

Sustainable energy

A bright future

Technology Futures Institute Annual Research Day,
in collaboration with the School of Science & Engineering

Tuesday 15 May 2012
9.00am - 5.00pm



Inspiring success

It is my
pleasure to
welcome you.



The **Technology Futures Institute's** (TFI) main mission is to plan and deliver cutting edge, internationally recognised research and development in advanced processing, nano technology, project and technology management and sustainability. Since the Institute was established almost four years ago, it has excelled in its mission.

This year, the annual research day focuses on sustainable energy. To maximise the impact of our research outputs to business and ultimately to the wider community, we have invited leading edge companies and academics to support the cross fertilisation of research ideas. Today's programme includes presentations from world-renowned industrial and academic speakers. More than 25 of our PhD students will also be giving oral and poster presentations which highlight their original contribution to knowledge in their chosen field of study.

It is vital to us that the business and research communities have an understanding of the role that our internationally recognised expertise can play for them. We hope that today helps to widen your understanding of how we can help both individuals and businesses reach their full potential. It is also essential that we understand business needs so that we can build our courses, research and innovation on areas that are of real interest to the business community.

I hope that you have a wonderful time and thank you for attending our TFI research day.

Find out how the Technology Futures Institute can support your business:
Professor Nashwan Dawood, Director, Technology Futures Institute
T: +44 (0) 1642 342405 | E: n.n.dawood@tees.ac.uk |
www.tees.ac.uk/technologyfutures

Professor Nash Dawood
Director
Technology Futures Institute

Poster presentations available to view throughout the day

P1 Temilade Ladokun
P2 Fathi Abugchem

P3 Salah Abuzaid
P4 Abdullah Albogamy

P5 Edvinas Rasyis
P6 Mark Butler

School of Science & Engineering

Supporting local industry to develop the problem solvers, innovators and leaders of the future



Inspiring success

We provide a wide range of engineering courses for work-based learners and those who are able to attend the campus in a flexible range of study modes.

Our provision includes traditional day release courses, such as the BTEC HNC and HND in engineering disciplines, and full-time and part-time foundation, undergraduate and postgraduate honours degrees.

Take advantage of Teesside University Open Learning (Engineering) online courses to efficiently develop your technical and engineering skills.

Our courses are equally suited to ongoing professional development of senior technical managers and to supporting established vocational training such as apprenticeships.

Find out how to advance your career in engineering and petrochemicals:

Postgraduate course enquiries:

T: 01642 738800

**E: sse-admissions@tees.ac.uk
tees.ac.uk/science&engineering**

Teesside University Open Learning (Engineering) course enquiries:

T: 01642 342740

**E: tuole@tees.ac.uk
tees.ac.uk/tuole**



A spark of **inspiration** 

The University for **BUSINESS**

VR design TM
Studio



FORUM8 is the world leader in 3D Visual Interactive Simulation technology.

The interactive 3D environments in VR-Design Studio are fully customisable. Roads and intersections are created automatically, traffic and pedestrians can be generated and external data from industry standard software can be imported, including microsimulation, CAD and 3D models.

Drive simulation and other interactive features make this software ideal for stakeholder consultation, research and training.

Use VR-Cloud® to share interactive 3D space online.

 **FORUM8**

+44 (0)207 822 1887 | office@forum8.com | www.forum8.com

Programme

| | | |
|---------|--|--|
| 8.30am | Registration and refreshments | |
| 9.00am | Welcome Professor Nashwan Dawood, Director, Technology Futures Institute | |
| 9.15am | The customer led network revolution – a multi-disciplinary smart grid project John Bird, Head of Sustainability, Northern Powergrid | |
| 9.50am | Modelling energy related data to support decision making in architecture and urban planning: methods and approaches Professor Leandro Madrazo, Universitat Ramon Lull, Barcelona | |
| 10.25am | Sustainable energy in an urbanised world Jørgen Hvid, Senior Consultant at RAMBOLL | |
| 11.00am | Refreshments and poster session | |
| 11.20am | CO₂: you have to measure it to manage it Dr Chris Ennis, TFI Research Fellow, Teesside University | |
| 11.40am | The green agenda: past, present and future challenges for domestic energy consumers David Lynch, Research Officer, National Energy Action | |
| 12.15pm | The role of driving simulators in electric vehicle research and development Dr Michael Knowles, University of Sunderland in collaboration with FORUM8 | |
| 12.50pm | Lunch and poster session | |
| 1.40pm | Parallel sessions (A and B) Delegates are invited to attend Session A or B | |
| | Session A: Manufacturing and process engineering Chaired by Michael Short Amal Metak C1 <i>Nanomaterial migration into food products</i> David Hughes C2 <i>In-vitro analysis of a new glenohumeral injury caused by rear automotive impacts</i> Yuosef Adraider C3 <i>Combination of laser technology and sol-gel ceramic coatings for surface modification</i> Hgubriyadh Al-Allaq C4 <i>Novel morphologies and controllable synthesis of mesoporous SBA-15 for plastic waste catalytic conversion into useful materials in supercritical water</i> | Session B: Engineering and sustainability Chaired by Mohammed Kassem Martin McKie C5 <i>A technology implemented improvement model in a UK iron foundry</i> Rajiv Chavada C6 <i>A framework for spatial-temporal conflict identification and resolution using game engine environment</i> Amit Mhalas C7 <i>A visual energy assessment tool for urban planning</i> Geoffrey Miller C8 <i>Serious games and health and safety training in construction</i> |
| 2.55pm | Refreshments and poster session | |
| 3.15pm | Parallel sessions (C and D) Delegates are invited to attend Session C or D | |
| | Session C: Measurement control (signals) and communications Chaired by Sebastian Emanuel Elhashmi Abujaafar C9 <i>Application of cavity enhanced absorption spectroscopy (CEAS) to analytical measurement</i> Anwar Rasoul C10 <i>Multi-phase, multi-component prediction in the chemical process industries</i> Yashaswini Nanjundaiah C11 <i>The influence of cell free probiotic supernatant on bacterial macrophage interactions</i> Bo Li C12 <i>Spectral and hyperspectral imaging in forensic scenarios</i> | Session D: Sustainability and security Chaired by Gillian Taylor Angela Addison C13 <i>The importance of engaging science and engineering students in virtual-world learning</i> Claudia Garrido-Varas C14 <i>Asymmetry of the adult human humerus and its use in forensic anthropology</i> Haitham Mansour C15 <i>Evaluation of the operational performance of workover activities in oilfields</i> Osama Alaskari C16 <i>Critical successful factors (CSFs) for successful implementation of lean tools and ERP systems</i> |
| 4.30pm | Award for best student poster and closing remarks Professor Simon Hodgson, Dean, School of Science & Engineering | |

