



Welcome from Professor Duncan McFarlane

Welcome to the spring edition of the DIAL newsletter. We have recently been revising our



brochure (an electronic version will be available on line soon) so it seems a good opportunity to review each of our three underlying themes and why they are central to each

development or project we undertake.

- *Management of disruption and change:* Almost twenty years ago we concluded that while much of the focus for operational performance was on steady-state behaviour there was significant benefit associated with being better at dealing with non steady-state behaviour: i.e. managing both planned and particularly unplanned changes. These days phrases such as *resilience* and *future proofing* are also linked to this topic.
- *Distributed, intelligent automation:* Contrary to popular belief, automation is not just about robots! They play a role in some automation systems but our approach to automation covers not only automated actuators like robots but also automated sensing, information management and decision making. In line with our interests in change management we particularly focus on logically distributable automation as such

approaches tend to support system changes most readily.

- *Getting the best value out of information:* This third theme underlies our view that “good information is gold” and should be treated as such! Whether the information is sourced from new or improved sensors, our interest is on the value it generates for the operations it supports. Much of our work is on quantifying that value and trying to maximise it.

These three underlying themes have provided a sensible pointer for DIAL projects since the mid 1990s and I expect they will continue to do so into the future. Enjoy this issue of the DIAL newsletter.

Meet DIAL's new Research Associate: Amer Dheedan



Amer joined the Distributed Information and Automation Laboratory in February 2013 as a research associate. His research interests include software engineering, safety assessment, computer-based on-line monitoring of safety-critical systems, artificial intelligence and distributed and collaborative reasoning. He is currently working on a research project related to the fault diagnosis and maintenance of the modern locomotive systems.

Amer graduated from the University of Hull in June 2012 with a PhD in distributed on-line safety monitoring for critical systems. The novelty of his research emerges from the generic applicability of the developed monitor to large-scale systems that

involve various engineered sub-systems and whose behaviour is dynamic, incorporating state transitions among different operational phases and modes.

Another novel research aspect is that the exploitation of the off-line safety assessment models that are produced during the development life cycle of critical systems. Those models include thorough knowledge about the operational and failure behaviour of systems and they cease to be useful following the certification and deployment of systems. Amer developed an approach to bring this knowledge forward to the operational phase of systems and usefully exploit it for developing a cost-effective on-line safety monitor. Currently exploited models are those produced by Architectural Analysis and Design Language (AADL), and Hierarchically Performed Hazard Origin and Propagation Studies (HiP-HOPS).

The developed safety monitor has been successfully applied to different aviation case studies. The obtained results demonstrated a real-time ability to contain functional failures before they develop to hazards, through the delivery of a range of on-line safety tasks extending from prompt fault detection and diagnosis to effective alarm annunciation and automatic fault controlling.

DIAL's collaborator RedBite Solutions

RedBite Solutions was established in 2006 as a spin out from the Cambridge Auto-ID Lab. As a software company, RedBite develops complete Auto-ID based track and trace applications for various industrial and smartphone devices. RedBite's track record includes deployments with Wilmar International, Sony Europe, Rolls-Royce and the Bank of Tokyo among others as well as having more than 25 installations globally.



The company's flagship product is RedStore which tracks spare parts, tools and equipment in a manufacturing environment aiming to significantly reduce time taken for both stock check and automate movement of goods between locations.

A lite version is also available with handheld operations only, for facilities management environment.

Recent Developments

RedBite Solutions recently demonstrated its new cloud-based asset tracking system in the Cambridge Auto-ID laboratory. The team has deployed their latest application in the Cambridge Auto-ID Lab



to demonstrate their capabilities for the academic research team. Their web based application server was linked with various RFID devices and handhelds to provide inventory control capabilities for keeping track of some of the equipment in the lab.

The capabilities demonstrated include:

- State-of-the-art RFID portal capabilities, including a high performance slim RFID antenna
- Process synchronisation between fixed readers and handheld operations
- RFID handheld locate feature using "Geiger counter" mechanism - beeps louder and faster as it gets nearer to the tag
- Logic to convert sensor data into physical event detection.
- Cloud based inventory data storage
- Web interface to real time data system

RedBite has also demonstrated its standards compliance with TDT, LLRP, ALE and EPCIS according to the GS1 EPCglobal standards.

The Future

With the knowledge and experience of the team, the impressive back catalogue of global clients and recent awareness in "Internet of Things", RedBite has plans for a future in which Auto ID systems are used to intelligently link physical objects to cloud based information services.

