to the future steady state. This talk describes the two modelling approaches and compares and contrasts them, noting the pros and cons of the two methods.

What is the nature of your talk?: Very practical

Does your talk require prior knowledge of the subject area?: None

Is your talk accessible and relevant to Practitioners?: Highly

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| 24/09/2015 : 09:30 : Room 4 White Hall Rm 1 | Code: YOR19A1506 |

**Stochastic modelling and streamlining of the diagnostic pathway for patients presenting to ED with chest pain.**

**Dr Andrew Salmon**, **Prof Chris Hyde**, **Prof Martin Pitt** and **Dr Sebastian Rachuba** *(University of*

*XETER)*, **Dr Scott Watkins** *(South West AHSN)* and **Dr Zhivko Zhelev** *(University of EXETER*

Chest pain accounts for approximately 5% of emergency department (ED) visits each year but 25% of all acute admissions. Acute coronary syndromes such as myocardial infarction cannot always be confidently diagnosed solely on the basis of clinical examination, history and serial electrocardiogram testing. Serial measurements of serum troponin can be very helpful, but under most current protocols, the definitive sample is taken at 6-9 hours after onset of symptoms. This frequently necessitates short-term admission to hospital due to the ED ‘four hour’ target. Recently introduced high sensitivity troponins are potentially able to rule out MI at three hours after pain onset, and have received NICE approval for this purpose. Implementation of three hour rule-out strategies is not yet widespread. We collaborated with the ED staff from the seven NHS acute trusts in the south west region of the UK to construct process maps of the current pathways for managing the diagnosis of acute chest pain in ED. We then constructed a series of discrete event simulation models, which were parameterised using data supplied by each trust, to reflect key differences in service delivery and protocol. The models represent the relevant processes within each department, and discharge destination, co-ordinating these with the turnaround of patients’ troponin samples. Stochastic distributions for each parameter were chosen according to goodness-of-fit testing and subject to sensitivity analysis. Using ‘what if’ scenarios we plan to use the models to demonstrate that a three hour rule out strategy could lead to considerable savings in terms of cost, staff time, patient wait, treatment time, and bed occupancy. There is potential to extend the model to examine other aspects of service re-design e.g. the impact on patients of being admitted to hospital unnecessarily.

What is the nature of your talk?: Very practical

Does your talk require prior knowledge of the subject area?: None

Is your talk accessible and relevant to Practitioners?: Highly

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| 24/09/2015 : 10:00 : Room 4 White Hall Rm 1 | Code: YOR19A1530 |

**Queueing networks for a healthcare system: modelling the flow of patients through a**

**ealthcare system.**

**Mr Geraint Palmer** and **Prof Paul Harper** *(Cardiff University)*

This talk will discuss the use of open queueing networks, or Jackson networks, to model flows of patients across a health system. An initial basic analytical model will be shown and compared with results obtained using a simulation model built in Python. Modelling across a whole health system using the queueing network model is particularly useful for strategic planning of resource in different healthcare settings. Our motivation and application is to the flow of elderly and frail patients within the Aneurin Bevan University Health Board in South Wales. In reality patients do not leave one part of the system and queue for access to the next part. If there is a lack of capacity at the next destination then they remain at their current location and block other patients from proceeding. The model is extended to include this blocking. A novel direction for this research is the potential to use reinforcement learning algorithms to find the optimal routing of patients through the health care system.

The use of a particular reinforcement learning algorithm, the q-learning algorithm, on queueing networks will be explored.

What is the nature of your talk?: Theoretical

Does your talk require prior knowledge of the subject area?: None

Is your talk accessible and relevant to Practitioners?: Somewhat

**SUPPLY CHAIN**



**Organiser: Emily Schutze**

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| 23/09/2015 : 09:30 : Room 4 White Hall Rm 1 | Code: YOR19A1557 |

**A MATHEMATICALLY REDUCED APPROACH TO PREDICTIVE CONTROL OF PERISHABLE**

**INVENTORY SYSTEMS**

**Dr Joanna Orzechowska** *(LLamasoft Europe Ltd.)*, **Prof Andrzej Bartoszewicz** *(Politechnika Łódzka )*, **Prof Keith J. Burnham** and **Prof Dobrila Petrovic** *(Coventry University)*