Speaker biographies



John Bird

The customer-led network revolution – a multi-disciplinary smart grid project

John is Head of Sustainability for Northern Powergrid, the electricity distribution business for Yorkshire and the North East. He has been based with Northern Powergrid since 2000 having worked for 18 years in several Government departments, including the Department of Energy and the Treasury, most notably on energy policy and the privatisation of the gas and electricity industries. Following this, David was Head of Government Relations with BNFL for seven years. He is a member of the CBI Energy Policy Committee and a Fellow of the Energy Institute.



Professor Leandro Madrazo

Modelling energy related data to support decision making in architecture and urban planning: methods and approaches

Leandro is a professor at the School of Architecture La Salle, Universitat Ramon Llull, Barcelona, and Head of the ARC Architecture Representation Computation research group since its creation in 1999. He graduated from the Universitat Politècnica de Catalunya, and later studied as a Fulbright scholar in the Master of Architecture programmes of Harvard University and at the University of California Los Angeles, where he obtained his master's degree. Leandro was based at the Department of Architecture and CAAD at ETH Zürich, completing his PhD in 1995. Participating in several European funded projects dealing with the application of ICT to foster the industrialisation of the construction sector, and to improve the energy efficiency of buildings and cities, Leandro is currently coordinating the research project SEMANCO – Semantic Tools for CO2 Reduction in Urban Planning – funded by the 7th Framework Programme 2011-2014.



Jorgan Hvid

Sustainable energy in an urbanised world

Jørgen has been a chief consultant in sustainable energy at Ramboll since the mid-80's. Throughout his career he has advised governments, local authorities and private companies on how to reduce energy consumption and implement renewable energy. For the last few years his primary focus has been on sustainable planning for large urban areas. Jørgen's recent projects include the development of sustainable energy concepts for the City of Copenhagen, the brownfield area of North Harbour in Copenhagen, the Skolkovo Innovation City in Moscow and the Chicago Lakeside brownfield development.



Dr Chris Ennis

CO₂: you have to measure it to manage it

Chris is a research chemist with a background in surface, atmospheric and physical chemistry. He has a particular interest in development of real solutions to tackle the threat of climate destabilisation from anthropogenic greenhouse gas emissions. His carbon management expertise is being employed in dozens of regional SMEs and his research is a central indicator of regional decarbonisation performance used by Tees Valley Unlimited, our Local Enterprise Partnership. Chris' physical science research focuses on the use of charcoal in soil for fertility improvements and long-term carbon sequestration. He is a founder member of the North East England – Tamil Nadu (NEEDIL) research network that is working to implement clean technologies and carbon sequestration based on algal biotechnologies.



David Lynch

The green agenda: past present and future challenges for domestic energy consumers

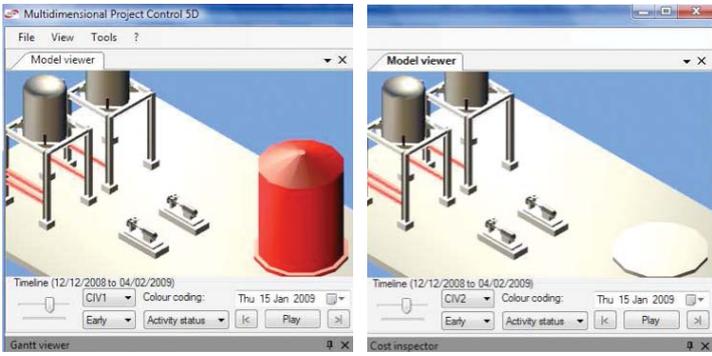
David is a Research Officer working at National Energy Action [NEA]. The NEA develops and promotes energy efficiency services to tackle the heating and insulation problems of low-income households and works in partnership with central and local government; with fuel utilities, housing providers and health services; and with consumer organisations. While working within NEA's Research Team, David has been heavily involved in designing, developing and delivering a whole plethora of research projects. His core research interests are assessing the economic impact of area based initiatives such as CESP, grid load impacts following the installation of new technologies and efficiencies of community based heating schemes in alleviating fuel poverty, and understanding and evaluating the social implications of renewable technologies.



Dr Michael Knowles

The role of driving simulators in electric vehicle research and development

Mike graduated from the University of Birmingham with an MEng in Electrical and Electronic Engineering and with PhD in Electrical Engineering (Machine Vision). In addition to working as a consultant for Birmingham Research and Development Limited and as an Associate Lecturer for the Open University, Mike has been employed by the University of Sunderland since 2007. He has worked in areas including intelligent systems, condition monitoring, intelligent diagnostic software, electric vehicle reliability and operational efficiency and driving.



The Technology Futures Institute

The **Technology Futures Institute** focuses on problem solving – we develop knowledge and technologies to support sustainable local, national and international business and public sector activities in the process, energy, environment, life sciences and security sectors.