New product releases in the pipeline include a



completely cloud-based inventory system which connects directly with fixed readers and handheld devices, and smartphone applications with QR barcodes linked with RFID data for ubiquitous business operations. These new capabilities will revolutionise the way end-users adopt, use and ultimately benefit from flexible tracking systems.

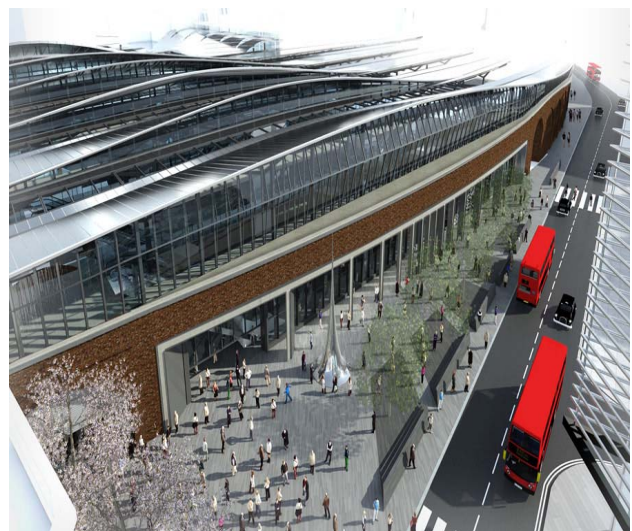
www.redbite.com

Redevelopment of London Bridge Station

London Bridge Station is the oldest station in Central London, and one of the oldest in the world. It is also one of the busiest, with more than 100,000 passengers passing through every day. As part of the Thameslink Programme to upgrade many of London's large mainline stations, London Bridge Station is currently being refurbished. Costain, the lead contractor, is working with the Centre for Smart Infrastructure and Construction (CSIC) to demonstrate a range of innovative technologies during the construction process.

The CSIC demonstration project is currently underway and includes methods of monitoring people as well as monitoring the building itself. Various approaches will be taken to track the public and construction workers as they navigate through the station to improve their experience. Wireless sensor nodes will be deployed to existing parts of the structure, measuring tilt, strain (to ensure works are not causing damage), and temperature (for calibration), while also measuring sound levels (to ensure compliance with legislation). Displacement of existing rail track will also be monitored in real time, to detect any movement during the works. Fibre optic cables will be installed in masonry structures to take high resolution strain measurements. To aid interpretation, results from these physical

measurement technologies will be compiled in a 3D reconstruction of the station, using augmented reality and computer vision techniques.



Courtesy of www.networkrail.co.uk

The Distributed Information and Automation Laboratory group is also involved in the project, and will use RFID to streamline the construction process itself. Specifically, the design of several areas of the station is such that modular components are prefabricated off site and delivered to the station for installation. The platforms in particular are manufactured as pre-cast sections. There are hundreds of these sections, which are subtly different but all look similar. This could lead to mistakes in installation and subsequent rework. To prevent this, DIAL and RedBite will develop an RFID based process, tagging the prefabrications as they are manufactured. Costain will be alerted to the dispatch of components and be able to track their delivery in real time. When components are scanned upon arrival, software will provide workers with unambiguous information about the exact design and the correct installation position. The components will be scanned once installed, and again once inspected and signed off, providing real time information on progress.

The redevelopment of London Bridge Station is a five year project, which is currently underway. The CSIC technology demonstration project will run for approximately two years. Please contact Phil Catton (phil.catton@eng.cam.ac.uk) for more information.

DIAL's research associate Rachel Cuthbert attended "Better Asset Management for an Uncertain Future" conference

CIRIA, the Construction Industry Research and Information Association, conference on 'Better asset management for an uncertain future' was held on the 28th February at the British Geological Survey (BGS) in Keyworth, Nottingham. This conference looked at how the UK infrastructure sector faces the daunting challenge of maintaining and modernising an ageing infrastructure asset stock. A key hurdle to the embedding of sustainable infrastructure asset management principles for many years has been the lack, and poor quality, of infrastructure asset data. Both location and condition data are important and real-time data is required to inform proactive planning and maintenance regimes. The conference speakers, from CIRIA, Ordnance Survey, BGS, the Highways Agency and Industry, covered aspects and challenges around the capture and management of asset data, innovations in data management to enable a better construction process, geospatial data to enable potential hazards to be realised when planning and building infrastructure, and the need to protect infrastructure against strategic risks, and to ensure critical asset resilience and monitoring.