The number of existing industrial and academic work dedicated to inventory replenishment reflects the importance of that problem in a business word. Nevertheless in academic approach the effect of system dynamics on inventory control is not usually reflected in traditional model formulations. This talk presents a new mathematical approach to inventory which combines benefits of control theory with traditional OR approaches, in order to control the impact of uncertainty on inventory stability. The design and optimisation of inventory replenishment systems has already been exhaustively studied by the operational research community. However in a real case scenario the lead-time, deterioration of goods and demand for product are likely to be time-varying and uncertain. Therefore, algorithms based on control theory have been investigated /proposed. Control theory is usually applied to reduce the system instability related to uncertainties, usually in engineering. Here we propose the application of control theory to inventory systems for cost-benefit inventory trade-off achievement. Although the application of control theory in inventory optimisation appears to be beneficial, there are certain reasons why the approach has gained yet little attention among the operational research community. One reason is that it cannot be adopted easily by researchers who are unfamiliar with control theory and another is a communication gap which exists between the control theory and operational research communities. Prompted by these observations, the talk presents a novel, systematic mathematical approach for finding the optimal order quantities. The proposed approach has been mathematically demonstrated to be equivalent to one of the well-established control theory techniques with industrial application today: the model-based predictive control. It provides the benefits of control of system dynamics without the necessity to fully understand control theory. The method is shown to be applicable for both perishable and non-perishable inventory.

What is the nature of your talk?: Theoretical

Does your talk require prior knowledge of the subject area?: Some

Is your talk accessible and relevant to Practitioners?: Somewhat

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| 23/09/2015 : 10:00 : Room 4 White Hall Rm 1 | Code: YOR19A1563 |

**KEYNOTE: Cheers! – Modelling the supply chain of beer**

**Ms Katinka van de Velde** *(Argusi.org)*

Your pint of beer has actually come a long way before it finally could be enjoyed. This presentation is based on a network-design project executed at a Dutch beer brewer. Not only outbound transport to customers has been taken into account, but also the brewing process has been mathematically modelled. Lastly, inbound flows have been optimized. Where to purchase casks, kegs, bottles, cans and malt such that constraints are met and costs are minimized? This presentation explains some of the key parts of a network-footprint study. The focus is on strategic and tactical optimization, with the beer case as a guiding example.

What is the nature of your talk?: Practical

Does your talk require prior knowledge of the subject area?: A little

Is your talk accessible and relevant to Practitioners?: Highly

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| 23/09/2015 : 14:00 : Room 4 White Hall Rm 1 | Code: YOR19A1513 |

**Supply Chain Network Optimisation with Supply Chain Guru - a case study of a European tyre**

**company**
**Dr Byron Song** *(LLamasoft Europe Ltd)*

This case study shows how network optimisation techniques are used to help a major rubber manufacturer to find the right balance between customer service and overall costs. Most supply chains in existence are characterised by complexity and interdependencies inherited from historical mergers and development. The transformation of the supply chain from an historical accident to an intentionally engineered system is the goal of network optimisation. Removing inefficiencies in the supply chain is especially fundamental to any business/supply chain who was to survive in the competitive environment today. But that alone is not enough. More importantly, the key to success is the question: How to strike the perfect balance between service and cost? This case study offers a real life business example, where such question is answered by "Supply Chain Guru" - a supply chain modelling software designed to offer multiple options for finding hidden inefficiencies and test alternative structures in the supply chain. The client in the case study is ranked among the world’s largest tyre and rubber manufacturers and distributers, who currently owns 9 Manufacturing facilities, 2 Regional Distribution Centres (RDC) and 12 Local Distributions Centres (LDC) in the EMEA region. With the number of facilities in the network, they can offer an excellent 24 hours service to vast majority of their customers in the region. The client, however, believes there are space for cost saving in both warehousing and transportation, if they could strategically lower the service levels for certain products/customers/order types. The 3-month project covers data collection, verification, baseline and scenario modelling. The findings include potential inefficiencies in the current network flows, and cost-service impact of the various scenarios which gives the client a range of options to lower the overall supply chain cost while maintaining the service level for key aspects of the business.

What is the nature of your talk?: Practical

Does your talk require prior knowledge of the subject area?: A little

Is your talk accessible and relevant to Practitioners?: Very

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| 23/09/2015 : 14:30 : Room 4 White Hall Rm 1 | Code: YOR19A1525 |

**Assessing the Wider Resilience of the Defence Industrial Supply Chain**

**Mr Jay Edwards** *(BAE Systems)*

Recent catastrophic weather events such as Hurricane Katrina in 2005 and the 2011 Tohoku earthquake & tsunami resulted in severe disruption to global supply chains. It is expected that supply chain risk is likely to increase in the future due to global warming, resource scarcity and the drive to find the lowest cost supplier anywhere in the world. Thus it is important to understand these risks and find a way to manage them. A study of the wider resilience of the UK Ministry of Defence industrial supply chain has been conducted to understand if it is vulnerable to natural hazards and how risk identification, analysis and mitigation can be approached. This paper will demonstrate the importance of understanding and managing supply chain risk by drawing on historical examples of supply chain disruption. It will also use a case study to demonstrate a method that can be used by all industries to monitor and manage both natural hazard and other supply chain risks.

