

# The OR Society OR59 Annual Conference

12-14 September 2017

*Loughborough University, Loughborough, Leicestershire. LE11 3TU*

**Airport Operations Management**  
**Organiser: Ammar Al Bazi**

12/09/2017 : 15:00 : Room 7 - JF D.0.02 (x56)

Code: OR59A3087

## **The Airport's Noise: Modelling a Fair Distribution of Flyover**

**Mr Paul Chatelain** (*Université Catholique de Louvain*)

While air transport generates social and economic benefits, it also generates negative environmental externalities among which noise pollution is one of the most cited. Few global propositions to control this externality have been proposed. According to several studies, the noise generated by this flyover can increase the risk of serious damage for the health and is also uncomfortable on a daily basis. This noise disturbance leads to many complaints from local residents. While many politicians have studied the problem each new plan generates tensions and protests among the citizen associations. Although an airport is a source of noise, it is also a vector of economic development (taxes, employment, city attractiveness ...) and brings some satisfaction for the users. Welfare, health and fairness are of peculiar importance in our modern societies. Thousands of people suffer from the lack of solution relative to this environmental problem. Moreover, such topics – how to deal with environmental issue? , have gained major interested in society those last decades. The aim of the project is to develop a model which provides a fair, structured and documented arbitration resource allocation between the different stakeholders (citizens, airports management, airlines companies, airport's employees, political authorities (with different level of power)). The model aims to be efficient in term of social welfare and will integrate ethical question. Specifically, the model should be able to answer the following questions: - What are the relevant aspect of the problem, who are the stakeholders? What are their hidden expectation? - How to model the problem and solve it? - How to allocate flight on routes according to the ethical criterion selected? - What is the "price" of each ethical criterion regarding the optimal solution? - Sensitivity Analysis: Is it possible to improve situation by developing new routes?

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

12/09/2017 : 15:30 : Room 7 - JF D.0.02 (x56)

Code: OR59A3089

## **Airports Efficiency Over Time: 'How has the 2008 Economic Crisis Affected the Efficiency of Spanish Airports? A DEA Analysis'**

**Miss Ane Elixabete Ripoll-Zarraga** (*Universitat Autònoma de Barcelona*), **Prof Cecilio Mar-Molinero** (*Kent Business School*) and **Dr Fabiola Portillo Pérez de Viñaspre** (*Universidad de la Rioja*)

We study DEA efficiencies of 47 Spanish airports over the period 2009-2013 under a variety of input/output specifications. 186 input/output specifications are estimated using DEA. The results are analysed using the tools of multivariate statistical analysis, in particular the Individual Differences Scaling model of Carroll and Chang. This model reveals what has remained invariant over the period, what are the most salient characteristics of airport efficiency, and how these characteristics have changed in importance during the crisis period. Given the large differences in size between the airports we use the Variable Returns to Scale approach. Since it is a characteristic of economic crisis that some capacity remains idle, we use the output oriented form of DEA. The results reveal an important drop in efficiency between 2009 and 2010, followed by a period of slow recovery.

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

12/09/2017 : 16:30 : Room 7 - JF D.0.02 (x56)

Code: OR59A3106

## **Multi-Agent Based Optimisation System for Resource Allocation, Scheduling and Routing in Aircraft Ground Handling Operations**

**Miss Hayat El Asri** (*Coventry University*) and **Dr Ammar Al Bazi** (*Coventry University*)

This work addresses the resource allocation-routing problem in the aircraft Ground Handling (GH) context. This problem is classified as one of the challenges that most of the ground-handling operators face nowadays. It consists of allocating a number of resources including workers and vehicles to aircraft of different service requirements and specifications. The allocation deals with the assignment of  $m$  teams of  $n$  skilled workers to  $k$  special purpose vehicles to serve  $i$  aircraft on the air-side area, while the routing is to determine the optimal route used by a group of workers integrated with vehicles when serving one or more aircraft. Both the allocation and routing tasks are affected by a number of constraints including different aircraft types and sizes, different aircraft service times, and various GH operation details based on flight types. Therefore, the main aim of this research is to develop an autonomous system to deal with the allocation, planning, and scheduling of resources. The methodology followed involves a number of algorithms that act and interact with one another towards achieving the best allocation and routing process. These algorithms include Agent Based Modelling (ABM) to simulate the GH operations, Hamiltonian algorithm to provide the optimal route of workers embedded within vehicles, Fibonacci heap algorithm to optimise the rules used between agents, and Genetic Algorithm (GA) to optimise the number of workers and vehicles required for each GH operation individually and combined. In addition, logic, sequence, and state diagrams are developed to reflect the workflow in the air-side area. A Java based allocation and routing system provided with a friendly graphical user interface is being developed to test the efficiency of the proposed methodology. The results will show how proper resource allocation and routing processes affect the total service time and resource utilisation.

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

12/09/2017 : 17:00 : Room 7 - JF D.O.02 (x56)

Code: OR59A3115

### **Developing an Overbooking Fuzzy-Based Optimisation Model for Multi-Leg Flights**

**Mr Emre Uney** (*Coventry University*) and **Dr Ammar Al-Bazi** (*Coventry University*)

Overbooking is an important revenue management strategy that is currently used in many industries including airline industry. Briefly, overbooking lets airlines to mitigate the risk of flying with empty seats. However, identifying an overbooking level is a complicated task due to the uncertainties associated with the external factors that affect the booking process fundamentally. There have been many methods proposed for overbooking problem on a single-leg flight, yet few studies have been conducted on airline networks. Although, overbooking problem can be handled at the single-leg level in practice, considering the problem as a network revenue management problem can be more profitable for the airlines due to the fact that seat allocation in one leg affects other legs in the network. In this paper, a fuzzy linear programming model is proposed for the overbooking optimisation problem in multi-leg flights with multiple fare-classes. Unlike the majority of the previous studies, the uncertainties related to demand are addressed by defining the demand as fuzzy numbers. Our main aim is to propose an optimisation method that maximises the overall revenue of the flight network by minimising the number of empty seats and the number of denied passengers. Moreover, we strive to show that the proposed model can be used as a decision support tool by the airline revenue management analysts or the decision makers to assist the process of determining booking limits for different flights in airline networks. We expect to test the proposed method for different scenarios and upon successful completion of this research we will investigate the advantages of using fuzzy theory in airline network overbooking problem.

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

## **Behavioural OR**

**Organiser: Sally Brailsford**

12/09/2017 : 14:30 : Room 911 - JF D.2.02 (x52)

Code: OR59A3171

### **Physics, Foibles and Failings: Applying the 'Behavioural Turn' to the Breadth of System Dynamics Practice**

**Prof David Lane** (*University of Reading*)

Whilst there are some difficulties in finding a clear definition of 'Behavioural OR', the 'behavioural turn' is in full sway across OR. This paper consider its broad application to System Dynamics Modelling. Interest is then on complex dynamic systems, how they perform over time, whether what humans do when dealing with such systems departs from what normative rationality says they should do, and how modelling can contribute to all of these. Referencing the Behavioural Decision Theory roots of the behavioural turn, is rapidly becomes clear that a 'Behavioural SD' approach has much promise, across a broad territory. Within the SD field there is, for example, already a considerable amount of empirical evidence regarding human inability to understand stock/flow relationships and difficulties in

extrapolating exponential trajectories, along with a long-standing interest in deficiencies in mental models and their consequences for system performance. In fact, the 'territory' is rapidly seen to involve a network of areas, from human response to and understanding of actual systems of this type, to the use of maps and models to learn about them, the difficulties in creating such models, how one represent 'behavioural effects' within such models and the problem of getting individual or groups to learn from such models. The sketch of the territory therefore reveals much scope for the application of a behaviouralist view to SD. However, the paper also tries to consider whether 'Behavioural OR' is merely a vast conceptual blanket, little more than an exercise in changing the labels on historically well-established areas of interest to OR, or whether it provides a conceptual lens that can generate important new insights. With that in mind, a definition is proposed, one which underpins the sketch of the 'Behavioural SD' territory and which offers the BehSD way forward.

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

12/09/2017 : 15:00 : Room 911 - JF D.2.02 (x52)

Code: OR59A3133

### **Designing Product Rollovers and Managing Style Obsolescence**

**Mrs Esma Koca** (*Imperial College Business School*), **Mr Tommaso Valletti** (*Imperial College Business School*) and **Mr Wolfram Wiesemann** (*Imperial College Business School*)

When releasing a new version of a durable product, a firm should consider whether to convince its consumer base to upgrade while attracting new consumers. To this end, the company designs a rollover strategy, which selects the price of the new product, as well as whether to continue the sales of the old product at a discount (dual rollover) or not (single rollover). We argue that the effectiveness of a rollover strategy crucially depends on the consumers' perception of the obsolescence of the previous version, and that the company can influence obsolescence by a prudent timing of the new product launch. We explore the impact of the timing decision in solo and dual rollovers in markets consisting of myopic and strategic consumers.

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

12/09/2017 : 15:30 : Room 911 - JF D.2.02 (x52)

Code: OR59A3177

### **Understanding the Link Between Employee Engagement Survey and Employee Behaviours**

**Dr Jonathan Malpass** (*British Telecom*) and **Mr Matthias Stottmeier** (*LSE*)

Employee Engagement is seen as an important factor in organisational performance; highly engaged employees are less likely to leave the organisation, be more productive and have a positive impact on customer experience. Whilst high Employee Engagement is desirable, it is difficult to capture – except via surveys. Unfortunately, such surveys are open to gaming and also to the mindset of the employees at the time of completion. Furthermore, the variation in interpretation of a generic survey across a large organisation can also cause results to be of questionable value. This presentation will describe the research into a large employee engagement survey which had two aims: first, to understand the value of the survey from an organisational behaviour perspective and second, to identify potential interventions that might reduce respondent bias. Some general observations into the value of employee engagement surveys will be made placed in the context of employee and management behaviour.

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

12/09/2017 : 16:30 : Room 911 - JF D.2.02 (x52)

Code: OR59A3170

### **Designing a Nudge-Type Intervention to Increase Employee Volunteering**

**Dr Jonathan Malpass** (*British Telecom*) and **Mr Rafael Cabalero-Saldivar** (*LSE*)

Behavioural interventions, or "nudges", have recently been used to guide people to make a certain choice, but work effectively when that choice is of benefit to them. This "paternalistic" view of nudge does not always align to situations within businesses. One sphere for businesses where nudges may be effective is volunteering. It is recognised that employees who volunteer for non-work related activities take fewer sick days, are more engaged with their work and are less likely to leave the organisation. BT has an objective to increase the level of employee volunteering, be it through formal partnerships, skill-based activities or involvement with other organisations often seen as hobbies. Although there are several efforts supporting BT's goal, there are a number of barriers that inhibit

meeting the objective. To try to overcome some of these issues, BT wants to test nudge-type interventions. This presentation will describe the barriers to volunteering and meeting the current objective, a framework that has been adapted for trialling nudges within a business setting and the design of an intervention within the volunteering environment.

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

12/09/2017 : 17:00 : Room 911 - JF D.2.02 (x52)

Code: OR59A3108

**Behavioural Analytics: Beginnings of a Body of Work**

**Dr Martin Kunc** (*Warwick Business School*), **Dr Michael Mortenson** (*Warwick Manufacturing Group*) and **Prof Richard Vidgen** (*University of New South Wales*)

Following the growing interest in analytics, Big Data and data science, as well in behavioural approaches in the analytical fields (behavioural economics, behavioural OR), this research investigates the development of behavioural analytics, a field at the intersection of these trends. The paper identifies two areas of work: upstream behavioural analytics, where behavioural patterns act as the stimulus and subject of analytics; and downstream behavioural analytics, where approaches such as visualization are used to give analytics and data science greater influence on the behaviour of decision makers. Using a computational literature review, these areas are analysed and compared, and directions for future research are offered.

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

14/09/2017 : 10:00 : Room 912 - JF LT CC.00.21(x120)

Code: OR59A3063

**KEYNOTE: Behavioural OR: The Role of Statistical Analysis**

**Dr Konstantinos Katsikopoulos** (*University of Southampton*)

Behavioural OR has been attempting to establish a base of knowledge about human behaviour in largely the same way as its sister discipline, behavioural operations management, and their successful predecessor, behavioural economics have: Through experimental investigations of how human behaviour relates to the predictions of normative models in areas such as (1) probabilistic reasoning; (2) decision under risk; and (3) strategic interaction. The experiments produced data which has been analysed statistically. The conclusion of the statistical analyses has been that people exhibit a number of biased or unreasonable behaviours such as (1) overconfidence and hot-hand fallacy (probabilistic reasoning), (2) certainty effect and four-fold pattern of risk attitude (decision under risk), and (3) reciprocity and inequity aversion (strategic interaction). I will review (relatively) recent research, which shows that these behaviours might well be artefacts of regression to the mean, results of careless estimation, or unappreciated logical implications of reasonable cognitive processes. In sum, this talk will demonstrate the merits of critically evaluating highly publicised claims.

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

14/09/2017 : 11:30 : Room 912 - JF LT CC.00.21(x120)

Code: OR59A3031

**Decision Conflict in the Newsvendor Game**

**Dr Ilkka Leppänen** (*Loughborough University*)

In the newsvendor game an agent orders stock to prepare for a selling season before knowing the random demand realization. If the demand distribution is known the game has a normative expected profit-maximizing solution. Behavioural experiments on the newsvendor game frequently report that decision making is suboptimal. We conjecture that ordering behaviour in the newsvendor game is affected by the possibility that customer demand is left unsatisfied. We assume that some newsvendors derive utility from the nonpecuniary factors of satisfying customer demand and avoiding goodwill losses. Because the components of the utility functions that could possibly model such factors are unobservable we rely on the dual-process literature on decision conflict. We argue that decision conflict between the pecuniary motive of profit maximization and the nonpecuniary motive of satisfying customer demand is the driving force behind non-normative behaviour. We test our conjecture by behavioural experiments where in addition to observing decisions we record decision times that indicate intuitive processing and cognitive regulation of decision conflict. We also elicit social value orientations (SVOs) to obtain individual

measures of how subjects value the nonpecuniary motives. We find that the previous round situation affects current round decision time such that "intermediate" situations where demand was not satisfied and the decision was not normative produce more decision conflict and deliberation in the current round than "extreme" situations where either demand was satisfied or/and the decision was normative. We also find that for high-SVO subjects the probability of choosing normative increases in decision time. Our study demonstrates that decision conflict between pecuniary and nonpecuniary motives can affect newsvendor decision making. These results offer explanations to many well-known newsvendor decision making regularities reported in the Behavioural OM literature.

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

14/09/2017 : 12:00 : Room 912 - JF LT CC.00.21(x120)

Code: OR59A3198

**Hidden Profiles and the Need for Closure: An Agent-Based Simulation of Group Discovery of Hidden Profiles**

**Dr Duncan Robertson** (*Loughborough University*) and **Prof Alberto Franco** (*Loughborough University*)

We combine the psychological concepts of Need for Closure and Hidden Profiles by means of a novel Agent-Based Model of group decision making. We model Need for Closure by way of a NFC Threshold that represents the willingness of participants to accept an outcome relative to the next best alternative in a decision task. Increasing this NFC Threshold has a positive effect on the ability to discover a hidden profile, but with a cost of increased time for the group to make a decision. We model increasing task pressure in order to simulate increased NFC: increasing the pressure increases the speed at which the task is completed, with the time at which this pressure is stopped being more important than when this pressure is initiated. Furthermore, our model is consistent with the shared information bias hypothesis.

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

14/09/2017 : 13:15 : Room 912 - JF LT CC.00.21(x120)

Code: OR59A3132

**Enhanced Understanding of the Current Police Custody Risk Assessment Process**

**Mrs Melanie-Jane Stoneman** (*Loughborough University*), **Dr Louise Cooke** (*Loughborough University*), **Dr Sarah Dunnett** (*Loughborough University*) and **Dr Lisa Jackson** (*Loughborough University*)

Each year a number of detainees die or self-harm whilst in police custody. An essential part of preventing this is through a risk assessment process. Guidance on risk assessments and risk management levels (observations) is provided by the College of Policing, however adherence to this guidance is not mandatory. Previous research into risk assessment within police custody has focused on the ability of the assessment to accurately capture all the health needs of the detainee. To date, there has been no research into the effectiveness and efficiency of the risk assessment process itself. The aim of the research is to evaluate the current practice and to make the risk assessment process more efficient. This is to be achieved through the adoption of optimised questioning to facilitate an accurate yet quicker decision making process with a direct impact on resources and capacity. The contribution of this research presented is to fill the gap in knowledge in the area of current practices. Data have been collected through inspection reports and statistical analysis and risk assessment mapping carried out. Initial findings of the research show that there is wide variance in processes across police forces in England and Wales. These findings, alongside the detailed analysis are to be presented. The future strategy for extending these findings to relate to risk management levels is outlined.

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

14/09/2017 : 13:45 : Room 912 - JF LT CC.00.21(x120)

Code: OR59A3167

**Making OR Practice 'Visible': An Ethnomethodological Study of a Facilitated Modelling Workshop**

**Prof Luis Alberto Franco** (*Loughborough University*) and **Dr Christian Greiffenhagen** (*The Chinese University of Hong Kong*)

Empirical studies attempting to open the 'black box' of the practice of OR are beginning to appear in the literature, particularly within the area known as behavioural OR. Many scholars within this community share a commitment to both, empirically investigate what OR practitioners and users actually do when engaged in OR-supported processes, and evaluate what the effect of these 'doings' is. In this presentation, I treat real-time OR practice as an analytical

problem, and use ethnomethodology to bring to the fore its material and interactional features for close examination. Using a video vignette drawn from a facilitated modelling workshop in which causal mapping was used with a top management team, I will first illustrate how an ethnomethodologically-informed perspective can reveal the ways in which OR-supported activity is practically accomplished by those involved, moment by moment, and with what effects. I will then discuss the potential contribution that these kinds of fine-grained studies make to the behavioural OR agenda, and outline some useful avenues for future behaviourally-inspired research of OR practice.

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

### Big Data Technology

Organiser: Michael Mortenson

12/09/2017 : 11:00 : Room 4 - JF CC.01.09 (x44)

Code: OR59A3222

#### **The Big Data Game! A Simulated Exercise in Managerial Decision Making with Big Data**

**Mr Michael Mortenson** (*University of Warwick*) and **Mr Christian Lerke**

The challenges of Big Data have been studied extensively in respect to business uses, but less so (within the OR field at least) in respect to education and training. While many courses in "Analytics", "Data Science" and "Big Data" have been introduced, predominantly they focus on the technical skills required. As part of a new module in "Big Data Analytics & Visualisation", we have designed a novel simulation 'game' to be used which gives participants a rare opportunity to experience managerial decision making in the face of high velocity, varied, and volatile data streams. The talk explains the architecture of this software, as well as the novel approaches used, including a structural topic model correlated to sentiment analysis, geo-mapping visualisations and other analytical techniques.

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

12/09/2017 : 11:30 : Room 4 - JF CC.01.09 (x44)

Code: OR59A3224

#### **Writer's Block: An Extended Computational Literature Review (XCLR) of Blockchain**

**Mr Ronald Ajoku** (*University of Warwick*), **Mr Michael Mortenson** (*University of Warwick*) and **Prof Richard Vidgen** (*University of New South Wales*)

The Blockchain has been described as the one of the most disruptive technologies of our time. The potential uses of the Blockchain have been extended to almost all sectors of the world today, including governmental databases, asset management, cryptocurrencies and more. However, the most prominent use of the Blockchain in current times is its application in enabling the functionality of cryptocurrencies such as Bitcoin and Ether. However, the main potency of the Blockchain relies on its distinct ability to operate as a distributed database, for any and all purposes, shared and stored across user-networks in a verifiable manner. The literature on Blockchain is wide-ranging, from computer science, information systems, economics and the social sciences. However, to date, there has been no comprehensive review of this work. It is this gap that the research presented here will seek to meet. To do so we present a computational literature review (CLR) of Blockchain, evaluating which topics are most prominent in different disciplines, and suggest a framework for future research and for application areas in OR and beyond.

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

12/09/2017 : 12:00 : Room 4 - JF CC.01.09 (x44)

Code: OR59A3221

#### **KEYNOTE: Big Data and Document DBs, or: How I Learned to Stop Worrying and Just Treat Everything Like a Document**

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

Big Data is one of the most over-used, over-hyped and often nebulous terms of the 21st Century. However, one aspect that on which there is consensus is that Big Data has introduced considerable heterogeneity into the data used to fuel analytics and OR models. With this comes increasing demands on the databases that can store such data, and the variety of options available to organisations. This talk will cover some of the basics of the modern database ecosystem, and make the case for the applicability of document databases to a wide variety of use cases,

including natural language processing and Internet-of-Things (IoT). To demonstrate this argument, reflections on practical projects and demonstrations using MongoDB, Python and R will be presented.

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

12/09/2017 : 14:00 : Room 4 - JF CC.01.09 (x44)

Code: OR59A3225

### **Chain Reactions: Investigating the Impact of Blockchain on the Sharing Economy**

**Mr Wladimir Kossov** (*University of Warwick*) and **Mr James Pennington** (*University of Warwick*)

Sharing economy and its manifold synonyms do all refer to old market principles with new interpretations, dimensions and potential. Driven by socio-economic factors, it revolves around a) conscious consumption in a decentralised manner, b) accessibility over ownership and c) extraordinary efficiency. Thus, it mirrors a new "zeitgeist" which is dawning in the developed world. Since technology is a key enabler of sharing economy concepts, Blockchain is one of the youngest and probably most exciting ones. The hype within the sphere of information technology enthusiasts, financial investors and traders brings back memories of the dot-com bubble. One important lesson learned from this was the urgent need to distil viable, beneficial and future-oriented use cases. The aim of the presented work is to determine on common issues of modern concepts of sharing economy that can be effectively solved through Blockchain applications. Furthermore, a practical framework is provided that includes key factors of implementing Blockchain technology in sharing economy concepts.

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

12/09/2017 : 14:30 : Room 4 - JF CC.01.09 (x44)

Code: OR59A3057

### **Efficient Information Collection on Portfolios**

**Mr Michael Pearce** (*University of Warwick*) and **Prof Juergen Branke** (*Warwick Business School*)

This paper tackles the problem of efficiently collecting data to learn a classifier, or mapping, from each task to the best performing tool, where tasks are described by continuous features and there is a portfolio of tools to choose from. A typical example is selecting an optimization algorithm from a portfolio of algorithms, based on some features of the problem instance to be solved. Information is collected by testing a tool on a task and observing its (possibly stochastic) performance. The goal is to minimize the opportunity cost of the constructed mapping, where opportunity cost is the difference between the performance of the true best tool for each task, and the performance of the tool chosen by the constructed mapping, summed over all tasks. We propose several fully sequential information collection policies based on Bayesian statistics and Gaussian Process models. In each step, they myopically sample the (task, tool) pair that promises the highest value of the information collected. We empirically demonstrate that our methods significantly outperform standard approaches on a set of synthetic benchmark problems.

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

12/09/2017 : 15:00 : Room 4 - JF CC.01.09 (x44)

Code: OR59A3104

### **Fitting the Bartlett-Lewis Rainfall Model Using Approximate Bayesian Computation**

**Prof Owen Jones** (*Cardiff*) and **Mr Nanda Aryal** (*University of Melbourne*)

The Bartlett-Lewis rainfall model is a well-known model based on a clustered point process. It is defined using primary and secondary processes. The primary process is known as the parent process or the storm arrival process. Starting at each point of the parent process there is an associated secondary process called a daughter process or a cell arrival process. Each cell then has an associated rainfall duration and intensity, and the total rainfall intensity at time  $t$  is the sum of the intensities from all active cells at that time. The standard Bartlett-Lewis model uses a Poisson process for the storm arrival process. The cell arrival processes are also Poisson, stopped after an exponential time (the storm duration). Cell durations and intensities are also given independent exponential distributions. Even in its simplest form, this model has an intractable likelihood and cannot be fitted using maximum likelihood. Instead we consider two likelihood free parameter estimation regimes: Generalized Method of Moments (GMM) and Approximate Bayesian Computation (ABC). GMM is currently the preferred method for fitting Bartlett-Lewis rainfall models. This frequentist method compares empirical and theoretical statistics using weighted least

squares. ABC is a new approach for fitting Poisson cluster rainfall models, and instead of the theoretical statistics used by GMM it uses simulated data statistics. This allows us to use statistics for which we have no nice theoretical expressions. ABC-MCMC combines ABC and Monte Carlo Markov Chain sampling. We present a comparative study of ABC Markov Chain Monte Carlo (ABC-MCMC) and GMM, using simulated and real data sets. We show that ABC-MCMC outperforms GMM when applied to Bartlett-Lewis rainfall models. This opens a new avenue for fitting Poisson cluster models to real data without having to derive theoretical statistics, which, in some cases, are impossible to obtain.

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

12/09/2017 : 15:30 : Room 4 - JF CC.01.09 (x44)

Code: OR59A3130

**Risk Structure in an Extended Version of Merton's Jump-Diffusion Model Where Jump Magnitudes Follow an Autoregressive Process of Order 2**

**Dr Daniel Wei-Chung Miao** (*National Taiwan University of Science and Technology*) and **Dr Xenos Chang-Shuo Lin** (*Aletheia University*)

Merton's jump-diffusion model is a popular model for asset price dynamics as it incorporates jumps to capture price discontinuity. However, the independent increments in both the diffusion and jump parts make it unsuitable to describe a real market with momentum and reversal effects. To model these inherent market characteristics, we extend the jump structure and assume the sequential jump magnitudes follow an autoregressive process of order 2, or an AR(2) process. By introducing two additional parameters, the proposed model allows for a wide range of correlation structure among the successive jumps. A mathematical analysis is given for our model and some analytical results are derived for the asset return distributions and the European option prices. Using these results, we provide numerical examples to investigate how the two autoregressive coefficients influence the asset return distributions, the European option prices, and the risk measures such as value-at-risk (VaR) and expected shortfall (ES). We demonstrate that both the autoregressive coefficients have a significant influence on the risk structure but they affect the above risk measures in a different 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

12/09/2017 : 16:30 : Room 4 - JF CC.01.09 (x44)

Code: OR59A3197

**DSaaF: Data Science as a Framework**

**Ms Sayara Beg** (*Datanut Sciences Ltd*)

The purpose of this Framework is to establish a best practice and a benchmark in the field of Data Science and Big Data Analytics to ensure consistency of understanding and application. As a Framework, its structure and layout enables professional and academic institutions to create a learning program that suits their specific target audience and provide them with key transferable skills and knowledge across vertical industrial sectors. The Framework is split across three core subject areas: - Application of The Scientific Method: The U.K. Science Council provides a definition of Science, i.e. Science is the pursuit and application of knowledge and understanding of the natural and social world following a systematic methodology based on evidence. Tools of the Trade: In this subject area, the emphasis is on understanding the technologies that support Data Science and Big Data Analytics and to also explain the evolution technologies for analytical purposes. Interpersonal & Communication Skills: In this subject area, the emphasis is on developing an individual's interpersonal and communication skills for employability to improve the individual's capability for gaining and remaining employable.

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

12/09/2017 : 17:00 : Room 4 - JF CC.01.09 (x44)

Code: OR59A3226

**Measuring Up: Creating a Performance Management Dashboard for the ORS' Analytics Development Group**

**Mr Eduardo Rodriguez Gonzales** (*University of Warwick*) and **Mr Michael Mortenson** (*University of Warwick*)

Non-profit organisations often face the question of how to adequately measure the performance of their initiatives and activities in support of their strategy, especially those aimed at increasing stakeholder engagement. The Operational Research Society (ORS), which has the goal to advance the interest, knowledge and education in

Operational Research, faces such a situation. This paper presents the steps followed for the design of a performance measurement system, including the development of a functional dashboard, which meets the needs of the ORS's Analytics Development Group initiative. A design science research approach was followed, including requirements definition, design of the measurement system, development and evaluation of the dashboard. The result was the production of a functional cloud-based dashboard which will help the ORS monitor the progress of its Analytics Development Group towards achieving its community engagement and knowledge advancement goals. Guidelines as to how to best structure the performance measurement system were drawn from the design and development activity. Conclusions drawn from the followed design and development process, as well as from the evaluation of the resulting artefact (dashboard), can shed some light as to how non-profit organizations, especially knowledge advancement oriented societies, can adequately measure their performance.

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

13/09/2017 : 10:15 : Room 4 - JF CC.01.09 (x44)

Code: OR59A3212

**The Use of Synthetically Generated Imagery for the Training of Deep Convolutional Neural Network Image Classifiers**  
**Dr Stephen Lucek (NSC), Dr Philip Gibson (Dstl), Dr Craig Hack (NSC) and Mr Matthew Willis (NSC)**

There have been a number of recent advances and successes in computer vision in the field of visual classifiers. However, accurate classification requires a large amount of training imagery, with many machine-learning breakthroughs constrained not by the limitations of algorithms, but by the availability of high-quality training datasets. We describe the technical approach taken by NSC to investigate the potential benefits of using synthetic training datasets to address this challenge. We cover the configuration of a Deep Convolutional Neural Network (DCNN), to achieve good classification results, whilst quick to train running on GPU, allowing for extensive trials comparing DCNNs trained across many image portfolios. We detail some of the issues remaining with DCNN, requiring tight tuning and customisation for specific problems and/or objects. We present the utility of training datasets generated using synthetic images. Even simplistic synthetic imagery generation helps some classes of objects, and more sophisticated approaches may well be more generally useful. The control over image composition allows us to consider the important role of the background in image classification. We discuss how it both helps (providing context) and hinders (providing clutter) accurate classification. We therefore suggest an exciting approach prepossessing images using segmentation techniques to remove backgrounds.

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

13/09/2017 : 10:45 : Room 4 - JF CC.01.09 (x44)

Code: OR59A3240

**Business Analytics and Data Visualisation on Financial Statements**  
**Mr Eduardo Contreras Cortes (EY)**

EY is transforming the traditional way of analysing financial data by using advanced calculation and visualisation techniques to bring insight to their clients. EY has moved on from static pdfs and excel files to adopt cutting edge tools like R to extract and transform large amounts of financial statements into interactive dashboards and interrogate in a more intuitive way the financial performance of their clients. The dashboards allow our clients to analyse their data with minimal technical knowledge using any mobile browser or even a tablet. In this talk we will present the core elements from R that made possible the data extraction and data transformations and the most relevant components of building these kinds of data visualisation tools.