- ◆ **International** leaders in research and innovation including sustainable business, industrial and construction technologies and methods, advanced processing, engineering management, and crime and security
- ◆ **Collaboration** with world leading companies, research organisations and partnerships with the voluntary, community and public sectors
- ◆ **Particularly** active in knowledge transfer and demonstration projects funded by the DTI, EU and British Council which help businesses increase competitiveness, productivity, annual profit and make better use of cutting edge knowledge, technology and skills.

Find out how the Technology Futures Institute can support your business:
 Professor Nashwan Dawood, Director, Technology Futures Institute
 T: +44 (0) 1642 342405 | E: n.n.dawood@tees.ac.uk |
www.tees.ac.uk/technologyfutures

Manufacturing and process engineering

Chair: Michael Short

From catalysts to car crashes, this session presents a selection of our PhD students' pioneering work including cutting-edge surface modifications and investigations of nanocomposite safety.

Nanomaterial migration into food products

C1

A Metak, SS Connolly, SN Connolly, F Nabhani

Nanocomposites are able to deliver desirable properties for packaging materials, as well as, enhancing the durability of perishable products through reduction of waste, generated post manufacturing, and lowering energy consumption. Commercial nanocomposite food packaging containers and coating films were tested on real food matrices to determine the degree of migration. Analyses, performed according to the relevant European safety directives, involved the application of Inductively Coupled Plasma Mass Spectrometry (ICP-MS) and Atomic Absorption Spectrophotometry (AAS) to identify the range of silver nanoparticles involved in migration. The migration assessment of Nano-silver packaging was conducted in assays involving a wide range of food materials. Similarly, simulations using de-ionised distilled water and 2% nitric acid were performed to validate the results obtained for food matrices. Scanning Electron Microscopy (SEM) and Energy-Dispersive X-ray Spectroscopy (EDS) were also employed to confirm the existence of Nano-silver, originating from the packaging, in the food samples.

The data demonstrates insignificant levels of migration on selected food matrices for the Nano-silver polymer containers compared to coated Nano-silver cling films, which showed higher levels of nanoparticle release. The studies also confirmed the antimicrobial activity of commercial Nano-silver food packaging.

In-Vitro analysis of a new glenohumeral injury caused by rear automotive impacts

C2

DJ Hughes, S Hodgson, F Nabhani

Whiplash injured patients often complain of pain in the shoulders following rear impact. This investigation aims to assess the cause and effect of these pains and advise on corrective measures. A 3D model was generated and a finite element analysis was performed simulating a crash situation to assess and define this injury more clearly. The model is validated against a mechanical test rig to confirm the results. The model displays a clear proximal force resulting from the impact scenario which created an increased loading on the supraspinatus.

This injury occurs when a driver sees a vehicle approaching from behind and braces himself/herself for the impact locking the elbows and pressing against the steering wheel. This causes the shoulder center to become posteriorly and proximally located so that during distal impact, large forces are impacted on the supraspinatus and subscapularis tendons. It is hoped that with the information gathered from this study that these injuries will be diagnosed earlier and lead to better long term recovery.

Combination of laser technology and sol-gel ceramic coatings for surface modification

C3

Y Adraider, YX Pang, F Nabhani, S Hodgson

Laser processing of sol-gel coatings is an innovative route to engineer the materials' surfaces without affecting the bulk properties, because of the localised processing nature of laser beam.

This new surface engineering technology has attracted wide interests due to the versatility of sol-gel coatings which allow variety and speciality in designing surface structure and properties for various engineering applications, such as enhancing oxidation resistance, improving optical properties and strengthening mechanical performance.

The behaviour of the sol-gel coating materials and their interaction with the laser beam are, however, still not fully understood. This study was carried out to achieve further understanding of the scientific fundamentals and technological factors of this combination and provide the guidelines for future investigation. Pulsed ytterbium fibre laser radiation ($\lambda = 1062\text{nm}$) in continuous wave mode was applied to sol-gel alumina and titania to fabricate ceramic coatings on stainless steel (AISI316). Various laser parameters and sol-gel coating conditions were investigated and the resulting surfaces analysed by ATR-FTIR, XRD, SEM, contact angle and mechanical measurements.

The key factors controlling the composition and structure of the resultant ceramic coatings were obtained and, in turn, applied to interpret the formation mechanism of crystalline ceramic coatings with the help of laser irradiation. Alumina coatings produced by laser irradiating on dried sol-gel films on AISI316 consist of $\gamma\text{-Al}_2\text{O}_3$ and $\alpha\text{-Al}_2\text{O}_3$, and the hardness of coated surface reaches the level of $\alpha\text{-Al}_2\text{O}_3$, ideal for mechanical applications. Titania coatings fabricated by laser-induced deposition from sol-gel dispersions exhibited rutile and anatase crystalline phases, with potentials for photovoltaic and self-cleaning applications.

Novel morphologies and controllable synthesis of mesoporous SBA-15 for plastic waste catalytic conversion into useful materials in supercritical water

C4

R Al Allaq, M Olea, S Hodgson, P Russell, P Yongxin

This research investigates the design of a commercial process for the conversion of plastic waste into useful materials using catalysts in supercritical water (SCW). Mesoporous silica, SBA-15, is prepared as a support for acidic catalysts due to its high surface area, high thermal stability and chemical resistance.

SBA-15 and other common, commercially available catalysts are destroyed under the aggressive reactor conditions (highly acidic SCW and high mechanical stress of melted plastic). Therefore we have designed novel morphologies of SBA-15 with high mechanical and chemical resistance.

