

## POSTERS

At The OR Society SW18 Simulation Conference  
19-21 March 2018  
Ettington Chase Hotel, Stratford, Worcestershire. UK. CV37 7NZ

At SW18 there is a very important poster stream, which is chaired by Tom Boness from ORH Ltd. Poster presentations are a good alternative when a full paper presentation is too formal or not suitable for the project. Posters are provided by the authors and the poster session begins with each contributor providing a two-minute 'elevator pitch' to introduce their work followed by a networking session where everyone can come and talk to the presenters. This session provides valuable one-to-one feedback about the theory behind projects and useful discussions about practical realities and other related projects.

## ABSTRACTS

### MODELLING DEMAND AND CAPACITY AT HEALTH BOARD LEVEL

*John Boulton (ABCi, ABUHB), Tracey England, ABCi; Cardiff University), Izabela Spernaes, Doris Behrens and Daniel Gartner (ABCi).*

In 2012, Aneurin Bevan University Health Board submitted a business case for a new Specialist and Critical Care Centre. The application to Welsh Government was based on a detailed Excel model which considered the number of beds needed, per specialty, based on the average length of stay (LoS) if each specialty achieved a LoS that matches the top 25% performing hospitals. In October 2017, the ABCi Modelling Unit were commissioned to relook at the existing model and develop more robust models, one for the current situation and one for the planned future. This poster shows the resulting discrete event simulation (based on over 608,000 patient episodes) that replaced the two proposed models. The main benefit of the simulation was that it could model the whole healthboard system from A&E to the ward and enable an evaluation of the relationship between bed utilisation and hospital performance (4-hour target) to be conducted.

### VALIDATION CHALLENGES WITH NEXT GENERATION MODELS

*Paul Glover (Dstl)*

Defence is seeking to establish agile collaborative working as the new norm in its approach to simulation. Most of the systems being studied are Complex Adaptive in nature, with key socio-technical elements and the required Validation concerns counter-factual analysis of emergent situations. New approaches to Validation are thus needed in the face of increasingly evolutionary approaches to simulation. These approaches need to encompass appropriate expression of the consequential Uncertainty associated with such modelling.

Part of the challenge is that it is anticipated that some partner organisations may wish to offer 'Black Box' solutions for parts of a simulation. In this regard academic discussion indicates increasing concern about the challenges of meaningful inter-working between differently founded perspectives. The bottom line is to be able to recognise how 'wrong' a simulation model needs to be and in what ways before it no longer produces meaningful insight.

### SIMULATING ALTERNATIVE NURSE STAFFING STRATEGIES

*Christina Saville and Peter Griffiths (University of Southampton), Tom Monks (NIHR CLAHRC Wessex Data Science Hub) and Jeremy Jones (University of Southampton).*

The Safer Nursing Care Tool (SNCT) is used by many NHS hospitals to set nurse staffing levels. Using this tool involves categorising patients based on their acuity and dependency on nursing care. The patient counts in each category are weighted and summed to obtain the staffing requirement in whole-time-equivalents. The staffing requirement is assessed over a baseline period, then averaged to obtain the number of staff to employ on the ward.

The aim of this simulation study is to test alternative strategies both for setting staffing using the SNCT and for sharing staff between wards. We present a generic hospital simulation where the wards are agents. This simulation model will be parameterised with a years' worth of data from 4 hospitals. Our expected contributions are validation of a widely-used nurse staffing tool and providing guidelines on its use in different ward types.

#### **DETECTING BIAS DUE TO INPUT MODELLING IN COMPUTER SIMULATION**

*Lucy Morgan (Lancaster University), Barry Nelson (Northwestern University), David Worthington and Andrew Titman (Lancaster University).*

Bias due to input modelling is caused by having only a finite amount of data to estimate the input processes that drive the simulation model. Until now this type of error has been assumed negligible and ignored. This is due to bias due to input modelling decreasing faster than input uncertainty as the amount of real-world data available for modelling increases. However, this does not mean bias is irrelevant when considering the error in a simulation performance measure caused by input modelling.

On this poster we present a response surface approach to bias estimation for a simple tandem queuing model with two unknown inputs. Along with a diagnostic test for identifying, with controlled power, bias due to input modelling of a size that would be concerning to a practitioner.

#### **AIRLINE DISRUPTION RECOVERY USING SYMBIOTIC SIMULATION AND MULTI-FIDELITY MODELLING**

*Luke Rhodes-Leader (Lancaster University), Bhakti Stephan Onggo (Trinity College Dublin), David J. Worthington (Lancaster University) and Barry L Nelson (Northwestern University).*

The airlines industry is prone to disruption due to various causes. Whilst an airline may not be able to control the causes of disruption, it can reduce the impact of a disruptive event, such as a mechanical failure, with its response by revising the schedule. Potential actions include swapping aircraft, delaying flights and cancellations. This poster will present our research into how symbiotic simulation could potentially be used to improve the response to a disruptive event by evaluating potential revised schedules. Due to the large solution space, exhaustive searches are infeasible. Our research is investigating the use of multi-fidelity models to help guide the search of the optimisation algorithm, leading to good solutions being generated within the time constraints of disruption management.