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

**Chartered Scientist**

**Organiser: Agne Sniukstaite**

**Community OR and Sustainable Development**

**Organisers: Eliseo Vilalta-Perdomo, Martha Vahl and Rebecca Herron**

12/09/2017 : 11:00 : Room 7 - JF D.O.02 (x56)

Code: OR59A3125

**Researching Communities of Non-Profit Organisations Supporting Mining Heritage in Cornwall**

**Dr Rebecca Herron** (*University of Lincoln*)

It is 10 years since non-profit organisations (and other key partners) developed a successful bid to gain UNESCO World Heritage status for the mining heritage landscape of Cornwall and Devon (UK). This research looks at the forms of non-profit organisation these enterprises take, their business and community models and the nature of their social, economic and environmental activity. It looks at how these communities of enterprise mobilise the past to help sustain and build the future in mid and west Cornwall and considers how analysing these systemically as a networked community adds insights.

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?: Highly

12/09/2017 : 11:30 : Room 7 - JF D.O.02 (x56)

Code: OR59A3178

**Stalking Cattle in the Meres and Mosses of the Marches**

**Dr Jane Holland** (*Plantagenet Consulting Ltd*)

Since fleeing the Learning and Skills Council in 2003, I have been working as an external consultant, at first with Government and arms length departments. However austerity and the Coalition Government meant that there was ever less interest in evidence based policy, and, with some very honourable exceptions, looking at what works in employment and skills. I needed to find new markets. In 2015, after a number of years trying, I finally broke into my target market of Heritage Lottery Fund evaluation, and since then I have been working with Wildlife Trusts and other environment oriented organisations to help them with their monitoring and evaluation work. How I eventually broke into this market is interesting in itself. In addition, the work is enjoyable, not particularly well remunerated and from our perspective relatively straightforward. It does come with some novel challenges however. In this presentation on practice, I will review briefly how I got into this area of work, the projects I have been or am still involved with, and the techniques that have been most useful to my clients. I will explain about the cattle. I will also draw out the overarching lessons that are becoming apparent through this series of consultancy assignments.

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

12/09/2017 : 12:00 : Room 7 - JF D.O.02 (x56)

Code: OR59A3064

**Creating a 'Shared Space' to Build Value Between Business and Communities**

**Dr Miles Weaver** (*Edinburgh Napier University*), **Dr Kenny Crossan** (*Edinburgh Napier University*), **Mrs Lorna McCallum** (*Elephant Communications*), **Mr Steven Paxton** (*Voluntary Action Fund*) and **Dr Hock Tan** (*Edinburgh Napier University*)

The presentation provides examples on how systems approaches have helped identify better ways for communities and socially responsible businesses to build value. The examples are the outcome of a two-year Knowledge Transfer Partnership with a Scottish fund manager (manages funds on behalf of others), the Voluntary Action Fund (VAF) who sought to ask: 1. How best to unlock and release the resources held by the for-profit sector (as part of responsible business practice) into communities? 2. How can these communities themselves, represented by third sector organisations help to evaluate the impact of this resource allocation? The project followed a soft systems approach to gain the perspective from over 300 Scottish businesses, third sectors organisations, Scottish and local government and their agencies) on the problem area (a perceived lack of alignment and connectivity between and within sectors to address the challenges facing communities) and to build practical solutions to address them. We argue that a fund manager, like VAF, can act as a conduit to unlock a 'shared space' based on a match of shared aspirations and goals, between multiple partners and collaborators and facilitate the co-creation of value that supports business growth and communities to flourish. This approach is outlined, including a set of guiding principles to unlock and facilitate the 'shared space' with examples from an initial pilot. We also found that the approach adopted drew additional benefits to build social capital with collaborators, partners and clients that form part of the 'whole system'; enter a strategic dialogue with those holding power (e.g. Scottish Government and their agencies; Umbrella bodies) and to develop new models informed and refined in consultation with stakeholders.

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?: Highly

12/09/2017 : 12:30 : Room 7 - JF D.0.02 (x56)

Code: OR59A3055

**Researching Territorial Capital Accumulation: The Intertwined Roles of Local Public Policies and Entrepreneurial Activities**

**Dr Eliseo Vilalta-Perdomo** (*University of Lincoln*)

This paper discusses forms of investigating the impact that entrepreneurship has in the accumulation of complementary expressions of capital. It focuses in four manifestations of 'territorial capital' that can be developed in local spaces: economic, cultural, social and environmental, and identifies research approaches that may be applied to better-informed local policy-making. It bounds the application of these research approaches to local public policies that support the development of micro-entrepreneurs, the role the former may play in building the latter, the contributions these approaches can offer and the limitations they may suffer. An extension to traditional approaches of discussing decision-making in terms of territorial capital is introduced. This extension considers Kahneman's systems 1 and 2, and two languages for intervening in the accumulation of territorial capital are introduced: language of needs and language for interactions.

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

12/09/2017 : 14:00 : Room 7 - JF D.0.02 (x56)

Code: OR59A3105

**Support Communities to Become 'Great' Again?**

**Ms Martha Vahl**

Recent developments in the UK emphasise the importance of communities in dealing with everyday life, both in a positive and negative sense. People in communities can be expected to be able to absorb grief and anger and to grow stronger in adverse situations. If they aren't they require support. This means finding ways to generate the resources that support community activities to deal with their own variety and diversity. Unfortunately, as is now widely recognised, in the practical context of daily life the role of theory in the traditional academic sense is limited. What is proposed to be required is support for activities like those in Kahneman's system 1, i.e. of people as embodied and embedded beings. Activities in his system 2 should not be the only ones to provide such support, as they are known to 'steal' embedded personal experiences. This suggests searching for a method in system 1 to improve activities in system 1 – analogous to the (scientific) method in system 2 that improves activities in system 2. It is proposed to use stories or narratives in support of improvement in system 1 – rather than their study via system 2. An application is the construction of anecdotes in social innovation. Their advantage is that they make use of experiences that via the method of system 2 are excluded (the set of such experiences is referred to as the bulk). The loss due to such exclusion is deemed serious. The proposed method reduces that loss.

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

12/09/2017 : 14:30 : Room 7 - JF D.0.02 (x56)

Code: OR59A3207

**Paradoxical Methods of Community OR**

**Prof Gerard de Zeeuw** (*University of Lincoln*)

Efforts at theorising often distinguish between two types of action that individuals can be recognised to perform: a first type consisting of fast and intuition driven actions and a second type consisting of actions that improve actions of the first type. Without the first type people wouldn't be able to survive in daily life. Even so they can often be improved. This is where the second type comes in. Its development is based on applications of the scientific method – both to actions of the first type and to actions of the second type. These applications have led to areas of study like operations research, analytics and cybernetics. Comparison of the two types of action suggests the possibility that there is an action of the first type that helps to improve actions of the same type. If so it would serve as an analogue of the scientific method, but unlike that method would include individual experiences as well as intentions and hence apply to individual domains. To operationalise this second method the type of mathematics that might facilitate applications of either method is identified. Models that are used in the scientific method are like the eigenforms of transformations. Models that are used in the second method appear to be like the negative eigenforms of such transformations (i.e. are of the form  $xx = \approx R(xx)$ ). The characterisation via negative eigenforms has a number of consequences for the way Community OR is studied. Examples are discussed.

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

### Data Envelopment Analysis

Organiser: Ali Emrouznejad

12/09/2017 : 11:00 : Room 5 - JF CC.01.10 (x36)

Code: OR59A3054

#### Efficiency Analysis of Production Lines Using Operational and Quality Factors: A Data Envelopment Analysis Approach

**Dr Sahand Daneshvar** (*Eastern Mediterranean University*), **Mrs Saba Ahmed** (*Eastern Mediterranean University*) and **Mr Mustapha D. Ibrahim** (*Eastern Mediterranean University*)

The change in customer preference has led to intense competition in the soft drink product market among the fast moving consumer goods (FMCG) industry. Since the market share is getting narrower among competitors, consequently the profit margin of manufacturers lessens. Thus, eliminating or improving inefficient production lines is a necessity towards sustaining profitability. This paper presents a data envelopment analysis (DEA) approach for evaluating efficiency of production lines in a beverage producing company using quality and operational factors, and identifying changes that causes (in)efficiency. Production lines of the factory are considered as decision making units (DMUs). Sensitivity analysis is employed to identify the factors that have more effect on efficiency. The result shows that quality factors, such as number of defective products is imperative for efficiency of the production lines. Estimate for the magnitude of input adjustment required to make a production line efficient is suggested. Findings of this study can help management in process modifications to attain efficiency, consequently sustaining profitability of production lines.

What is the nature of your talk?: Practical  
Does your talk require prior knowledge of the subject area?: Quite a lot  
Is your talk accessible and relevant to Practitioners?: Relevant

12/09/2017 : 11:30 : Room 5 - JF CC.01.10 (x36)

Code: OR59A3156

#### Categorizing Decision Making Units Based on Multi-Level Frontiers in Data Envelopment Analysis

**Dr Robabeh Eslami** (*Faculty of Technology and Engineering, South Tehran Branch, Islamic Azad University, Tehran, Iran*) and **Dr Mohammad Khoveyni** (*Yadegar-e-Imam Khomeini (RAH) Shahre Rey Branch, Islamic Azad University, Tehran, Iran*)

This study comments on the data envelopment analysis (DEA) approach which was presented to grade countries/territories by Yang et al. (2016) [Yang, G.-I., Ahlgren, P., Yang, L., Rousseau, R., & Ding, J. (2016). Using multi-level frontiers in DEA models to grade countries/territories. *Journal of Informetrics*, 10, 238–253]. We show the fundamental problem of their approach and propose a DEA approach to tackle this problem.

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

12/09/2017 : 12:00 : Room 5 - JF CC.01.10 (x36)

Code: OR59A3155

#### Determining the Strongly and Weakly Most Congested Decision Making Units in Data Envelopment Analysis

**Dr Mohammad Khoveyni** (*Department of Applied Mathematics, Yadegar-e-Imam Khomeini (RAH) Shahre Rey Branch, Islamic Azad University, Tehran, Iran*) and **Dr Robabeh Eslami** (*Department of Mathematics, Faculty of Technology and Engineering, South Tehran Branch, Islamic Azad University, Tehran, Iran*)

Determining the strongly and weakly most congested decision making units (DMUs) is a very important issue for decision makers, however, there is no study on determining these DMUs in data envelopment analysis (DEA). Hence, to do this, we first propose a DEA approach to recognize congestion status of DMUs and then, two integrated mixed integer programming (MIP)-DEA models is presented to determine the strongly and weakly most congested DMUs. Finally, a numerical example is provided to illustrate the purpose of this research.

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

12/09/2017 : 12:30 : Room 5 - JF CC.01.10 (x36)

Code: OR59A3065

### **Estimating the Total Productivity Growth of Insurance Companies Listed in the Iraqi Stock Exchange**

**Mr Subhi A. Jarwaan** (*Anbar of University*), **Prof Ahmad H. BATTAL** (*University of Anbar*) and **Prof Aysar Y. FAHAD** (*Al-Iraqia University*)

The study aimed to measure the growth of total productivity in the insurance companies listed in the Iraqi Stock Exchange for the period 2005-2014. By employing the Malmquist total productivity index, which is widely used to estimate total factor productivity, which consists of two parts, the first is technological change and the second is due to the technical efficiency change. The study sample included five insurance companies listed in the Iraqi Stock Exchange for the period (2005-2014). The data for the study were obtained from the Iraqi Stock Exchange website. The results showed that there was a negative growth of Iraqi insurance companies during the studied period and the negative growth rate reached 15% according to the Malmquist total productivity index. This negative growth is due to the decrease in productivity growth by 21% and the decline of technological development by 11%, although two companies registered a positive growth according to the index, but the general average shows the weak performance of insurance companies and the decline in their financial role during the period of study, which may be due to the weakness of financial depth and shallowness in Iraq.

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?: Somewhat

12/09/2017 : 14:00 : Room 5 - JF CC.01.10 (x36)

Code: OR59A3085

### **Measuring the Effect of Competition on the Efficiency of Primary Schools in Pakistan by Data Envelopment Analysis**

**Miss Maaida Hashmi** (*Lancaster University, UK*)

This study aims at finding the drivers of relative efficiency in public and private sector in the provision of primary education and further investigates the causes of inefficiency of schools. Efficiency analysis was done in two stages. In the first stage, Data envelopment analysis (DEA) was done to compare all types of schools based on efficiency scores. Further, second stage regression analysis was done by using variables of public and private schools to investigate the key factors responsible for efficiency. The results of the DEA analysis reveal that private schools are far better than government schools in terms of provision of quality education mainly because of student's background so policy makers should focus on students' home environment. Moreover, results of Tobit second stage regression analysis show that teachers training have a negative and significant impact on efficiency scores and facilities provided to the students affect school performance in long run. Competition is also a positive factor among the schools and encouraged them to perform better. Overall, this study is important for policy makers in planning and designing policies to increase the efficiency of primary schooling. Similarly, it can benefit the donors, civil society, researchers and academia.

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

12/09/2017 : 14:30 : Room 5 - JF CC.01.10 (x36)

Code: OR59A3086

### **Discriminating Power of DEA and Selecting the Number of Inputs, Outputs Versus Number of DMUs: A Simulation Study**

**Mr Yongjun Li** (*USTC*), **Prof Ali Emrouznejad** (*Aston University*) and **Ms Xiao Shi** (*USTC*)

Ever since the birth of Data Envelopment Analysis (DEA), the question of how to choose the number of inputs, outputs versus the number of DMUs has been one of the focal research points. Conceptually, it is well known that if too many inputs and outputs or too few DMUs are used, the discriminating power of DEA models will be much weakened. Many guidelines for selecting the number of inputs, outputs and DMUs to improve the discriminating power of DEA are thus proposed based on empirical studies, but without any quantitative analysis. In this study, we propose a new guideline to select the number of inputs, outputs and DMUs. First, we define a new measure to evaluate the discriminating power of DEA models (CCR and BCC model). This measure does not only evaluate the discrimination between efficient DMUs but also evaluates the discrimination between inefficient DMUs with the same ranks. Then, by employing a simulation study, we show how the discriminating power of DEA is related to various combinations of the number of inputs, outputs and DMUs. Finally, based on the proposed approach, we quantitatively provide a guideline how to choose the number inputs, outputs and DMUs.

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?: Very

12/09/2017 : 15:00 : Room 5 - JF CC.01.10 (x36)

Code: OR59A3092

### **A Formula for Efficiency Based on DEA Scores**

**Dr Christopher Tofallis** (*University of Hertfordshire*)

We present a simple and obvious way for constructing a formula which expresses efficiency scores in terms of input and output values. The formula may have the same form as that used to obtain the DEA scores, be it a ratio of linear expressions or a multiplicative form. The parameters in the formula are estimated by regressing the DEA scores on the underlying data. Regression allows a best fit to the DEA scores, which are treated as upper bounds. This provides a compact efficiency formula which avoids the often unrealistic input and output weights arising in DEA and the associated lack of discrimination. This may be viewed as an Automatic Democratic Method, as all units contribute to the formula. It also permits a direct ranking of units.

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

12/09/2017 : 15:30 : Room 5 - JF CC.01.10 (x36)

Code: OR59A3145

### **Environmental Event Prediction Using Voronoi Clustering and Temporal-Spatial Relationship Analysis via Surveillance Sensors**

**Mr Kamkin Lao** (*Macau University*), **Prof Simon Wong** (*Macau University*) and **Prof Lili Yang** (*Loughborough University*)

In this paper a novel spatial and temporal analysing model is introduced, which is combined with different space time analysing models and assists users to identify the trend of related environmental information and space time clustering. Many different analysing models are combined to build up the environmental surveillance system. Voronoi diagram builds up the polygon region area from coordinated point system via mathematical algorithms, and then the region is resigned and established in a polygon region map with the coordinated point system. This paper also applies the spatial co-relation analysing in environmental surveillance system with LISA Moran's I function in different time series. After achieved the clustering relationship, the result can be transferred and applied in temporal association analysing, from which users can build up a supervised system to make the well grouping and concerning the sequence, to summarize and generate the spatial relationship in each temporal interval as the "Spatial and temporal inertia". It can make users to have a clear view of identifying the trend of the spatial clustering as "inertia", and use it to explore the phenomenon. Based on the times series analysis for each sensor, it is possible to identify the acceptable range from each sensor. If its value is far from the predicting value, it can be explained as an outlier and monitors can trace back the problems immediately. Defining the value via the traditional regression model is practiced as one of the predict model to explore the environmental information in the seasonal time series. The system can send the warning to the users and notice whether there are any accident or sensor is out of order, such as short circuit from high humidity or temperature. Therefore users can understand and implement the improvement immediately based on this environmental information.

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

12/09/2017 : 16:30 : Room 5 - JF CC.01.10 (x36)

Code: OR59A3149

### **Ownership Structure and Efficiency Analysis in Indian Banking Sector: A Directional Distance Function based Meta Frontier DEA Approach**

**Mr Jatin Goyal** (*Punjabi University, Patiala*), **Mr Kanwaljeet Singh** (*Sri Aurobindo College of Commerce and Management*) and **Mr Rajdeep Singh** (*Punjabi University, Patiala*)

Government of India aims at making the Indian Banks internationally competitive. In the wake of intense competition and changing global and national business environment, the efficiency issues have emerged as an important pillar of success in the Indian banking sector. Therefore, it is an essential task to comprehend the efficiency levels of the overall Indian banking sector and also across different ownership structures (viz. Public, Private and Foreign). The present study endeavors to carry out an assessment of intra-sector efficiency in the Indian banking sector based on a cross-sectional data of 66 banks for the year 2015-16. The authors employ directional distance function based meta-frontier DEA approach and the results reveal that the Indian banking sector is 73.44% efficient. It also confirms the existence of different production functions across different ownership structures of the industry. Among the different ownership structures, the group frontier of foreign banks coincides with the meta-frontier. The group

frontier of private sector banks was the second closest to the meta-frontier and public sector banks were found to be the laggards in the overall industry. The study gains special significance in the backdrop of the recommendations floated by the Reserve Bank of India and Ministry of Finance (Government of India) to consolidate the public sector banks in order to retain fewer but healthier banks. The finding of the study fully support these recommendations and affirms that consolidation in the industry will bring positive synergies and will lead to the enhancement of efficiency levels in the industry.

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

12/09/2017 : 17:00 : Room 5 - JF CC.01.10 (x36)

Code: OR59A3150

### **Modelling the Financial Efficiency in Indian Textile Industry: An Application of DEA and Tobit Regression.**

**Mr Jatin Goyal** (*Punjabi University, Patiala*), **Mrs Harpreet Kaur** (*Punjabi University, Patiala*) and **Mr Rajdeep Singh** (*Punjabi University, Patiala*)

For an emerging economy like India, where textile industry contributes up to 13% in export earnings, 10% in total industrial production and 2% in Gross Domestic Product, it is an imperative task to comprehend the financial efficiency levels in the Indian textile industry and also delve deeper into the relative importance of its determinants. The present study attempts to carry out an in depth analysis into the financial efficiency levels of 171 firms based on cross-sectional data of 2015-16 using DEA approach. The DEA results highlight that the financial efficiency of firms in Indian Textile industry is only 30.94% and the level of financial inefficiency is a whopping 59.06%. Therefore, there is a huge scope for improvement in financial efficiency in the industry. In order to devise a more focused strategy to remove this inefficiency, tobit regression was run with financial efficiency scores from DEA as a dependent variable. The results of tobit regression revealed that firm size, marketing intensity, technological advancements, R&D, credit rating had a positive and significant impact while firm age, export intensity and sales growth had a negative and significant impact on financial efficiency scores. The findings hold an important place in the wake of the overwhelming contribution of Indian Textile industry to India's economy and the need for maximizing the shareholder's value so as to make it attractive for the investors globally. The inferences bear strong implications for the managers in their attempt to chalk out a focused approach to enhance financial efficiency in the Indian textile industry.

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

## **Ethics & Governance in OR**

**Organisers: Giles Hindle and Richard Vidgen**

12/09/2017 : 11:00 : Room 8 - JF D.1.02 (x54)

Code: OR59A3045

### **Unique ID for Every Citizen – A Case Study from India**

**Mr Kumaravel Sivakumar** (*Indian Institute of Management Tiruchirappalli*) and **Mr Vimal Kumar** (*Indian Institute of Management Tiruchirappalli*)

"Aadhaar" is a 12 digit unique, identity (UID) number issued to all Indian citizens, by the government of India, based on demographic and biometric information, including iris scan, digital fingerprint and photograph. This UID project is aimed at providing every citizen a unique ID that could be used to access to various Government services and benefits. As on date, it is the world's largest biometric identification system with over 1.13 billion members enrolled. With rising data privacy concerns, the Aadhaar legislation was passed in the Indian parliament in March 2016. Further, the judiciary has admonished the government not to mandate UID for a citizen to avail benefit from social welfare schemes and has evinced apprehension over ensuring a citizen's right to privacy. With increasing instances of data leaks and the ongoing debate on ethical use of the information captured by the government, our study tries to analyze the Indian policy framework in light of GDPR and how the UID has become more pervasive, with a wider scope in the recent years. The objectives of our study are: 1. To outline the different stakeholders in this large-scale programme, involving the process of collection, handling and storage of huge volume of data. 2. To look at the concerns of data breach in the UID project, compare and contrast the Indian legislation with the framework of GDPR, with view to identify gaps and come up with policy recommendations. 3. To examine the linking of UID with other existing identification mechanisms from a sociological perspective of surveillance and intrusion. Our analysis is based on the Government's policy documentation and published news reports in the print media for a period of eight

years (2010-2017). The study is pertinent at this juncture, when India is on the cusp of transforming into a digitally empowered society.

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

12/09/2017 : 11:30 : Room 8 - JF D.1.02 (x54)

Code: OR59A3058

**Good Enough for Government Work - Introducing a Modelling Integrity Network Approach to Quality Assurance of Operational Research in Support of Public Policy Design and Implementation**

**Mr Ian Mitchell** (*Department for Business, Energy and Industrial Strategy (BEIS)*)

This presentation describes the introduction of a Network approach to the delivery of Quality Control and Assurance (QA) processes in the Department for Business, Energy and Industrial Strategy (BEIS). It introduces the context, considering motive, means and opportunity for the delivery of Modelling Integrity. Recognising the limitations of any model the presentation reviews the underlying motivation for modelling integrity laid down by the Macpherson Review and AQUA Book. Using a 5 step cycle the presentation describes the use of the means, 3 working tools, comprising a QA log, Model report and Assumptions Log. The QA Log includes the use of a Multi Criteria Model operating at individual model and Departmental levels. The Network approach recognises the importance of independence for the assuring analysts at the boundary between real and model worlds. It relies on mutual support between analysts from separate policy areas to provide flexible capacity through collaboration. The presentation describes the reapplication of lines of development to build the Modelling Integrity Network. It includes consideration of challenges from the combination of different organisational cultures through a Machinery of Government transition. The presentation invites discussion on what now constitutes requisite, rigorous and reliable modelling. In the current circumstances of national transformation and abundant data what is good enough for government work?

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

12/09/2017 : 12:00 : Room 8 - JF D.1.02 (x54)

Code: OR59A3109

**KEYNOTE: Will the New EU General Data Protection Regulation (GDPR) Stand in the Way of Data Science and OR?**

**Mrs Armelle Cressent** (*Ecole des Hautes Etudes en Sciences Sociales*)

Focus on privacy is on the rise. In May 2018, a new EU regulation will dramatically change the way in which data relating to individuals can be used. From data collection to analytics through data mining and storage: not a single step will be spared. Algorithms, profiling, commercial research are to fall under intense scrutiny. No doubts data scientists will have to adapt their methodologies, possibly even their mindset. The GDPR pushes the use of data in a complete opposite direction to where most data scientists aim to. Whereas data science tends to maximise data collection and to find new ways of using data, the GDPR not only strives for minimising data collection but also for reducing the use of data. Hence the question: Will the GDPR stand in the way of data scientists? Opportunities from data are huge and no one would dispute the fact that data science is key for innovation and wealth creation. Conflicting objectives does not mean that data scientists and privacy advocates are not pursuing the best interests of citizens. Measuring compatibility between data science and privacy might therefore not be the right approach. Instead data scientists should take privacy into account as an integral part of their activity. They also need to know exactly what they are looking for in the data, but also what they should not be looking for. And more importantly, they need to be part of the wider discussion about Privacy and understand the GDPR implications on their activity. The aim of this keynote speech is to examine the GDPR impact on data science and to highlight some of the conflicting goals between data protection laws and current dynamics within data science.

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?: Highly

12/09/2017 : 14:00 : Room 8 - JF D.1.02 (x54)

Code: OR59A3161

**An Historical Review of Ethics in OR**

**Dr Giles Hindle** (*University of Hull*) and **Prof Richard Vidgen** (*University of New South Wales*)

There is much excitement around business analytics and data science as commercial organisations explore how they can use their large volumes of data to create value in their business, and governments and communities seek

to create value of a broader nature through exploitation of their data resources. However, these developments are driving a review of data governance and privacy. For example, in May 2018, the new EU General Data Protection Regulation will change the way in which data relating to individuals can be collected, stored and used. This presentation gives a brief overview of the history of ethics within OR. Using a workshop that took place in Rensselaer Polytechnic Institute (USA) in 1989 as a platform, the presentation summarises the main concerns of OR from an ethical standpoint since the 1950s. Ethical questions which have been asked include: What is the proper relationship between the model builder and the model user? Should model builders assume professional responsibility for the results of their models? Do model builders have a responsibility to those affected by the results of their models besides the clients? What are the ethical implications of the boundary judgement we make in OR practice?

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?: Highly

14/09/2017 : 12:00 : Room 2 - JF CC.00.14 (x40)

Code: OR59A3159

### **Ethics of O.R.: Codes of Practice and Real-Life Challenges**

**Ms Ruth Kaufman** (*The OR Society*)

The OR Society first published an ethical code of practice some years ago. More recently, with the agreement by the Science Council to licence the ORS to award Chartered Scientist status, we have developed a code of practice that is mandatory for anybody awarded CSci. This talk reviews some of the key requirements, and some of the real-life situations where an O.R. professional's first instinct may be in contravention of the code, or where genuine ethical dilemmas may arise.

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

14/09/2017 : 13:15 : Room 2 - JF CC.00.14 (x40)

Code: OR59A3147

### **KEYNOTE: White Hat Psyops: Repurposing Weapons of Mass Persuasion within a New Ethical Framework for Data Science Practitioners**

**Mr Ian Randolph** (*Trainline*)

Recent news revealing the role of data analytics firms in tipping the electorate towards Brexit and Trump demonstrates the chilling power of mass persuasion tools in the hands of those with underdeveloped worldviews. The intention of this talk is to present a practical ethics which might help reorient these powerful technologies towards defensible ends. We will begin by detailing how these weapons of mass persuasion work and placing them within a larger taxonomy of data science capabilities. Using examples of best practice from Trainline and other industry leaders, we will conclude by discussing three ethical design principles which will help data science practitioners better inspire human strength rather than prey on human weakness.

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

## **Forecasting**

**Organisers: Bahman Rostami Tabar and Devon Barrow and Bahman Rostami Tabar**

12/09/2017 : 11:00 : Room 911 - JF D.2.02 (x52)

Code: OR59A3094

### **KEYNOTE: Uncertainty in Predictive Modelling**

**Dr Nikolaos Kourentzes** (*Lancaster University Management School*)

Forecasts are central to decision making. Over the last decades there have been substantial innovations in business forecasting, resulting in increased accuracy of forecasts. Models and modelling principles have matured to address company problems in a realistic sense, i.e. they are aware of the requirements and limitations of practice; and tested empirically to demonstrate their effectiveness. Furthermore, there has been a shift in recognising the importance of having models instead of methods to facilitate parameterisation, model selection and the generation of prediction intervals. The latter has been instrumental in refocusing from point forecasts to prediction intervals, which reflect the relevant risk for the decisions supported by the forecasts. At the same time the quality and quantity of potential model inputs has increased exponentially, permitting models to use more information sources and support higher frequency of decision making, such as daily and weekly planning cycles. All these have facilitated and made

necessary an increase in automation of the forecasting process, bringing to the forefront a new dimension of uncertainty: the model selection and specification uncertainty. The uncertainty captured in the prediction intervals assumes that the selected model is 'true'. This is hardly the case in practice and we should account for that additional uncertainty. First, we discuss the uncertainties implied in model selection and specification. Then we proceed to develop a way to measure this uncertainty and derive a new way to perform model selection. We demonstrate that that this not only leads to superior selection, but also provides a natural link to model combination and specifying the relevant pool of models. Last, we demonstrate that once we recognise the uncertainty in model specification, we can extract more information from our data by using the multiple temporal aggregation frameworks, and empirically show the achieved increase in forecast accuracy and reliability.

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

12/09/2017 : 12:00 : Room 911 - JF D.2.02 (x52)

Code: OR59A3206

### **Evaluation of Forecasting Platforms: the Case of the UK's International Natural Hazard Forward Look**

**Dr David Collier** (*LSE*), **Dr Victor Javier del Rio Vilas** (*University of Surrey*), **Dr Lisheng He** (*Warwick University*), **Dr Helen Roberts** (*Defra*) and **Miss Xiaoxuan Wang** (*LSE*)

The International Natural Hazard Forward Look (INHFL) aims to improve situational awareness of decision makers across the UK government on global weather, volcanic, human, and animal health events. The INHFL is produced weekly by a multi-hazard partnership consisting of UK Government Science Agencies who hold expertise in their respective fields. This includes the Animal and Plant Health Agency, British Geological Survey, Met Office and Public Health England. After 1.5 years in operation, the multi-hazard partnership is now pursuing the evaluation of the platform. We will present results of a multi-prone evaluation of the tool, with focus on animal health threats. Specifically, we will report results of an assessment of the processes around detection, risk characterization and communication to Ministries of the recent wave of highly pathogenic cases of avian influenza (H5N8) across Africa, Asia, the Middle East and Europe in the winter of 2016-17. These analyses are part of wider array to comprehensively evaluate the effectiveness of INHFL that include: i) descriptive analyses of the threats by relevant classifiers (e.g. pathogen type or country of origin) to support comparisons with other threat or driver classification efforts; ii) validation of the predictive value of INHFL by means of following flagged hazards and deriving metrics of predictive occurrence; and iii) an exploration of approaches to assess all the dimensions of decision quality. Our results will inform a proposal to improve the accessibility of the evidence and develop an exhaustive audit trail of decisions, thus delivering a continuous and systematic assessment of the 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?: Highly

12/09/2017 : 12:30 : Room 911 - JF D.2.02 (x52)

Code: OR59A3220

### **A Model for the Alignment of Supply Chain Inventory Control and Financial Decisions**

**Mr Safi Elegbede** (*Coventry University*), **Dr Mohammad Ali** (*Coventry University*), **Dr Devon Barrow** (*Coventry University*), **Prof Kamil Omotoso** (*Coventry University*) and **Dr Bahman Rostami-Tabar** (*Cardiff University*)

Abstract Traditional literature has demonstrated strong association between the performance of supply chain inventory control policies and profitability. Integration of operational policies with financial decisions has long been seen as an avenue to improve and to better corporate strategic financial objectives in supply chain sector organisations through optimal inventory investment. This is quite important since measures to improve financial performance implicitly influence and restrict operational performance including the management of inventory. However, in measuring the impact of one on the other, previous research has tended to focus on modelling inventory separately, and using the resulting output to access financial impact, based on sensitivity analysis or simulation. In this paper, we develop and propose two models, one of inventory and another of finance, and explores the connections between these two models in forecasting future demands and inventory investments. We further propose a meta-heuristic algorithm that explores the fundamental trade-offs between operational and financial considerations and takes into account relevant financial constraints such as working capital funding needs and trade credits (countenanced and consented upstream and downstream payment delays) for enhanced supply chain coordination. We assume a periodic review inventory policy with finite horizon and single product.