What is the nature of your talk?: Practical

Does your talk require prior knowledge of the subject area?: A little

Is your talk accessible and relevant to Practitioners?: Somewhat

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| 24/09/2015 : 12:00 : Room 5 White Hall Rm 2 | Code: YOR19A1496 |

**Scheduling handling operations in an automated storage yard employing rail mounted gantry cranes**

**Mr Sam Heshmati**, **Dr Wim Vancroonenburg** and **Prof Greet Vanden Berghe** *(KU Leuven,*

*Department of Computer Science, CODeS & iMinds-ITEC)*

Operational efficiency of warehouses plays an important role in boosting the capacity of supply chains. In this study, we consider the product handling problem in an automated warehouse employing rail mounted gantry cranes (RMGC). We develop dynamic heuristic algorithms to tackle this problem. Reducing the handling cost and handling I/O requests in time-critical and dynamic situations is essential for the operation of any warehouse. In this study, we develop decision support for handling operations in an automated warehouse consisting of a storage yard where products are stored and stacked subject to set of constraints, a number of input/output (I/O) points where incoming and outgoing products arrive and leave the system, and automated RMGCs operating on a single pair of rails to move products. Each I/O point may put storage or retrieval requests which have to be processed before their due time. The gantry cranes may work in parallel to process the requests. Each crane can move one unit-load at a time along the warehouse. There is no distinct working area for cranes and each crane can serve the whole yard. In order to avoid collisions between two neighboring cranes a safety distance has to be maintained at all times. The objective is to determine storage locations for products in the yard, assign the movement requests to the cranes, and sequence the job execution by each crane in such a way that the costs of storage, delays, and crane utilization are minimized. We investigate different optimization approaches for the problem. In order to validate and compare the approaches, a number of test problems are generated by a random instance generator. Experimental tests are conducted to evaluate the performance of the approaches based on various data settings.

What is the nature of your talk?: Practical

Does your talk require prior knowledge of the subject area?: A little

Is your talk accessible and relevant to Practitioners?: Relevant

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| 24/09/2015 : 12:30 : Room 5 White Hall Rm 2 | Code: YOR19A1459 |

**Vehicle Fill vs Service Level, how to use simulation to understand the tradeoff**

**Miss Victoria Forman** *(LLamasoft)*

When managing a complex global supply chain it is always a trade off between filling vehicles and service levels. Wait until the vehicle is full and the delivery might be late or send the delivery on time and have half empty containers on the roads. I will present a way of using simulation to solve this issue, presenting the decision makers with the information and strategies they require to make the decision on the trade off between empty vehicles and service levels.

What is the nature of your talk?: Practical

Does your talk require prior knowledge of the subject area?: Some

Is your talk accessible and relevant to Practitioners?: Highly

**SYSTEM DYNAMICS**



**Organiser: Jennifer Morgan**

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| 22/09/2015 : 17:00 : Room 4 White Hall Rm 1 | Code: YOR19A1470 |

**KEYNOTE: Agile System Dynamics: Fast, Effective Reliable Modelling of Business and Social Systems**
**Dr Kim Warren** *(Strategy Dynamics Ltd)*

System Dynamics is a powerful methodology, underpinned by rock-solid theory. But its adoption remains limited, possibly due to the way in which the method has been taught and used. Books, courses and published cases suggest we start by defining how the issue of concern is changing over time, then build qualitative causal-loop diagrams with stakeholders. The resulting shared mental model is taken to both encompass the scope of the issue and represent well the causal mechanisms involved. Stock-and-flow structures are then added to the model and data is sought with which to populate and formulate those structures, so as to create a working mathematical model. The process is difficult, time-consuming and unreliable; risking serious flaws and omissions, and producing different models for similar cases. The science of the method suggests a simpler process, which moves directly from the performance behaviour to a quantified mapping of how stocks and flows are changing. From there, interdependencies are traced – again with quantified support – and significant feedback mechanisms identified. Models are easier and faster to build, cutting the time and effort involved by as much as an order of magnitude, and the method builds in validation from the start. Valuable insights also emerge throughout the process – reminiscent of the “agile” approach which now dominates the field of software development. The approach merits more widespread testing to confirm these benefits. The method is also consistent with a complementary approach, common among leading practitioners, of leveraging proven structures repeatedly across similar cases.