Big Data Workshop

DIAL, in partnership with the UK chapter of DAMA (International Data Management Association) and the BCS DMSG (British Computer Society Data Management Specialist Group), hosted a one-day event on Big Data on 11th April 2013. The meeting was held at the Institute for Manufacturing in Cambridge.

The focus of the event was on data management challenges and technologies that can harness and leverage the new opportunities offered by today's voluminous, varied and fast-paced data. The event was chaired by Dr Philip Woodall (DIAL) and Lee Edwards (DAMA) and included four leading

speakers from industry and academia who gave their views on big data.

Frank Terburg, Director of Technical Solutions

EMEA, Clustrix Inc., presented the top make or break database trends in 2013 for big data. Dr Mark Harrison, Director of Auto-ID Lab, DIAL, presented how linked data technology can tackle Big Data challenges. Andrew Graham, Director of Sales, AIIM International, presented 'The Big Data Balancing Act: Too Much Yin and Not Enough Yang'. Finally, Nigel Turner, Vice President of Information Management Strategy at Trillium Software, discussed the relationship between big data and data quality.



At the end of the day, delegates were treated to a tour of DIAL's robot lab

The four main themes and thoughts for the future that emerged from the day included:

- The cost of data storage is not free (certainly when considering that data needs to be maintained) and determining whether or not to delete data needs to be based on factors such as:
 - When the data is likely to be used (just because it may not be of immediate use does not mean that it will never be useful). One example of this is the use of historical crime data from the San Francisco area—diligently collected many years ago—that is now being analysed to identify patterns in crime.
 - Other people who are likely to use it (and each person is likely to need it at different times and for varying purposes).
 - Other nature of the data itself (does it concern trivial facts or key business strategic indicators).
 - Regulations that govern the data.

- Philip Woodall suggested that the data management solutions of the future for business intelligence may need to amalgamate both NoSQL and traditional databases into some sort of hybrid database technology—and not just give the appearance of being both. Currently, many important business intelligence questions for organisations require the integration of transactional data (in their operational systems) with less structured data such as social networking data and log files. These types of data have different storage demands, and therefore the technologies of the future will need to support both of these while finding the right balance between the conflicting requirements.

- There are many opportunities for organisations to leverage open and linked data from the web that need to be explored. Linked data can provide meaning to otherwise arbitrary data, and so can be used by organisations to convey unambiguous messages to potential customers about their products and services. Open data is a resource that organisations are yet to fully explore. An example of open data is with governments who are now releasing their datasets online (see <http://data.gov> for U.S. data and <http://data.gov.uk/> for U.K. publically available data sets). Their aim is to be more transparent, but this data can also provide benefits to the public who often funded its collection through taxation.

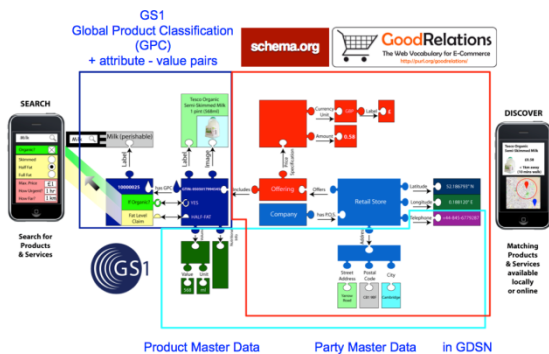
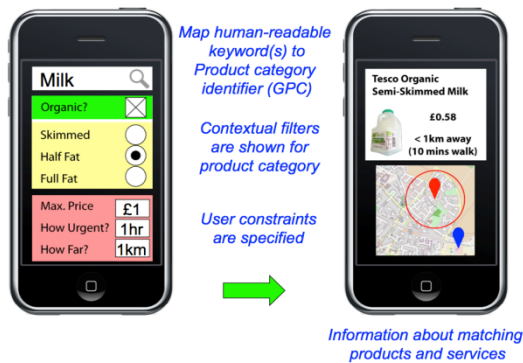
- The business intelligence community is not fully aware of many existing data quality technologies, and is, in some cases, re-inventing the wheel. Both communities therefore need to take an active role in initiating and sustaining a mutually beneficial dialog.