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

12/09/2017 : 14:00 : Room 911 - JF D.2.02 (x52)

Code: OR59A3154

**Forecasting Product Returns from Past Demands: Effect on Optimal Inventory Policy and System Cost**

**Dr Chee Khian Sim** (*University of Portsmouth*)

We consider a finite horizon periodic review backlog inventory model based on a system faced with random demands and remanufactures two types of cores: buyback cores and normal cores. A way to forecast from past demands for product returned as buyback cores is incorporated into the model. We write the optimal expected system cost in the finite planning horizon as a dynamic program and then obtain an optimal remanufacturing and disposal policy. The effect on the optimal inventory policy when return's forecasting change due to change in past demands is investigated. We also study numerically how forecasting product returns from past demands affects system cost.

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?: Not at all

14/09/2017 : 10:00 : Room 911 - JF D.2.02 (x52)

Code: OR59A3067

**Comparative Review of AI Application in Finance**

**Dr Arash Bahrammirzaee** (*NIB Group*)

Nowadays, many current real financial applications have nonlinear and uncertain behaviors which change across the time. Therefore, the need to solve highly nonlinear, time variant problems has been growing rapidly. These problems along with many other traditional models' problems caused growing interest in artificial intelligent techniques. In this paper, comparative research review of three famous artificial intelligence techniques, i.e., artificial neural networks, expert systems and hybrid intelligence systems, in financial market has been done. A financial market also has been categorized on three domains: credit evaluation, portfolio management and financial forecasting and planning. For each technique, most famous and especially recent researches have been discussed in comparative aspect. Results show that accuracy of these artificial intelligent methods is superior to that of traditional statistical methods in dealing with financial problems, especially regarding nonlinear patterns.

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

14/09/2017 : 10:30 : Room 911 - JF D.2.02 (x52)

Code: OR59A3131

**An Empirical Approximation for Setting Safety Stocks**

**Mr Patrick Saoud** (*Lancaster University*), **Prof John Boylan** (*Lancaster University*) and **Dr Nikolaos Kourentzes** (*Lancaster University*)

Companies strive to maintain inventories at an optimal level, as shortages drive customers away, while excessive level of stocks incur losses. In practice demand predictions are never accurate, and safety stocks are used to buffer against demand uncertainty. While a tremendous body of research has been devoted to optimising inventory levels in various contexts, the quantification of the uncertainty stemming from demand has attracted less attention. The conventional method, adopted by many standard textbooks, consists of multiplying the variance of one-step-ahead forecast errors by the lead-time to produce an estimate of the variance of forecast errors over lead-time. This method hinges on an important assumption: that the demand is i.i.d.. However, in practice this is seldom the case and the actual variance of forecast errors is often underestimated, resulting in lower achieved service levels. This paper aims to demonstrate the shortfalls of the current method from an analytical perspective, highlighting the underlying covariances that inflate the uncertainty when the i.i.d. assumption is not realistic. We proceed to propose an intuitive approach to estimate the lead time demand variance, independent of the underlying demand process. This is coupled with an inventory simulation that illustrates the impact on cycle service levels of the proposed lead time demand variance approximation, as compared with existing benchmark approaches, confirming that the suggested one performs best.

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

14/09/2017 : 11:30 : Room 911 - JF D.2.02 (x52)

Code: OR59A3184

### Call Centre Forecasting Using Multiple Temporal Aggregation

Dr Devon Barrow (*Coventry University*), Dr Nikolaos Kourentzes (*Lancaster University*) and Dr Bahman Rostami-Tabar (*Cardiff University*)

Current approaches to call centre forecasting involve forecasting weekly demand and subsequent disaggregation into half-hourly, hourly and daily time buckets as forecast are required to support multiple decisions and plans. Once the weekly call volume forecasts are prepared, accounting for any seasonal variations, they are broken down into high frequencies using appropriate proportions that mainly capture the intra-week and intra-day seasonality. Although this ensures reconciled forecasts across all levels, and therefore aligned decision making, it is potentially not optimal in terms of forecasting. On the other hand, producing forecasts at the highest available frequency, and aggregating to lower frequencies, may also not be ideal as very long lead-time forecasts may be required. A third option, which is more appropriate from a forecasting standpoint, is to produce forecasts at different levels using appropriate models for each. Although this has the potential to generate good forecasts, in terms of decision making the forecasts are not aligned, which may cause organisational problems. Recently, Kourentzes et al. (2014) proposed the Multiple Aggregation Prediction Algorithm (MAPA), forecasting with multiple temporal aggregation (MTA) levels. MAPA models a series at multiple aggregation levels separately, and subsequently combining the forecasts using the implied temporal hierarchical structure. Athanasopoulos et al. (2017) proposed a more general MTA framework than MAPA, defining appropriate temporal hierarchies and reconciliation mechanisms, and thus providing a MTA forecasting framework that is both flexible and model independent. Given the high frequency, multi-temporal nature of the forecast requirements and the subsequent planning associated with call centre arrival forecasting, MTA becomes a natural, but yet unexplored candidate for call centre forecasting. This work evaluates whether there are any benefits from temporal aggregation both at the level of decision making as well as at the level of aggregation in terms of forecast accuracy and operational efficiency.

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

14/09/2017 : 12:00 : Room 911 - JF D.2.02 (x52)

Code: OR59A3151

### Forecast Quality Improvement with Action Research: A Success Story at PharmaCo

Dr Christina Phillips (*Bangor/Leeds University*) and Prof Konstantinos Nikolopoulos

There is a gap in forecasting research surrounding the theory of integrating and improving forecasting in practice. The amount of academically affiliated consultancies and knowledge transfer projects taking place, due to a need for forecast quality improvement, would suggest that there are many interventions or actions taking place. However, the problems surrounding practitioner understanding, learning and usage are rarely documented. In this article we make a first step in trying to rectify this situation by using a specific case study of a fully engaged company. A successful action research intervention in the Production Planning and Control work unit improved the use and understanding of the forecast function, contributing to substantial savings and enhanced working practices.

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

14/09/2017 : 13:15 : Room 911 - JF D.2.02 (x52)

Code: OR59A3164

### Improving Forecasting and Inventory Management at a Local SME

Mr Marc Davies (*Bangor University*), Dr Siwan Mitchelmore (*Bangor University*) and Prof Kostas Nikolopoulos (*Bangor University*)

forLAB, was invited to assess a local SME's planning and inventory systems with a view to improving their forecasting systems in their production methods. The company saw a need to alter their production scheduling so that it was less reactive and more anticipatory of orders. At the start of the project the company ran on a mainly make to order paradigm and utilized little forecasting. One of the main challenges was the highly variable nature of the individual products demand patterns. forLAB proposed implementing a hybrid make to order/make to stock system in order to both level production and provide better planning capacity for both raw materials and production scheduling. In order to tackle the variable demand characteristics of each product a method was developed that competed 6 forecasting methods against each other to select the most suitable model for each product. The ADIDA methodology was used to transform intermittent time series into continuous time series to increase the available forecasting methods. An intuitive and simple selection criteria was used to determine if a product was either make to order or make to stock using the average demand and coefficient of variation. A software solution using the R statistical language was developed by forLAB to aid the managers in their production scheduling and raw material

purchasing decisions. Ease of use was a main requirement, and the software solution meant the managers could use it without detailed statistical knowledge. This case study highlights the journey a company makes when changing to a new production paradigm, the selection of the correct forecasting method for each product time series, selecting the correct aggregation level, and the positioning of the order penetration point.

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

14/09/2017 : 13:45 : Room 911 - JF D.2.02 (x52)

Code: OR59A3166

### **The Impact of Temporal Aggregation on Production and Inventory Costs**

**Dr Bahman Rostami-Tabar** (*Cardiff University*) and **Prof Stephen Disney** (*Cardiff University*)

Temporal aggregation is seen as an intuitively appealing forecasting strategy that reduces uncertainty by transforming the series into lower frequencies allowing one to identify the time series characteristics better. The effect of temporal aggregation on the stock control, via inventory costs and service levels, has been analyzed empirically and its benefits are discussed in the literature. However, there is little theoretical support identifying when temporal aggregation can improve supply chain utility. Herein, we analytically investigate the impact of non-overlapping temporal aggregation on supply chain inventory and production costs. For an ARMA(1,1) demand process, forecasted with the MMSE approach, we model a supply chain consisting of a retailer and a manufacturer. We calculate the inventory and production costs at both stages using non-aggregate and non-overlapping aggregated demand. They reveal how temporal aggregation affects supply chain costs and when each approach is superior. We provide suggestions about when to use temporal aggregation for minimizing supply chain costs.

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

## **Health and Social Care**

**Organisers: Navonil Mustafee and Andrew Fordyce**

12/09/2017 : 15:30 : Room 912 - JF LT CC.00.21(x120)

Code: OR59A3080

### **Easy in But Not Easy Out: Reducing the Number of Delayed Discharges in NHS Hospitals**

**Dr David Halsall** (*NHS England*)

Computer simulation has proved very useful in understanding and improving patient flows in hospitals. Despite growing demand from an ageing populations the NHS in England has been able to maintain patient flows for emergency care without increasing significantly the number of hospital beds. But there has been a well reported pressure on the interface between hospital discharge and step-down social care to receive patients who are medically fit. This has led to an increasing number of patients whose discharge is delayed by days or even weeks. Modelling will be described which used to investigate the dynamics of the discharge process and investigate cost effective ways to reduce the problem. This has provided insight into the need for an agile response from social care capacity if delayed transfer of care is to be reduced.

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

12/09/2017 : 16:30 : Room 912 - JF LT CC.00.21(x120)

Code: OR59A3038

### **Controlling Mass-Casualty Flow for Emergency Healthcare: A Simulation Analysis**

**Dr Mohsin Nasir Jat** (*Lahore University of Management Sciences (LUMS)*), **Dr Raza Ali Rafique** (*Lahore University of Management Sciences (LUMS)*) and **Mr Sanna Ullah** (*Lahore University of Management Sciences*)

An engagement of multiple medical facilities in response to a mass-casualty incident implicates the issue of an efficient distribution of casualties within the facilities. We seek to explore this issue through a discrete event simulation analysis of a terrorist bomb attack instance in a major city of Pakistan—a country that has experienced frequent terrorism incidents in the recent past. The work compares three response approaches. The first involves directing all of the casualties towards the nearest hospital. When the nearest hospital's capacity is exhausted, the casualties are redirected to the other hospitals in the system. This standard approach essentially places the control center role at the nearest hospital. The second approach involves directing some set proportions of the casualties towards the hospitals. In the third approach, the casualties are directed towards the nearest hospital until some

capacity threshold level is reached, triggering the diversion of the traffic to the other hospitals. The latter two approaches require the casualty flow control at the incident location. Though the analysis is based on a terrorism related incident, the insights can be relevant for any type of urban disasters resulting in instantaneous mass-casualties, e.g., transportation and industrial accidents.

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

12/09/2017 : 17:00 : Room 912 - JF LT CC.00.21(x120)

Code: OR59A3163

**Assessing the Financial Impact of Adopting a Tailored Approach to Treating Patients with Long Term Conditions**  
**Mr Stephen Foggo** (*SIMUL8 Corporation*) and **Mr James Sheffield** (*Datalytics Technology*)

Multi-morbidity in England is common. Research suggests only 10% of patients living with a long term condition have only one and as the population ages this is only going to get worse as we know the older the age cohort the larger the proportion of those with multiple morbidities. Recent research demonstrates that frailty should be understood as a long term condition. Currently 33% of all GP consultations are with people with multi-morbidity. With evidence to suggest there is an increase in over-treatment, causing harm, patients are having a reduced quality of life. Many health systems are starting to develop new models of care to better meet the needs of people living with long term conditions, with the aim to reduce unwarranted hospital visits. However, it can be a challenge to predict the likely financial outcome of these new models of care given the complexity of patients and their use of services. Implementing without an understanding of financial outcomes is a risk. How can we help health systems understand the financial impact of adopting a person centered care approach? SIMUL8, alongside NHS England, has developed a simulation tool to test out the cost impact of introducing a person centered care approach. Some real life examples have been included in the tool to allow users to test out how different approaches will be expected to perform in their locality while still allowing users to create their own model of care and test out how this is likely to perform from a financial point of view. This session will outline how the simulation is constructed and how it is being used to support real world decision making.

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

14/09/2017 : 10:00 : Room 913 - JF LT CC.00.13(x201)

Code: OR59A3110

**Restructuring Existing Ward Structures at a Public Hospital**

**Dr Nalan Gulpinar** (*The University of Warwick*) and **Dr Sebastian Rachuba** (*University of Exeter*)

In this paper, we present a two-stage stochastic optimisation model for the ward restructuring problem at a public hospital. The optimisation model assigns beds to wards and departments and takes into account demand uncertainty per department and various room sizes. The effects of restructuring are demonstrated in a case study using real world data. We analyse the trade-offs between restructuring effort, the resulting costs and the quality of new structures in terms of both operational and managerial implications.

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

14/09/2017 : 10:30 : Room 913 - JF LT CC.00.13(x201)

Code: OR59A3116

**Assurance, Trust and Security – the Role of Healthcare Systems?**

**Ms Penelope Mullen**

Whilst promoting health and preventing ill-health are primary objectives of health care, it can be argued that a major objective of healthcare systems, whether tax or insurance based, is to provide security – to assure that health care is available when needed. Nevertheless, health-gain maximisation has been widely adopted as the primary or even sole objective in healthcare priority-setting by policy makers, health economists and other analysts, including Operational Researchers. However, health-gain maximisation (QALY maximisation) can have a number of consequences which run counter to assuring the availability of needed health care, including reinforcing inequalities and discrimination against those with rare diseases, against those with pre-existing disabilities and against those needing more costly interventions. Modifications to 'pure' health-gain maximisation, for example, weighting QALYs or adjusting funding thresholds, have been proposed but they fail to question the underlying assumptions of the pursuit of health-gain maximisation or to address issues such as security and assurance. This paper discusses

whether security, in the form of assurance, trust and predictability, should be adopted as a major objective in healthcare priority setting and health system modelling. It goes on to explore the implications and analyse how such an approach might be pursued in practice.

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

14/09/2017 : 11:30 : Room 913 - JF LT CC.00.13(x201) Code: OR59A3060

**KEYNOTE: Applications of Big Data Analytics in the Healthcare Field**

**Dr Korina Katsaliaki** (*International Hellenic University*) and **Mrs Panagiota Galetsis** (*International Hellenic University*)

Big Data Analytics (BDA) in Healthcare involves the wide amount of electronic data related to patient healthcare and well-being which comes in various forms and from various sources and locations that in the past was difficult to be measured by traditional software/hardware. The BDA capabilities to harvest these data, through the advancement of information technologies, is creating enormous opportunities for companies to improve patient outcomes while managing costs. The aim of this study is to profile research in the field of Healthcare analytics and its applications and to generate discussion about the emergent themes and the future trends of this movement. The methodology is based on the selection of articles in the field using bibliometric techniques from the Web of Science and Scopus databases, published from 2000 through 2016, followed by text-analysis and synthesis of literature in thematic areas with the use of the Nvivo software. The objective of this study was twofold: a) to develop a conceptual framework for the classification of articles dealing with 'big data analytics in healthcare industry' and use it for summarizing the existing knowledge in terms of big data capabilities, types of value creation from 'big data', beneficiaries, benefits of the use of analytics and challenges, and b) to illustrate future research directions where the use of 'big data analytics in healthcare industry' is likely to have huge impact. We believe that the discussion on the findings will have implications for patients, healthcare providers, pharma companies, medical technology and software companies, researchers, data analysts, journal editors and research institutions.

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

14/09/2017 : 13:15 : Room 913 - JF LT CC.00.13(x201) Code: OR59A3138

**The Role of Beacon Technology in Developing a Home Based Healthcare System**

**Mr Luke Power** (*Loughborough University*)

As the global population age increases due to advances in medical science and improving living conditions, national healthcare systems have been placed under ever increasing strain with the projected workforce in the medical field becoming incapable of meeting demand in the near future. As such, the demands on hospital beds has increased efforts to care for patients with NCD (non-communicable diseases) in the home using technology as a method of care without direct patient observation which requires extensive manpower. Current research on sensors technologies used in healthcare such as infrared lack accuracy, practicality and interoperability. Other methods of remote care may be seen as too intrusive and insecure such as cameras. This research aims to explore the role of BLE (Bluetooth Low-Energy) beacons in this endeavour by sensing how patients are coping with independence and disease management within their own homes while being practical, secure and accurate. Sensors will observe patients engaging in activities of daily living while estimating the patient's possibility of malnourishment, levels of independence, isolation and detect accurate vital statistics both bodily and environmental such as temperature, air quality and light levels. This will be achieved by placing small (3mm) BLE sensors on the patient, in their home and on OOI (objects of interest) such as water bottles, kettles and microwaves. Initial stages of the research are in the development of a healthcare algorithm to utilise these beacons to accurately measure patient sedentary levels and independence by observing movement between beacons such as from kitchen to dining room and interactions with OOI. The developments in the methodology of designing and implementing this technology will be presented alongside future expectations and challenges of further work to investigate independence and malnourishment through remote home patient observation in the highly variable home environment using BLE sensors.

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

14/09/2017 : 13:45 : Room 913 - JF LT CC.00.13(x201) Code: OR59A3254

## **NHS Quicker - A Mobile App on ED/MIU Waiting Time for Devon**

**Dr Navonil Mustafee** (*University of Exeter*), **Dr Andrew Fordyce** (*Torbay & South Devon NHS Foundation Trust*) and **Prof John Powell** (*University of Exeter*)

The aim of the research is to provide information transparency, through the use of a mobile App (NHS Quicker), on ED/MIU waiting times which would allow recipients, including, significantly, patients who are in need of urgent medical attention, to make informed decisions as to the facility that could best serve their needs. It is expected that this work will contribute towards nudging patients' emergency department (ED) attendance behaviour and thereby reduce pressure in ED by redistributing demand for minor ailments among the MIUs. The App is being developed by the Health & Care IMPACT Network (<http://www.health-impact-network.info/>). Previously, the IMPACT Network has worked with Torbay and South Devon NHS Trust (TSDFT) and the Royal Devon and Exeter NHS Trust (RD&E), to develop two external facing websites which provide real-time ED/MIU information. We have monitored the use of the TSDFT web page since its launch (March 2016), and the web page remains the single most visited URL for the whole Trust. Our NHS Quicker App project extends this work across other Trusts in Devon. It offers an extensible solution wherein wait times are made available irrespective of NHS catchments. Indeed, our project focus on the wider Sustainability and Transformation Partnership (STP), rather than the individual Trusts.

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

### **Impact Cases**

**Organiser: Jiyin Liu**

13/09/2017 : 10:15 : Room 913 - JF LT CC.00.13(x201)

Code: OR59A3247

#### **Preparing Impact Case Studies with Reference to REF**

**Prof Tom Archibald** (*Edinburgh University*) and **Prof John Arnold** (*Loughborough University*)

Practical impact becomes an increasingly important aspect for assessing research work in the Research Excellence Framework (REF). Most universities now encourage academics to conduct research that makes real impact in practice and that can be written up as case studies to demonstrate the impact in REF submission. Two REF panel members, Prof Tom Archibald and Prof John Arnold will present their observations and views on the types of impact that research work in general and OR research in particular can make, insights into how to engage with industrial collaborators and how to write the impact case studies. This will be followed by discussions. Practitioners with experience of working with academia may also contribute to this session.

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

### **Information Systems**

**Organisers: Oliver Kayas and Crispin Coombs**

13/09/2017 : 10:15 : Room 8 - JF D.1.02 (x54)

Code: OR59A3082

#### **Creating Trusted Data for Global Value Chains**

**Dr Donna Champion** (*Cranfield University*)

Achieving the United Nations 2030 Sustainability Goals of equitable access to resources, will require co-operation between partners where there is little trust, or willingness to co-operate, particularly around critical infrastructures, such as those for Water, Food, and Energy. Blockchain applications (distributed ledger technology) are now being widely applied as a means of managing trade and asset transfers between partners who often remain anonymous and unknown to each other. These technologies are also increasingly being regarded as a means to offer an information infrastructure that provides a trusted data source across global value chains. Blockchains allow information to be openly shared, but can also protect privacy and intellectual property if necessary. One of the challenges in blockchain however, is how to set up and govern the peer-to-peer networks that underpin blockchain transactions in enterprise applications. In the Bitcoin and Ethereum blockchain networks, participation is open to anyone, but in enterprise applications, networks can be private, membership only affairs (i.e. permissioned); or indeed a hybrid network, where some activity occurs 'off-chain' and is re-validated onto a blockchain later in the trading cycle. Each of these different types of network has inherent risks and challenges, but currently the behaviour of these networks is not well-understood. This research is examining the behaviour of different types of peer-to-peer network underpinning the consensus protocols for different applications of blockchain, in order to create a prototype

theory around what behaviour across a network produces a chain where the data is trusted. This work will contribute towards formulating the governance and standards that will be required to operate planetary-scale enterprise blockchains in an open, trusted and sustainable way.

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

13/09/2017 : 10:45 : Room 8 - JF D.1.02 (x54)

Code: OR59A3192

**Factors affect Internet of Things and Information Communication Technology to Sustain Built Heritage in Egypt**

**Dr Mahmoud Abdelrahman** (*Newcastle Business School, Northumbria University*)

It has been impossible nowadays not to come across the term "Internet of Things" (IoT) or "Big Data Analytics" one way or another. Information communication technology (ICT) has significantly affected the way data & information are analysed, presented, exchanged and processed. ICT in particular are being touted as the catalyst by which governments and organisations move away from geographic and time constraints to more immediate, customised responses to citizens and customer needs. In an increasingly globalised world, where information technology has become one of the key determinants of growth, many developing countries are facing new challenges as a result of the emerging of information age. The enabling role that Big Data Analysis, IoT & ICT can play in facilitating and accelerating socio-economic development is now being recognised by most governments; which need more investigation and exploration. Therefore, governments around the globe are recognising the power of the Internet and are making efforts to bring about social change in the move to the information economy to enable Visual Analytics of Egyptian Heritage. This issue can be considered as a promising innovative project in Egypt to respond to the most recent challenges of social change (individualisation, pluralisation of lifestyles, education, learning, shift of focus in values). Accordingly, in order to enable the implementation of such new digital innovation strategies, government infrastructures will be in need of new governance principles, tools, and processes in order to effectively and efficiently manage, coordinate, and connect the required resources within and beyond the existing boundaries. Thus, many new opportunities are emerging for researchers to contribute to the solution of demanding real-world challenges and create direct value for customers to enable visual analytics of Egyptian Heritage for quality of life; social welfare and economic impact in Egypt.

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

13/09/2017 : 11:15 : Room 8 - JF D.1.02 (x54)

Code: OR59A3118

**IoT and Analytical Practices in Traditional Industries: A View of the Farming and Agricultural Sector**

**Dr Masoud Fakhimi** (*University of Surrey*), **Dr Konstantina Spanaki** (*Loughborough University*) and **Dr Anastasia Anagnostou** (*Brunel University London*)

Contemporary advancements in technology and analytical methods have attracted great interest from the farming and agricultural sector. Internet of Things (IoT) and Big Data Analytics can provide opportunities for improving the farming and food production operations. Such initiatives in agriculture are becoming financially viable due to relatively low cost of sensor devices, data storage and processing in cloud environments. Furthermore, the development and expansion of mobile networks have enabled efficient and reliable transmission of relatively large data sets from fields around the world to data centres. The affordability of such technologies means that big and small farms can benefit equally from the use and sharing of information, technology and equipment for improving the farming practices. The use of smart sensors and IoT devices in farming practices can generate renewed interest in transforming the traditional business models to digital ones that focus on achieving value through the Big Data evolution. However, this transition and the implications it can entail into traditional organisational and operational practices challenges not only digital and technological sectors but also traditional sectors like agriculture and farming more than ever before. Clearly, a new research agenda is required to update and understand the implications of digital disruptive innovations in traditional industries. To address these challenges, this study focuses on a) describing current views on operational and business model disruption b) exploring the value of IoT in agricultural and farming sector and c) drawing a research agenda in the field and the empirical patterns that could be examined 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

13/09/2017 : 11:45 : Room 8 - JF D.1.02 (x54)

Code: OR59A3129

### **Consequences of the New Artificial Intelligence Era for Businesses: the Case of Call Centers**

**Dr Cesar Souza** (*University of São Paulo*) and **Mr Sergi Pauli** (*University of São Paulo*)

A new wave in the IT revolution is unfolding, called by some as the New Artificial Intelligence Era, based on recent developments in several areas, but particularly in fields related do Machine Learning, Big Data, Data Mining, Cognitive Computing and other subfields of Artificial Intelligence (AI). This recent revival of AI is bringing transformation and disruption to economy, industries, businesses, organizations and people, but to what extend and intensity it is still to be defined. Nonetheless, it will most likely affect business models, challenge companies core competitive advantages and long-term strategies, change work processes and enhance productivity thru replacement or complementation of humans in unpredictable ways. This is so because instead of automating routine tasks as previous systems and technologies, AI is aiming to substitute for labor in a wide range of non-routine cognitive tasks. One of the industries that could be most impacted is Call Center Services. This highly human intensive labor industry employs millions of people around the world, becoming the 'factory floors' of the 21st century to some. However, these jobs are now threatened: in Frey & Osborne's (2016) rank of occupations in risk of computerization, the "telemarketer" had the highest probability of having its human labor replaced by computers in up to 10-20 years. This paper describes a research proposal to answer to following question: "How will the new wave of AI impact businesses"? Motivated by Frey & Osborne's research and findings, the business is narrowed down to the Call Center services industry and in a timeframe of twenty years. The idea is to investigate the assumptions of this previous research and identify new factors motivating or hindering AI automation. We present the research model and describe the proposed methodology, which will comprise a Delphi Panel and subsequent survey among Call Center workers, managers and executives.

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

14/09/2017 : 10:00 : Room 8 - JF D.1.02 (x54)

Code: OR59A3119

### **KEYNOTE: Crossing the Analytics Wilderness: The Route According to a 'Born Again Optimisation Evangelist'**

**Mr Eddie Griffiths** (*IBM*)

This is the personal view and journey of the author, gained over 40 years in Information Systems and Analytics, mostly in industry, latterly from the perspective of software vendor. Since graduating in OR in the '70s, it is still extremely disappointing how few businesses are using the potential of analytics. The original obstacles related to poor tooling, feeble computers, lack of data and lack of skills and knowledge; have largely been overcome. Unenlightened businesses are still running their businesses using rudimentary spreadsheets. There is a void, which I term the 'Analytics Wilderness', where predictive and prescriptive analytics should be being used. To cross this wilderness, we need to examine what the current inhibitors are and work out how to overcome them. We need to do some things differently to solve this problem to unleash the potential of analytics, providing a guide to crossing the 'Analytics Wilderness'.

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

14/09/2017 : 11:30 : Room 8 - JF D.1.02 (x54)

Code: OR59A3046

### **Embedding Big Data and Analytics in the University Curriculum: A Review of Strategies, Tools and Challenges**

**Mr Thomas Cameron** (*Loughborough University*) and **Dr Crispin Coombs** (*Loughborough University*)

There has been considerable growth in employer demand for graduates with knowledge and skills in Big Data and Analytics. Universities are responding to this growth in demand through the development of specialist postgraduate and undergraduate courses. However, recent Higher Education Statistics Agency data shows that recruitment of students onto these programmes in the UK remains at low levels. Therefore, there is a need to consider alternative ways of developing these skills among graduates. One approach is to embed Big Data and Analytics knowledge in a wider range of university subject curricula beyond specialist analytics degrees. This paper presents the findings of a co-created faculty and student project that investigated the strategies and resources for incorporating Data Analytics and Big Data in the curriculum at Loughborough University. The findings will include collating current analytics curricula approaches, mapping available analytics resources (e.g. Watson's Analytics) and discussing challenges, curricular issues and research implications.

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

14/09/2017 : 12:00 : Room 8 - JF D.1.02 (x54)

Code: OR59A3180

### **A New Application of the Internal Model Control Principle**

**Dr Mark Gregory** (*University of Hull*) and **Dr Tom McNamara** (*Rennes School of Business*)

This paper builds upon the classical internal model principle of control theory, itself a specific application of the good regulator principle originally suggested by Ross Ashby and Roger Conant. It applies that principle to the personal work system which each of us as knowledge workers constitute in our daily work. To the extent that we do succeed in carrying out and regulating that daily work, it must be the case that each of us possesses an internal model. We show that that model must have both some representation, whether implicit as a mental model or perhaps more explicit; and that it must have active characteristics. The active model will have informational content; a trivial example would be that we note that we must be in a certain place at a certain time from our calendar, and make the necessary travel arrangements to ensure that we can attend. We further posit that this personal working model evolves as we learn. We report research into the personal working model specific to the first author. The representational knowledge modelling language used in this research is Conceprocity, concept process reciprocity. The active informational component is a composite personal information management application which incorporates elements such as a calendar, personal messaging and data classification and categorisation. The principal contribution made by this paper is further to demonstrate that modelling is essential to understanding and to regulation – a position which is common both to operational research and to information systems.

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

14/09/2017 : 13:15 : Room 8 - JF D.1.02 (x54)

Code: OR59A3194

### **Critical Success Factors Affecting Knowledge Management Systems in the Libyan Oil Sector: A Case Study**

**Dr Soleman Saleh** (*The University of Manchester*) and **Prof Trevor Wood-Harper** (*The University of Manchester*)

ABSTRACT In the modern era, the developments in information technology have been dramatically shaping the ways people live as well as the ways organisations deal with their businesses in their professional business domains. Implementing various kinds of information systems, such as Enterprises Resource Planning (ERP) systems, Decision Support Systems (DSS), and Knowledge Management Systems (KMS) has been recognized as one of the necessary tasks organizations have to perform in order to continue to survive. Given the tremendous amount of efforts organisations have devoted to the implementation of knowledge management system, organizations in Libya are still continuously suffering from the failures of Knowledge management (KM) implementation. The purpose of this paper is to provide a conceptual theoretical framework that can help organisations to understand the context of Knowledge management system implementation. By having accurate assessments, the framework can in turn help the organisations to develop effective strategies or policies in order to maximize the probability of success in implementing Knowledge management systems.