To increase the mechanical strength of SBA-15 three new SBA-15 types were synthesised: single tube (ST), bent tube (BT), and spherical (S). This presentation reports the characterisation of these types. Pore structure was investigated with low angle X-ray diffraction (XRD) and surface morphology was studied by scanning electron microscopy. Release of copolymer from SBA-15 pores was investigated thermogravimetrically, and sample surface area was determined with N₂ adsorption-desorption isotherms.

The XRD results illustrate well-ordered hexagonal structures for the traditional multi-tube SBA-15 and for our ST, and BT samples. XRD results were supported by N₂-adsorption studies. Multi-tube, ST and BT demonstrate highly ordered mesopores, whereas S samples exhibit randomly distributed mesopores.

Engineering and sustainability

Chair: Mohammed Kassem

This session highlights how our PhD students are developing innovative computer-based technologies to increase efficiency, promote safety and reduce environmental damage in engineering and construction.

Research into and implementation of a technology implemented improvement model

C5

M McKie, F Nabhani, P Shelton

The foundry industry in the United Kingdom has been in decline for a number of years. There are various reasons for this but one reason seems to be the increase in the production of low integrity castings from China which has grown over 300% since 1991.

The research aims to firstly identify, via the use of a questionnaire, technologies utilised within the industry and the benefits achieved from them. Secondly it will demonstrate the implementation of a technology implemented improvement model in a UK iron foundry. The foundry, a small to medium enterprise (SME) based in the North East of England, agreed to adopt a number of linked research projects over a two year period. These research projects included the implementation of computer-aided design, finite element analysis, lean methodology, a foundry specific enterprise resource planning system and a bespoke subcontracting process.

These processes were designed and integrated to support one another in achieving improved business efficiency within the SME. This research will demonstrate and explain the benefits achieved from the implementations and the cross utilisation of the technologies. Hence, the benefits to UK foundries from these implementations and cross utilisations will be determined. These benefits will lead to foundries being more competitive in domestic and international markets.

A framework for spatial-temporal conflict identification and resolution using game engine environment

C6

RD Chavada, N Dawood, D Scott, M Kassem

Construction workspace is regarded as one of the main constraints on construction sites. Construction workspaces are generally difficult to proactively plan and manage due to the dynamic nature of a site where workspace requirements keep changing over time. Mostly, project managers intuitively develop a project plan for detailed activities and analyse activity conflicts in their head. Their capacity to do this is, however, limited. Hence, project managers are looking for ways to develop proactive site plans for the workspaces required for construction activities as this can impact not only on the cost and project duration, but can also contribute positively to site safety. We present an approach for integrating workspace management within the planning process using a serious game engine technology. We first illustrate a review of the workspace management practices and advanced visualisation techniques in the construction industry. A process framework is presented which provides an interactive environment, integrating workspace planning into 5D planning to enable safer, more efficient and more productive sites.

The prototype will identify spatial-temporal conflicts and the severity of their conflicts and allow construction planners to resolve spatial conflicts prior to construction. Finally, we present the current progress in the development of an initial prototype and outline the future work and research.

A visual energy assessment tool for urban planning

C7

A Mhalas, N Dawood, T Crosbie

The UK has ambitious CO₂ emission reduction targets of 20% by 2020 and 80% by 2050.

The energy used in homes accounts for more than a quarter of energy use and CO₂ emissions in the UK and the UK has some of the least energy efficient housing stock in Europe. More energy is used in housing than either road transport or industry. Therefore it is imperative to improve the energy performance of the existing domestic building stock and fully exploit renewable energy sources. The problem is that it is difficult for decision makers to assess which options for reducing CO₂ emissions have the most potential. There are a number of databases holding information about the domestic building stock in the UK.

This research investigates how this information with the aid of information technology and visualisation systems can be used to support informed decision making in energy related urban planning. A pilot tool is being developed to estimate the environmental and financial implications of different approaches to reducing the energy consumption of and CO₂ emissions from domestic buildings at the neighbourhood level.

The tool will support town planners, local authorities and social housing providers in the development of the policies and interventions necessary reduce the CO₂ emissions from domestic building stock. In this way the research seeks to help town planners and local authorities to meet CO₂ emission reduction targets.

Serious games and health and safety training in construction

C8

G Miller, N Dawood, M Kassem, D Scott

The use of serious games for training construction workers is explored in this research as part of an on-going effort to improve health and safety. This work combines advances in games design with existing virtual training tools and industry data models. Building information modelling tools that document both the structure of buildings under construction and the schedule for the completion of the different stages of the construction process are widely used. This provides an interesting vector for the development of virtual training tools. By using this existing information and models of construction products and processes it is possible to replicate a construction site virtually and show the site changing over time. This allows training tools to take a broader view of the training area. Instead of training people in discrete sections, the site can be moved back and forward in time to allow training in different skill sets within the same training environment.

This will enable trainees to visualise the site they will be working on at different time periods during the construction process, give them a greater feeling of immersion in the virtual training environment and support their recognition of the site from day one of the construction process until the completion of that process. A prototype site has been developed based on an existing building. This prototype replicates the features of a live construction site to increase the authenticity of the virtual training environment.

The overall aim of the research is to illustrate how the cross pollination of tools used in the gaming and construction industries can yield a rich and effective educational environment for health and safety training.



Measurement control (signals) and communications

Chair: Sebastian Emanuel

This session presents our PhD students' leading work into application of spectroscopy, probiotics and chemical process modelling.

Application of cavity enhanced absorption spectroscopy (CEAS) to analytical measurement

C9

E Abujaafar, M Islam, Z Ali, S Connolly

Broadband cavity enhanced absorption spectroscopy (BBCEAS) is probably the simplest technique which improves the sensitivity of conventional absorption spectroscopy by increasing the effective path length. BBCEAS can be achieved by using an optical cavity formed by two high reflectivity mirrors (> 0.99 nm) to multi-pass light many times through the detection area. The objective of this study is to develop a relatively inexpensive and enhanced broadband optical detection system on a macro-scale, to allow the detection of substances in a liquid phase with high sensitivity and simplicity. In this work we describe the use of BBCEAS technique to measure the content of ferric ions in water. Iron (III) ions were determined by reaction with potassium thiocyanate to produce a complex ion.

