DIAL Quarterly January 2015: Sohoma 2014, ALADDIN transition, Update from JQ Wang, AutoID for Smart assets and cities workshop, latest publications and much more.

Meet DIAL's visitor :

Irene Roda

Irene Roda is a PhD student at the Department of Management, Economics and Industrial Engineering at the Politecnico di Milano (Italy). Her main area of interest is engineering asset management and her research is currently focusing on the evaluation of Total Cost of Ownership as a decision-making support for managing industrial assets. She joined the DIAL group as a visiting PhD student in November 2014. Irene is an Industrial Engineer; she completed her BSc degree at the University of Bologna in Management Engineering and her MSc degree at the Politecnico di Milano, specializing in Manufacturing & Management Engineering. Her research interests are Physical Asset Management,

Introduction from Professor Duncan McFarlane:

Welcome to the Winter 2015 edition of the DIAL Newsletter

Twenty-three years ago when I was working at BHP Co Ltd running an automation and control research programme in the steel industry, I was presented with the opportunity to become involved in the newly formed Holonic Manufacturing Systems consortium. It was one of six consortia being formed under the umbrella of the global Intelligent Manufacturing Systems [IMS] programme. After an initial glance, I prepared to discard the request. The steel industry at that time [and ever since] was in cost-cutting mode, our research was very short term in focus. I needed sponsorship for such an endeavour from our steelwork operations and I simply couldn't envisage convincing any of my industrial control colleagues to become involved. However, I dutifully bundled off some documentation and sent it to our Newcastle and Pt Kembla steelworks noting that such developments might help BHP Steel manage some of the rapid market changes that it often faced. The response was surprising. I received an emphatic "Yes" from both steelworks who cited examples of production delays, lack of flexibility, lost market opportunities, etc which they believed could be attributed to excessive rigidity of the production control systems we used. This was deep in the age of Computer Integrated Manufacturing [CIM] where computer control architectures were prescriptive, hierarchically structured and where command-

Maintenance Management and Production Management.

Meet DIAL's new PhD students:

Joel Adams

Joel Adams joined DIAL in January 2015 to pursue a PhD, under the supervision of Dr Ajith Parlikad. In his PhD Joel is researching Condition-based Maintenance. Joel holds a Master's degree in Control Systems from the Imperial College London. He also holds BEng.(1st Class Honours) in Electrical & Electronics Engineering from the Niger Delta University, Nigeria. After completing his first degree he worked for AOS Orwell, an Oil Service company, for a few months. In his free times he enjoys singing gospels. His research Interests are: automated fault detection and diagnosis, industrial automation and instrumentation operations-based asset management

Mudassar Ahmed

Mudassar Ahmed joined DIAL in January 2015. With a background in automation, as evidenced in the successful demonstration of

control to ensure smooth operation overrode the need to flexibly adapt. I was particularly told of a lost opportunity within the steel plate operations to meet a market need for a thinner plate than we usually produced. Mechanically it had been a relatively easy opportunity to adapt the plate rolling mill to execute the additional rolling passes to achieve the new thickness and to determine the changed spray cooling conditions to achieve the correct metallurgy. But it took almost six months to be confident that the mills planning, scheduling and control systems could be successfully adjusted. By this time the market opportunity had disappeared.

So into Holonic Manufacturing we went. It literally changed my working life. It took a long time to take root that the main challenges for industrial control were not generally to do with machine control – my previous area - nor generally with off line planning and scheduling but rather in the mushy zone in between where the execution of orders takes place, where material flow has to be controlled and at the same time operations on that material accurately managed. It was also the era when Statistical Process Control [SPC] gained a strong foothold – but only for the monitoring and control of steady operations in steady-state – and in the steel industry as we sought to adjust to changing customer needs – there were more starts up, change overs and shut down than ever before. And when I moved to Cambridge in 1995 I could see that these challenges were widespread across many manufacturing sectors. So the notions of managing manufacturing execution operations under disruptive or changing conditions became a focus and holonic manufacturing and the multi-agent based control stood out as providing a guiding light as a way of enabling machines to "think for themselves" under changing conditions. Sometime in the mid-nineties people began to wonder whether the product being made might also benefit from thinking for themselves and the seeds of product intelligence emerged. Elsewhere over the next years other bio-inspired paradigms were also proposed, and developments in internet, multi agent software, flexible logic controllers, radio frequency tagging, and real-time data management helped to provide a more convenient platform for developing these solutions. So in 2015 it is interesting to reflect on the expansion and diversion of this domain. This volume based on the SOHOMA 2014 Workshop provides an excellent snapshot on the current state of work in this area – albeit from a predominantly European perspective.

As the Editors indicate in their Preface, this book is able to update the reader on a range of developments ranging from distributed AI, the influence of complexity and big data on this domain and extends from manufacturing to consider closely related logistics issues. It will be a very useful addition to your bookshelf!