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

14/09/2017 : 13:45 : Room 8 - JF D.1.02 (x54)

Code: OR59A3081

### **The Importance of Culture in an Enterprise Resource Planning (ERP) System Implementation: a Case Study**

**Dr Dimitra Skoumpopoulou** (*Northumbria University*) and **Dr Andrew Robson** (*Northumbria University*)

The study aims to develop detailed understanding of how Organisational Culture (OC) steers the development and implementation of an ERP system. Understanding this role involves various multi-faceted and inter-linked determinants, the complexity of which is recognised in the literature. This assessment builds on extant Information Systems literature, which stresses the underlying role of OC alongside systems complexity and organisational change, recognising opportunity to build further understanding about their inter-relationships and the high rate of failure in ERP system implementation when these links are ignored. By means of a case study with a single organisation acting as a charity with a public sector ethos and 15 interviews with key internal stakeholders, the study seeks to determine the role played by OC around its shaping of employees' systems expectations and attitudes towards change. The change aspects of the study further recognise the organisational transition to greater

commercial orientation and addressing the dual challenges of the competitive environment and cuts in government support. These impact on ERP implementation since the pace of decision-making and risk taking represent two changes that have historically played much less an organisational role. The interviews point to system implementation accompanied by change to a highly centralised organisational environment resulting in various managers losing power and influence and consequently becoming resistant to change. The new ERP system has helped in strengthening the organisation's values as well as enhancing employees' role effectiveness and efficiency. Stakeholder input involved multi-employee input to system development and implementation, supported by organisational commitment to training and employee readiness.

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

## Infrastructure

Organiser: Tohid Erfani

13/09/2017 : 10:15 : Room 911 - JF D.2.02 (x52)

Code: OR59A3201

### **Trade-Off the Efficiency for Resiliency in Adaptive and Flexible Multi-Stage Infrastructure Planning Under Uncertainty**

**Mr Kevis Pachos** (*UCL (London Global University)*)

Planning for water resources infrastructure includes selecting engineering projects in order to cost-effectively meet future water demands. Despite cost being usually the main objective, water resources challenges has a multi-objective nature as asset managers should consider wider objectives including economic, environmental impacts as well as robustness, adaptivity, stability, and irreversibility of an investment plan. The performance of a water resource system is largely dependent on the uncertain changes in climate, technological, socio-economic and political situations. The effect of rapid urbanisation and climate change make future water supply demand highly uncertain. This uncertainty complicates strategic long-term planning that aims to deliver reliable quality water to customers without interruptions. If changes in water supply or demand are different from those awaited and scheduled for, security of supply may be at risk. This work describes a novel adaptive model for the multi-objective optimisation of water resources considering sequential capacity investment decision-making over time through the use of scenario trees. A scenario tree reflecting the different levels of demand growth for water is implemented. A flexibility-base optimisation coupled to multi-objective method based on Evolutionary Algorithms and simulation is used to solve the adaptive model, identifying optimal investment programmes for each node on the decision tree. The intervention plans are evaluated under a wide range of plausible supply futures ensuring that plans remain robust to a wide range of hydrological scenarios. This methodology is tested on the London supply demand problem. A hundred plausible future demand growth realities over a 50 year planning horizon at 5-year intervals are used to produce a set of pathways that remain optimal under certain demand growth scenarios. The value of the proposed method is attributed to the ability of the system to adapt to uncertainty around water supply and demand in a cost-effective and timely manner.

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

13/09/2017 : 10:45 : Room 911 - JF D.2.02 (x52)

Code: OR59A3049

### **Supportability Engineering and OR**

**Mr Matthew Gibbon** (*Aspire Consulting Limited*)

Supportability Engineering (SE) is a discipline concerned with designing effective support systems for complex systems and platforms. Within the defence industry, SE is often also used interchangeably with the term Integrated Logistics Support (ILS), which forms part of the mandated procurement process for UK MoD equipment. SE incorporates a wide range of techniques and methods, from Reliability Engineering and Maintenance Planning, Project Management and Cost Analysis, through to Simulation, Optimisation and a range of Soft OR techniques. This talk will provide a brief introduction to the subject, explaining what SE is and why it is used. The talk will go on to describe, with examples, how OR techniques are used within SE. Finally, the talk will highlight a few "open questions" within SE, and how OR could be used to approach these questions.

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

**Lean Manufacturing**

**Organiser: Hom Dhakal**

**MAI Making an Impact**

**Organisers: Matthew Robinson and Hilary Wilkes**

13/09/2017 : 15:15 : Room 2 - JF CC.00.14 (x40)

Code: OR59A3040

**Making a Real Difference with the O.R. in Schools Programme**

**Miss Charlene Timewell** (*The OR Society*)

O.R. practitioners...did you know that you could refine and develop your repertoire of skills by sharing your experience within the classroom? This exclusive workshop provides insight into one of The OR Society's key strategic projects: O.R. in Schools (ORiS), which promotes Operational Research to young people and their teachers in a bid to fulfil the Society's vision that "every school child knows what O.R. is". Explore the vital role of an ORiS Volunteer, how they are supported by The OR Society, and the benefits they enjoy. Find out how O.R. practitioners from all backgrounds of experience across the UK are currently enthusing, inspiring, and motivating young people with demonstrations of and discussions about the applications of maths skills to solve real world problems and by opening their eyes to an array of career opportunities within O.R. Enjoy hands-on tasters of the most popular, interactive ORiS sessions and perhaps discover whether you have what it takes to make an impact upon the future of young people.

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

13/09/2017 : 15:15 : Room 5 - JF CC.01.10 (x36)

Code: OR59A3248

**Data Science Speakers Club: A Toastmasters Demonstration Meeting**

**Ms Sayara Beg** (*Datanut Sciences Ltd*)

Attendees will participate in a Toastmasters International demonstration meeting, to give them an opportunity to experience and get a taste of what is involved in a Toastmasters club meeting. Toastmasters International is a world leader in communication and leadership development with more than 345,000 memberships globally. Members improve their speaking and leadership skills by attending one of the 15,900 clubs in 142 countries and in UK South, there over 150 clubs and over 4000 members. T The world needs leaders. Leaders head families, coach teams, run businesses and mentor others. These leaders must not only accomplish, they must communicate. By regularly giving speeches, gaining feedback, leading teams and guiding others to achieve their goals in a supportive atmosphere, leaders emerge from the Toastmasters program. Every Toastmasters journey begins with a single speech. During their journey, they learn to tell their stories. They listen and answer. They plan and lead. They give feedback—and accept it. Through a community of learners, they find their path to leadership. The Data Science Speakers Club, is a Toastmasters Club sponsored by The OR Society, in acknowledgement of and address its member's requirements to continually and professionally develop their leadership and communication skills. Come along to the workshop and have a go at being a Toastmaster.

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

13/09/2017 : 15:15 : Room 4 - JF CC.01.09 (x44)

Code: OR59A3249

**Design Principles for Analytics Projects**

**Ms Joanna Levitt** (*IBM United Kingdom Ltd*)

Visual design of analytics solutions is frequently left until the end of projects when delivery is imminent. Design is the intent behind an outcome and consideration at the start of an analytics project will help successful delivery. This workshop will be interactive with participants being introduced to design principles for analytics projects and the use of design thinking with practical exercises. IBM Design Thinking will be used during the workshop. The presenter will share recommendations for visual dashboard design to understand what makes a good dashboard visually with practical examples of good and bad practice.

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

### MCDA - Multi Criteria Decision Analysis

Organiser: Valentina Ferretti

12/09/2017 : 11:00 : Room 6 - JF CC.01.11 (x48)

Code: OR59A3229

#### KEYNOTE: Challenges for the Growth of MCDA

Prof Lawrence Phillips (*London School of Economics*)

The number and breadth of MCDA applications at this year's stream attests to the growth I noted in my keynote talk on decision analysis at this annual conference in 2005. In this talk, I suggest why MCDA has grown so quickly, where new opportunities are appearing, and what challenges are evident. MCDA has grown quickly because uncertainty, the main impetus for decision analysis, is not the main concern of many clients, and financial outcomes are of lesser or no importance compared to non-financial criteria. Rather than focusing on quality decisions, many clients are more concerned to create alignment of key players on a project. Many of us take a socio-technical approach to our work, with more emphasis on the social aspects of an intervention than on the technical modelling. Also, five characteristics of MCDA models, to be illustrated, enable application to a broad range of problems and issues. New opportunities have arisen in public policy. I'll present some examples drawn from the allocation of health budgets, radio-active waste disposal, health policy on the misuse of drugs, and, a most recent example, tobacco policy in South Africa. The growth in MCDA brings new challenges. Many claims for models as 'MCDA', are little more than weighting-and-scoring, based on no or unsound theory, whose inputs are unsound, and whose practitioners are unable to explain to clients what the numbers emerging from a model represent. Although most legitimate MCDA models are developed in groups, proper training of facilitators remains under-developed. How many understand the principles of process consultancy, have undertaken instruction in facilitating groups, and have developed skills in understanding and dealing with groups? If MCDA is to survive and grow, we will need these personal skills as well as sound technical knowledge of MCDA.

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

12/09/2017 : 12:00 : Room 6 - JF CC.01.11 (x48)

Code: OR59A3141

#### Capturing Preferences for Fairness in Resource Allocation

Dr Nikolaos Argyris (*Loughborough University*), Dr Ozlem Karsu (*Bilkent University*) and Prof Alec Morton (*University of Strathclyde*)

We consider the problem of a central planner choosing among different distributions of resources across different parties. We take an axiomatic approach: we construct an "equitable preference ordering" based on which combines structural assumptions relating to efficiency and inequality-aversion with explicit preference data from a survey, past policies, or the planner's paternalistic views. We show that the set of all such functions that rationalise the preference ordering has a succinct polyhedral characterisation. This can be used to compute the subset of equitably-efficient distributions. We show how these results can be used to introduce fairness constraints in optimisation formulations of resource allocation problems (e.g. to stipulate that the optimal distribution must equitably-dominate another reference distribution).

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

12/09/2017 : 12:30 : Room 6 - JF CC.01.11 (x48)

Code: OR59A3230

#### Multi Criteria Decision Analysis in Action: Assisting a Caribbean Based FinTech Company in Evaluating Markets for International Expansion

Mr Kevin McCrossan (*The London School of Economics and Political Science*), Dr Valentina Ferretti (*London School of Economics and Political Science*), Mr Oliver F. Sabga (*Term Finance*), Mr CJ Sabga (*Term Finance*) and Mr Colin Sabga (*Term Finance*)

Term Finance Group is a financial technology (FinTech) business offering innovative credit products to small businesses and consumers through their completely web-based lending platform. Over the past two years, Term

Finance has enjoyed success in the Caribbean region and is now interested in entering larger international markets. The decision about which international market Term Finance seeks to enter is a complex one. There are multiple objectives at play (some conflicting), several stakeholders and decision makers involved and high levels of uncertainty about each market's potential and regulatory environment. To this end, the present work develops and deploys a Multi-criteria Decision Analysis intervention based on the combined use of Multi Attribute Value Theory and problem structuring methods. The focus of this project was to help the client structure the context of the decision problem, identify viable markets to enter, and evaluate those markets based on various objectives, taking into account each stakeholder's own values and preferences. This process resulted in a ranking of viable markets along with insights from a real-time sensitivity analysis. The approach helped facilitate an informed decision-making process. This talk will not only explain how the intervention developed but also what lessons could be learned from the Decision Analysis in action.

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

12/09/2017 : 14:00 : Room 6 - JF CC.01.11 (x48)

Code: OR59A3169

### **How to Improve Educational Programs for Underprivileged Children? The Impacts of Value-Focused Decision Analysis**

**Ms Gabriella Csányi** (*London School of Economics*) and **Dr Valentina Ferretti** (*London School of Economics*)

The selection of underprivileged children for educational programs represents an important decision-making problem as, if successful, it can help children to realize the positive attitude and behavioral changes that will help them become happy, healthy, and successful adults, thus contributing to decreased unemployment rates, improved quality of life and better social integration. It is a distinctly complex decision problem, compared to personnel selection decisions, as the process requires increased sensitivity and the heightened influence of emotional factors can increase subjectivity. The Csányi Foundation, a non-profit organization focused on talent development for underprivileged children, has been experiencing the drawbacks of the lack of adequate selection processes, that have constrained the operations of the Foundation. This paper presents an integrated decision tool, combining Value-Focused Thinking and Multi Attribute Value Theory, that was developed to improve the Foundation's admissions process in May 2017 and was deployed using a facilitated modelling approach. The aim of the intervention was to provide a tool that can (i) help identify a comprehensive and shared list of objectives, (ii) support the evaluation of the candidates, (iii) provide a recommendation of the 17 most suitable candidates, (iv) be reused for future selection processes. While there have been numerous decision analysis applications for personnel selection problems, to the author's knowledge, this prescriptive intervention represents the first application of a Multi Attribute Decision Analysis approach in the context of underprivileged children selection for educational programs. The objective of the paper is to contribute to the debate about multi-methodology interventions and to provide a replicable framework intended to be reused for the evaluation of all future applications of underprivileged children but also for dealing with similar as well as different complex decision making problems, thus further increasing the use of Decision Analysis and Operational Research in practice.

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

12/09/2017 : 14:30 : Room 6 - JF CC.01.11 (x48)

Code: OR59A3234

### **An Integrated Framework for Environmental Multi-Impact Spatial Risk Analysis**

**Dr Valentina Ferretti** (*London School of Economics*) and **Prof Gilberto Montibeller** (*Loughborough University*)

Quantitative risk analysis is being extensively employed to support policy makers and provides a strong conceptual framework for evaluating decision alternatives under uncertainty. Many problems involving environmental or health risks are, however, of a spatial nature, i.e. containing spatial impacts, spatial vulnerabilities, and spatial risk-mitigation alternatives. Recent developments in multi-criteria spatial analysis have enabled the assessment and aggregation of multiple impacts, supporting policy makers in spatial evaluation problems. However, recent attempts of conducting spatial multi-criteria risk analysis have so far been poorly conceptualised, without adequate roots on quantitative risk analysis. On the other hand, recent attempts of assessing spatial risk often neglect the multi-dimensional nature of spatial impacts (for example, social, economic, human) often present in such decision problems. The aim of this paper is therefore to suggest a conceptual quantitative framework for environmental multi-criteria spatial risk analysis based on expected multi-attribute utility theory. Such framework proposes: i) the formal assessment of multiple spatial impacts; ii) the aggregation of these multiple spatial impacts; iii) the

assessment of spatial vulnerabilities and probabilities of occurrence of events; iv) the assessment of spatial risks; v) the comparison of spatial risk mitigation alternatives; vi) the design of spatial risk-mitigation alternatives (e.g. reductions of vulnerabilities and/or impacts). We illustrate the use of the framework in practice with a case study based on a flooding risk analysis developed recently in the Piedmont region of Northern Italy.

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

12/09/2017 : 15:00 : Room 6 - JF CC.01.11 (x48)

Code: OR59A3218

### **Maps and Risk Perception**

**Mr Ruel Dsouza** (*London School of Economics*) and **Dr Valentina Ferretti** (*London School of Economics*)

There has been extensive research related to cognitive and motivational biases in risk analysis. However, the possible implications of the presence of a spatial dimension in this context have not been explored yet. The following two features make spatial risk analysis a particularly interesting field for exploring spatial dimensions of cognitive and motivational biases: (i) The intrinsic presence of a spatial dimension of both alternatives and criteria/impacts, thus calling for the use of geographical maps in the decision-making process; (ii) The higher degree of uncertainty (about future impacts and consequences as well as about their spatial distributions) compared to other decision-making contexts, thus calling for the elicitation of experts' judgments on both performances of alternatives and significance of evaluation criteria. Within this context, the research question we are interested in is the following one: can the use of spatial information (i.e. geographical maps) "bias" the perception of risk in spatial risk analysis? If yes, to which extent? In particular, we are interested in exploring, through the design of a lab study, the presence of loss aversion in spatial decisions. This talk will thus discuss the preliminary results of a first behavioural experiment that we conducted at the LSE Behavioural Research Lab in June 2017 with 99 participants.

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?: Somewhat

12/09/2017 : 15:30 : Room 6 - JF CC.01.11 (x48)

Code: OR59A3117

### **Decision Rule Approach to Analyse and Combine the Assessments of Different Credit Rating Agencies**

**Dr Salem Chakhar** (*University of Portsmouth*), **Dr Yaseen Ghulam** (*University of Portsmouth*), **Prof Alessio Ishizaka** (*University of Portsmouth*) and **Prof Ashraf Labib** (*University of Portsmouth*)

The credit worthiness is generally defined as the judgment of a country current and future ability and inclination to honour debt obligations as agreed upon. There are different rating agencies and their assessments may lead to different rankings. One way to avoid this 'divergence' in the rankings consists in combining the assessments of different credit rating agencies into a common and comprehensive ranking. The objective of this talk is thus to introduce a new approach permitting to objectively construct such a common ranking. The proposed approach relies on the Dominance based Rough Set Approach (DRSA), which is a well-known multiple criteria sorting method. The approach is composed of three phases: (i) analysis of individual assessments as established by each rating agency; (ii) aggregation of individual rankings; and (iii) inference of collective decision rules. The latter permit to synthesize the judgements established by the different rating agencies into a common ranking. These rules can also be used to predict future rankings based on current and estimated data. The proposed approach is illustrated by using the data relative to credit worthiness for a set of 28 European countries as established by three rating agencies, namely Fitch, Moody and S&P.

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

12/09/2017 : 16:30 : Room 6 - JF CC.01.11 (x48)

Code: OR59A3233

### **Evaluating Capabilities of Health Systems with Multi-Criteria Decision Analysis**

**Dr Gilberto Montibeller** (*Loughborough University*), **Dr Ashley Carreras** (*Loughborough University*), **Dr Victor del Rio Vilas** (*University of Surrey*) and **Prof L. Alberto Franco** (*Loughborough University*)

The design of robust health systems against disease outbreaks is crucial for the management of population health but challenging for policy makers. It encompasses a wide provision of services and goods, from vaccines and doctors to educational and preventive campaigns, among many others. The evaluation of capabilities of such systems nowadays is typically based on checklists, but this prevents an overall quantitative assessment of the

health system as a whole and provides very limited guidance for the efficient allocation of resources for capability building (or for the management of capability reduction when budgets shrink). In this paper we suggest that multi-criteria analysis can provide a useful framework for the quantitative and comprehensive evaluation of capabilities and support policy makers in an efficient allocation of scarce resources. We illustrate this framework for the assessment of capabilities against rabies, a neglected and deadly disease, which we conducted recently for the Pan-American Health Organization.

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

12/09/2017 : 17:00 : Room 6 - JF CC.01.11 (x48)

Code: OR59A3042

### **A Method to Model the Dependency Between Options within a Balance of Investment**

**Miss Ellie Hargreaves** (*Dst*) and **Dr Nick Walmsley** (*DSTL*)

Currently, a linear weighted sum method of Multi Criteria Decision Analysis (MCDA) is used to prioritise the order of buy of military capability options. Such a procedure ranks the importance of the options subject to a set of criteria; allowing selection of those options with highest utility where financial constraints mean the full option selection cannot be taken forward. However, such an MCDA method does not take into account any type of dependency between the options, for example if Option A can only be delivered if Option B is also delivered. Typically, the approach to this type of problem would indicate a Mixed Integer Linear Programming (MILP) solution; however, due to the dimensions of the problem space and constraints on software use, this was unsuitable for this problem. Drawing upon the mathematical domain of graph theory, we propose a method using the concepts of adjacency matrix and depth first search spanning tree to provide a more optimised order of buy that takes into account inter-option dependency, using no specialist functions or software. The spreadsheet model solution allows the generation of an initial order of buy and also gives an indication of impact should an option not be funded, both the direct impact on immediate dependents and wider impact on the rest of the system of options.

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

14/09/2017 : 10:00 : Room 6 - JF CC.01.11 (x48)

Code: OR59A3102

### **Can Airports' Inefficiency be Determined by Tourism Variables?**

**Miss Ane Elixabete Ripoll-Zarraga** (*Universitat Autònoma de Barcelona*) and **Dr Josep Maria Raya Vílchez** (*Tecnocampus & Universitat Pompeu Fabra (UPF)*)

Airports efficiency estimation has been addressed by using different methodological approaches usually classified as parametric and non-parametric. The estimation of how well airports are performing usually refers to a relation between inputs and outputs (traffic) with technological constraints. Nevertheless, few studies attempt to explain the externalities affecting inefficiencies essentially in the Spanish airport-system beyond the presence of LCC or the number of passengers. A previous study (Ripoll-Zarraga, A.E. and Adler, N. 2017) has demonstrated that the regulatory framework affect the performance of the Spanish airports and it has driven to a significant number of inefficient airports due to the over-investments made in the latest years and the inability of airports' managers to decide commercial policies in terms of price and quality of the service provided. One clear consequence is areas overcrowded with no congested airports that also, are not allowed to compete. With this regard, it is essential to find further explanations of the inefficiencies rather than ownership and management forms. The welfare of the city; demographic characteristics of the city-region where airports are located may become an important driver explaining the attractiveness of these airports in terms of passengers. The location of the airports is also determining the attractiveness of a specific airport to increase the level of traffic. In this study, stochastic frontier analysis is applied to estimate the technical inefficiency of the Spanish airports. In a second stage a regression is performed with tourism indicators as proxy of attractiveness of visitors to the cities where the airports are located. The results should provide some insights in order to provide policy recommendations to increase the efficiency of the airports less attractive from a tourism perspective.

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

14/09/2017 : 10:30 : Room 6 - JF CC.01.11 (x48)

Code: OR59A3093

## Supporting Decisions in Public Policy Making Processes: Generation of Alternatives and Innovation

Dr Irene Pluchinotta (*Universite Paris Dauphine*), Dr Valentina Ferretti (*London School of Economics and Political Science*) and Prof Alexis Tsoukias (*Universite Paris Dauphine*)

The design of alternatives is an essential part of decision making that has been neglected in theory and practice. Most scholar articles in Decision Analysis and Operational Research introduce a problem formulation that starts with the claim "given a set A of alternatives". Both researchers and practitioners know that in reality the set A of alternatives is rarely "given". It is rather constructed during the decision aiding process and, most of the times, (re)defined several times during that same process. This topic is particularly relevant in the context of public policy making, where policy design represents a crucial step of the policy cycle since it determines the quality of the policy alternatives being considered. This talk addresses the question of how the generation of policy alternatives can lead to innovation within a decision aiding process. By innovation in decision aiding we mean the mechanism that allows to expand the solution space and discover new alternatives to solve the problem under consideration. The talk is based on two real case experiences from Southern Italy: a planning problem in a UNESCO site and a groundwater management and protection policy issue.

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

14/09/2017 : 11:30 : Room 6 - JF CC.01.11 (x48)

Code: OR59A3043

## Efficiency Measurement and Enhancement of Saudi Arabia Schools

Miss Tahani Alzkari (*Portsmouth University*)

Education in Saudi Arabia has received considerable attention from the government in the hope of finding the key to improving the performance of schools, which is essential to economic development. However, education in Saudi Arabia has been criticised due to the quality of teachers, their salary, and the curricula and resources used. Although the international literature reviews important issues of efficiency in education, there is still no research project which studies in-depth the efficiency challenges and constraints pertinent to Saudi schools. The purpose of this research is to use operational research (OR) models focused on assessing and improving the performance of private schools in the Kingdom of Saudi Arabia, especially the Riyadh districts. Case studies are developed based on 57 schools for descriptive efficiency measurement and 12 schools for prescriptively improving the performance. Data collection was implemented through the Quality and Planning Department of the Ministry of Education who liaised with the school managers. In terms of model formulation, a combined algebraic model is formulated and the techniques of: Data Envelopment Analysis (DEA) for measuring efficiency, the Analytical Hierarchy Process (AHP) for ranking priority of the objectives of improving the schools' performance, and Goal programming (GP) for improving the efficiency of schools. The results that can be obtained from building these models can be beneficial for parents, schools, and governments. Efficient schools yield better outcomes and support a higher quality of education, which increases the knowledge and skills of students. Those students will then contribute more effectively to the future development of their countries. In addition, high-performing schools delivering high levels of education to students can encourage the economic growth of a nation.

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

14/09/2017 : 12:00 : Room 6 - JF CC.01.11 (x48)

Code: OR59A3059

## Do Patents Provide Protection to Innovative Consumer Technology Companies Anymore? Using the Constrained Rationality Framework to Model and Analyze the Apple vs Samsung Conflict, as an Example

Dr Majed Al-Shawa (*Strategic Actions*)

Despite the wall of design and utility patents that Apple Inc. has invested in to protect its iconic and game changers iPhone and iPad products, multiple competitors produced similar ones, in look and functionality, and started selling them at cheaper prices. The biggest of these competitors is Samsung Electronics Co., and one of Apple's essential component suppliers. In April, 2011 Apple sued Samsung Inc. for infringing on its technologies. Days later, Samsung counter-sued Apple alleging it infringed Samsung's patents for mobile-communications technologies. Immediately, a patent war was unleashed, with patents infringement cases were filed by both in multiple countries. The conflict between Apple and Samsung holds many features of a strategic business intellectual property conflict that real product innovators found themselves facing these days. Was Apple right in assuming that patents will provide protection for its investment in creating game changing technologies? Was Apple right in the course of actions it took and the timing of it? Do patent laws and market conditions these days provide new ways for rivals to copy

others' innovative technologies and get away with it? We use the Constrained Rationality framework, a formal value-driven enterprise knowledge management framework for strategic decision and conflict analysis with robust multi-agent decision support methodological approach with fuzzy reasoning mechanisms to: model the Apple vs. Samsung strategic conflict; analyze the players options and strategies including the possible cooperation between Apple and Samsung to settle, and the possible formation of coalitions between Samsung and Apple's competitors; and then elicit the most stable equilibrium end states of this conflict, and similar ones. We, finally, compare the analysis produced by the framework's contextual game models, stability analysis and coalition analysis with how the conflict actually is unfolding; and conclude by discussing our findings.

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

14/09/2017 : 13:15 : Room 6 - JF CC.01.11 (x48)

Code: OR59A3217

**Capturing Uncertainty in Decision Making by Integrating AHP with Grey Systems and Neutrosophic Set Theory: Agility Evaluation Case of Mass Customisation Manufacturing**

**Mr Amin Vafadarnikjoo** (*University of East Anglia*)

Regarding common representation of vague concepts in decision making data, it has been realised that crisp values are incapable of efficiently modelling real-life problems. In the multiple attribute decision making (MADM) studies a variety of non-deterministic theories such as fuzzy, intuitionistic fuzzy set theories, and grey systems have been integrated with various MADM methods. Studying the traits of each non-deterministic theory has led to proposing new theories such as neutrosophic set (NS). The aim of this research is twofold: 1) Integrating analytic hierarchy process (AHP) with single valued trapezoidal neutrosophic numbers (SVTNNs) calling as the Neutrosophic AHP (NS-AHP) 2) Extending group AHP to grey environment where whitenising grey numbers and consistency ratio calculation are not required. The proposed modified group grey AHP (G-AHP) is capable to preserve grey characteristic of grey numbers during the AHP computing steps. It efficiently obtains the aggregated opinion of decision makers (DMs) along with handling the ambiguity of DMs' subjective judgements through preserving grey values. The application and validity of the proposed method has been explored in the agility evaluation of mass customisation (MC) manufacturing in the Iranian steel industry. MC deals with manufacturing individually designed products and services that needs high process flexibility and integration. To efficiently implement MC, it is required to extend an agility-based manufacturing system. Agile manufacturing has been considered as the 21st century manufacturing paradigm and the concept of agility has been stressed by leading manufacturing enterprises as a means of obtaining competitive advantage. Hence, it is a paramount task for operations managers to identify significant MC agility factors. Manufacturing agility indices in accordance with the traits of MC that were undertaken in this study included organisation management agility, product design agility, processing manufacture agility, partnership formation capability and integration of information systems.

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

14/09/2017 : 13:45 : Room 6 - JF CC.01.11 (x48)

Code: OR59A3128

**A Mixed-Methodology Decision Aid Approach for Renewable Energy Evaluations**

**Ms Shima Ghassemi** (*The London School of Economics and Political Science*) and **Dr Valentina Ferretti** (*The London School of Economics and Political Science*)

Mixed-methodology approaches are emerging as a method of choice for conducting evaluation in regards to decision problems in the field of renewable energy. Iran is becoming an attractive market for renewable energy projects with its ideal topographic and geographic conditions. As a result, as sanctions are lifted, policy makers are eager to entice private sector investment in the renewable energy market. Nevertheless, taking into consideration the interests and values of all parties involved in the decision-making process, the selection of an optimal renewable energy resource for investment is a delicate task. This intervention is aimed at constructing a participatory and collaborative mixed-methodology framework by integrating (I) Stakeholder Analysis, (II) Value Focused Thinking and (III) Multi-Attribute Value Theory (MAVT). Initially, stakeholder representatives are identified, categorized and their interconnections are determined in order to provide a systematic framework for understanding networks in the governance of renewable energy. Subsequently, Value Focused Thinking approach is used to define values of stakeholders. Lastly, these two approaches are incorporated in the problem-structuring phase of MAVT to select the best performing alternative. Recommendations are provided for the application of the proposed mixed-methodology approach in practical settings, more specifically in the context of renewable energy selection in Iran. It is found that

wind energy is the most appropriate renewable energy option for investment in Iran in the post-sanctions era. The proposed framework also sheds light on the role of models as potential boundary objects in decision science interventions.

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

### Meet the Editors

**Organiser: Antuela Tako**

13/09/2017 : 11:15 : Room 911 - JF D.2.02 (x52)

Code: OR59A3246

#### MAI Meet the Editors

**Mrs Antuela Tako** (*Loughborough University*)

Jiyin Liu and Antuela Tako, Loughborough University Building upon the popularity at the previous OR58 conference, we are pleased to announce again the 'Meet the Editors' sessions at the MAI day at the OR59 Conference. This session is aimed at OR academics and practitioners seeking advice on publication. Attendees will have the opportunity to meet the editors of the following leading OR journals: • Professor Tom Archibald, University of Edinburgh Editor of JORS – Journal of the Operational Research Society • Robert Dyson, Emeritus Professor, University of Warwick Editor of EJOR – European Journal of Operational Research • Professor Bart Macarthy – University of Nottingham European Editor of IJPE - International Journal of Production Economics • Professor Gilberto Montibeller – Loughborough Area editor and on behalf of journal of MCDA - Journal of Multi-criteria Decision Analysis. • Dr. Graham Rand - Lancaster University Editor of the OR Society's Impact Magazine • Professor Stewart Robinson, Loughborough University and Past President of the OR Society Founder and on behalf of the Editors of JoS – Journal of Simulation This session will start with a short presentation by the editors about the journal, scope statistics and acceptance rates, and it will then be open for participants to ask the editors questions and share their experiences. The aim is to cover the following topics: what constitutes a successful submission, how best to capture the interest of editors and reviewers, how to (or not to) structure a paper, how to demonstrate your paper's added value, communicating the research idea effectively, responding to referees' feedback, etc.

