Distributed Information and Automation Laboratory

UNIVERSITY OF CAMBRIDGE

DIAL Quarterly October 2013: Book about Maximising the value of data and information assets, Intelligent data at Boeing, Cambridge Service Week, Asset Management Conference and much more.

Introduction from Professor Duncan McFarlane: Preparing Systems for an Uncertain Future

Writing this introduction the day after some extremely high winds have shut down power, train lines and roads across the UK it seems more than appropriate to spend a few lines discussing the issue of future proofing. One way or another we seem to be quite heavily involved in this area at the moment whether it be in assessing and developing capabilities for greater operational resilience to disruptive events or in helping prepare operations for future changes and developments that are not yet conceived. In the former case, we completed a study in June with G's Growers, the UK's largest producer of salad vegetables, auditing their lettuce supply chain's resilience to a myriad of disruptions and climatic variations that occur on a daily basis. We are also working with Boeing examining pathways to more resilience to disruption in some of their US production facilities. In terms of preparing for future changes, we are devoting considerably energy to understanding, quantifying and improving the ability of key infrastructure [and its owners] to prepare for future changes with a particular focus on retaining and maintaining appropriate information. This follows on from previous work examining the potential for manufacturing operations and airports to be reconfigured and in identifying the effort required to do so. These developments do not reduce the likelihood of disruption and change - in fact we must assume this will increase - but do perhaps at least put us in a position to better anticipate them and/or manage these events when they do occur.

DIAL's new PhD student Tengku Norazman Tengku Abdul Aziz (Azman Aziz)

Tengku Norazman joined DIAL in October 2013 as a PhD student, under the supervision of Dr Ajith Parlikad. He completed his first degree in Electrical and Electronics Engineering at Universiti Tenaga Nasional and his master's degree in Control Engineering at Imperial College London.

He worked in industry for about 9 years, including companies such as Avago Technologies, Flextronics and Celcom in Malaysia. Examples of his roles and responsibilities included the Network Development Trainee at Celcom, designing access networks for Orna Resort Melaka, the Development Engineer in the Surface Mount Technology Business Unit at Flextronics, developing programs and optimizing hardware maintenance of automated inspection machines and the senior R&D Engineer at Avago Technologies, characterising, improving and qualifying optical sensor products like encoders.

At IfM, he will be working on Asset Management and Maintenance, exploring novel methods that can solve existing problems in the manufacturing sector. One such approach incorporates empirical datasets from the industry, data that is analysed using mathematical models. By processing the data, organisation enablers can quantify the value, allowing them to optimally manage the mix of cost, risks and performance over the whole life of their assets.

Intelligent Data at Boeing

The Boeing Company is presently working with the University of Cambridge, Distributed Information and

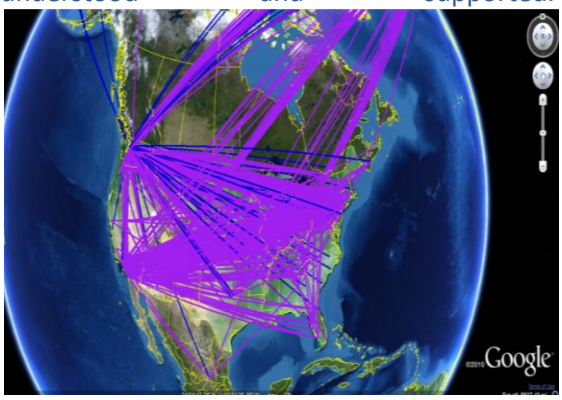
Automation Lab (DIAL) on a project entitled Achieving Leveraged Advantage from Distributed Information (ALADDIN). The objective of the three-year ALADDIN project is to develop a methodology for transforming data from passive to active, with organic awareness of its own value in order to reduce recurring data management costs and to improve intelligence discernment capability. The resultant intelligent data will enable autonomous delivery to users that will realize the greatest benefit and to systems that will realize the greatest value from the data. Intelligent data elements will actively participate in determining how and where it is used. This basic research and development project is funded by the Boeing Research & Technology organization with initial focus on manufacturing and support domains. One of the key characteristics of the project though is that the enabling data intelligence technology is domain agnostic which significantly boosts the strategic value of the project due to the potential for revolutionizing the way data is processed and managed across the enterprise.