GS1 Industry and Standards event in Dallas

Mark Harrison participated in the GS1 Industry and Standards event in Dallas during the week of 18-22 March 2013. The week included face-to-face meetings of the GS1 Architecture Group, as well as technical work groups, such as the Pedigree Security, Choreography and Checking Services work group, in which we play an active role. Together with our colleagues from the other Auto-

ID Labs around the world, we provided an overview of current research activities, including work at Cambridge on intelligent products and infrastructure, as well as developments in the area of linked data and opportunities for the GS1 community (i.e. manufacturers, distributors, wholesalers, retailers).

Following an Auto-ID Labs research meeting to further develop our research agenda and plan for improved collaboration with researchers in our partner labs, we had a very interesting discussion about the opportunities of using linked data technology to improve the ability to discover and compare product master data online. The GS1 community has developed standards for product categories (the Global Product Classification (GPC) system) and for exchange of master data about products and organizations, which is synchronized between businesses using the Global Data Synchronization Network. By making the GPC system available in linked data format and also by developing export tools to provide companies with the ability to export a subset of their consumer-facing master data in linked data format, accurate master data about products (such as ingredients, nutritional information, ethical and environmental accreditations) can be made available online and we can envisage new applications and more contextual search services that can help consumers to find the information they need in order to find the products that best match their needs. The Auto-ID Labs researchers plan to work together with GS1 and a number of interested companies to develop and pilot some proof-of-concept prototypes of this technology, to demonstrate the advantages and possibilities, as well as better understanding the potential risks of making detailed authoritative master data available online. Mark has also presented on this topic to GS1 UK and GS1 Germany and there is keen interest to understand the opportunities that this technology enables, especially given recent developments outside of GS1, such as the Good Relations vocabulary and the schema.org initiative backed by the major web search engines. Mark also presented these ideas at the W3C / ODI / OKF “Open Data on the Web” Workshop in London on 23-24 April and participated in discussions there.



New consumer-facing contextual search applications for products and services can be enabled by developing tools to export qualitative and quantitative master data and category data about products.

Recent Publications:

Wu YR, Huatuco LH, Frizelle G, Smart J A Method for analysing operational complexity in supply chains. *Journal of the Operational Research Society* (2013) 64, 654 - 667.

Lu, W., Giannikas, V., McFarlane, D., Hyde, J.,: The role of distributed intelligence in warehouse management systems. In: 3rd International Workshop on Service Orientation in Holonic and Multi-Agent Manufacturing and Robotics, Valenciennes, France (2013).

McFarlane, D., Giannikas, V., Wong, A.C.Y., and Harrison, M. (2013), Product Intelligence in Industrial Control: Theory and Practice, *Annual Reviews in Control*, 37(1)

If you are interested in anything that has been featured in the newsletter or would like further information about DIAL, then please do not hesitate to contact us on dial-enquiries@eng.cam.ac.uk or call Petra Kasmanova on +44 (0)1223 764306.

Recent DIAL Seminars:

Dr. John Ahmet Erkoyuncu (Cranfield University), "The impact of uncertainty on cost for Industrial Product-Service Systems", Thursday 28 March 2013, 14:00-15:00, Seminar room 3, IfM

Peter Demian (Loughborough University), "The Future of Construction and Infrastructure Information: BIM, the Death of the Document, the Importance of Information Retrieval and Future-proofing in Design", Tuesday 19 March 2013, 14:00-15:00, Seminar Room 3, IfM

Barry O'Brien (ARUP), "Real Time Real Estate Management for Smart Buildings", Thursday 28 February 2013, 14:00-15:00, Seminar Room 3, IfM

Ivian Casali Duarte (University of Espirito Santo, Brazil), "Carbon Emission - A general approach to road freight transportation", Thursday 07 February 2013, 14:00-15:00, Seminar Room 3, IfM

Upcoming DIAL Seminars:

Torben Jess and JiaQiang Wang (DIAL), 1st Year PhD Conference, Thursday 09 May 2013, 14:00-15:30, Seminar Room 3, IfM

Vaggelis Giannikas (DIAL), Tuesday 28 May 2013, 14:00-15:00, Seminar Room 3, IfM

Nipat Rasmekomen (DIAL), Thursday 13 June 2013, 14:00-15:00, Seminar Room 3, IfM

Michael Gibson (Aston Martin, UK), "Warranty – The Visible Cost of Failure", Thursday 20 June 2013, 11:00–12:00, Seminar Room 1, IfM

James Hyde (Six Works Ltd), Distributed Intelligence in Warehouse Management: A case study, Thursday 2nd May 2013, 14:00 – 15:00, Seminar Room 3, IfM

Institute for Manufacturing

Department of Engineering, Alan Reece Building, 17 Charles Babbage Road,