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

### Metaheuristics

**Organisers: Andrew Parkes and Ender Ozcan**

13/09/2017 : 10:15 : Room 5 - JF CC.01.10 (x36)

Code: OR59A3062

#### Meta-Heuristics for Tactical Inventory Planning in Closed-Loop Supply Chains

**Dr Carla Di Cairano-Gilfedder** (*BT*), **Mr Pierre Desport** (*Angers University*), **Prof Frederic Lardeux** (*Angers University*), **Prof David Lesaint** (*University Angers*), **Dr Anne Liret** (*BT*) and **Prof Gilbert Owusu** (*BT*)

Field service industries traditionally operate multi-echelon supply chains to deliver the spare parts required by field personnel for repair and maintenance activities. Following concerns over the environmental and economic impact of used parts, supply chains are now evolving towards closed-loop networks that integrate the return and repair of used parts. This paper addresses the tactical distribution planning problem (TDPP) arising in this context. Given a demand forecast over a chosen time horizon (i.e. a number of parts to deliver and pick-up on each network site per time period), the problem is to plan transfer and repair operations that minimise storage, backorder, repair and transport costs while satisfying network constraints and inventory management rules. We show TDPP is NP-hard and propose a Mixed Integer Programming formulation and a metaheuristic. The latter is a form of local search that iteratively adds to the current plan the best improving sequence of return, repair and/or supply actions. We report experiments on pseudo-random instances that demonstrate the scalability of the metaheuristic. We also empirically investigate whether different weightings of the cost function map to different local inventory management policies, showing for instance how to enforce just-in-time delivery. Finally, we study the impact of the re-planning frequency in the face of demand uncertainties. Indeed, the more often plans are generated the easier it is to limit the impact of uncertainties. However, the more plans are regenerated, the harder it is to keep consistency from one plan to another. As a result, the frequency has to be chosen carefully to ensure good performances and consistency.

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

13/09/2017 : 10:45 : Room 5 - JF CC.01.10 (x36)

Code: OR59A3186

### **Dynamic Capacitated Arc Routing Problems**

**Dr Jonathan Thompson** (*Cardiff University*) and **Mr Wasin Padungwech** (*Cardiff University*)

Most routing problems are considered to be static, meaning all problem features are known at the start of the solution process. More recently a number of dynamic problems have been considered where features of the problems change over time. This talk will introduce the dynamic arc routing problem, where new required arcs become known over the time horizon and the solution needs to be adapted to incorporate the new requirements. A tabu search method is used to produce high quality solutions which includes move and swap neighbourhoods, but allows entire routes to be re-ordered when receiving a new edge from another route. We will consider whether it is better to only update the solution occasionally, so more information is to hand at the update stage, or whether to update the solution frequently so new requirements can be considered immediately. Waiting strategies are also considered in order to determine whether new requirements can be addressed more rapidly by locating waiting vehicles in a strategic point. New data sets are introduced and experimental results will show that it may be better to "forget" some information at the start, in order to create better results in the long term.

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

13/09/2017 : 11:15 : Room 5 - JF CC.01.10 (x36)

Code: OR59A3219

### **Progress in Analysis of the Space of Heuristics**

**Dr Andrew Parkes** (*University of Nottingham*), **Mr Neema Beglou**, **Mr Andrew Burnett** (*University of Nottingham*) and **Dr Ender Özcan** (*University of Nottingham*)

Many heuristic or metaheuristic algorithms for solving combinatorial optimisation problems, have at their core a short decision procedure. The procedure encodes some choice of heuristic that is used in order to make help create, or improve, a solution. The performance of such heuristics is key to the overall algorithm; however, generally they are created by hand. We report on two methods towards automating the creation of such heuristics. Firstly, a study of "WalkSAT" methods to solve propositional satisfiability, and in which we give results on the landscape of the space of heuristics, Secondly, a study of fine-grained parameter-based heuristics for online bin-packing, and the potential for machine learning to recognise the features of good heuristics.

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?: Not at all

13/09/2017 : 11:45 : Room 5 - JF CC.01.10 (x36)

Code: OR59A3199

### **A Risk Based Ant Colony Optimisation Based Model for Real Time Route Optimisation in Unmanned Surface Vehicles**

**Mr Samuel Andrews** (*Polaris Consulting*)

Autonomous platforms have undergone rapid development in recent times, with path-planning and obstacle avoidance becoming an increasingly important aspect. Through previous Centre for Defence Enterprise funding, Polaris Consulting developed an Optimised Routing and Collision Avoidance tool, which was successfully demonstrated in 2016. Further funding has allowed Polaris to develop the tool further to a TRL-6 level system. The system, written in C++, makes use of Ant Colony Optimisation (ACO) techniques that allow for an agent-based routing system that not only optimises through time using environmental factors such as distance, risk, and cost, but can also rapidly avoid non-stationary obstacles. The nature of ACO makes it an ideal technique for routing as it allows for navigation without the need for graphs populated by nodes. This presentation shall highlight the key features of the system, with details on how ACO was applied, what behaviours were implemented into the agents, as well as the scoring mechanics used to determine optimal routes. The presentation shall also discuss the results of both simulation and sea-trial testing, with details on its performance, speed, and accuracy.

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

## Optimisation

Organiser: Jiyin Liu

12/09/2017 : 11:00 : Room 910 - JF D.2.01 (x52)

Code: OR59A3112

### **Transforming and Solving Multi-Objective Linear Programming Problems to Single-Objective by Using Correlation Technique**

**Mr Maher Kaki** (*Cihan University*)

This paper solves Multi-Objective Linear Programming Problems (MOLPP) by transforming them to Single-Objective Linear Programming Problems (SOLPP) using correlation coefficient for optimal solution with the value of the function and suggests an algorithm with the new technique. The algorithm is tested by solving several numerical examples. The example problems are also solved by Sen's technique. Comparison of the objective function values obtained by the two techniques will be presented.

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?: Relevant

12/09/2017 : 11:30 : Room 910 - JF D.2.01 (x52)

Code: OR59A3142

### **A Matheuristic Approach for the Quickest Multicommodity K-Splittable Flow Problem**

**Dr Antonino Sgalambro** (*The University of Sheffield*) and **Ms Anna Melchiori** (*National Research Council of Italy*)

The literature on k-splittable flows provides evidence on how controlling the number of used paths enables practical applications of flows optimisation in many real-world contexts. Such a modeling feature has never been integrated so far in Quickest Flows, a class of optimisation problems suitable to cope with situations such as emergency evacuations, transportation planning and telecommunication systems, where one aims to minimise the makespan, i.e. the overall time needed to complete all the operations. In this talk, in order to bridge this gap, we introduce a novel optimisation problem, the Quickest Multicommodity k-splittable Flow Problem (QMCKSFP). The problem seeks to minimise the makespan of transshipment operations for given demands of multiple commodities, while imposing restrictions on the maximum number of paths for each single commodity. The computational complexity of this problem is analysed, showing its NP-hardness in the strong sense, and an original mixed-integer programming formulation is detailed. We propose a matheuristic algorithm based on a hybridised Very Large-Scale Neighborhood Search that, utilising the presented mathematical formulation, explores multiple search spaces to solve efficiently large instances of the QMCKSFP. High quality computational results obtained on a set of benchmark instances are presented and discussed, showing how the proposed matheuristic largely outperforms a state-of-the-art heuristic scheme frequently adopted in path-restricted flow problems.

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

12/09/2017 : 12:00 : Room 910 - JF D.2.01 (x52)

Code: OR59A3048

### **Availability Prediction of M/G/1 Multi-Component Fault Tolerant Machining System with Common Cause Failure and Reboot**

**Mr Rakesh Kumar Meena** (*Indian Institute of Technology Roorkee*), **Dr Madhu Jain** (*Indian Institute of Technology Roorkee*) and **Mr Mayank Singh** (*Indian Institute of Technology Roorkee*)

The M/G/1 model for multi-component fault tolerant machining system by incorporating the feature of common-cause failure, reboot and standby support has been investigated. The queue size distribution of the concerned system is obtained by using recursive and supplementary variable approach, by taking the remaining service time as supplementary variable. The availability indices of R-out-of-M: G structures have been evaluated analytically. For specific distributions such as Exponential, 3-stage Erlang distribution and Deterministic, the explicit formulae for availability are established. Some indices for fault tolerant system consisting of mixed standbys have also been provided. The system performances for specific configuration have been examined by computing the numerical results by taking suitable illustration of power plant. For the optimal system design, the cost optimization is done by using quasi-Newton approach.

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?: Highly

12/09/2017 : 12:30 : Room 910 - JF D.2.01 (x52)

Code: OR59A3241

**Semi-supervised methodology for SAT solver-portfolio approaches**

**Mr Alexandre Martin** (*Satalia*) and **Mr Riccardo Volpato** (*Satalia and London School of Economics*)

In industry hard optimisation problems typically have long solving times. They can usually be solved by many algorithms, although the performance can vary widely in practice. Research has shown that no single algorithm outperforms all the others; thus, it is crucial to select the best algorithm for given problem. Algorithm selection and portfolios are now state-of-the-art technology in optimisation research. To make these tools accessible to everyday professionals, Satalia, an optimisation solutions company, created the SolveEngine, an online platform that solves problems optimally by picking the best algorithm within a portfolio of solvers. Among optimisation problem formats, Boolean Satisfiability (SAT) formulas are widely used, such as for scheduling or software verification. The latest research proves that supervised machine learning models can accurately predict which solver is best for a given SAT problem. Supervised methods are traditional machine learning classifiers that use only labelled data to train a model. They require to run every solver in the portfolio for every problem in the library. This approach cannot support a platform that aims to solve millions of problems using hundreds of solvers. Semi-supervised learning addresses this problem by using a large amount of unlabelled problems, together with the problems bench-marked across the solvers, to build better classifiers. Developing on existing research, we developed a semi-supervised methodology to teach the SolveEngine how to select the best solver for a given SAT problem.

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

12/09/2017 : 14:00 : Room 910 - JF D.2.01 (x52)

Code: OR59A3075

**KEYNOTE: KBP:A New Pattern Reduction Heuristic for the Cutting Stock Problem**

**Mr Constantine Goulimis** (*Greycon Ltd*) and **Dr Alfredo Olivera** (*Greycon Ltd*)

The classic one-dimensional cutting stock problem exhibits a great deal of degeneracy, in that multiple solutions with the same waste level are possible. An industrially-relevant aspect is to find, within the minimum-waste solution population, those with as few patterns as possible. There have been many attempts at this problem over the years, but these have not satisfactorily resolved the issue. In this paper we present a new type of heuristic, which is computationally cheap and nicely complements previous ones. We present experimental results for two variants: the first obtains a 3.4% reduction in the total number of patterns (average time 0.15 seconds / instance) and the second 4.2% (average time 0.24 seconds / instance), for a testbed of 120 problems. A third variant was also examined, but proved inferior.

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

12/09/2017 : 15:00 : Room 910 - JF D.2.01 (x52)

Code: OR59A3231

**Markovian Analysis of an Order-up-to-Level Policy for Deteriorating Inventory with Stochastic Review Intervals**

**Dr Harshal Lowalekar** (*Indian Institute of Management Indore*)

We model a periodic review system with order-up-to-level policy for deteriorating items using continuous time markov chains. The time interval between two consecutive reviews is assumed to be a random variable while the lead time is assumed to be zero. Variations in shortage, wastage and average inventory levels of the system are examined with respect to the changes in the order-up-to-level and the ordering frequency.

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

12/09/2017 : 16:30 : Room 910 - JF D.2.01 (x52)

Code: OR59A3033

**Approximation of Closed Convex Set by Semidefinite Representable Set**

**Ms Anusuya Ghosh** (*IIM Bangalore*) and **Prof Vishnu Narayanan** (*IIT Bombay*)

Approximation of convex set takes major role in modern convex optimization. Victor Klee (1959) proved that a convex set can be approximated by boundedly polyhedral set. As polyhedral set is trivial example of semidefinite representable set, we generalize boundedly polyhedral set as compactly semidefinite representable set. We prove that a closed convex set can be approximated by compactly semidefinite representable set. Further we extend our approximation result and we develop a technique by which a closed convex set can be approximated by semidefinite

representable set. The technique of approximating a closed convex set by semidefinite representable set is new in semidefinite programming.

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

12/09/2017 : 17:00 : Room 910 - JF D.2.01 (x52)

Code: OR59A3123

### **Resource Allocation When Planning for Simultaneous Disasters**

**Dr Xuan Vinh Doan** (*The University of Warwick*) and **Prof Duncan Shaw** (*The University of Manchester*)

We use stochastic and robust optimisation techniques to develop models to allocate scarce national resource across eight cities to best respond to three simultaneous disasters happening across these locations. Our first model analyses the risk of not being able to achieve performance targets given pre-set resource constraints while our second model analyses the resources needed to meet target performance levels. Sensitivity analysis is performed by looking into different settings of location importance. A third hybrid model constructed from the first two models is used to analyse the implications of different financial budgets. We reflect on the use of such modelling techniques for these problems and discuss the influence of political aspects of resource allocation which such models cannot address.

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

## **OR and Strategy**

**Organisers: Frances O'Brien and Martin Kunc**

12/09/2017 : 11:30 : Room 9 - JF D.1.09 (x58)

Code: OR59A3052

### **Is it Worth Fighting a Patent Troll? Using the Constrained Rationality Framework to Model and Analyze the Showdown between RIM and NTP, as an Example**

**Dr Majed Al-Shawa** (*Strategic Actions*)

In late 2001, Research in Motion Ltd (RIM), the game-changer famous for the BlackBerry device, found itself defending itself in what initially looked like a small normal patent infringement lawsuit against NTP Inc., a patent holding company with no real products. Four and a half years later, RIM found itself mysteriously embroiled in a battle for its own survival. The conflict between RIM and NTP holds many features of a classical strategic business conflict that real product innovators found themselves facing: a patent troll holding patents on paper with no real products asking them to pay licensing fees or stop production. Do they settle and pay? If yes, when and why? If no, why? And for how long they should keep fighting the patent troll? We use the Constrained Rationality framework, a formal value-driven enterprise knowledge management framework for strategic decision and conflict analysis with robust multi-agent decision support methodological approach with fuzzy reasoning mechanisms to: model the RIM vs. NTP strategic conflict; analyze the players options and strategies including the possible cooperation between RIM and NTP to settle, and the possible formation of coalitions between NTP and RIM's competitors; and then elicit the most stable equilibrium end states of this conflict, and similar ones. We, finally, compare the analysis produced by the framework's contextual cooperative game models, stability analysis and coalition analysis with how the conflict actually ended; and conclude by discussing our findings.

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

12/09/2017 : 12:00 : Room 9 - JF D.1.09 (x58)

Code: OR59A3153

### **Getting To Market: A New Innovation Strategy Framework**

**Dr Mahmoud Abdelrahman** (*Newcastle Business School, Northumbria University*) and **Dr Paul Kirkham** (*PK Consulting*)

There are countless examples of innovative companies not gaining an adequate return on their investment, if any, due to much better resourced imitators or fast 2nd movers out-performing them and going on to profit from the innovation instead. But why does this keep happening? It is due in part to innovative company management blindly following established business school paradigms (Porter's 5 Forces, Game Theory, Resourced Based View, etc.) that do not consider strategies other than the pursuit of traditional profit-maximising/market share gaining strategies

that expose the innovation to imitation. This has implications for the UK and its small innovators who, despite being strong at creativity, ingenuity and innovation, ultimately do not benefit from their hard work and investment. Is there a better way for management to execute their strategy of getting a new innovative technology to market? By literature research and the opportunity to reflect via live case study and interviews with industry professionals, strategic management techniques and business models were investigated and how they are applied to failing/stalling high technology companies. From this it has been possible to suggest that an analysis of the competitive environment in terms of complementary resources, the type of innovation technology (sustaining versus disruptive) and the policeability of intellectual property protection should be considered by innovators before the application of traditional business models and paradigms. Ultimately this research paper recommends that the application of traditional management paradigms and business models is not recommended and hence a new model/framework has been created that suggests pre-emptive strategies for innovative companies at the early adopter stage of the technology adoption life cycle.

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

12/09/2017 : 12:30 : Room 9 - JF D.1.09 (x58)

Code: OR59A3181

### **A Dynamic Model of Inter-Firm Strategic Interaction: An Agent-based Model of Market-Oriented and Customer-Led Strategies**

**Dr Duncan Robertson** (*Loughborough University*)

We present a dynamic model of inter-firm strategic interaction where firms compete for customers within a competitive market. We develop an agent-based model where firms move in a strategic space in order to capture customers. The competitive landscape faced by a firm changes not only as the result of firm-firm interactions but also from the indirect interaction between firms and customers. We show that the interaction between firms and customers is non-linear but is in fact a complex interaction. Each firm has a different representation of their competitive landscape; for the first time, this landscape is itself modeled and can be visualized rather than being purely a metaphor. Our model is both dynamic and competitive, overcoming the opposing weaknesses of two literatures: Porterian models that are competitive but non-dynamic, and NK models that are dynamic but non-competitive. We model different levels of competition within the market, and discern the efficacy of different market-oriented and customer-led strategies under different competitive conditions, showing that market oriented strategies can, as suggested by Slater and Narver, be a source of competitive advantage, but not in all cases as they suggest. In this paper, we model specific customer-led and market oriented strategies, the model can however be modified to give insights into other contemporary debates within the management literature.

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

12/09/2017 : 14:00 : Room 9 - JF D.1.09 (x58)

Code: OR59A3168

### **Reorganising Existing Multi-Facility Networks in Congested System Using a Multi-Period Model**

**Miss Zati Aqmar Zaharudin** (*The University of Sheffield*), **Dr Andrew Brint** (*The University of Sheffield*) and **Dr Andrea Genovese** (*The University of Sheffield*)

The suitable location of facilities is a key factor in achieving efficient supply systems both in the public and private sectors. Nowadays, most non-profit bodies offering essential services (such as healthcare or environmental management facilities) are suffering from severe funding limitations and budget cuts. In handling this scenario, the decision-maker must take any possible action in order to ensure facility networks can keep operating and providing a minimum required service level, even though, due to financial reasons, some facilities might be downsized (and their operating hours reduced) or, in extreme cases, closed down. Any reduction made to the system's availability, such as a reduction in a facility's operating hours or even its closure, will increase the congestion level of the system, as the demand will have more limited choices. For essential services, will mean an increase in waiting times for server availability; and so some demand could consider moving to another facility or, at a certain point, leaving the system. Many location-allocation studies can be found in the literature, but there is a lack of studies developing congestion considerations in a scenario of supply reduction. To fill this gap, our study deals with the problem by developing a multi-period model for a multi-facility network, focusing on the possibility of having demand transfer across facilities with financial limitations in a congested environment. Initial computation results are presented, along with relevant case studies and avenues for future research.

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

12/09/2017 : 14:30 : Room 9 - JF D.1.09 (x58)

Code: OR59A3204

### **Understanding the Impact and Implications of Floods: a Telecommunications Case Study**

**Miss Zirui Feng** (*School of Business and Economics, Loughborough University*), **Dr Jon Malpass** (*British Telecom*), **Dr Grammatoula Papaioannou** (*School of Business and Economics, Loughborough University*) and **Dr Rupal Rana** (*Loughborough University*)

A rise in natural disasters over the recent years has increased the need to develop mechanisms for disaster operations management. Floods are the most common natural disaster occurring globally during 2005-2014, and hence a number of methodologies have been employed in this area, however, there is still a lack of research in problems related to the impact on a large business. This study focuses on understanding how floods impact a telecommunications business. We analyse historical data and examine extreme weather conditions against the job intake for these periods. To begin with, we focus on Cumbria as it has been hard hit by floods in the recent years. Through interviews with engineers and managers we aim to understand the impact of flood on Cumbria and the range of different mitigation measures. The mitigation measures will depend on the location; these could include structural or non-structural measures as well as maintenance regimes for existing equipment. Initial results are presented.

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?: Highly

12/09/2017 : 15:00 : Room 9 - JF D.1.09 (x58)

Code: OR59A3090

### **Optimal Design of Uptime-Guarantee Maintenance Contracts**

**Dr Behzad Hezarkhani** (*Nottingham University*) and **Prof Mahesh Nagarajan** (*Sauder School of Business*)

Uptime-guarantee contracts are becoming increasingly popular among Original Equipment Manufacturers (OEM) for offering maintenance services to their customers. This paper analyzes the strategic interactions in uptime-guarantee maintenance contracts between an OEM (vendor) and a customer, and addresses the revenue management problems therein. Both parties hold some private information. The vendor does not know the customer's valuation for changes in device's uptime, i.e. her type. The customer, on the other hand, cannot observe the vendor's investment, i.e. his effort level, to systematically increase the device's expected uptime during the length of contract. We characterize the conditions for the existence of contracts that are both **profitable to the vendor and acceptable to the customer, and provide closed-form solutions to the optimal uptime-guarantee contract design problem. We show that despite the possibility of having multiple revenue-equivalent optimal contracts, the structure that guarantees 100% uptime level is general enough to be offered at optimality in all situations. Furthermore, we demonstrate the advantages as well as limitations of contract menus to increase the vendor's (expected) profits.**

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

12/09/2017 : 15:30 : Room 9 - JF D.1.09 (x58)

Code: OR59A3103

### **The Future of the OR & Strategy SIG**

**Dr Martin Kunc** (*University of Warwick*) and **Dr Frances O'Brien** (*Warwick University*)

The OR & Strategy SIG is one of the OR Society's Special Interest Groups. It has run successfully over a number of years with a wide variety of activities and speakers, ranging from half day events to two day mini conferences on a specialist theme. The purpose of this session is to discuss the future of the SIG and hopefully to encourage some more people to join a committee to help plan and run future activities.

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

12/09/2017 : 16:30 : Room 9 - JF D.1.09 (x58)

Code: OR59A3120

### **Optimal Selling Prices for Small Sized Poultry Farmers**

**Prof Hidefumi Kawakatsu** (*Onomichi City University*), **Prof Kosuke Kato** (*Hiroshima Institute of Technology*) and **Dr Dong Li** (*University of York*)

There are many small and middle sized poultry farmers in Japan. Each small sized poultry farmer would normally sign a certain exclusive contract with a dominant buyer such as large wholesalers or meat processors, which signifies that their financial conditions are completely dependent upon the order quantities of the dominant buyer. There is a possibility that poultry farmers could stabilise and secure profit by producing their own branded chicken. This study considers the situation where a small sized poultry farmer not only produces Broilers (Product 1) to meet the demand of the dominant buyer, but also introduces their own branded chicken (Product 2) for other customers. The breeding area is limited and divided into two regions; one is for Product 1 and the other for Product 2. Each product has a different breeding period. The product with longer breeding period has higher selling prices. We formulate the poultry farmer's total profit per unit of time as a function of selling prices and prove the existence of an optimal selling price for each product, which maximises the total profit. Some numerical examples are also 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

12/09/2017 : 17:00 : Room 9 - JF D.1.09 (x58)

Code: OR59A3179

### **Can we be Dumbledore or are we just Mystic Meg?**

**Mr Andrew Hodges** (*Arke Ltd*) and **Mrs Charlotte Watson** (*Arke Ltd*)

A comprehensive evidence base is necessary to drive forward future investment decisions. Analysis with a full system perspective across the whole capability lifespan can inform both a push (financial approvals) as well as pull (design review) function. How can this information be better used to shape future research and development alongside articulation of the value proposition? When examining the likely cost of ownership for future defence capability concepts, it is necessary to interrogate the whole system in which the capability will be delivered. It is relatively simple to conceptualise the cost of a system in terms of its lifecycle equipment costs (development, integration, maintenance and support). This is in spite of the obvious uncertainty in specification and use-case for novel technologies in relation to a relevant historical basis, accounting for divergence factors surrounding policy, operational requirements and emergent technologies. The special focus of this presentation will be on whether it is quite so simple to forecast the wider capability enabling elements such as the training, personnel and end-to-end logistics. This encapsulates the overarching problem associated with ensuring research is readily exploitable in a real-world context. What level of operational analysis is appropriate and proportionate to the maturity and complexity of the problem? How can we bridge the valley of death? This leads us to consider alternative ways of first capturing, but also quantifying uncertainties to proactively reduce risk exposure. Research in this context is focused on becoming risk aware, whilst maintaining a healthy risk appetite in the portfolio. A framework is presented which informs support planning and requirement setting by highlighting the drivers of a changing future landscape in terms of their probability, magnitude and timing. This provides a pre-cursor for the development of an agile capability management solution which can proactively account for changing future operating conditions.

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

14/09/2017 : 10:00 : Room 9 - JF D.1.09 (x58)

Code: OR59A3174

### **Living Business Models with System Dynamics - Now Easier, Faster and More Reliable Than Alternatives**

**Dr Kim Warren** (*Strategy Dynamics Ltd*)

While system-dynamics modeling of enterprise issues and plans has long been possible, creating them has been a long and complex process. Recent advances in 'agile' modeling methods, rigorous attention to sound theoretical principles, and easy-to-use tools has brought us to the point where such models are (genuinely!) easier, faster and more reliable than any alternatives - notably the impenetrable and error-strewn spreadsheets that dominate efforts to assess plans and tackle issues. The dynamic behaviour of real-world cases are replete with accumulating stocks, interdependence and feedback, and threshold effects - all of which system-dynamics was purpose-built to handle. The challenge for enterprise-modeling is to capture all significant such mechanisms - across organisational silos - in an easy-to-understand format. Fortunately, the core structures relating to customers, staffing, capacity and other critical resources are \*identical\* to those that the accounting profession has used for cash for many centuries. This paper will demonstrate the transparency and ease-of-development for such models in the context of modeling tech startup businesses.

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

14/09/2017 : 10:30 : Room 9 - JF D.1.09 (x58)

Code: OR59A3100

**Understanding Value Creation under Dynamic Complexity: The Use of Resource Mapping with 'Integrated Reporting'**  
**Dr Martin Kunc** (*Warwick Business School*), **Mr Federico Barnabe** (*University of Siena*) and **Mrs Maria Cleofe Georgino** (*University of Milano-Bicocca*)

The paper attempts to offer a glimpse of the dynamic complexity involved in creating value in companies. The case is based on a new accounting report, Integrated Reporting, that aims at providing all the needed principles and guidelines to assist companies in developing an integrated reporting process able to convey a holistic view of their organizations in terms of operations, risks, opportunities and drivers generating value for all the relevant shareholders and stakeholders in the short, medium and long term. To evaluate the dynamic complexity, this paper combines Integrated Reporting with resource mapping, a combined System Dynamics (SD) and Strategic Management technique, on the basis of the common idea that organizational resources (or type of capitals, according to terminology) are interconnected and ought to be managed simultaneously to create value in a holistic perspective. Our contribution to SD is to present a promising avenue to communicate dynamic complexity to different audiences by reflecting the causal relationships, and feedback loops, between type of capitals (resources) and governance actions. The analysis can also communicate fundamental leverage points where the value creation process lies.

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

14/09/2017 : 11:30 : Room 9 - JF D.1.09 (x58)

Code: OR59A3193

**An Exploration of the Influencing Factors of Strategy Implementation Processes**  
**Dr Moataz Alhilou** (*Liverpool John Moores*) and **Dr Ronald Ramlogan** (*University of Manchester*)

Equally likely both practitioners and academics have argued that the majority of strategy initially planned, fail to get implemented successfully. They either fail to achieve the intended objective/s, on time and/ or within the resources initially allocated. Many factors do have an influence on business strategy implementation processes. This has relatively been less researched in the literature. The majority of previous work does focus on the planning phase and these previous research were mainly conducted in the West. This research provides a more holistic understanding of the potential factors that could influence the entire strategy implementation process.

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

14/09/2017 : 12:00 : Room 9 - JF D.1.09 (x58)

Code: OR59A3208

**Linking Business Modelling with OR and Strategy**  
**Dr Giles Hindle** (*University of Hull*) and **Prof Richard Vidgen** (*University of New South Wales*)

There has been a considerable growth of interest in business modelling within mainstream academic and practitioner management journals since around 1995. This has resulted in special issues of the journals Long Range Planning (2010) and Advances in Strategic Management (2015) and the best-selling business book Business Model Generation by Osterwalder and Pigneur (2010). We argue OR has a strong track record in research contributing to the theory and practice of business modelling through the work of authors such as Beer, Dyson, Checkland, Wilson, Eden, O'Brien, Morecroft, Kunc and others. This presentation reviews the literature on business modelling and presents an analytic approach to business modelling based upon the OR tradition.

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

14/09/2017 : 13:15 : Room 9 - JF D.1.09 (x58)

Code: OR59A3244

**Expert Consensus to Support Evidence Based Decision Making - a Case Example of Systems Level Improvement in Care Homes**

**Dr Sally Fowler Davis** (*Sheffield Hallam University*)

Health care commissioning is based on using the best available data and research evidence and strategic operational improvements are based on decisions made in the Care Commissioning Groups (CCG) . This case example reflects on a pilot project to develop quality indicators and metrics that enable managers to understand the improvements to health within the population of frail elderly people within the care homes sector. The operational research included the use of nominal group methods with expert practitioners and stakeholders and a structured literature review, to achieve a set of evidence based indicators of health and wellbeing for frail older people. Health Impact Assessment (HIA) has been structured around a key policy framework for the health improvement and service improvement in the care home sector. Cost and quality are critical challenges within the health sector with a particular focus on reducing hospital based costs and the strengthening primary care (general practice). The strategic development of the Care Home sector is highly complex involving whole systems thinking and a range of particular priority initiatives including workforce education and training and the deployment of systems level data management to collect and analyse population health metrics. The implementation of system wide programme of organisational development in the care home sector is based on participation and stakeholder management across clinical, commissioning and service management. Operational research is being used to drive change and to engage a range of expert stakeholders and to inform the strategy and development quality improvement work stream.