In the supply chain domain alone the sheer volume of supplier data and complexity of a multitude of supplier management and procurement systems vividly illustrate the strategic importance of the project in order to meet unprecedented production rates.

At the present time it takes enormous numbers of labour hours to mitigate supply chain induced shortages or disruptions. Many of the supply chain issues however could have been identified prior to occurrence if the data were intelligent enough to reveal potential issues in a predictive manner as envisioned under the ALADDIN project. Additionally, the human resources that presently must manually comb through volumes of data could be reallocated to focus on more strategic oriented business objectives. The main objective of ALADDIN is to let the data reveal issues or opportunities that otherwise would have gone undetected through current data management methods.

The ALADDIN project is a paradigm shift from having people and systems attempt to manage, distribute, and determine the value of data towards a new model where the data is given the capability to perform the actions autonomously. Intelligent Data provides a mechanism through which new data can actively determine its own value (in accordance with business objectives) and seek the places, systems and tools that need it the most.

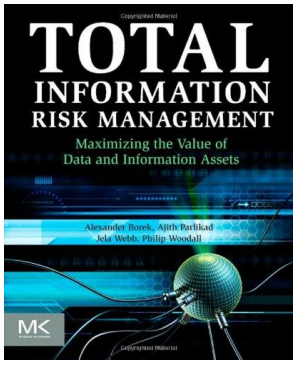
Boeing is pleased to undertake this project with the Cambridge Principal Investigator, Prof. Duncan McFarlane as well as research associates Dr. Mark Harrison, Dr. Philip Woodall, and PhD student Torben Jess. The project is due to transition to Boeing in September of 2014 and the research team actively works with the Boeing user community to ensure their objectives are understood and supported.



Sample Supply Chain Illustration for Boeing Commercial Airplanes

Bill Krechel, Boeing Research & Technology, Supply Chain Technologies Lead Engineer

Total Information Risk Management book



Philip Woodall and Ajith Parlikad (DIAL) have published a new book on their work on managing information quality-related risks to industrial organisations. This was developed as part of the DIAL IQAM (Information Quality in Asset Management) project with their ex-DIAL colleague Alexander Borek.

The book describes how industrial organisations can measure the consequences of poor quality information to determine what level of risk this poses to the business. IfM Education and Consultancy services are planning to use a software tool developed in DIAL, and based on this approach, to support organisations in their efforts to mitigate the problems caused by poor quality data - a critical problem in today's "big data" era.

Past Event: Cambridge Service Week

Cambridge Service Week 2013 was held from Monday 30 September to Friday 4 October 2013. The key events during the week were:

•Industry Day - Successfully Making the Shift to Solutions, 1 October 2013
This one-day conference focused on how companies can successfully make the shift to solutions. The event provided unique insights from leading service providers and academic institutions and offered a valuable opportunity to hear the latest developments in service thinking. It showcased new research from the Cambridge Service Alliance - the 'Collaborate to Innovate - How Business Ecosystems Unleash Business Value' report.

•Partners Day - Understanding and Innovating the Solutions Ecosystem - 2 October 2013
This was an executive workshop for Partner organisations of the Cambridge Service Alliance, where they shared the latest insights and tools for mapping the ecosystem and designing innovative solutions.

•Academic Conference - New Directions for Service Research, 3-4 October 2013
The Fourth Academic Conference brought together leading research experts in the area of services to explore New Directions for Service Research. This provided a unique forum for discussion and debate on the latest developments in service thinking. As interest in services continues to grow, new elements are emerging that may be important for the future of their science. The questions asked at the 2013 Cambridge Service Alliance Academic Conference were how is the service scenario evolving and what are the aspects that service research should most importantly address.

Future Event: Asset Management Conference

The IET Asset Management Conference will take place on 27th - 28th November 2013 in the St Paul's London. This event is annually attended by over 250 asset management professionals from around the world representing a wide range of asset intensive industry, public and academic sectors.