The concentration of $[\text{Fe}(\text{SCN})_5]^{2-}$ in liquid phase was measured by UV-Visible spectrophotometry with BBCEAS experimental setup. The average number of beam passes achieved was 92, α_{min} ($2.96 \times 10^{-5} \text{ cm}^{-1}$), and LOD were also calculated ($3.39 \times 10^{-8} \text{ M}$) and compare very well to published results. Results demonstrated that BBCEAS is a sensitive, simple and low cost technique to measure absorption of liquid-phase analytes.

Multi-phase, multi-component prediction in the chemical process industries

C10

A Rasoul, C Peel, D Pritchard

Thermodynamic modelling of phase equilibrium is a core activity in the chemical process industries. It relies on a precise description of thermodynamic properties for the phases in mixtures. In this work the Peng Robinson Styrjek Vera Equation of State (PRSV EOS) combined with the UNIQUAC activity coefficient model required in the Wong Sandler Mixing Rules (WSMR) is utilised to model multi-component heterogeneous systems. The capability and limitations of the EOS and WSMR is tested using range of modelling approaches. The Nelder-Mead simplex is used to produce the necessary correlations and optimisation. The Tangent Plane Intersection (TPI) method was applied to a range of binary and ternary heterogeneous systems. It was found that the TPI method is sensitive to starting values and due to this can suffer from instability. Therefore a new algorithm was developed to generate realistic initial values. However, it is difficult to expand the TPI for quaternary systems which require constructions in four dimensional space. Consequently this work developed a new algorithm based on Gibbs free energy minimisation, which is called Tangent Plane Distance (TPD). This method has been applied to a range of selected VLLE ternary and quaternary systems and for these systems the results using the TPD method are extremely encouraging. The method takes less computational time than TPI.

The use of EOS in modelling extreme behaviour, such as that found in multicomponent, polar, heterogeneous systems, relies as much on the mixing rules used as the EOS employed. This work illustrates the usefulness of the PRSV Model used in conjunction with WSMR and demonstrates real progress in the convergence between predictions and the real data now available in this experimentally difficult field.

The influence of cell free probiotic supernatant on bacterial macrophage interactions

C11

YS Nanjundiah, Z Ali, DA Wright, M Sarker

Probiotics are shown to have health beneficial effects. However, the mechanism is poorly understood with many papers reporting contrary immunostimulatory or immunosuppressive effects. This study uses a gentamicin protection assay (GPA) to assess the influence of probiotics on both the bacterial (*E. coli*) ingestion and digestion phases of phagocytosis by macrophages (J774). The GPA was performed at a multiplicity of infection of 50:1 in DMEM alone or DMEM supplemented with either $20 \mu\text{gml}^{-1}$ lipopolysaccharide (LPS), 10% cell-free *Lactobacillus rhamnosus* GG (LGG) supernatant or a combination of LPS-LGG. Following gentamicin treatment, ingested bacteria were recovered from macrophages at 30 and 60 minutes. Bacterial uptake is significantly reduced when treated with LGG supernatant and the LPS-LGG combination treatment ($p < 0.05$). LPS alone has no significant effect on bacterial ingestion.

To study the bacterial digestion, *E. coli* was incubated with macrophages for 60 minutes prior to the gentamicin treatment. The recovered ingested bacteria were subsequently monitored at regular time intervals to determine the digestion rate. The LPS and the LPS-LGG combination, brought about significant increase in the digestion rate when compared to control ($p < 0.05$). LGG alone had no significant effect on bacterial digestion.

The data suggest LGG inhibits bacterial ingestion, but does not influence digestion, whereas LPS does not influence ingestion but enhances bacterial digestion. The treatments involving LPS-LGG supernatant in combination demonstrate that neither treatment interferes with the others distinct mode of phagocytic modulation.

Thus, LGG may suppress the total microbial load on macrophages, and, hence, the extent to which the free radicals are generated. Future work will focus on whether the LGG driven suppression of ingestion is also associated with a reduction of pro-inflammatory molecules and can maintain this suppression in the presence of LPS.

Spectral and hyperspectral imaging in forensic scenarios C12

Bo Li, P Beveridge, L O'Hare, M Islam

Bloodstains are some of the most frequent and significant evidence found at crime scenes by police officers. The distribution and morphology of bloodstains play an important role in crime reconstructions and ultimately in determining the type of crime committed. To fully exploit the forensic information of a bloodstain an accurate way of the determining the age of the stain is required. To date experiments have focused on the visible range of the spectrum. This can provide information on the chromophores and fluorophores present in a molecule.

Reflectance spectroscopy is a novel technique for the estimation of the age of a bloodstain which offers the possibility of more accurate results. In this study, a microspectrophotometer (MSP) was used to take the reflectance spectra and spectral pre-processing and feature selection techniques were applied to all spectra. Linear discriminant analysis (LDA) was used as the statistical model, and after pre-processing the spectra by Fourier transform, and applying Fisher's weight as feature selection method, 99.2% leave-one-out validation for the mathematical model was achieved.

Later experiments used liquid crystal tunable filter (LCTF) coupled with a CMOS camera as imager, and PCA loadings were implemented as the feature selection technique. Two bloodstains were tested one acting as the training dataset and the other acting as the test dataset. The results of the LCTF experiment illustrate a significant improvement in the correct classification rate.



Sustainability and security

Chair: Gillian Taylor

PhD students present their pioneering work across a range of topics including forensic anthropology, resource planning and process efficiency.