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

14/09/2017 : 13:45 : Room 9 - JF D.1.09 (x58)

Code: OR59A3228

#### **Developing the Strategy for New Models of Care - Experiences from Vanguard Sites**

**Mrs Kinga Lowrie** (*University of Sheffield*), **Dr Steven Ariss** (*University of Sheffield*) and **Dr Sally Fowler-Davis** (*Sheffield Hallam University*)

Following the publication of NHS Five Year Forward View, NHS England commissioned a series of Vanguard sites to test out New Models of Care. It is believed that moving care out of hospitals enables cost reduction and quality improvement. One of the Vanguards sites we are working with is currently testing whether the integrated clinical teams can achieve more delivering care beyond traditional organisational boundaries. This presentation will discuss our experiences of working with healthcare professionals and decision makers on evaluation of the Vanguard activities and how OR methodology facilitated the development of shared understanding. We describe how we assisted in the development of a consensus on operational aspects of the Vanguard e.g. What is the optimum number of patients the service can deal with? What capacity is needed? What would be the most robust scenario to "roll-out" the service to the rest of the region? We will discuss practical issues of strategy development and the challenges of being involved in the projects of similar type.

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?: Very

#### **OR in Asset Management**

**Organiser: Mahmood Shafiee**

13/09/2017 : 10:15 : Room 7 - JF D.0.02 (x56)

Code: OR59A3191

#### **Degradation-Based Preventive Maintenance Policy for Railway Transport Systems**

**Ms Fateme Dinmohammadi** (*Glasgow Caledonian University*)

Railway transport maintenance plays an important role in delivering safe, reliable and competitive transport services. It also is one of the major costs for rail transport operations. In order to reduce the operating expenditure (OPEX) while maintaining high standards of safety, the asset managers must determine a planning period and find optimum preventive inspection policies for various railway systems, such that the total cost incurred over the life span is minimized and/or the rail network's reliability is maximized. Common railway defects are caused by degradation processes such as rolling contact fatigue (RCF) or wear. The degradation of assets may result in substantial losses to the rail transport operators if it is not prevented in an efficient way. In this paper, we investigate an optimal age-dependent preventive inspection policy for railway assets subject to gradual degradation phenomena. The degradation processes initiate following Non-Homogenous Poisson Process (NHPP) and propagate according to gamma stochastic process. When the size of degradation reaches a critical level, the asset will unexpectedly fail and it has to undergo a corrective repair. This unexpected failure may also interrupt rail operations, cause passenger

dissatisfaction or even some accidents like derailment or overturning. To avoid such undesired defects, the asset is preventively inspected at regular time intervals. The problem is to determine an optimal inspection time interval such that the long-run expected cost rate is minimized. The proposed model is applied to support maintenance decision-making for a railway asset on the Scottish rail network. The results show that the use of the proposed inspection policy allows a significant reduction of the maintenance cost compared to the strategy when only corrective repair is considered.

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

13/09/2017 : 10:45 : Room 7 - JF D.0.02 (x56)

Code: OR59A3071

### **Maintenance Optimization of Wind Energy Farms: Models, Methods and Strategies**

**Dr Mahmood Shafiee** (*Cranfield University*)

In recent years, maintenance optimization has received the attention of many researchers and practitioners from different sectors of the wind energy industry. Optimizing the maintenance decisions for wind energy farms is a complex task involving a high degree of uncertainty due to diversity of assets and their corresponding failure modes, weather-dependent transport conditions, unpredictable spare parts demand, insufficient space or poor accessibility for maintenance and repair, limited availability of resources in terms of equipment and skilled manpower, etc. In this research, we propose a classification framework for the study of maintenance optimization in wind energy. The developed framework addresses a wide range of theoretical and practical issues, including the models, methods, and strategies of the inspection planning and maintenance optimization in wind farms.

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

13/09/2017 : 11:15 : Room 7 - JF D.0.02 (x56)

Code: OR59A3157

### **Performance Prediction of Polymer Electrolyte Membrane (PEM) Fuel Cells**

**Dr Lei Mao** (*Loughborough University*) and **Dr Lisa Jackson** (*Loughborough University*)

As a potential energy generation source, fuel cells, especially the polymer electrolyte membrane (PEM) fuel cell, has attracted much attention due to its characteristics such as zero emission and high efficiency. In the last few decades, the PEM fuel cell has been equipped in several applications, including stationary power stations, automotive power trains, and consumer devices. However, its reliability and durability are still major barriers preventing the PEM fuel cell from further commercialization, since PEM fuel cell systems, especially those under dynamic load conditions like automotive, cannot meet the requirement of their designed useful life. As a possible solution, reliable performance prediction of PEM fuel cell system is urgently required, as the results can provide valuable information for the control and maintenance strategies to extend system performance. In this study, the prediction of PEM fuel cell performance is investigated at different operating conditions, including steady state conditions and dynamic conditions. In the steady state condition, adaptive neuro-fuzzy inference system (ANFIS) is applied to predict the PEM fuel cell performance, where results demonstrate that with proper selection of ANFIS inputs and training, PEM fuel cell voltage can be predicted with good quality. While under dynamic conditions, the particle filtering approach is utilized for the performance prediction, as it can capture the fuel cell internal behaviour variation, thus can provide better understanding of fuel cell performance degradation. From the results, fuel cell performance for dynamic conditions can be predicted with reasonable accuracy using particle filtering approach.

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

13/09/2017 : 11:45 : Room 7 - JF D.0.02 (x56)

Code: OR59A3190

**Isaac Animah**

**Mr Isaac Animah** (*Cranfield University*)

Many physical assets operating in safety critical industries (e.g. offshore oil and gas, wind power, nuclear power plant and electrical transmission and distribution companies) are designed to operate for a period of 20-25 years. The majority of assets in these industries have reached the end of original design life or approaching the end of original design life and asset managers have to make a decision whether to decommission, replace, repower or extend the operational lives of the assets. Among the end of life management strategies for physical assets, life

extension is regarded as the most appropriate strategy due to its economic, environmental and social benefits. However, to successfully extend the operational lives of assets that have reached the end of life, asset managers must address technical, economic, regulatory, environmental as well as health and safety challenges associated with life extension phase of operation. The purpose of this study is to present a detailed analysis of the challenges likely to confront asset managers in these safety critical industries during the life extension phase of operation, share good practices and experiences from other industries, and highlight the opportunities associated with life extension phase of operation.

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

14/09/2017 : 10:00 : Room 7 - JF D.O.02 (x56)

Code: OR59A3069

### **Information Support Plan (ISP) for New Combat Search and Rescue (CSAR) Helicopter HH-60W**

**Mr David Jennings** (*ORPA Consulting*)

This paper describes the communications lines, network endpoints, and information packages for the operations of the new United States Air Force Combat Search and Rescue Helicopter, the HH-60W. The "60-Whiskey" is a new aircraft being produced to be the replacement for the aging fleet of HH-60Gs. Information support plans are the United States Department of Defense (DoD) Corporate Information Office (CIO) responsibility to institute, monitor, and ensure interoperability of information technology and national security systems throughout the Acquisition Lifecycle. The ISP also acts as the DoD CIO's single source to collect and analyze information requirements for adherence to DoD policy, document program interoperability risks and issues, and propose mitigation strategies (as applicable). The ISP for the HH-60W was created using IBM Rational software suite to develop the process models and communication paths for this aircraft. The process modeling effort extended to the nature of communications, the process steps for a standard CSAR mission, and the flight profiles and aircraft packages required for a successful CSAR mission, from initial sortie planning to the "After Action Reporting" phase. This static simulation provided the engineers and process designers an information process map that was nimble in response and defined each connection between the actors, their roles and responsibilities, and the manner clear lines of demarcation.

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

## **OR in Consultancy**

**Organisers: Jane Parkin and Ian Seath**

13/09/2017 : 11:15 : Room 6 - JF CC.01.11 (x48)

Code: OR59A3189

### **Excitement from Day 1: Art of Simulation and Practical Approaches to Ensure Client Engagement**

**Mr Liam Hastie** (*Simul8*)

Liam Hastie of SIMUL8 Corporation will give a talk on planning for active engagement with clients when starting a project. This will combine both the Art of Simulation (an approach developed across 22 years of running successful Process Simulation projects) and tried and tested practical approaches to facilitate rapid process understanding, establishing project objectives and building rapport. Recognizing modern consulting delivery practices, the talk will include learning from working remotely and onsite, dealing with system complexity and enabling clients to take control.

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

13/09/2017 : 11:45 : Room 6 - JF CC.01.11 (x48)

Code: OR59A3196

### **From Ivory Tower to Coalface: How to Survive (and Even Flourish) in the Real World**

**Mrs Jane Parkin** (*Carr House Consulting*)

Academia can be a very sheltered existence: everyone is intelligent, well-educated, interested in their subject, knows all about applying for research funding and writing academic papers, and is prepared to spend hours discussing arcane topics. For some, it's a shock moving from this to a very different world and carrying out practical OR projects for real clients. This talk will cover the major differences between the two worlds and hopefully help academics considering a move to flourish in the outside world. Topics covered will include: • Speaking with clients in their own

language • Running meetings for successful outcomes • Project planning (and why deadlines matter) • Carrying out projects in collaboration with clients • Practical analysis and modelling • Reporting results and conclusions (how to ensure results are useful).

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

13/09/2017 : 15:15 : Room 6 - JF CC.01.11 (x48)

Code: OR59A3195

**Tips and Tricks for Leading a Pro Bono OR Consultancy Project. A Workshop Session for Those Interested in Contributing to a Pro Bono Project**

**Mrs Jane Parkin** (*Carr House Consulting*) and **Mr Ian Seath** (*Improvement Skills Consulting Ltd*)

Working with Third Sector organisations can be a very satisfying experience for OR people. The OR Society's Pro Bono Scheme is an opportunity to "give something back" but if you're unfamiliar with the way charities work, it can be rather daunting. In this workshop, you will have an opportunity to: - find out how projects are defined and offered to Pro Bono OR volunteers - consider how to prepare for an initial meeting with a charity client - understand some of the challenges facing charities when they work with OR people - develop tactics for managing a Pro Bono project that will help you and the charity - hear some tips and lessons learnt from consultants who have completed several PBOR projects Timing: 90 minutes (tbc)

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

14/09/2017 : 10:30 : Room 7 - JF D.0.02 (x56)

Code: OR59A3053

**The Sciences of Improvement and the Skills of the Circus**

**Dr Geoff Royston**

Recent years have seen the growth of activities, journals and even scientific disciplines focused on specific issues of importance to O.R. practitioners, such as implementation or evaluation. Similar, earlier, growth has occurred around issues of decision or design. What skills do O.R. practitioners need to thrive in this changing methodological environment? How might they be acquired? How could or should O.R. respond as a profession? This presentation will address these questions through considering the activities and abilities of circus performers such as jugglers, clowns, lion tamers, fire breathers and tightrope walkers.

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

14/09/2017 : 11:30 : Room 7 - JF D.0.02 (x56)

Code: OR59A3079

**Daisy Daisy: Moving from What to How on a Bicycle Made for Two.....**

**Dr David Halsall** (*NHS England*)

Operational Research famously starts with a problem, usually a tricky problem. Describing and gaining a shared understanding of the problem between the customer and operational researcher is often the first step in finding a solution. But the strength of operational research is built on painting a compelling picture of what the future might look like. Operational research has been described as looking backward to enable us to look forward. For the operational researcher being able to convince their customer that the picture they are painting of possible solutions are compelling requires a high degree of trust to have been built up. This trust is often built at the early stage of the project, at the description of the problem stage. This talk will describe hints and tips of how you can move from soft OR problem structuring techniques to predictive tools such as simulation so that you and your customer can share the journey together.

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

14/09/2017 : 12:00 : Room 7 - JF D.0.02 (x56)

Code: OR59A3209

**Organising Consultancy Teams**

**Mr David Collier** (*White Ox Ltd.*)

Business, government and consultancies have to decide how to organise their specialist operational research resources and related disciplines such as decision analytics or human factors/behavioural science. There are different ways to approach the problem, including matrix management, internal consultancies, and embedding specialists in delivery teams. Each has their strengths and weaknesses and picking the right one for the context can make a huge difference to the effectiveness of specialist input, knowledge transfer, and staff development and retention. The author has direct experience of most of the options over his 35 year career and has also carried out research for clients into best practice as an independent management consultant. This presentation summarises some key insights from his experience and comments on current trends, with reference to some recent literature.

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

14/09/2017 : 13:15 : Room 7 - JF D.0.02 (x56)

Code: OR59A3114

### **Caught in the Middle: How to Stand Out as an Internal Consultant in a Sea of Other Analysts**

**Mrs Katie Gronow** (*Department for Transport*)

Working for an internal OR consultancy within a large organisation provides an opportunity for a great variety of projects, both in terms of application of techniques and access to different business areas, but also has its challenges. We are a small team of analysts, and unique in our organisation in the way we operate. We face competition from both external consultancies and internal analytical resource who are "bedded-out" in business areas, and are always trying to improve the way we can make an impact and keep interesting projects coming in. This presentation will look at some of the challenges we face (and these are not exclusive to internal consultancies, or even consultancies in general), and the ways we are trying to overcome these, for example: • Building and maintaining client relationships, especially when staff and policies change. How do you find leverage when you are not part of a business area, and how can you influence decision making? • Getting involved in projects sooner – how can we find out where we are needed, and where and when to aim our marketing? • Ensuring that analysis is timely and fit for purpose, and effectively communicated • Ensuring we innovate – how do we build in time to develop our skills and keep abreast of developments in the OR world?

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

14/09/2017 : 13:45 : Room 7 - JF D.0.02 (x56)

Code: OR59A3176

### **Making the Leap – from Paid Employee to Freelance Consultant**

**Mr Kevin Sheehy** (*AxSim Solutions Ltd*)

Thinking of moving from the security of paid employment to branch out on your own? Been made redundant and wondering what to do next? Just want to be in control of your own destiny? This is where I was just over two years ago. Based on my recent experiences over the last couple of years, this presentation shares my experiences of branching out on your own:- • What has worked well? • What do I wish I had done before? • Would I do the same again? • Does panic set in during a quiet period? • Would I recommend you go for it? The talk will also give a flavour of the things to think about before getting started – e.g. Sole Trader v Limited Company, do I need an accountant, social media, website, branding, day rates etc. In addition, with my background in simulation, the talk will also discuss the type of projects I have done and the tools I have used.

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

## **PANEL SESSION**

**Organiser: Gilberto Montibeller**

## **PLENARY TALKS**

**Organiser: Hilary Wilkes**

## POSTERS

Organisers: Antuela Tako and Tatiana Gherman

## PRESIDENTS MEDAL

Organisers:

### Problem Structuring Methods

Organisers: Alberto Paucar-Caceres, Christine Welch and Diane Hart

12/09/2017 : 11:00 : Room 2 - JF CC.00.14 (x40)

Code: OR59A3084

#### **Incorporating Maturana's onto-Epistemology into Checkland's Soft Systems Methodology**

**Prof Alberto Paucar-Caceres** (*Manchester Metropolitan University*) and **Mr Bruno Jerardino-Wiesenborn** (*Universidad de Santiago de Chile*)

This paper addresses Checkland's Soft Systems Methodology (SSM) limitations and proposes a theoretical framework that incorporates key concepts from Maturana's Theory of Autopoiesis (ToA) and Biology of Cognition (BoC). The proposed framework aims to help to expand and complement Checkland's SSM application process. We outline and examine paradigmatic compatibility between Checkland's ontological position (reality is problematic and unknowable) and interpretivist epistemology (multiple perceptions will enrich the ever-changing and 'unknowable' reality). We argue that Maturana's phenomenological onto-epistemology resonates with SSM tenets making feasible to combine and graft some of Maturana's key concepts (structural determinism/structural coupling and organisational closure) into some of the phases of the Checkland's well-known SSM seven-step process. The proposed framework could help to overcome SSM limitations and real world practical applications will be substantial. An enriched and improved SSM process will have substantial implications in the Operational Research and Systems community. Furthermore, the conceptual framework can have significant social implications since it will incorporate the well-known influential ideas ToA and BoC into Operational Research methodology.

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

12/09/2017 : 11:30 : Room 2 - JF CC.00.14 (x40)

Code: OR59A3188

#### **Varieties of Mindfulness for Creative OR Practice**

**Dr Jose-Rodrigo Cordoba-Pachon** (*Royal Holloway, University of London*)

The purpose of this session is to bring forth two varieties of mindfulness which could help foster creativity in OR practice. The popularity of psychological approaches to OR is on the rise (or maybe rediscovery?). Dealing with messy situations requires to some appreciating the full picture of what is going on. Mindfulness as the opposite of mindlessness requires full attention to how we think about or frame situations as well as what and how we think about ourselves. Two takes on mindfulness are proposed: One that revisits thinking categories with a view of redefining them (Langer, 1995); and another which invites us to become 'one with the world' that we are experiencing (also implying harmonising mind and body) (Varela et al, 1995). Both takes could yield different types of insights to foster our creativity in the vase of messy or interesting situations. The session will develop two practical exercises which aim to reflect the systemic features of each take on mindfulness and will elicit some reflections from participants with a view to further our understanding of how mindfulness could help us in our OR practice.

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

12/09/2017 : 12:30 : Room 2 - JF CC.00.14 (x40)

Code: OR59A3068

#### **Data Analytics and Dashboards in Higher Education: Exploring the Use of Systems Thinking in Evaluating Their Role in Quality Enhancement Processes**

**Dr Diane Hart** (*Manchester Metropolitan University*)

This presentation will outline some of the preparatory work and plans for further longitudinal, qualitative research to explore how academic staff in a UK higher education institution are using data analytics and dashboards to inform their improvement planning. The researcher's interest is in exploring how inquiry through the lens of complex adaptive systems, particularly the viable systems model, could help generate useful insight to help improve the communication, interpretation and use of data and analytics tools in quality enhancement processes. There is growing interest in the potential for big data and data analytics to be used effectively in quality assurance and enhancement processes in UK higher education. Recent work in the sector has highlighted that higher education is lagging behind the commercial sector in this area, and that the UK HE sector is also lagging behind the US and Australia. Previous studies in the field of quality in HE studies have argued that UK HE quality processes over-emphasise assurance in relation to enhancement. The concern is that this encourages attention to be directed towards a narrow range of the same externally defined parameters used to compare institutions, but these have limited value in helping practitioners understand how well their specific strategies, in specific contexts, are working in practice. Whilst there has been growing interest in the application of systems thinking and practice to this issue, there are limited studies that give practical insight into how to approach this, or evidence of benefit.

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?: Somewhat

12/09/2017 : 14:00 : Room 2 - JF CC.00.14 (x40)

Code: OR59A3203

### **Problem Structuring and the Founders of OR**

**Prof Robert Dyson** (*University of Warwick*) and **Dr Frances O'Brien** (*Warwick University*)

Soft OR and PSMs have, particularly in recent years, been associated with OR in the UK and Europe. There have been attempts to break into the US market and in particular into the prestigious US OR-related journals, to no avail. This paper explores the origins of soft OR in relation to the founders of OR, and in particular through the works of some of the US founders.

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?: Somewhat

12/09/2017 : 14:30 : Room 2 - JF CC.00.14 (x40)

Code: OR59A3083

### **Use of Problem Structuring Methods in OR Interventions – Evidence from JORS**

**Mr Harry Kogetsidis** (*University of Nicosia*)

Problem structuring methods (PSMs) provide a collection of participatory modelling approaches that can be used to address problematic situations, characterised by multiple actors with different perspectives and quite often conflicting interests. There have been many cases of successful application of problem structuring methods and, as a result, PSMs are often discussed in the annual conference of the OR Society. The aim of this presentation is to review the recent use of problem structuring methods (PSMs) during OR interventions, as these have been reported in JORS – the official journal of the OR Society. The presentation will look into whether particular problem structuring methods are used alone or in combination with other methods or tools, as well as the broader research paradigms that these approaches to intervention are associated with. The presentation aims to examine whether problem structuring methods still have an important contribution to make in the field of OR.

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

12/09/2017 : 15:00 : Room 2 - JF CC.00.14 (x40)

Code: OR59A3135

### **Evidence Based Systems Inquiry and Design: Where Soft Systems Meets Data and Design Thinking**

**Prof Richard Vidgen** (*University of New South Wales*) and **Prof Lucy Kimbell** (*University of the Arts London*)

In an uncertain and complex world there is an unprecedented need for an approach to frame problem situations and develop action plans. While problem structuring approaches, such as soft systems methodology, have been used extensively by the OR community the amount of traction these approaches have achieved in the wider world is questionable. The evidence-based systems inquiry and design (ebSID) framework draws on techniques from SSM such as purposeful activity system modelling and rich picturing, and enhances it with approaches from other disciplines and areas of systems thinking. The extensions include: (1) using the Cynefin framework to categorise problem situations (is it best thought of complex, chaotic, simple, or complicated?), (2) adopting a fast-form

ethnographic approach to understand the situated reality of users and others in the problem situation, (3) using design thinking to iterate the development of practical and grounded solutions, (4) stakeholder analysis to assess the impact and feasibility of change (cultural feasibility), and (5) the explicit development of an evidence base to capture what is known about a problem situation (facts, assumptions, causal relationships, and qualitative data). A key challenge for ebSID is presenting the approach as a coherent, intuitive and logical whole, and as an agile and rapid methodology that can be adapted to the situation at hand. ebSID is being developed through practice as part of a new and innovative MBA programme developed in a partnership between a business school and a creative arts school.

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

12/09/2017 : 15:30 : Room 2 - JF CC.00.14 (x40)

Code: OR59A3122

### **Integrating Systemic Methodologies to Improve Strategic and Operational Management: a Case of an SME in the Argentinean Textiles Industry**

**Prof Mischel Carmen Neyra Belderrain** (*ITA – Instituto Tecnológico de Aeronáutica*), **Ms María Alejandra Castellini** (*Universidad de Buenos Aires*), **Prof Alberto Paucar-Caceres** (*Manchester Metropolitan University*) and **Prof Jose Luis Zanazzi** (*Universidad Nacional de CórdobaCórdoba, Argentina jose.luis.zanazzi@unc.edu.ar*)

The paper reports on the combined use of operational research (OR) methods in a multi-methodological framework. We use some stages of two 'British born' problem structuring methods: Soft Systems Methodology (SSM) and Strategic Options Development and Analysis (SODA) combined with tools such as Quality Management techniques and methods from hard OR like linear programming and multi criteria decision analysis. We map these into the multi-methodological grid proposed by Mingers and Brockelsby for integrating methodologies and used it in a real-world case study. The framework proposed lies on what will be a multi-paradigm multi-methodology OR practice. Through an action research case study, we report on the application of the proposed framework to help the general management of an SME operating in the textile industry in the northwest of Argentina. Application findings are reported at two levels: we provide guidelines for decision makers at a strategical level but also we provide guide for continuous improvement of products and processes. The paper contributes to the current debate on multi-paradigm and multi-methodology practice in OR and with the recent trend to combine Soft OR methods from "outside" the traditional soft OR portfolio with hard methods. The findings suggest that by deploying a substantial range of hard and soft OR methodologies can produce a comprehensive strategic plan that is viable (a first validation is also reported) and that the exercise improves the understating and interpretation of the sometimes conflicting strategical aims. The paper should be of interest to academics and systems practitioners intending to use OR methods in a single systemic framework; consultants advising strategic planning; and managers working in designing strategic plans in complex environments in emergent economies.

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

12/09/2017 : 16:30 : Room 2 - JF CC.00.14 (x40)

Code: OR59A3232

### **Cycles of Dominance/Eclecticism and Fractal Patterns of Divisions/Convergence in Operational Research over the Last 30 Years**

**Prof Alberto Paucar-Caceres** (*Manchester Metropolitan University*), **Prof Carmen Neyra Belderrain** (*ITA – Instituto Tecnológico*) and **Mrs Leila Abuabara** (*Universidade Federal de Sao Paulo (UNIFESP)*)

Operational Research theory and practice is continually developing. To the already well-known armoury of OR methodologies, methods and techniques, seemingly new approaches are added. In some cases, these new approaches/ways of practicing OR claim the status of 'new' fields or subfields between the OR discipline. This paper uses the ideas of the sociologist Andrew Abbott to formulate a framework in which OR knowledge is seen as continuously reconfigured and rediscovered. We propose a conceptual framework to discuss the unfolding of OR field over the last 30 years arguing that this phenomenon can be seen as part of a cyclical process in which some of the subfields claims are in fact resurgence of approaches, theory and concepts that have been trading in OR circles for some time. Taking time slices (from 1980 to 2016), we aim to study the dynamics of OR in terms of two mutually dependent stages of (a) Dominance which can be perceived when some concepts used in the OR field become prevalent. Dominance is then followed by stages of (b) Eclecticism. These can be seen when previous concepts become fragmented, divided or associated in different ways. Based on what we consider a systemic and cyclical nature of OR knowledge, we propose a framework to explore the development of themes and concepts in

OR over time. We hope to explore the framework using the case of Behavioural Operational Research (BOR), a subfield of OR that over the last three or so years has emerged and has gained increased visibility amongst academic and practitioners OR circles. We explore the raise of BOR against the development (and decline?) of Soft OR/PSM an established OR sub-field with a longer tradition in the UK OR movement and assess the current and future status of both PSM and BOR subfields.

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

13/09/2017 : 10:15 : Room 2 - JF CC.00.14 (x40)

Code: OR59A3127

### **Identification of Health and Safety Policies for Promotion Industrial Workers Active Aging Using Value-Focused Thinking**

**Prof Mischel Carmen Neyra Berderrain** (*Instituto Tecnológico de Aeronáutica*), **Miss Giselle de Oliveira Coelho** (*Instituto Tecnológico de Aeronáutica*) and **Mr Alberto Paucar-Caceres** (*Manchester Metropolitan University Business School*)

Technology and globalization have changed the way people work and the types of risks to which they are exposed in the workplace. In addition, the aging of the workforce brings new challenges to the industrial health and safety regarding the adaptation of the workplace, occupational risk factors, intergenerational knowledge exchange, among others. Economic growth generates jobs that in the future will be occupied by an aged population requiring initiatives that meet the needs of these professionals. Seeking to meet these needs the present study has as main objective to identify policies to promote active aging industry workers. The Value-Focused Thinking (VFT) approach was used with the author's participation as facilitator and selected stakeholders. The results obtained using VFT were analyzed and compared with the guidelines of the 2016-2017 campaign of the European Agency for safety and health at work. Policies such as "Perform the recognition of workplace risks according to the limitations of the individual", "Adjustment of working hours", "Promotion of qualification of the worker" were obtained, among others.

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

13/09/2017 : 10:45 : Room 2 - JF CC.00.14 (x40)

Code: OR59A3037

### **The Risk Systemicity Questionnaire: Using Causal Risk Mapping to Support Resilience Building in Cities**

**Prof Susan Howick** (*University of Strathclyde*), **Prof Colin Eden** (*University of Strathclyde*) and **Dr Igor Pyrko** (*University of Strathclyde*)

The resilience of cities has become a matter of concern around the world. EU interest in this topic has led to the EU Commission funding a number of projects in this area, one of which is the Smart Mature Resilience (SMR) project. This is a 3 year project involving 13 partners, including 4 academic institutions and 7 EU cities. The project aims to develop a number of new tools to support cities in becoming more resilient. One of these tools is the Risk Systemicity Questionnaire (RSQ). Traditional risk assessment tools only consider risks as independent events, however research has shown that when risks combine with one another the impact can be severe. Therefore, the RSQ focusses on risk scenarios which are complex networks of risk consequences. The development of the tool involved group workshops with representatives from 7 EU cities. Causal risk mapping was used to bring together the differing perspectives of the cities with respect to the risks that are of most concern to them, how these risks impact one another and their complex consequences. The resulting network of risks was then represented as a series of interacting risk scenarios in a tool created in Excel. Users of the tool are asked to consider whether these risk scenarios are of concern to their city and their responses lead to an evaluation of the highest risk areas. The tool has been implemented in 3 cities and in each case has been used as a prompt for facilitating a directed conversation regarding risk systemicity and thus highlighting risk areas that require most attention by the city.

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

### **Scheduling and Planning**

**Organiser: Jiyin Liu**

14/09/2017 : 10:00 : Room 4 - JF CC.01.09 (x44)

Code: OR59A3047

### **Survivable Regenerator Location Problem - Exact and Approximation Algorithms**

**Dr Yash Aneja** (*University of Windsor*)

In this paper we consider the problem of locating regenerators optimally on certain nodes in an optical network to ensure that all nodes can communicate with each other even when (at most) one edge, of the physical network topology, can fail. The quality of an optical signal propagating through a wavelength division multiple multiplexed (WDM) network deteriorates due to physical layer impairments such as optical noise, chromatic and polarization mode dispersion, cross-phase modulation and cross talk. When the quality of signal becomes unacceptable, it is necessary to carry out the 3R-generation (reamplify, reshape and retime) on the optical signal to bring the signal to its original quality. The optical reach is defined as the maximal distance a signal can travel before it requires the regeneration. We present a  $(3+\ln(\delta+2))$ -approximation algorithm for a special case of this problem.

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

14/09/2017 : 10:30 : Room 4 - JF CC.01.09 (x44)

Code: OR59A3035

### **An Efficient and Truthful Algorithm for Fair Scheduling on Related Machines**

**Miss Ruini Qu** (*Warwick University*) and **Prof Bo Chen** (*Warwick University*)

With rapid expansion of traditional scheduling models to multi-agent systems, soliciting true system information owned privately by individual agents is fundamental in scheduling for system optimality. In this study, we are concerned with allocating a set of independent jobs to a number of related machines that are owned by self-interested agents in such a way that the allocation is as fair as possible (in terms of minimizing some Chebyshev distance to a virtually fairest allocation). The related machines differ only in their processing speeds, which are private information of the individual agents who own the machines and hence subject to misreports. Our challenge is to establish an allocation mechanism that is of high quality on all three objectives: (a) efficiency in allocating jobs, (b) truthfulness in soliciting private information of speeds and (c) optimality in achieving fairness. As a touchstone for the design of efficient algorithms for scheduling parallel machines, LPT (the largest-processing-time-first) heuristic has been attracting research attention since late 1960s. In this talk, we show that a modified LPT algorithm proposed in the literature is of high quality in fairness (c) in addition to its already recognized efficiency (a) and truthfulness (b).

What is the nature of your talk?: Very theoretical

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

Is your talk accessible and relevant to Practitioners?: Somewhat

14/09/2017 : 11:30 : Room 4 - JF CC.01.09 (x44)

Code: OR59A3210

### **A Refined Column Generation Approach to Rostering Problem**

**Miss Hanjing Zhang** (*Loughborough University*), **Dr Lisa Jackson** (*Loughborough University*) and **Dr Antuela Tako** (*Loughborough University*)

Roster scheduling problems are about sequences of working shifts and rest periods. Consider the penalty cost that comes from both the demand coverage and the individual work preference, this paper presents our research on column generation to solve roster scheduling problems. To increase the efficiency of column generation procedure, we proposed two strategies to generate promising columns (personal shift schedules). A network linear programming model is employed to obtain diverse columns; and a dynamic cost threshold is set to discard columns of poor quality. Computational experimental results demonstrate the efficiency of the refined approach.