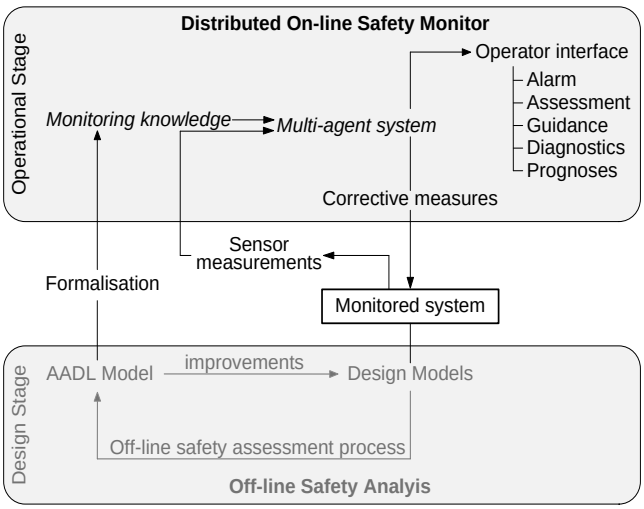
This conference is offering:

- Dual and tri parallel sessions which will be filmed,
- Conference proceedings containing all of the technical papers,
- A keynote presentation from David Wright, Director Electricity Transmission Asset Management, National Grid,
- Interactive posters sessions.

The second day of the conference will be filled with workshops.
Two of DIAL's papers will be presented on the first day. The first paper is "Information futureproofing for Large Scale Infrastructure" (Tariq Masood and Duncan McFarlane). The second paper is "Condition monitoring of infrastructure assets: Building the business case" (Ajith Kumar Parlikad, Raj Srinivasan, Duncan McFarlane and Phil Catton).

4th IFAC Workshop on Dependable Control of Discrete Systems (DCDS)

DIAL's RA, Amer Dheedan, attended the 4th IFAC Workshop on Dependable Control of Discrete Systems (DCDS). Dependability is mostly seen as an umbrella term that covers a number of non-functional properties of the engineered systems. In this context, those properties range from the establishment of the reliability, safety, availability and maintainability during the design and development stages to the preservation of those properties during the operational stage of systems. In the same context, the term "discrete systems" is used to denote a class of engineered systems that operate dynamically to deliver their functions, as their operational behaviour incorporates a number of state and mode transitions (e.g. phased-mission systems).
The DCDS workshop was held from 4th to 6th September 2013 in the University of York, UK. Researchers from academia and industry have been brought together to tackle problems and discuss up-to-date techniques in the field of Dependable Control of Discrete Event Systems. The researchers were driven by the needs of a number of applications in that field, namely Power Production Systems, Production Systems, Transport Systems and Embedded Systems.
Throughout the three days of the workshop, research was presented in three main topics. The first is Model-based Safety Assessment; this topic was focusing mainly on improving the safety, reliability and availability during the design and development stages of the discrete systems. Among the researched and targeted assessment models were: fault tree, binary decision diagram, Markov chain, Petri Net and AltaRica modelling language.
The second presented topic was Model-based Safety and Optimisation. Along with this topic, the researchers were tackling real-time issues that concern the operational stages of the discrete systems, such as optimisation of preventive maintenance, safety monitoring and integrating and optimising the attractive characteristics of different dependability analysis techniques to develop well-designed systems. Co-authored with Ajith Parlikad, Amer Dheedan presented a paper on this topic. The paper developed a distributed safety monitor that can scale-up and cope with the distributed and dynamic behaviour nature of the modern critical systems and ultimately deliver an integration of effective monitoring tasks. Fault detection and diagnosis, alarm alerting and fault controlling were the deliverable tasks of the monitor. In order for the monitor to scale up, a number of Belief-Desire-Intention (BDI) agents are deployed semi-independently in a collaborative architecture. The real-time reasoning of those agents is informed by thorough and consistent knowledge that is derived – in a cost-effective approach – from the off-line safety assessment models of the monitored system. The illustration below summarizes the entire approach of the paper.



Finally, the last topic was Discrete Event Systems Control. In this topic the researchers were tackling issues that mainly concern the fault-tolerance technique and how systems are able to correct or adapt their real-time faults.

It is worth mentioning that such a workshop represents an opportunity for researchers to extend their contact networks and also to keep themselves aware of recent research challenges and new techniques that can be exploited to tackle those challenges.