The importance of engaging science and engineering students in virtual-world learning

C13

A Addison, WT O'Hare, E Bel, J Terkeurst

The fields of science and engineering require students to be involved in complex learning environments and activities. This type of engagement design would be expected to ensure that graduates develop excellent basic employability skills; however, employers advise this is not the case.

Achieving the necessary reality and complexity in educational design for science and engineering contexts, to enhance graduate skills, can be difficult. Higher education settings can be restrictive. Problems accessing environments, such as heavy plant or chemical manufacture, are compounded by changes to student ethnography. Institutions must consider how to deliver learning experiences at a distance and/or collaboratively with students who are geographically separate from each other. New technologies present academics with further challenges to their delivery modes but could they hold the answer to some of these problems?

Role play attempts contextualised educational reconstructions which actively engage students in learning, but students, rather than feeling empowered to learn through role play, may feel encumbered by it due to a "stage fright" like reaction. Virtual world role play offers an anonymity that may overcome such difficulties.

This presentation draws on a comparative study of role play in both a virtual world and traditional class/lab based settings, undertaken to determine some of the answers to these serious issues. A group of science based learners (n=5) were interviewed pre and post activities to seek their views on the experience. The design centred on a regulatory discipline programme and utilised a blended learning approach. The participant group included

traditional (n=3) and mature (n=2) students, combining males (n=3) and females (n=2) with an age range of 18 to 50 years.

Initial analysis of the data suggests that the immersive sense of virtual world role play provides opportunities for students to recreate actual application in real terms, giving a clear picture of likely performance/failings. Academics have a valuable chance to identify and give meaningful feedback and improve graduate and employability skills for students.

Asymmetry of the adult human humerus and its use in forensic anthropology

C14

C Garrido-Varas, T Thompson, I Spears

The mixing or commingling of skeletal elements is a complicated scenario in forensic anthropology. Being able to pair match elements belonging to an individual has major importance in many analytical processes such as estimating the most likely number of individuals, selecting the most adequate sample for genetic study and repatriation of the remains. It is proposed in this study that combined shape and size analysis of the remains is a better means of pair matching elements than size or shape on their own.

Geometric morphometrics was used for this purpose on a sample of adult humans from a modern Chilean population. Pictures were taken in a standard position of 64 humeri and two dimensional data were retrieved as a matrix of Cartesian coordinates which included the location of nine landmarks. Size was quantified using centroid size, which is a measure of the spread of the landmarks around the centroid of each configuration. Shape was extracted from the landmark coordinate data using a generalized Procrustes fit. Asymmetry and error were calculated using Procrustes analysis of variance (ANOVA).

Results showed that the mean difference of centroid size between the right and left side of each individual was 0.078, with standard deviation of 0.057 and standard error of 0.01. ANOVA for effect of centroid size showed statistical significance among and between individuals ($P < 0.0001$), and directional asymmetry was present ($P = 0.0006$ for right being larger than left). ANOVA for shape effect showed significant difference among and between individuals ($P < 0.0001$) and no directional asymmetry of shape was detected ($P = 0.87$). Measurement error was 24 times smaller than the minimum biological variation of shape.

After the Procrustes superimposition, data were analyzed with principal component analysis and subsequently cluster analysis was performed which successfully detected pairs by means of maximum likelihood among configurations aiding in the process of pair matching.



Evaluation of the operational performance of workover activities in oilfields

C15

H Mansour, M Ahmad, N Dhafr, H Ahmed

To support continuing efforts to improve processes and reduce costs in oilfield production this research models and measures operational performance in oilfields. The research focuses on the remedial operations used on a producing oil well to try to increase production.

A method of evaluating these workover processes, including Emergency shutdown procedures (ESP), was developed to assess the operational performance of workover rigs and measure overall equipment effectiveness (OEE). The approach developed is based on the availability of equipment, the performance of the rig and the quality of output. In this presentation a successful and effective evaluation of OEE, is discussed, this provides useful observations for operational improvements in Oilfield production.

The results of the evaluation indicate that introducing OEE for the assessment workover activities is valuable as it indicates how these activities can be improved. A new model is suggested to solve current problems in workover activities and improve overall workover operational performance.

Critical successful factors (CSFs) for successful implementation of lean tools and ERP systems

C16

O Alaskari, MM Ahmad, N Dhafr, R Pinedo-Cuenca

Due to market competition and continuous pressure on businesses, there is always a need to adopt innovative tools and techniques to reduce waste and concentrate on value adding activities. Consequently, integration of lean tools and enterprise resource planning (ERP) systems currently seem to be in high demand for both manufacturing and service organisations. However the implementation of lean tools and ERP systems can lead to undesirable outcomes if implemented incorrectly and these can adversely affect improvements in the process.

This research investigates the critical success factors (CSFs) involved in implementing lean tools and ERP systems with the aim of understanding how these factors have changed over time and considering the future directions. To achieve this aim, a comprehensive review of the published literature was conducted to identify the CSFs and achieve a depth of understanding of the various CSFs already identified by other researchers.

The findings of this work support both manufacturing and service organisations seeking to implement lean tools and ERP systems, by determining both the factors that lead to successful implementations and those elements of the implementation process upon which most emphasis should be placed.



EEN ad

Poster presentations

Six of our PhD students are giving poster presentations which highlight their original contribution to knowledge.

Mitigating stresses in pressure vessels: finite element modelling of cylindrical shell

P1

T Ladokun, F Nabhani, S Hodgson

Due to the differential operating pressure of pressure vessels, they are potentially very dangerous. Accidents can be deadly when a vessel's contents are flammable/explosive, toxic or reactive. Stress induced operating factors (eg process-upset or catalyst regeneration) and stress related defects (eg fatigue creep, embrittlement and stress corrosion cracking) account for approximately 24.4% of reoccurring catastrophic failures in pressure vessels in the process industries. In many instances these catastrophic failures have led to the loss of several lives, severe damage to property and even the evacuation of local residents.