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

14/09/2017 : 12:00 : Room 4 - JF CC.01.09 (x44)

Code: OR59A3121

### **An Integrated Modelling Approach for Vehicle Scheduling and Container Storage Problems with Uncertain Traffic Conditions in a Straddle Carrier System**

**Dr Jiabin Luo** (*De Montfort University*) and **Dr Yue Wu** (*University of Southampton*)

Container terminal functions as a link between the sea side and land side for transporting and storing of containers. Therefore, efficient scheduling of vehicles and allocating of container storage spaces are important to container terminal operations. Due to such an increase in the number of containers handled by each terminal, traffic congestion within the terminal is a common problem which can significantly reduce the terminal's operational

efficiency. Because container ships usually spend a large amount of time docked at the terminal, the efficiency of a terminal is typically represented by ship's berthing time, which we aim to minimise in this study. This research investigates the integration of vehicle scheduling and container storage allocation with considering the traffic conditions during the unloading process in a straddle carrier based terminal, in which quay cranes (QCs) and straddle carriers (SCs) are used to handle containers for a single ship. During such handling process, containers are unloaded from the ship by QCs and then transported by SCs to their allocated locations in the storage yard. The ship's berth time can then be evaluated when all the containers have been unloaded from the ship. Traffic condition is interpreted by the travel speed of SCs, which indicates congested traffic with slower speed and smooth traffic with faster speed. More specifically, travel speed of SCs is described by a fuzzy parameter with a triangular membership function that incorporates the uncertainty of the traffic condition. This problem is thus first modelled as a fuzzy optimisation model and then de-fuzzified into a crisp mixed integer programming model. Various experiments are carried out to analyse the impact of the number of QCs and SCs on the objective, and to examine the impact of different traffic conditions on the objective.

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

14/09/2017 : 13:15 : Room 4 - JF CC.01.09 (x44)

Code: OR59A3051

### **Dynamic Resource Scheduling Problem for Audit Planning**

**Dr Ethem Canakoglu** (*Bahcesehir University*), **Mr Onur Adanur** (*Bogazici University*) and **Dr Ibrahim Muter** (*University of Bath*)

Resource scheduling has been one of the most prominent problems in the operations research literature due to its technical challenges and prevalence in real-life. These problems include a set of tasks, resources to perform these tasks under some constraints (resource capacity, time limitations, etc.). In this paper, we focus on an extension of the parallel machine scheduling problem with additional resources. This problem also arises in audit scheduling in which the local branches of a financial firm are to be audited by a team of auditors with different experience levels. The quantification of the auditor experience and the branch experience requirement enables us to model this problem as an extension of the aforementioned scheduling problem with some extra constraints and objectives related to the auditing process. Due to the dynamic structure of team building problem, it can be classified as a dynamic resource constrained parallel machine scheduling problem with unspecified job-machine assignment. We build mathematical models for these problems and propose heuristic algorithms to find upper bounds for the problem. We analyze the effectiveness of algorithms through computational experiments on the generated instances.

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

14/09/2017 : 13:45 : Room 4 - JF CC.01.09 (x44)

Code: OR59A3111

### **An Omni-channel Retailing Challenge: How Should Online Orders Be Picked in a Conventional Retail Store?**

**Miss Lina Zhang** (*Nottingham University Business School*), **Prof Bart MacCarthy** (*Nottingham University Business School*) and **Dr Luc Muyldermans** (*Nottingham University Business School*)

Leveraging existing assets for online fulfilment is common practice for omni-channel retailers. Many retailers seek to pick online orders for both home delivery and 'click-and-collect' offerings from their conventional retail stores. While the upside of this strategy are obvious - lower system-wide stocking levels, reduced product markdowns, and less pressure on capital investment - the challenges of picking online orders in conventional stores are formidable. Conventional stores have not been designed to facilitate efficient order picking. Many stores are plagued by low inventory accuracy and visibility and are constrained by limited space. Store-based picking is more onerous than warehouse picking as walk-in customers arrive to shop throughout the opening hours. All demands on the store – from walk-in customers and from online customers- must be handled with a finite set of resources. Retailers have to maintain a high service level for walk-in customers and reduce the store congestion level caused by mobilizing pickers for online orders. Thus, store picking efficiency for orders received online can fluctuate with the arrival rate of traditional walk-in customers. To this end, we develop analytical models to provide decision support for retailers when adapting the way they manage their conventional stores to fulfil online orders. In particular we consider: (i) how to set optimal cut-off times and deadlines for online orders; (ii) when to start picking online orders with a pre-defined deadline; and (iii) how to assign labour resources for different tasks in stores. We also conduct sensitivity analysis to investigate the impact of different parameters such as the relative sizes of online and walk-in customer

demand and the time length between cut-off and deadlines for online orders, on the picking process in a conventional retailer store.

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

### Simulation

**Organisers: Antuela Tako and Katholiki Kotiadis**

12/09/2017 : 11:00 : Room 3 - JF CC.00.29A (x64)

Code: OR59A3088

**KEYNOTE:A Model Simulator: The Lives of Jay W Forrester**

**Prof David Lane** (*University of Reading*) and **Prof John Sterman** (*Sloan School, MIT*)

Forrester's presence as one of the 23 members of the IFORS 'Operational Research Hall of Fame' rests on his creation, development and application of the System Dynamics approach. However, his career also involved highly significant theoretical and applied work in, and contributions to: servomechanisms, computer memory, digital computing technology, flight simulators and defence information systems. Rich and varied as these experiences were, they involve a consistency and commonality of interests and approach. The paper outlines Forrester's life and how his background and early careers led to the creation of System Dynamics.

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?: Highly

12/09/2017 : 12:00 : Room 912 - JF LT CC.00.21(x120)

Code: OR59A3139

**Enhancing Predictive Policing: Simulation and Analysis of Police Custody**

**Miss Heather Callaghan** (*Loughborough University*), **Dr Sarah Dunnett** (*Loughborough University*), **Dr Lisa Jackson** (*Loughborough University*) and **Dr Antuela Tako** (*Loughborough University*)

The police are the primary law enforcement agency in the UK and are charged with upholding the law and protecting the public. In recent years, the police force has faced cuts to staffing levels and significant budget decreases. Consequently, it is now more important than ever to optimise the use of police officers and resources. Police custody is an important part of the police procedure as every person arrested on suspicion of committing a crime, whether ultimately charged or not, must go through this process. It is important for police custody suite to be well equipped and to have adequate resources to deal with any situation, such as self-harm or violence that may arise while detainees are held in police custody. This research work has reviewed the current research into the custody process and an initial model of this process has been developed. The intention of this research is to build a simulation model to accurately predict the demand that will be placed on police custody and how best resources can be appropriated to meet this demand. In real terms, this will give staff working in police custody suites some insight into how their resources are currently distributed and make them aware of areas that require more attention. While simulation of the process has yielded initial findings, a gap has been highlighted through data collection with regards to the availability of data and knowledge on various steps in the current custody process that may impact the ability to build an accurate simulation model. Real term implications of these findings are presented alongside the planned future work.

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

12/09/2017 : 12:00 : Room 3 - JF CC.00.29A (x64)

Code: OR59A3039

**Ten Years of Development in Conceptual Modelling for Simulation**

**Prof Stewart Robinson** (*School of Business and Economics*)

It is 10 years since the Journal of Simulation published a special issue on Conceptual Modelling (JOS Vol. 1, Issue 3). This issue was at the start of an increase in research activity on this important, but not well understood, topic. Conceptual modelling is the activity of abstracting a model from the real world, or determining what to model and what not to model. The editorial paper in the special issue identified a set of priority areas for research related to both the problem domain and the modelling domain. In this talk we will review progress among these research priorities and discuss what needs to be done next.

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

12/09/2017 : 12:30 : Room 912 - JF LT CC.00.21(x120)

Code: OR59A3143

**Discrete Event Simulation of Traffic Flows at the Port of Dover**

**Dr Cliff Preston** (*University of Kent*), **Mr Phillip Horne** (*Dover Harbour Board*), **Dr Jesse O'Hanley** (*Kent Business School*) and **Dr Maria Paola Scaparra** (*Kent Business School*)

The Port of Dover is Europe's busiest ferry port, handling up to 5 million vehicles per year and 17% of the UK's trade in goods. At a gross scale, the Eastern Docks ferry terminal can be viewed as a sequential queuing system involving border controls, check-ins, and embarkation. Traffic flows are complex and sensitive to small variations in processing rates. To aid the Port's Masterplanning process, which envisages a 40% growth in freight traffic by 2030, a discrete-event simulation model of the Eastern Docks was built in Simul8. The model is designed to draw on up-to-date data sources within the Port in order to predict traffic flows and dwell times for freight, tourist cars and coaches. Simulations have helped to reveal potential future bottlenecks within the Port and identify interventions to improve resilience. Modelling results have also provided key insight into the relative value of different uses for land, which is vital given the Port's tightly constrained spatial footprint. From this, a clear, prioritised set of costed investments over the next 5-10 years has been developed and evaluated in detail. Sensitivity analysis that varies assumptions about future growth have been performed to ensure conclusions are robust.

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

12/09/2017 : 12:30 : Room 3 - JF CC.00.29A (x64)

Code: OR59A3061

**Can we learn from wrong models in a facilitated environment? An experiment on biases and learning through simulation**

**Mr Naoum Tsiptsias** (*Loughborough University*), **Prof Stewart Robinson** (*Loughborough University*) and **Dr Antuela Tako** (*Loughborough University*)

Simpler simulation models are preferred compared to complex ones when holding facilitated workshops with clients. This however could affect the clients' perception of model validity. This paper presents the results of an experiment carried out that aims to understand whether the level of model complexity affects the learning achieved. We investigate differences in learning achieved as a result of using simple versus more complex models. Undergraduate students, who were taught simulation modelling as part of their studies, participated in a laboratory experiment. They were asked to solve a resource utilization task for an ambulance service problem. The treatment variables were defined based on the type of model used (two fidelity levels: a relatively complete (complex) simulation model and a simplified version (simple) of the same model) and no use of a model at all (conceptual model). The students were randomly split into the treatment groups and were asked to work in groups of 7 to solve the task given, emulating a facilitated workshop environment. Two questionnaires were administered: the first questionnaire intended to capture participants' initial attitudes towards the solution, and a second questionnaire to identify their attitude changes towards the solution after having discussed the problem in their groups. We analyse the data gathered to compare the learning achieved by participants in the three treatment groups. Initial results indicate that participants using simple models had a better understanding of the problem compared to the other two treatment groups, while they were sufficiently able to overcome certain biases inherent in the problem. This study aims to provide insights on the use of simple models to aid decision making and to inform the emerging facilitation practice in simulation modelling.

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

12/09/2017 : 14:00 : Room 3 - JF CC.00.29A (x64)

Code: OR59A3077

**OSCAM: US Navy's Operating and Support Estimating Tool**

**Miss Emma Woodham** (*Decision Analysis Service Ltd*)

The Operating and Support Cost Analysis Model (OSCAM) is a System Dynamics tool used widely by the US Navy for estimating operating and support (O&S) costs for ship classes and aircraft types. At least 80% of a platform's operating and support costs are committed at the design phase of a project, consequently OSCAM plays a vital role

in developing submissions for milestone decisions during the US Department of Defense procurement process. In the 20 years since the first prototype model of OSCAM was created it has developed from a niche model to a standard tool that is used on a variety of projects across the organisation. The presentation will give a brief history of OSCAM, provide examples of applications within the US Navy and detail how it has been developed to meet user requirements. The presentation will also consider the model features that have enabled it to become an essential tool for a widespread user base and how it has enhanced the understanding of operating and support costs, processes and interdependencies.

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

12/09/2017 : 14:00 : Room 912 - JF LT CC.00.21(x120)

Code: OR59A3096

### **Using Facilitated Simulation Modelling to evaluate Health and Social Care Services in Leicestershire**

**Dr Antuela Tako** (*Loughborough University*), **Dr Anastasia Gogi** (*Loughborough University*), **Prof Zoe Radnor** (*Leicester University*) and **Prof Stewart Robinson** (*Loughborough University*)

This paper discusses facilitated simulation modelling and its capacity to promote debate and help improve health and social care services. We present the approach employed to evaluate four real life services working closely with the relevant teams, as part of the second phase of the SIMTEGR8 project. SIMTEGR8 is a research collaboration carried out at Loughborough University, working with Leicestershire County Council (LCC), HealthWatch Leicestershire and SIMUL8. Facilitated simulation modelling is used to test the impact and effectiveness of integrated health and care services offered through the Leicestershire Better Care Fund, including the impact of interventions targeted to reducing emergency hospital admissions. The evaluation process involves three facilitated workshops, two held with project leads (health and social care professionals) and one with service users (i.e. patients and carers), for each integrated service. Simulation models are developed after agreeing project aims and confirming service pathways with relevant stakeholders in a workshop and then used in subsequent workshops as a catalyst to generate understanding and discussion around the effectiveness of the services and potential improvements, with both staff and service users. This paper presents a brief overview of the interventions and how these were run comparing the difference in settings and the outcomes. The concept of using models in facilitated workshops as a means of communication and reflection, but also as an agent for stimulating service improvements has been effective. The lessons learnt and considerations informing the existing facilitated simulation modelling practice are put forward.

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

12/09/2017 : 14:30 : Room 3 - JF CC.00.29A (x64)

Code: OR59A3098

### **Strategic Options Review Model: System Dynamics Supporting 18 Years' of North Sea Oil Strategic Business and Infrastructure Investment Modelling**

**Mr Mirek Gliniecki** (*Strategy Simulation Limited*)

STORM (STrategic Options Review Model) is a System Dynamics model developed with BP for forecasting and managing throughput, capacities, cash flow and revenues associated with operating the Forties Pipeline System (FPS) infrastructure and supporting FPS commercial decisions regarding contractual commitments and capital investments. The model development started in 1998 and STORM utilised unique technical approaches for the user interface, integration with Excel, and SD model compiler technology. The model was used in two modes, deterministic (STORM) and probabilistic (PSTORM), the latter allowing Monte Carlo simulation and risk evaluation of contracted throughput versus system capacities based on uncertainty in individual field uptime and throughput variation. STORM has continued to be used and supported for over 18 years with a number of significant enhancements and overhauls to reflect the changing nature of the FPS infrastructure, expansion of the number of oil fields and changes in business and accounting processes. The presentation will provide a history and overview of STORM, the business needs that it has supported and the technical approaches which have ensured its continued use and development as a business critical tool for BP. Mirek Gliniecki, MSc., is a Director of Strategy Simulation Limited. He has over 25 years' experience of working on business and operational analysis projects developing and delivering decision support tools, models and simulations to inform client strategies, decision making and planning processes. Mirek has developed simulations in many market sectors including projects in pharmaceuticals, IT, defence and oil and gas industries. An expert software developer, he has developed SD compiler technology to

support significantly enhanced model run-times and to aid model distribution. He is also the main software architect and developer of MyStrategy simulation software.

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

12/09/2017 : 14:30 : Room 912 - JF LT CC.00.21(x120)

Code: OR59A3162

**Short-term hospital bed modelling: a simulation-based feasibility study utilising time series forecasting methods and real-time data feeds**

**Mr Edward Ostler** (*SIMUL8 Corporation*)

SIMUL8 Corporation has undertaken a year-long feasibility study in the area of modelling hospital bed utilisation over the short-term planning horizon with the aim of assisting hospital bed managers in their daily decision-making. Continuing from previous work in long-term bed modelling, which resulted in SIMUL8 Corporation's Bed.P.A.C. tool, this study investigated the viability of achieving this through the use of real-time data alongside historical data. This is accomplished by firstly populating a hospital specialty's bed base to the 'current state' before then simulating patient arrivals (using time-series methods to forecast emergency patients together with planned elective demand) and departures over the forthcoming week to predict the future performance of the system. This study focused on testing the feasibility of overcoming a set of identified technical challenges: 'Does the generic approach work?', 'Are short-term forecasts useful?' and 'Is data available in the right format?' Here we discuss the level of success in meeting these challenges and consider the practical applications of this work going forward.

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

12/09/2017 : 15:00 : Room 3 - JF CC.00.29A (x64)

Code: OR59A3095

**Enhancing the theoretical framework behind the integration of System Dynamics and Agent Based modelling for use in pharmaceutical systems**

**Mr Rossen Kazakov** (*Strathclyde Business School*), **Prof Susan Howick** (*Strathclyde Business School*) and **Prof Alec Morton** (*Strathclyde Business School*)

A novel view for an integrative SD and AB modelling framework for use in pharmaceutical systems is proposed. This is centred around the key concepts of resources, agents and information imperfection and is supported by the theoretical perspectives of resource-dependence theory and resource based view, behavioural decision theory, information economics theory and anticipatory systems theory. Each of the above theoretical perspectives provides different knowledge and explanations of socio-economic phenomena and integrating them provides a more holistic view for critically exploring and interpreting market resource and agent interrelated behaviour. Conceptualizing the pharmaceutical market as an anticipatory adaptive socio-economic system emerging out of agents heuristic rules and forward-looking behaviour, competing for limited resources within an informationally imperfect market environment, would further complement the general systems and complex adaptive systems theoretical frameworks underpinning the practical integration of SD and AB modelling approaches. The proposed theoretical framework will be illustrated in the context of the External Reference Pricing regulation on the pharmaceutical market in EU. The analysis focuses on the relevant market agents and market resources involved, the main information imperfections and related phenomena that could lead to market imperfections and market failure from the public healthcare perspective of providing equitable and timely access to affordable medicinal products. The resource/agent/information integrated framework proposed here contributes to the ongoing efforts of the modelling and simulation community to develop an enhanced epistemological paradigm in support of the integration of SD and AB methodological approaches. Another practical contribution is to the call of the European Council for a systemic evaluation of the pharmaceutical regulation in EU and associated pharmaceutical market system effects.

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

12/09/2017 : 15:00 : Room 912 - JF LT CC.00.21(x120)

Code: OR59A3173

**Simulating capacity and transfers in the Wessex Neonatal Network**

**Dr Marion Penn** (*University of Southampton*), **Dr Thomas Monks** (*University of Southampton*), **Mr Kujan Paramanantham** (*Thames Valley & Wessex Operational Delivery Networks*) and **Miss Roxanne Peach** (*Thames Valley & Wessex Operational Delivery Networks*)

Neonatal units within hospitals specialise in the care of babies who are born early, have low birth weights or who have medical conditions that require specialised treatment. The Wessex Neonatal Network is a clinical network within the NHS, providing neonatal treatment to the approximately 1 in 10 babies who require such care. The network consists of 9 Units in the South of England. Within the network there are variations in the complexity of cases that the units can treat, including one unit that treats babies requiring surgical interventions and specialist cardiac care from the broader local area. This talk will present a simulation model of the flow of babies through the network, including:

- The ability to change the level of care provided at individual units.
- The ability to change the capacity of three different bed types at any of the units in the network.
- Transfers between units for both clinical reasons and due to capacity constraints.
- Transfers into and out of the network.
- The potential to add new units to the network.

The model is designed so that network managers, who have access to simulation software but no training in its use can run scenarios via an Excel interface. This interface is sufficiently flexible to make the model sufficiently generic that it could be used to model another similar network. In addition to explaining the structure and features of the model this talk will explore features adapted to and implications of creating a simulation model for use by 'clients'.

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

12/09/2017 : 15:30 : Room 3 - JF CC.00.29A (x64)

Code: OR59A3255

### **Complex Events and Feedback Within and Between Different Levels of Aggregation: Implications for the Development of Hybrid SD/ABM Simulations**

**Mr Bernd Wurth** (*University of Strathclyde*), **Prof Susan Howick** (*University of Strathclyde*) and **Dr Niall MacKenzie** (*University of Strathclyde*)

Combining system dynamics (SD) and agent-based modelling (ABM) has a tremendous potential to model complex systems in various fields. Though the number such hybrid approaches is constantly increasing, some of the fundamental issues are still unanswered and compromise the practical applicability. This paper re-visits the concept of hybrid simulations with a particular focus of combinations of SD and ABM. The desirability and feasibility of hybrid SD/ABM simulations are addressed, including philosophical, theoretical, and methodological considerations. Two key issues that separate SD/ABM from other hybrid simulation approaches are the conceptualisation of feedback across SD and ABM boundaries and inconsistencies with regard to emergent phenomena from the ABM module. A common approach for the interface between SD and ABM is aggregating agents' states, but this does not sufficiently address the complexity of dynamic systems with emergent properties. The implications of this issue are illustrated using the example of the collaborations between universities and industry. Entrepreneurial activities of universities are modelled using system dynamics and multiple universities interact with a set of agents, representing companies and start-ups in innovation ecosystems. Complex events, a collection of interrelated (simple) events, are introduced as a means to deal with emergent behaviour and feedback within and between different levels of aggregation. This has wide implications for combining SD and ABM but also for the study of complex systems in general. A model development process (MDP) for hybrid SD/ABM simulations that incorporates these ideas is provided based on the case study. The MDP is based on conceptualising feedback using causal loop diagrams before any separation between agents and aggregated variables and the operationalisation of complex events. The paper concludes with directions for future research.

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

12/09/2017 : 16:30 : Room 3 - JF CC.00.29A (x64)

Code: OR59A3183

### **Building the Multiplex: An Agent-Based Model of Network Relations**

**Dr DUNCAN ROBERTSON** (*LOUGHBOROUGH UNIVERSITY*) and **Prof LEROY WHITE** (*WARWICK BUSINESS SCHOOL*)

We present an agent-based model of information propagating through a hierarchical organizational network. We add interpersonal 'short cuts' to the network either randomly or with preferential attachment, and show that there is a tradeoff between redundant network links and the time for information to spread across the network.

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

12/09/2017 : 17:00 : Room 3 - JF CC.00.29A (x64)

Code: OR59A3182

### **Spatial Transmission Models**

**Dr DUNCAN ROBERTSON** (*LOUGHBOROUGH UNIVERSITY*)

Society relies on the transmission of communications, ideas, and messages. If the transmission of these communications are interrupted, costs are accrued to companies, individuals, and society. Conversely, if diseases, pathogens, fires, or dissent are allowed to transmit, costs are also accrued. We discuss general models of transmission over geographic space, although we also introduce transmission over non-Euclidean spaces such as social networks and non-planar spaces such as airline networks. In many models, this spatial element is not examined explicitly – epidemiological models may ignore the space over which transmission is propagated, as this leads to a more elegant, analytically tractable model. Where spatial models have been introduced, they often assume regularity of space, for example individuals being located in a two dimensional regular cellular automata. We shall show that these cellular systems are special cases of network models, and we review different network models and their applicability for modelling systems that exists within a geographic, Euclidean space. We introduce percolation measures for measuring risk, where the system exhibits critical dependence and tipping points from a safe region to a system that is out of control. We further introduce agent-based models as a generalization of network models, where individual agents can (but are not required to) have heterogeneous properties. We further introduce dynamic agent-based models, where actions of individual agents can have an effect on the system as a whole.

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

13/09/2017 : 10:15 : Room 3 - JF CC.00.29A (x64)

Code: OR59A3185

### **PANEL -Does simulation need other methodologies?**

**Dr Siôn Cave** (*Decision Analysis Services Ltd*), **Dr Kathy Kotiadis** (*Canterbury Christ Church University*) and **Dr Antuela Tako** (*Loughborough University*)

Multiparadigm multimethodology, with simulation being one of the core methods used, is common practice these days. The panel will debate the need to combine simulation (DES/ABS/SD) with other methods/methodologies/techniques to ensure the success of a study. Panel members will consider their experience and put forward a view on whether simulation can work just as well without any other formal approach. Differences between the simulation paradigms will be considered in answering the question.

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

13/09/2017 : 11:15 : Room 3 - JF CC.00.29A (x64)

Code: OR59A3137

### **New methodologies to exercise Government emergency response plans**

**Dr Hubert Barucki** (*Dstl*)

The presentation describes a number of novel approaches which have been developed and used in Dstl to test the preparedness of response and communications plans in Government. These have involved simulating decision making and information flows, under pressure either in COBR (Cabinet Office Briefing Rooms) or in SAGE (the Scientific Advisory Group for Emergencies which provides science advice to support decision making in COBR) against a number of emergency scenarios. My talk will cover the design and application, of these methodologies; some key insights from the exercise where they have been used, and the benefits and outcomes they have provided to wider Government customers and Stakeholders.

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

13/09/2017 : 11:45 : Room 3 - JF CC.00.29A (x64)

Code: OR59A3066

### **Multidepartment Simulation in Hospitals: a Case Study in Outpatient Chemotherapy**

**Mr Guillaume Lamé** (*CentraleSupélec*), **Prof Oualid Jouini** (*CentraleSupélec*) and **Prof Julie Stal-Le Cardinal** (*CentraleSupélec*)

We mix different OR methods in order to tackle multidepartment coordination issues in hospitals. The novelty of our approach comes: (i) from the integrative view it takes of the two departments, their interests and their interdependencies; and (ii) from the comprehensive view on the problem solving process. The approach is developed and tested during an action-research project on outpatient chemotherapy delivery in Henri Mondor hospital, a French public academic hospital. Outpatient chemotherapy involves two departments: the outpatient oncology unit, and the pharmacy. The former wishes to minimize patient's waiting times, while the latter needs to minimize the cost of wasted chemotherapy drugs. We take into account the fact that globally optimal solutions may not be satisfactory because of the way accounting and reporting is split across separate units. We propose a method that mixes the computational power of simulation, with more qualitative methods that allow for the expression of interests and the negotiation of solutions (SSM, benchmarking, Service Blueprinting). We use SSM and benchmarking to support problem framing and scenario generation before simulation. We also support the later stages, once a concept has been chosen with simulation and must be developed into an operational business process, with Service Blueprinting workshops. We identify a concept which allows +20% activity while reducing waiting times. Implementation is underway but some issues are already discussed.

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

13/09/2017 : 15:15 : Room 3 - JF CC.00.29A (x64)

Code: OR59A3211

### **Improving Airport Queues: A Live Demo showing the benefits of optimising Border Force Officer deployment at Passport Control Points**

**Mrs Rekha Parmar** (*Home Office*)

This practical demonstration uses audience participation to simulate airport arrivals being processed by Border Force Officers at the Passport Control Point. The 'passengers' (audience members) will land in our immigration hall according to an arrivals schedule which mimics flight arrivals. Using live queuing data generated by the demonstration, we will review the impact of Passport Control Point desk staffing on passenger waiting times and show how OR plays a part in workforce planning for Border Force. Within the Home Office, Border Force Analysis have built a Dynamic Resourcing Tool (DRT) which recommends the optimal desk configuration for a given arrivals pattern and is already being used for desk allocation at the UK's largest airports and for future staff resourcing. After reviewing the results of the demonstration, we will also look at the OR behind this tool.

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

14/09/2017 : 10:30 : Room 3 - JF CC.00.29A (x64)

Code: OR59A3160

### **Developing BPMN for Process Improvement and Discrete Event Simulation**

**Dr Nathan Proudlove** (*Alliance Manchester Business School*) and **Dr Stephan Onggo** (*Lancaster University Management School*)

Process mapping is commonly a central technique in process improvement projects in healthcare. It is usually a physical activity involving groups of process stakeholders from along a patient pathway, conducted with post-it notes and long rolls of paper. Short of Value Stream Mapping symbols, there are a few sets of basic conventions – but these are rarely used. Physical construction is an involving activity, and recommended in the Operations Management literature, though the results can be hard to make further use of, display, manipulate and archive. When the process map is captured electronically this is generally done with MS Office. We have seen Visio used in the NHS, but licences and expertise are scarce. A process mapping tool starting to appear in the healthcare literature for is Business Process Model and Notation (BPMN) standard. It has many practical advantages, including very user-friendly freeware (a big plus in the NHS), validation of flow construction, the ability to build nested hierarchies of processes (recommended in the NHS for long pathways) and, being a standard, file transferability between software packages. An additional feature is that BPMN files can link with DES through standards such as BPSim or be imported into commercial DES software. Some freeware integrates BPMN and DES seamlessly using BPSim. This potential makes DES much more accessible, where OR expertise and DES software access are generally limited. There has been very limited use of this in healthcare. However, we have to be cautious. BPMN was not designed for process mapping for operations-management type process improvement nor for conceptual modelling for DES. In use, conceptual and technical limitations become apparent at DES stage, whether using BPSim or import to some commercial DES packages. Consequently we are investigating what developments to BPMN could make it more fit-for-purpose for both process improvement and DES.

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?: Somewhat

14/09/2017 : 11:30 : Room 3 - JF CC.00.29A (x64)

Code: OR59A3034

**Uncertainty analysis in performance based service contracts: A simulation study**

**Prof Partha Priya Datta** (*IIM Calcutta*)

As manufacturers transition to service focused strategies or "servitize" they face new range of uncertainties in implementing advanced solutions resulting in "hidden costs" that cannot be quantified by usual means of cost estimation. This paper analyses this issue in business to business sales by unpacking the uncertainties of servitization in the context of performance based contracts (PBCs) where the buyer purchases only the use of product. First focus group workshops are conducted with cost estimators and practising managers for complex engineering systems in the UK defence sector to investigate the uncertainties impacting the different cost drivers when service substitutes the product. Next this information is translated into a simulation model to identify the critical uncertainty drivers for PBCs. The findings show that, the solution provider firm in all the PBCs at different service life cycle stages, faced uncertainties in aligning the entire service network involving sub-suppliers and customers to successfully implement substitution of products by services. The contribution of this study is two-fold: a) it contributes to the growing field of servitization by highlighting the cost drivers and barriers of implementation taking a network level perspective when service substitutes the products; b) it enables managers of manufacturing firms to better analyse, benchmark and develop their life cycle offerings to improve performance by reducing hidden costs.

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

14/09/2017 : 12:00 : Room 3 - JF CC.00.29A (x64)

Code: OR59A3113

**Developing a Simulation Model of Resource Starvations in Automotive Assembly Lines**

**Mr Anees Abu-Monshar** (*Coventry University*) and **Dr Ammar Al-Bazi** (*Coventry University*)

Competition in the automotive industry is becoming more intense, the product life cycle is getting shorter and there is an increasing demand of customisation. High product variety along with faster new product introduction may result in an inefficiency in production. In order to be responsive to the market requirements, maximising the production rate is essential. At one of the vehicle manufacturers in the UK, the current sub-assembly process of tailgates, where tailgates are lifted by carriers, assembled then fed to the main assembly line to be fitted to their matched vehicles, is facing a problem of occasional starvations of empty carriers when they return from the fitting point. This problem flags a concern of stopping the main line and as a consequence, slowing down the production. In order to solve this problem, a flow diagram is developed to represent the logic of the process. A Discrete-event simulation approach is used to mimic operations of the sub-assembly line. A simulation model is then developed to identify the bottleneck(s), determine whether or not additional carriers are required and design scenarios for improving the process, taking into consideration random failures in the main line. The results show that starvations are caused due to the main line failures, which lead to high buffer levels of carriers lifting tailgates within the sub-assembly process. This leads to less empty carriers remaining for a new assembly cycle. A slight improvement of 1.2% in production speed could be achieved by reducing the bottleneck time by 15 seconds and less than 1% improvement if five more carriers are added. In case the main line runs without failures, decreasing bottleneck time by 45 seconds could result in 24.5% improvement and adding more carriers will not be beneficial to the process.