#### **PERFORMANCE ASSESSMENT OF OUTCOME-BASED CONTRACT OVER THE DELIVERY PHASE**

*Emmanuel Musa (Aston University).*

Previous research have focused on the design and development of outcome-based contracts underpinned by product-service systems. However, more research is required to assess the performance, management and execution of these contracts over its delivery phase. This poster uses discrete- event simulation method to assess the performance of an outcome-based contract offered by a medium-scale enterprise in the west-Midlands. The result is a description of key performance indicators that are essential to the improvement and delivery of outcomes.

#### **USING CASE STUDIES IN HEALTH CARE TO EXPLORE HOW CONCEPTUAL MODELS CHANGE OVER TIME**

*Kathy Kotiadis (Canterbury Christ Church University) and Thomas Monks (NIHR CLAHRC Wessex Methodological Hub).*

It is thought that very few simulation models in Health Care are used consistently over short or long periods of time. In recent years the idea of sustainability in simulation modelling has raised questions about the utility of models beyond the first use to subsequent use over short and longer periods of time. To prolong the utility of simulation models in Health Care we need to address conceptual model development so that it captures future states of the system of interest. One problem with that, is that there are currently no studies in health care to contribute to our understanding of how conceptual models change over short and longer periods of time. The study uses case studies of DES models developed in healthcare spanning over 10 years and shorter timeframes to explore questions such as how long does it take before a simulation model is no longer fit for use.

### **SIMULATING STORAGE POLICIES FOR AN AUTOMATED GRID-BASED WAREHOUSE SYSTEM**

*Michaela Wissing, Simon Malberg, Kevin Tierney and Christoph Weskamp (Paderborn University).*

Robotic fulfillment systems are becoming commonplace at warehouses across the world. High-density, grid-based storage systems in particular, such as the AutoStore system, are being used in a variety of contexts, but very little literature exists to guide decision makers in picking the right policies for operating such a system. Storage policies can have a large effect on the efficiency and storage capacity of robotic fulfillment systems. We therefore introduce a discrete event simulation for grid-based storage and examine input storage policies under a couple of storage scenarios. Our simulation provides decision makers with an easy way of testing policies before implementing them in a real system, and shows that selecting the correct policy can lead to up to a 7% input performance improvement, and 60% better box utilization.

### **AN INVESTIGATION OF SIMULATION MODELLING TECHNIQUES FOR THE APPRAISAL OF MEDICAL DEVICES.**

*Samuel Omoniyi (University of Exeter).*

Background: Medical devices are key components of the health technology used for healthcare interventions. Many health technology assessments (HTAs) focus on the particular products in terms of their efficacy, safety and cost-effectiveness. Most HTAs do not provide integrated technology assessment necessary to fully implement relevant decisions. HTA-informed healthcare decisions need to move beyond just providing technical evaluation of a technology to addressing policy issues on the operations management impact and applicability of the technology.

Study Objectives: These include identifying how to integrate pre- and post-launch appraisal of medical devices, and exploring the use of simulation modelling techniques to support decisions on development and operational use.

Methods: This study seeks to investigate how hybrid simulation modelling can be used to appraise medical devices by integrating health technology assessment with operations management.

Expected Contribution: This study is designed to provide decision support for healthcare decision-makers within a hospital setting.

### **A HYBRID SYSTEMS MODELLING APPROACH USING REAL TIME DATA AND COMPUTER SIMULATION IN HEALTHCARE.**

*Alison Harper and Nav Mustafee (University of Exeter).*

Reviews of simulation modelling in UK emergency departments highlight deficiencies in research design (Mohiuddin et al, 2017; Aboueljineane et al, 2013), alongside a continued interest in implementation challenges in healthcare simulation projects (Jahangirian, 2016). With increasing availability of healthcare operational data, opportunities exist to guide real-time decision making (Weiner et al, 2016). This study will explore the challenges and advantages to using real-time data in a hybrid systems modelling approach. Data is supplied by NHSquicker, a digital platform which provides information to low-acuity patients to inform their decision-making regarding urgent treatment (Mustafee et al, 2017). It provides current live wait-times for urgent-care centres in the South West. In order to evaluate the importance of this data, a questionnaire will investigate the influence of NHSquicker on patient decisions. This forms part of a wider evaluation to determine the value of the data prior to utilising it within a hybrid study.