DIAL's paper on warehouse management systems in HoloMAS 2013

Vaggelis Giannikas, doctoral student in the DIAL group, presented the group's research on warehouse management systems at the 6th International Conference on Industrial Applications of Holonic and Multi-Agent Systems at the end of August this year. The conference aimed to bring together researchers active in the area of holonic and multi-agent systems together with key engineers and industrial decision makers to share their views and experience in design, development and applying holonic and multi-agent systems for industrial problems. In his talk, Vaggelis explained how product intelligence can be deployed and used in warehouse operations as well as the first results of an ongoing industrial study which is done in collaboration with James & James, an e-commerce fulfilment company. For more information, contact Vaggelis at eg366@cam.ac.uk or access the article online at http://link.springer.com/chapter/10.1007%2F978-3-642-40090-2_20

Phil Catton's winning photo

DIAL's RA, Phil Catton, won 3rd Prize in this year's Carl Zeiss photography competition. This competition is organised by the Engineering department every year and it is open to all staff and students. His prize winning photograph titled "Mirror effect" shows researchers from CSIC (Centre for Smart Infrastructure and Construction) and engineers from The London Underground using a 3D laser scanner to measure deformations in the London Underground Northern Line station at Euston.

Congratulations to Alex Borek!

We have got the pleasure to announce that Dr Alex Borek won this year's competition for the 2013 Ballou-Pazer Information Quality Dissertation Award for his dissertation entitled, "A Risk Based Model and Process for Quantifying the Business Impact of Information Quality."

Alex Borek was DIAL's PhD student under the supervision of Dr Ajith Parlikad. He successfully completed his PhD studies in November 2012 and is currently working for IBM in London. Alex will be presented with his prize of $1,000 at this year's ICIQ conference in Little Roc, Arkansas.

Recent Research Publications

Giannikas, V., Lu, W., McFarlane, D. & Hyde, J. (2013). Product Intelligence in Warehouse Management: A Case Study. In V. Marík, J. L. M. Lastra & P. Skobelev (ed.), HOLOMAS 2013: 6th International Conference on Industrial Applications of Holonic and Multi-Agent Systems, Vol. 8062 (pp. 224-235). Springer Berlin Heidelberg.

Gao, J., Woodall, P., Koronios, A., and Parlikad, A.K. 2013. Data Profiling challenges in Engineering Asset Management Data – Conceptual Design for Next Generation Data Profiling Software. International Conference on Information Quality (ICIQ).

Oberhofer, M., Woodall, P. and Borek, A. (2013). Solution Architectures for Generating Synthetic Data while Retaining Data Quality Problems. In International Conference on Information Quality (ICIQ).

Woodall, P., Gao, J., Parlikad, A.K., and Koronios, A. 2013. Classifying Data Quality Problems in Asset Management. Proceedings of the World Congress on Engineering Asset Management (WCEAM).

Masood, T., Erkoyuncu, J. A., Roy, R., and Harrison, A., "Integrating design attributes, knowledge and uncertainty in aerospace sector", CIRP Journal of Manufacturing Science and Technology, Accepted for publication, 26 September 2013.

Masood, T., Cuthbert, R., McFarlane, D.C., Parlikad, A., "Information futureproofing for large-scale infrastructure", IET/IAM Asset Management Conference, to be held in London during 27-28 Nov 2013, Accepted for publication.

Recent DIAL seminars

Agent Based Modelling, Dr Elisabete Silva (Department of Land Economy, Cambridge University), 28th October 2013, IfM, Seminar Room 3.

Manufacturing and Information Management research at Loughborough University, Prof Tom Jackson (Loughborough University), 29th October 2013, IfM, Seminar Room 3.

Upcoming DIAL Seminars

Optimising Maintenance of Multi-Component Systems with Continuous State Degradation Interactions, Nipat Rasmekomen (DIAL), 31st October 2013, IfM, Seminar Room 2.

Interoperability on the Internet of Things, Pilgrim Beart (AlertMe.com Ltd), 7th November 2013, IfM, Seminar Room 3.

Information Requirements, Rachel Cuthbert (DIAL), 12th November 2013, IfM, Seminar Room 2.

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.