Pressure vessels store large amounts of energy. The higher the operating pressure and the bigger the vessel, the more the energy released in the event of a rupture and consequently the greater the risk. To prevent stress related vessel rupture and catastrophic failure, it is necessary to identify the main factors that contribute to stress development in pressure vessels and how they can be mitigated. This research presents critical design analysis of stress development. It uses 3D CAD models of cylindrical pressure vessel assembly, finite element engineering simulation of various stresses and deformation tests at high temperature and pressure.

The main objectives of this work are to identify possible stresses in pressure vessels and how they can be minimised with the aim of reducing accidents related to the catastrophic failure of pressure vessels in the process industries.

Towards a better understanding of impact of software and system architecture on performance and dependability in real time control system

P2

F Abugchem F, M Short, D Xu

Real-time and embedded control systems play an increasing role in modern safety-critical systems, such as robotics and avionics. Guaranteeing real-time requirement and desired control performance while making the most effective use of the available processing capacity requires performing a detailed and comprehensive study for all system aspects. There are many diverse factors that are either known – or suspected – to influence the performance and dependability of these systems. Although previous work has considered the application of formal techniques to prove the functionality and timing correctness of these systems, to date comparatively little attention has been paid to their underlying software and system architecture. This is an area that warrants further study. This research attempts to investigate the impact of different versions of underlying software and system architecture on the performance of real time control systems.

In this research study a test-bed will be constructed to allow simulation of hardware in the loop. Based on this test-bed a number of (non-trivial) real-time control systems such as ball and beam, inverted pendulum, and servo systems will be designed employing different control techniques such as PID (proportional-integral-derivative), adaptive and predictive techniques.

The next step is to apply different types of software and system architecture (for example: event- or time-triggered, pre-emptive or non-pre-emptive, static or dynamic and so on) to all versions of control systems which have been constructed. The performance and dependability of these designs will be evaluated and compared. Subsequently, an empirical dataset will be provided including the factors which are likely to impact the choice of software and system architecture in building a real time control systems. These data are expected to be of value to the control system designers in helping them to decide which types of software and system architecture fit their design requirement.

Relief materials for construction in disaster affected areas

P3

S Abuzaid, S Bloomer, P Shelton, R Cheng

Disasters cause a considerable amount of damage, affecting the population, structure and economy of many countries. Much of the physical damage is caused by the disaster's impact on buildings, structures and infrastructure. The impact of construction in disaster affected areas, therefore, is significant. Surprisingly, there is published data on this, and lessons learnt from construction failures in disaster are few.

The compressed timescale of relief projects makes them unique. This study is concerned with the relief materials for construction in disaster affected areas. Its key objectives are to achieve a better understanding of and factors affecting the nature, management and operation of the relief material. The proper management of relief materials is critical in disaster relief projects. Delays, suspensions and failures of the relief project result from poor management and ultimately affect the end-user. Evidence shows construction relief projects in disaster affected areas have been delayed, suspended, or have failed due to material problems. To improve relief materials' management and operation, the key factors affecting them must be understood, including supplying, expediting, receiving, warehousing and distribution of relief materials.



This study will: extend the literature about post-disaster construction operations; assist government departments and NGOs to be aware of the significance of the relief materials for construction in social, economic, political and environmental circumstances; help target resources more appropriately in post disaster construction work. Research methodology is based on the research questions and literature review. Data will be gathered via a structured questionnaire and interviews.

A risk management approach to address construction delays in the United Kingdom of Saudi Arabia

P4

A Albogamy, D Scott, N Dawood

Delay in the construction industry, a global phenomenon, is frequent and serious in the Kingdom of Saudi Arabia (KSA), having been described as a 'cancerworm' that has eaten deep the fabric of the KSA's construction industry. The overall aim of this research is to develop a framework for minimising the impact of delay in construction projects in five major cities in KSA. To this end, it has been hypothesised that 'Identifying and ranking the current and most significant causes of delays could help in developing a framework/model which might assist in reducing the amount of delay in construction projects in KSA'. In order to test the research hypothesis, this study is divided into two parts. The first part is intended to be exploratory, being aimed at identifying and ranking the most severe and frequent causes of delays in construction projects in KSA. Data were collected through a questionnaire survey among the three groups of project stakeholders (ie owners, consultants, and contractors). A total of 98 valid responses have been received and are ready for statistical analysis. The second part of the study will develop a framework for minimizing the impact of delay in construction projects in KSA.

At a later stage in the research, the proposed framework will be tested through an in-depth case study in some ongoing and completed projects. Such a framework/model will be the first of its kind in KSA and will, therefore, produce benefits by reducing the impact of delay.

Digital facility asset management using Web3D technology

P5

E Rasys, N Dawood, D Scott

Efficient digital asset management is crucial to the successful execution of projects in the oil and gas and civil engineering sectors. Current literature indicates that the information related to asset management is often fragmented, not readily accessible and lacks historical detail. This leads to human errors, project delays and budget overruns. The aim of this research is to develop a framework and a prototype tool for integrating data, knowledge and 3D content. This will enhance the efficiency and effectiveness of various business processes throughout the various stages of a facilities lifecycle (ie planning, project development and handover, operations, shutdowns, etc). Current literature suggests that there are gaps in the information integration and delivery of 3D content during the handover and operation phases of projects.

Most of the research in web based 3D model presentation focuses on 'online design' collaboration and uses technologies that are now considered obsolete. The evaluation of the prototype tool developed in this research illustrated that it is much faster than a model implemented on a relational database. The main advantage is the flexibility of the system, as data is driven by a simplified form of ontology. A flexible database schema definition allows incremental feature additions and the system itself can be scaled differently, based on the needs of the project.