What is the nature of your talk?: Very practical

Does your talk require prior knowledge of the subject area?: None

Is your talk accessible and relevant to Practitioners?: Highly

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| 23/09/2015 : 10:30 : Room 2 Stafford Rm 1 | Code: YOR19A1550 |

**Action Selection with Individual, Motivational, Reactive and Proactive Behavior for Virtual**

**Humans**
**Mr Oliver Handel** *( Chair of Computational Modeling and Simulation)*

In this paper the method System Dynamics is used to model the behavior of virtual humans. In particular System Dynamics is used from the bottom-up inside each instance of an agent population living in a persistent virtual environment. Hence, the submitted approach combines the method System Dynamics and Agent-Based Modelling. From the perspective of artificial intelligence research, it is shown how System Dynamics can be used to solve the action selection problem of virtual humans in the domain of an urban event, where the set of actions contains activities like consuming, socializing or satisfying basic needs. With this approach it is possible to provide individual, motivational, reactive and proactive behavior, to obtain a high degree of autonomy for the virtual humans. Thereby internal and external influences are taken into account, to be able that each human lives his own life and makes his own decisions continuously in real time. This paper describes in detail, how stocks, flows, sources and sinks – in other words the basic building block of System Dynamics models – will be used to change different motivations of virtual humans over time. Beside the internal activation of different needs in form of varying internal states, various information for each individual agent is collected from the environment and influences the action that is chosen by the agent. This approach takes into account different causal dependencies in the action selection process in respect of which actions the agent has chosen in the past. Moreover, this approach allows to model different characters of agents and therefore incorporate different personalities in the simulation. A 3D-visualisation of the results demonstrates that the approach is sufficiently robust and flexible to be used as a management tool to plan urban events, by enabling to model the behavior of the visitors.

What is the nature of your talk?: Practical

Does your talk require prior knowledge of the subject area?: Some

Is your talk accessible and relevant to Practitioners?: Highly

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| 23/09/2015 : 11:00 : Room 2 Stafford Rm 1 | Code: YOR19A1478 |

**Modelling policies for healthcare workforce management using system dynamics: alleviating**

**the Canadian rural care gap.**

**Dr Jennifer Morgan** *(Cardiff University)*

The concentration of healthcare professionals in urban areas mainly is a concern in many countries, including Canada. During many years, it has driven large number of government led initiatives to address the rural care gap. This research seeks to examine the efficacy of such policies on the workforce in the long term. A small system dynamics model is employed to simulate the distribution of general physicians at a jurisdictional level. The model represents the transition of general practitioners to provide insight into the dynamics of care provision over time. The movement, and competition, between rural and urban areas is modelled to explore in detail the proposed measures to alleviate the care gap. This small system dynamics model is developed for Canada’s reality, but its simple nature lends itself to easy application to other countries that experience a similar problem.

What is the nature of your talk?: A mix

Does your talk require prior knowledge of the subject area?: None

Is your talk accessible and relevant to Practitioners?: Very

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| 23/09/2015 : 14:00 : Room 2 Stafford Rm 1 | Code: YOR19A1535 |

**Overcoming complexity constraints related to new medicinal product market**

**mplementation strategy: an integrated modelling and simulation-based planning approach**

**Mr Ross Kazakov** and **Mrs Penka Petrova** *(Strateggo Ltd)*

Planning the market implementation of a new medicinal product could prove to be a highly complex task from the perspective of managing the dynamic interrelations of key resources and KPIs and related variability in the production and marketing stages of such projects. Especially when the case is related to the highly competitive branded generic drugs markets, where immediately after the patent expiry of the original pharmaceutical product a number of generic players compete on time and price to introduce alternative generic versions of the originator drug. Key decisions characterised with high complexity are related to sourcing APIs /active pharmaceutical ingredient/ compliant to EU regulations, determining the right excipients, utilizing the batch production process in terms of quality, time and resources in relation to Quality by Design concept, minimization of production costs, choosing a flexible pricing strategy with a future insight related to pricing and reimbursement regulation would-be changes and competitors pricing retaliating decisions, linking production quantities to consumer/patients demand, and influencing doctor prescribing behaviour. The whole complex of complicated processes, described above and the managerial decisions related to them needs a thorough systemic understanding in an anticipatory mode, and to this need we propose an integrated modelling and simulation-based planning approach, illustrated by a case of a generic product from the group of the statins. The key stages of the product market implementation are planned by a hybrid modelling approach including System Dynamics and Agent-based simulation. The findings of the experimental study give evidence for the high importance of the modelling and simulation-based planning approach in helping managerial decision making by overcoming production process and market dynamics complexity and in acting as a decision support tool /DSS/ in the planning and implementation of complex projects like the one described here.

What is the nature of your talk?: Very practical

Does your talk require prior knowledge of the subject area?: Some

Is your talk accessible and relevant to Practitioners?: Very