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

14/09/2017 : 13:15 : Room 3 - JF CC.00.29A (x64)

Code: OR59A3152

**Using participative simulation and modelling in an uncertain manufacturing environment; a transdisciplinary study**

**Dr Christina Phillips** (*Bangor University/Leeds University*) and **Prof Konstantinos Nikolopoulos** (*Bangor University*)

Participative simulation is used to augment lean development in a complex manufacturing environment which has a high degree of uncertainty stemming from both endogenous and exogenous sources. The PartiSim method is adapted for use under these circumstances and proves a useful framework for coupling interpretive and positivist methods making explicit the tension between the paradigms and how this can be exploited in practice. This is the

first time this method has been used in a manufacturing environment but it is not the first time that participative simulation has been used to augment lean in a semi-process industry, we look at parallels between this and the other studies. We also add to research by increasing the generalisability of the PartiSim method by examining its successful use in this case and how it can be adapted to augment lean practice in uncertain industries.

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

14/09/2017 : 13:45 : Room 3 - JF CC.00.29A (x64)

Code: OR59A3187

#### **PartiSim the journey so far...**

**Dr Kathy Kotiadis** (*Canterbury Christ Church University*) and **Dr Antuela Tako** (*Loughborough University*)

PartiSim, designed a decade ago, is a facilitated DES modelling approach advocating greater stakeholder involvement in the modelling process. This approach to simulation is aimed to fit the operational needs of the 21st century, addressing the increasingly complex problems found within organisational settings today. Facilitated DES has gained momentum in recent years. In this talk we examine PartiSim's journey from inception to its current form and explore its limitations and impact in the field in DES. We conclude by setting out our aspirations for the future.

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?: Highly

### **Sustainable Supply Chain**

**Organisers: Lampros Stergioulas and Masoud Fakhimi**

12/09/2017 : 16:30 : Room 8 - JF D.1.02 (x54)

Code: OR59A3134

#### **Fuzzy scenario based optimisation of suppliers risk management**

**Dr Jiabin Luo** (*De Montfort University*), **Prof Dobrila Petrovic** (*Coventry University*), **Dr Guven Demirel** (*University of Essex*) and **Prof Bart MacCarthy** (*University of Nottingham*)

This paper presents a fuzzy optimisation model developed for planning of risk management and supplier development initiatives to be carried out by a prime manufacturer in order to improve suppliers' performance. We consider a Make-to-order environment, where high costs are incurred from lateness or earliness in the delivery of parts and finished goods. Parts procured from the supply base are inter-related by a product build structure, where the lead times are subject to variations. It is assumed that initiatives have uncertain effectiveness and different costs are incurred by different types of initiatives. The effectiveness of each initiative is measured by a percentage of improvement of a supplier delivery lead time. It is specified based on a manager's subjective judgement and experience and modelled using fuzzy assessments as low, medium, high, very high etc. Optimisation is carried out based on scenarios where each scenario represents part allocation decisions and the realized supplier delivery lead times without any initiative being carried out. Scenarios are generated using historical data obtained from a real world manufacturer. As effectiveness of initiatives is fuzzy, the cost objective and constraints of the model become fuzzy too. They are transformed into a crisp optimisation model where both the objective and constraints are defuzzified. Various experiments are carried out to analyse the computational performance of the model and to gain better understanding of the impact of various parameters on suppliers' risk management, in particular, the impact of limited resources for carrying initiatives by the prime manufacturer and fuzzy effectiveness of initiatives.

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

12/09/2017 : 17:00 : Room 8 - JF D.1.02 (x54)

Code: OR59A3165

#### **Business model for cloud manufacturing**

**Prof Bart MacCarthy** (*University of Nottingham*), **Dr Gongtao Zhang** (*University of Nottingham*) and **Prof Kulwant Pawar** (*University of Nottingham*)

Cloud manufacturing is an emerging manufacturing paradigm, which offers on-demand access to a shared collection of manufacturing resources. By adopting cloud manufacturing solutions, organisations can potentially reduce production costs and allow for optimal resource loading, in response to clients' changing needs. Despite the increased knowledge of cloud manufacturing, few studies have been conducted to discuss the evolution of business models in this new technological context. This gap prevents us from developing a full understanding of the service

provision process of cloud manufacturing, its potential and its limitations, and in particular how value is created and captured from vendors to their clients. In this study, we review the key concepts of cloud manufacturing. We define a potential business model of cloud manufacturing based on a modular platform consisting of core and complementary components that serves as a foundation for client firms to build and offer their products, services or technologies. By investigating current and emerging practices relevant to cloud manufacturing, we propose a framework that identifies the most relevant elements of new business models of cloud manufacturing, focusing on how they interact in various contexts.

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

13/09/2017 : 10:15 : Room 9 - JF D.1.09 (x58)

Code: OR59A3202

**KEYNOTE:Supply Chain Analytics – Back to the Future?**

**Prof Bart MacCarthy** (*University of Nottingham*)

The definition of Analytics has been the subject of much debate in relation to 'traditional' Management Science /Operational Research. Here we examine how Analytics may be brought to bear to assist in the planning, management, and control of supply chains. We discuss Analytics for description (how we are doing), prediction (what will happen), and prescription (what we should do), as well as the emerging field of detection analytics. Examples from a range of sectors are discussed, covering industrial, consumer and retail products. We ask whether Supply Chain Analytics are new or different from what went before. Although we are rich in algorithms to support supply chain decision making, there are very significant challenges relating to the data needed to 'feed the algorithms'. We argue that Supply Chain Analytics can help to reinvigorate traditional operations planning and control concepts, methods, and techniques, particularly in the context of the digital supply chain.

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

13/09/2017 : 11:15 : Room 9 - JF D.1.09 (x58)

Code: OR59A3072

**The perfect recipe for continued success – a case study in ensuring a sustainable supply of shellfish across the globe**

**Dr Sophie Carr** (*Bays Consulting Ltd*) and **Mr Peter Keen** (*Keen Marine*)

The impact of illegal, unregulated and unreported fishing is having a devastating impact on fish stocks across the globe. Many people depend upon the oceans for food and the ability to sustainably manage food resources is of critical importance to the wellbeing of communities around the world. Conserving and managing fish and shellfish stocks is therefore a high priority. Establishing the origin of landed shellfish is critical for the enforcement of no-take zones, assuring regional branding of high value and creating sustainably maintained stocks. However, when a catch landed can law enforcement agencies actually prove where the shellfish were taken from? Over the last few years, Keen Marine and Bays Consulting have been part of a study into the use of carbonate microchemistry in mussel shells to determine if mussels could be assigned to the specific location in which they were grown. All the mussels in the study were sourced as spat from a single origin outside of the study area, and were cultured in three harbours with similar underlying geochemistry, but different surrounding land use. When harvested and the shells analysed for sixteen different trace elements. The analysis was undertaken without prior knowledge of where the three locations were, or which sample had been grown in which location to prevent analyst bias influencing the analysis. Initial results indicate not only improvements in the methodology for the chemical analysis of the shells, but also determined a microchemical "fingerprint" unique to mussels grown at each of the different locations. The results of this study have now being developed into a larger feasibility study to support evidence based policy making for protecting coastal fisheries and developing long term sustainable food sources.

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

14/09/2017 : 10:00 : Room 910 - JF D.2.01 (x52)

Code: OR59A3050

**Recourse Actions Within Inventory Systems: The Effect of Customer Service Levels**

**Dr Daniel Black** (*University of Edinburgh*) and **Prof Takashi Irohara** (*Sophia University*)

Within the context of a periodic replenishment multi-location inventory system we examine the use of recourse actions to manage demand when there is no stock at a location. Common approaches suggest either the use of a lateral transshipment from a sister location or an emergency transshipment from the supplier. A backlog until replenishment is made may also be possible if the time until the replenishment delivery is short. In practice service level measures may be used to evaluate either system performance as a whole or the performance at each location within the system. Such measures may feature (whether intentionally or otherwise) within the decision making process for recourse actions. We explore how the use of service levels can effect this decision making process.

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

14/09/2017 : 10:30 : Room 910 - JF D.2.01 (x52)

Code: OR59A3076

### **Information Sharing among Co-opeting Supply Chains with Competition Asymmetries**

**Mr Daniel Sanchez Loor** (*National Cheng Kung University*), **Dr Wei-Shiun Chang** (*National Cheng Kung University*) and **Mr Resa C. Nugraha** (*National Cheng Kung University*)

One of the main drivers to engage in collaboration with other entities is to reduce demand uncertainty. Vertical collaboration in supply chain is a more common practice than horizontal collaboration. Consequently, literature is extensive regarding vertical collaboration and the benefits of information sharing. Nonetheless, horizontal collaboration with competitors remains as an important practice in maritime shipping and airline industry, and we detect a gap addressing information sharing in horizontal collaboration, particularly when supply chains hold significant competition asymmetries. Applying a Stackelberg model, this study attempts to elucidate the effect of information sharing in horizontal collaboration among supply chains within the same industry. We analyze two main scenarios regarding collaboration: information sharing and non-information sharing, and regarding the number of supply chains: 1 leader – 1 follower, and 1 leader – n followers. Our results indicate that leader and follower supply chains benefit from information sharing, however, only the profits for a leader supply chain escalate significantly.

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

14/09/2017 : 11:30 : Room 910 - JF D.2.01 (x52)

Code: OR59A3148

### **Does Collaboration Pay in Agricultural Supply Chain? An Empirical Approach**

**Dr Grammatoula Papaioannou** (*School of Business and Economics, Loughborough University*), **Prof Samir Dani** (*University of Huddersfield*), **Dr Stella Despoudi** (*Coventry Business School*) and **Prof George Saridakis** (*Kingston Business School*)

This paper examines the effect of different types of collaboration on the level of Postharvest Food Losses (PHFL) and the proportion of low-quality peaches produced using a unique dataset of Greek peach producers. Quantile regression techniques are adopted to estimate the effects at different points of the conditional distribution of our variables of interest. The findings of this study suggest that high levels of collaboration between producers and cooperatives are associated with both low levels of PHFL and a low proportion of low-quality peaches. We also find that specific types of collaboration, especially 'goal congruence', can play a significant role in reducing PHFL and improving the quality of peach production at the extremes of the distribution. Important policy implications regarding collaborative practices and systems that can be implemented to reduce PHFL and boost a producer's performance together with sustainability credentials are drawn from this study.

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

14/09/2017 : 12:00 : Room 910 - JF D.2.01 (x52)

Code: OR59A3101

### **The impacts of 3D printing technology on supply chain structure—a new co-opetition model for manufacturer and logistic vendor**

**Ms Hui Lu** (*Northumbria University*)

3D printing, also known as 'additive manufacturing', is evolving rapidly in the industry from new materials, processes of manufacturing highly customized products to the end customers. According to the Wohler report (2016), the compound annual growth rate (CAGR) of 3D printing in 2015 was 25.9%, represents \$5, 165 billion in total and grown by \$1 billion. Companies are increasingly aware that the breadth of 3D printing technologies and materials will lead

to the transformation of supply chains, and more sophisticated consumer behaviour. Early last year, UPS as the world leading logistic vendor started to provide 3D printing service on its website and some US local stores (UPS, 2016). This kind of new business strategy makes the relationship between manufacturer and logistic vendor to be more complex than ever. However, facing this huge variety, many manufacturers and logistical vendors are lacking the knowledge to 1. evaluate the actual impacts of 3D printing technology on their business 2. identify whether 3D printing technology is suitable technology and application for their future business strategies 3. determine the timing for the 3D printing technology involvement Different from some existing qualitative researches on those questions, my research is from quantitative insights. First, I developed a mathematical model to compare the cost and price strategies before and after logistic vendor offer 3D printing service; then following by estimating the quantitative impacts of 3D printing technology on supply chain via analytical methods. At last, based on the numerical results obtained from the proposed models, managerial insights and analytical tools for the relevant stakeholders were derived. Reference: 3D Printing Services from The UPS Store. (2017). Theupsstore.com. Retrieved 12 April 2017, from <https://www.theupsstore.com/print/3d-printing> Wohlers Associates, Inc, (2016). Wohlers Report 2016: Additive Manufacturing and 3D printing State of the Industry. Retrieved from <https://wohlersassociates.com/2016report.htm>

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

14/09/2017 : 13:15 : Room 910 - JF D.2.01 (x52)

Code: OR59A3146

#### **Incentive scheme for services delivery to minimising CO2 emissions: a real case study**

**Miss Yizi Zhou** (*Loughborough University*), **Mr Mathias Kern** (*British Telecom plc*), **Miss Anne Liret** (*British Telecom France*), **Mr Jiyin Liu** (*Loughborough University*) and **Miss Rupal Rana** (*Loughborough University*)

Most CO2 emissions come from road transportations, which causes concerns to Telecom services providers who rely on specialised engineering force driving to sites for maintenance or installation. Customer service providers shall have a proper balance of economic and environmental objectives to remain competitive. The amount of CO2 emissions or fuel usage is directly related to travel speed, which is time-dependent. During congested time period of a day, the travel speed is significantly slower than free flow speed, so customers' delivery time slot option will affect the CO2 emissions as well as company's profitability. We developed a solution framework and mathematical models helping companies to determine reward to motivate engineers to book a task among recommended tasks that leads to lower emissions and lower fuel cost. In this paper, we focus on the real case application of this framework to a field services organisation. Field engineers can be offered a list of work recommendation with different features, such as location, skill requirement and CO2 emissions, during their delivery journey. Reward will reflect the cost of each task, which is calculated using the cost of CO2 emissions. The solution approach is twofold: once a user makes a task allocation choice, the system first solves a CO2 emission minimisation vehicle routing problem for each recommended task by variable neighbourhood search. Then the minimum additional cost for including this task is calculated. Secondly, reward will be calculated for each task by solving a discrete choice pricing model based on the additional costs. The pricing model is a non-linear programming model, and its demand function followed a multinomial logit model. This is solved by a differential evolution method. We compared routes influenced by pricing inputs and routes only based on engineer's choice without reward. By applying dynamic pricing techniques, we observed reduction in CO2 emissions.

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

14/09/2017 : 13:45 : Room 910 - JF D.2.01 (x52)

Code: OR59A3056

#### **Can merge-in-transit be sustainable? A micro-enterprise perspective**

**Dr Eliseo Vilalta-Perdomo** (*University of Lincoln*), **Dr Oliverio Cruz-Mejia** (*Universidad Autonoma del Estado de Mexico*) and **Prof Martin Hingley** (*University of Lincoln*)

The concept of 'sustainable supply chains' is explored from a particular configuration, Merge-In-Transit (MiT). Three different operational strategies: Postponement, Mass Customization and Rapid Fulfilment are revisited in the light of MiT. Limitations of current understandings of 'sustainability' are recognised and an extension to this concept is explored in the context of Micro-Businesses (MBs). In order to build operational approaches to this extension, different retailing structures are presented and discussed: direct marketing, supply chain, supply network and supply community. Finally, two languages: of needs and for interactions are presented and exemplified to show alternative approaches to build sustainability in supply chains where MBs participate actively.

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

### Third Sector Modelling

Organiser: Malcolm Fenby

14/09/2017 : 10:00 : Room 2 - JF CC.00.14 (x40)

Code: OR59A3158

#### **Changing the world, the O.R. way: Pro Bono O.R. and Theory of Change**

**Ms Ruth Kaufman** (*The OR Society*)

"Theory of Change" is a well-respected approach to evaluating the impact of charities. For O.R. people, it may almost seem like a prescription for stating the obvious: first say what change you are trying to achieve in the world (in as visionary terms as you wish), then identify the activities, outputs and outcomes that contribute to that change, and use the resulting 'model' to identify areas for measurement, analysis and/or improvement if you are to achieve the impact you desire. This talk will review how O.R. people can use Theory of Change, both in helping charities that are aiming to demonstrate or improve their impact, and in evaluating the Pro Bono scheme itself.

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

14/09/2017 : 10:30 : Room 2 - JF CC.00.14 (x40)

Code: OR59A3242

#### **Supporting the Third Sector through Student Projects**

**Mr David Collier** (*LSE*)

Many charities and other 'third sector' organisations make good use of – and sometimes completely rely on - interns and student support for internal analytics and for impact assessment work. Every year offers a wide range of opportunities for applying decision science and operational research methods. The vast majority work well for both organisation and student but there is still scope for increased effectiveness through better project selection and design, student matching and project management. This presentation covers some practical lessons learned in working with both large and small third sector organisations and uses case studies to highlight the types of project that deliver the greatest benefit and the conditions for a successful conclusion. The author is a coordinator for the LSE's Management Science MSc placements.

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

14/09/2017 : 11:30 : Room 2 - JF CC.00.14 (x40)

Code: OR59A3073

#### **An OR Society Pro-Bono Project: Improving Employer Engagement Processes at Action West London**

**Miss Shamim Rahman** (*Department of Health*), **Mr Darren Holland** (*Food Standards Agency*), **Mr Abdul Khaled** (*Food Standards Agency*) and **Mr David Millson** (*Scottish Government*)

Action West London (AWL) is a charity that helps people in west London into employment, self-employment, education and training. AWL wanted to increase the number of jobs available to their clients by improving the engagement process and using data analysis. An operational research (OR) analytical team from the Food Standards Agency undertook this project as part of the OR Society Pro-Bono Scheme and Civil Service Volunteering. This talk will cover the background to the project, the tools and techniques used, challenges and opportunities of working on a pro-bono project for the third sector, and the solutions proposed and benefits realised from the operational research consultancy services we provided. We approached the project in two strands – the first a soft OR look at the current processes followed by AWL and potential improvements; the second a more data-driven look at past results from different employers and job sectors. For the process strand, we used rich pictures and Iskikawa/fishbone (cause-and-effect) diagrams to identify the main problems and potential solutions, and created a purposeful action system model of the charity to map how employer engagement fits into the wider business, and suggest how to improve it. For the data strand, we identified the job sectors, job titles and employers most associated with successful job matches, as well as pointing out consistency issues with the data recording that was preventing more extensive data exploitation.

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

### Transport & Mobility/Routing Applications

Organiser: Djamila Ouelhadj

12/09/2017 : 14:30 : Room 8 - JF D.1.02 (x54)

Code: OR59A3074

#### **Job Insertion Algorithms for the Pickup and Delivery Problem with Time Windows**

**Dr Yi Qu** (*Northumbria University*)

Algorithms will be presented for solving job insertion scenarios arising within vehicle routing problems. The problem being solved occurs after a vehicle routing plan has already been created but new jobs become available for possible addition to the plan. The original plan must however be disrupted as little as possible. This means that jobs already assigned to vehicles cannot be changed to other vehicles and the order of the jobs already assigned must also remain the same. New jobs can be added though if it is feasible to complete them within the original plan. An optional constraint is to restrict changing original arrival times for already assigned jobs within fixed bounds. We present experiments with varying these arrival time windows and the effect on the solutions produced. One of the main requirements of the algorithm is to produce efficient solutions quickly. This is because only short computation times may be available between when the algorithm can start and when the plans will commence. For this reason, we focussed on heuristic methods using greedy and regret assignments heuristics within iterated algorithms. The algorithms are tested on the pickup and delivery problem with time windows. Instances of varying size are tested and the results are presented.

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

12/09/2017 : 15:00 : Room 8 - JF D.1.02 (x54)

Code: OR59A3213

#### **Ethical Decision Maker for Controlled Collisions involving Autonomous Vehicles**

**Mr James Pickering** (*Coventry University*) and **Prof Keith Burnham** (*University of Wolverhampton*)

With the likely future introduction of autonomous vehicles (AVs) to the vehicle fleet, the probability of AVs finding themselves in collision scenarios is inevitable, as witnessed with the Google AV. Although the Google AV is in the development phase, it is anticipated that collisions will occur for a number of years post AVs becoming the norm. With the inevitable collisions occurring, there is currently a major societal dilemma as to how to programme a driverless AV to be compliant with both regulatory and legal requirements. In short there are major philosophical and ethical issues to be addressed. To demonstrate the above problem, an example is presented where an AV is required to make a decision between continuing its course or to collide into 1 or 10 pedestrians, or alternatively swerving to avoid the pedestrians and colliding into a solid immovable wall. This highlights the following question: should AVs be programmed to minimise the number of fatalities or should they be programmed to save the AVs passengers at all costs? The utilitarian philosophical approach is to save as many lives as possible. Some automotive vehicle manufactures have stated that their designed AVs would risk injuring the passengers on-board their AV at all costs, this being known as the deontological approach, i.e. to allow the AV to follow the natural path without intending to take or save any lives. Finite element analysis (FEA) is used to investigate a single vehicle colliding into a solid immovable wall at various mass and velocity values. Mathematical models are built that capture the typical key FEA outputs i.e. structural deformation and occupant deceleration. Typical injuries sustained by pedestrian-vehicle collisions are obtained from prior research. The data provides knowledge used within the ethical decision maker, supported by socially understood actions of: mutualism, altruism, selfishness and spite.

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

12/09/2017 : 15:30 : Room 8 - JF D.1.02 (x54)

Code: OR59A3245

#### **Delivering on delivery: Optimisation and the future of vehicle routing**

**Mr Stephen Goodman** (*Satalia*), **Mr Paul Hart** (*Satalia*) and **Mr Adam West** (*Satalia*)

Abstract. As the demand for home delivery continues to grow, so too does the need for organisations to implement more efficient delivery operations. For our clients, the constraints imposed on home delivery are numerous – and it is a challenge that causes many organisations to struggle. Our clients have any number of vehicles, each with limited capacity. Vehicles are limited to certain routes, and routes are often limited by traffic, accidents or road closures.

Add driver shifts, multiple destinations and the rising desire for nominated time-window delivery (slots) and you get a scheduling problem no human operator can solve with any degree of accuracy. Our data-driven, operations research approach has, and will continue to improve the efficiency of home delivery; reducing costs for our clients, and vastly improving the customer experience.

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

14/09/2017 : 10:00 : Room 5 - JF CC.01.10 (x36)

Code: OR59A3097

**Capacitated hub location problem under congestion in liner shipping networks**

**Mr Cihan Butun** (*Nottingham University Business School*), **Dr Luc Muyldermans** (*Nottingham University Business School*) and **Prof Sanja Petrovic** (*Nottingham University Business School*)

Hubs are centres for collection, sorting, transshipment and distribution of cargo, passengers, and/or information. This research is concerned with the design of container liner shipping networks where transshipment hubs handle a considerable portion of container traffic. A hub-and-spoke network configuration has become a strategic choice for liner service design thanks to its benefits for the main stakeholders of the industry. In this study the task is to determine the number of hub ports and their locations, the allocation of feeder ports to the hubs, and the hub-level route in the liner shipping system to minimise the total cost. The total cost includes the collection and distribution cost incurred by feeder vessels, mainline cargo routing cost, cost of extra handling of cargo at hubs, and hub port time for feeder and mainline vessels. The problem is defined as a capacitated single-allocation hub location problem which considers congestion in liner shipping systems. The capacity limitations at hubs are set as the maximum cargo flow each hub port can handle. The hub-level route is designed to be a directed cycle, and the congestion cost is calculated by modelling of each hub port as a queueing system. The problem is formulated as a mixed integer non-linear programming model. The model is evaluated on two data sets: one that reflects real-world ports and employs available data about their characteristics and operations and the other which is artificially created. The results obtained by using CPLEX are evaluated from different aspects including the economies of scale, ports' hinterland traffic, sensitivity to changes of terminal handling charges, geographical centrality of hub ports, and effects of inter-hub flows on the hub-level route. Finally, an outline of an iterative solution approach to tackle the problems with larger data sizes is provided together with possible directions for future research.

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

14/09/2017 : 10:30 : Room 5 - JF CC.01.10 (x36)

Code: OR59A3070

**Adapting constructive heuristics and local search operators in green vehicle routing problem**

**Ms Norfaieqah Ahmad** (*University of Kent*), **Dr Adolf Acquaye** (*University of Kent*) and **Prof Said Salhi** (*University of Kent*)

The recent growing concern of the environment sustainability of current transport practices calls us to explore further the vehicle routing problem (VRP) in a manner that considers both the economic and the environmental benefits. Logistic activities largely depend on the road transport that contributes a significant amount of greenhouse gases especially carbon dioxide (CO<sub>2</sub>). In this study, we formulate this problem as a bi-objective optimisation method. The incorporation of economic and environmental criteria is constructed through the adaptation of constructive heuristics and local search operators. Initial results are found interesting when tested on a class of VRP instances from the literature.

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

14/09/2017 : 11:30 : Room 5 - JF CC.01.10 (x36)

Code: OR59A3172

**Assessing railway system vulnerability: metric-based rankings or optimisation models?**

**Dr Maria Paola Scaparra** (*University of Kent*), **Miss Annunziata Esposito Amideo** (*University of Kent*) and **Dr Stefano Starita** (*University of Warwick*)

As demonstrated by numerous recent events, railway systems are highly vulnerable to a variety of disruptions, including natural disasters, terrorist attacks and accidental failures. Due to the crucial role that railway infrastructures play in economic development, productivity and social well-being of communities, evaluating their

vulnerability and identifying their most critical components is of paramount importance. The problem of assessing railway system vulnerabilities has been studied from different angles. Broadly, existent quantitative approaches can be divided into two major categories: static rankings based on vulnerability indicators and interdiction models. Vulnerability indicators used to assess the criticality of railway infrastructure components include connectivity metrics (e.g., node degree and network accessibility), path-length based metrics (e.g., topological efficiency and node betweenness), and flow-driven metrics (e.g., passenger flow influence). These metrics are often used to devise a ranking among the components and then prioritize mitigation measures. Interdiction models are optimization based models that identify optimal ways to disrupt network operations, by removing nodes and edges. Therefore, they can be used to identify those assets that, when damaged or removed, reduce system performance the most. In this paper, we argue that interdiction models are a more effective and accurate tool to identify critical components than static rankings based on vulnerability metrics. The latter, in fact, fail at capturing component interactions after a disruption and often result in an underestimation of possible disruption extents. To prove our claim, we test both approaches on the Central London Tube to assess its vulnerability with respect to three performance criteria: accessibility, efficiency and passenger flow.

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

14/09/2017 : 12:00 : Room 5 - JF CC.01.10 (x36)

Code: OR59A3107

### **Railways Role in the Economic Expansion in Saudi Arabia: A Data Envelopment Analysis**

**Mr Saleh Alotaibi** (*Loughborough University*), **Dr Marianna Imprialou** (*Loughborough University*) and **Prof Mohammed Quddus** (*Loughborough University*)

The development of different economic sectors in the Kingdom of Saudi Arabia (KSA) has led to a high demand for an efficient transport infrastructure. The transport infrastructure affects most aspects of regional economic activities, because most economic activities either depend on or use transport means in the movement of goods. In addition, transport means would affect regional productivity by connecting regions to each other and allowing the interchange of goods and people to occur across them. Moreover, transport investment is considered a key component in business efficiency for the level of accessibility it provides to customers, markets, materials and labour. Therefore, it is necessary to identify and evaluate the level of the current transport infrastructure in KSA to show how the existing transport infrastructure would contribute to the economic growth. Data Envelopment Analysis (DEA) technique is used to examine technical efficiency of investment on the accessibility arises by railways infrastructure for each region of the country. The paper shows that future transport investment should focus on neighborhood regions, while, for the rest of the regions industrial investment is found to be more beneficial.

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

14/09/2017 : 13:15 : Room 5 - JF CC.01.10 (x36)

Code: OR59A3214

### **Small scale driving simulators : A source of realistic data ?**

**Dr Ben Waterson** (*University of Southampton*), **Mr James Baker** (*University of Southampton*), **Mr Aditya Tafta Nugraha** (*University of Southampton*), **Mr Chris Osowski** (*CobaltOtter*) and **Dr Gary Wills** (*University of Southampton*)

Driving simulators are a common way to assess the impact of car driver behaviour in situations that cannot be safely recreated on real roads, or where it is required to put a range of participants (age, gender, driving experience, etc.) in exactly the same scenario to assess variation in behaviour. Because the experiment participants know that they are not driving a real car however there remains an open question of how realistically drivers are behaving and therefore how representative of true conditions such data can be. Several full scale driving simulators exist where the driver sits inside a real car body and uses the actual steering wheel, pedals, etc. as the controls to maximise the sense of realism and encourage realistic driving. The high development and operating costs of full scale driving simulators make these inappropriate for smaller studies or where the simulator needs to be quickly moved between locations. This paper therefore reports on a study of driver 'immersion' (the feeling of being present in the simulated rather than the real world) in small scale driving simulators. Participants were seated in a standard office style environment and used combinations of off-the-shelf hardware for both vehicle control (from a keyboard and mouse to a mini steering wheel) and visualisation (from a large screen TV to a Virtual Reality headset) to drive around a simulated suburban and motorway scenario. Results show that even simple combinations of control/display can induce a feeling of immersion and realistic driving within participants, provided that fine levels of vehicle control and

vision are possible. This confirms the potential of smaller scale driving simulators to be a valid source of data for quantifying car driver behaviour.

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

14/09/2017 : 13:45 : Room 5 - JF CC.01.10 (x36)

Code: OR59A3216

### **Putting Intelligence back into Traffic Lights**

**Dr Ben Waterson** (*University of Southampton*), **Mr James Baker** (*University of Southampton*), **Mr Chris Osowski** (*CobaltOtter*) and **Dr Gary Wills** (*University of Southampton*)

The first sets of traffic lights (in the 19th century) were controlled by a person stood beside them, however as technologies have developed, humans have increasingly been taken out of the control loop. Modern traffic lights are designed to monitor approaching vehicles automatically and this data then forms the input for algorithms to decide which direction should get a green light and for how long. Over time these algorithms have become more complex (to account for wider policy aims such as pedestrian, cyclist and bus priority), but are limited by their inherent lack of flexibility in rapidly changing traffic conditions and high traffic flows, the very conditions where the adaptability of a human mind would be appropriate. This paper therefore reports on a study where teams of four human participants were given control of the traffic lights at four close proximity road junctions in a computer simulation. With no prior information, discussions or explanation of what the precise objective function of a control strategy should be, individuals were allowed to make up their own mind as to how they wanted the junction to operate and the consequential impacts on vehicles. Teams chose variously to either work cooperatively from the outset or to essentially ignore each other until other team member's performance began to have a direct impact. Conclusions are presented illustrating the range of control strategies that emerged and their resulting impacts on the overall performance of the simulated traffic network.

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