The proposed integration framework is expected to be of value to oil and gas and heavy civil engineering companies, dealing with large amounts of data during different stages of the project lifecycle.

A cluster analysis of crime scene examination practice using video footage and audio data

P6

M Butler, T Thompson, É Bel

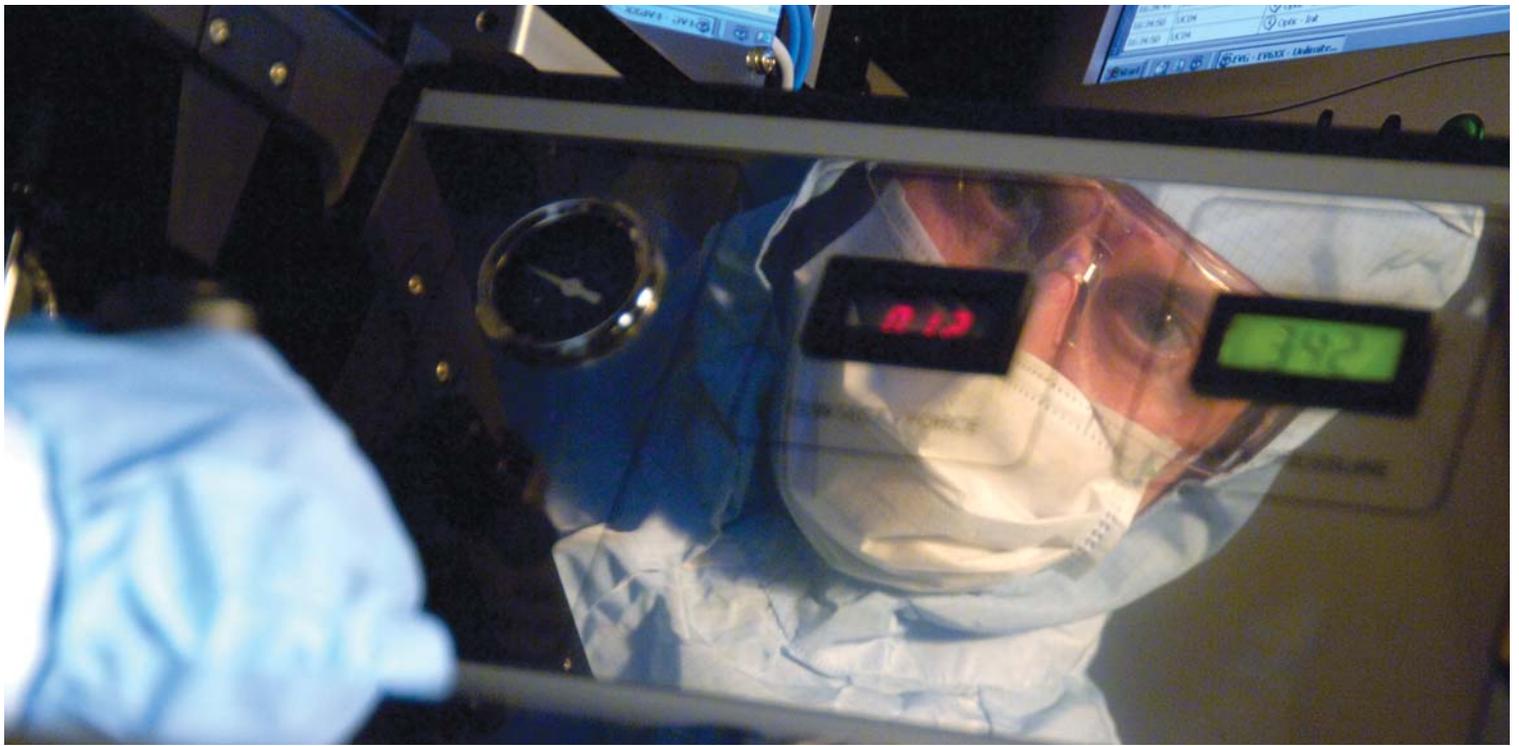
Studies of work have traditionally focused on observation, post account reflective testimonies and interviews. Little research exists in observing crime scene examination for patterns to inform practice and teaching. Similar studies in other dynamic domains such as fire fighting have used head-mounted camera footage from training programmes.

This study used head-mounted camera footage from four volume crime scene investigators over a seven-month period, capturing 58 crime scenes with mean time of 30 minutes. Video and audio data was transcribed and uploaded into NVivo9. Each video was coded based on an earlier devised framework. Over 1400 coding references were recorded; links to these codes were embedded as annotations for later retrieval and organisation of themes.

Dendrograms and 3-dimensional cluster maps were produced for all four participants and a further cluster analysis was performed showing the combined participants. Clusters were based on strength and frequency of nodes being coded. Although work was predominantly qualitative in nature, clusters for the combined participants had Jaccard's coefficients between 0.52 and 0.79 respectively. This allowed some security in establishing themes and connections of work based practices.

The results showed that examiners do not invest their energies in writing up their analysis or evaluations of the examination during their visual examination of the crime scene or property, despite these nodes having a strong degree of association as represented in the cluster map. Further evidence also suggests that documentation is only apparent during the examination when exhibits are being collected for storage, or further forensic work. Unsurprisingly the node gathering information was closely linked with the communication node.

The results have been triangulated with other data collection methods providing stability to the themes generated and moreover the clustering of nodes has exposed a way forward for educationalists to better understand practice.



This publication is available in alternative formats on request. Please contact the Enquiry Service on **+44 (0) 1642 342942** or email **enquiries@tees.ac.uk**.

Teesside University

Middlesbrough T: +44 (0) 1642 218121
Tees Valley F: +44 (0) 1642 342067
TS1 3BA UK www.tees.ac.uk