Autonomous Height Control of a toy helicopter, he aims to explore numerous mini-projects within Industrial Automation, Future Manufacturing and Self-healing amongst others. This is with a view to discovering a challenging problem with a commercial value. Out of his research, he hopes to start a spin-off company.

After graduating, Mudassar Ahmed worked at Siemens AG as a project engineer, where he gained some industrial experience. He graduated with an MPhil in Nuclear Energy from King's College Cambridge. Just last year, he was awarded the MPhil scholarship by the Industrial Club of Cambridge University Engineering Department as well as a Supplementary Exhibition Grant by King's College Cambridge. He has a background in Electrical and Electronic Engineering with a keen interest in Control and Automation.

Meet DIAL's new research staff:

Pascal Wichmann

Pascal Wichmann studied Business Engineering at the Karlsruhe Institute of Technology in Germany. Pascal visited DIAL for six months in 2010. His work at the time was on quality management of crowdsourced micro-tasks ("Human Computation").

AutoID for smart assets and cities workshop

AutoID for smart assets and cities workshop, hosted by DIAL, was the first in the series of CSIC events on emerging smart technologies for the construction industry, took place on 30th October 2014 at the Institute for Manufacturing.

Redbite's Keith Lee and Alex Wong demonstrating to the CSIC director Jennifer Schooling

Speakers from CrossRail, Laing O'Rourke, and ATC were among key speakers to discuss the challenges of tackling asset identification. Experts from the Cambridge University AutoID Labs and FlyingBinary put these challenges into perspective with reports of progress in other industries and the upcoming PAS182 Smart Cities standard. Sky High Technology, Cambridge Consultants and Redbite Solutions gave live, hands-on demonstrations of systems to identify objects, giving them a personality and tracking their location. Enlight explained how energy efficient lighting systems can be used to form the backbone infrastructure of a smart city.

Kate Duggan from Englight explaining energy efficient lighting systems

DropTag used their Bluetooth sensor tags to monitor the real-time behaviour of scaletrix cars and the track they are travelling on. SkyHigh showed the live feed from a detailed traffic survey outside

After having worked for three years as a strategy consultant, Pascal joined DIAL again in 2015 as a research assistant.

Pascal's current project will focus on the business management of supply chain issues using data-driven techniques, and aims to develop working prototype software systems which can demonstrate the ability to make supply chain-related predictions. It also aims to extend these prototypes into applications or methods to be used within actual operations, as well as measure and evaluate the effectiveness of these in a real environment. Pascal's research interests are data science, machine learning, data mining and "Big data".

Recent Research Publications:

Attwater, A., Wang, J.Q., Parlikad, A.K., Agnew, R., "Performance measurement of asset management systems," 4th IET/IAM Asset Management Conference, London, Nov 2014

Parlikad, A.K., Jafari, M., Zuashkiani, A., Schoenmaker, R., "A critical examination of asset management curriculum in the Europe, Australia and America," In Proc. 4th IET/IAM Asset Management Conference, London, Nov 2014

Mukai, T., Tomasella, M., Parlikad, A.K., Abe, N., Ueda, Y., "The competitiveness of condition monitoring of residential PV systems: a model and insights from the Japanese market," IEEE Transactions on Sustainable Energy, Volume 5, Issue 4, pp. 1176-1183, 2014.

the building, and Redbite showcased their cloud based asset tagging and tracking systems.

Tom Lawrie-Fussey from DropTag demonstrating using scaletrix cars

Workshop participants discussed how civil assets are being 'smartened up' by industry leaders, technology providers and policy makers and examined the layers of innovative technology used to automatically identify (AutoID) objects and people to streamline construction and asset management processes, creating the building blocks of a Smart City.

Key industry players revealed how they are working to revolutionise their approach to construction and asset management, using AutoID technologies to keep track of components and people, and demonstrations of state-of-the-art equipment illustrated how off-the-shelf technology can be used or adapted for construction and fed into Smart Cities initiatives.

This workshop was the first in a series of CSIC events on emerging smart technologies for the construction industry. DIAL will be hosting a similar session on the 'Internet of Things for Construction' on 25th February, and 'Big Data for Construction' on 25th June. To book your place or for more information, please contact the organiser, Dr Phil Catton at ppc29@cam.ac.uk.

"Aladdin-Transition"

The Achieving Leverage Advantage from Distributed Information (ALADDIN) project sponsored by Boeing, over the last three years, has developed state-of-the-art solutions to industrial data management challenges. The research phase of this project concluded in October 2014 and there is now the exciting opportunity to transition the research solutions into Boeing. A new "Aladdin-transition" project has been formed to support this endeavour, which will run for 12 months.

As part of the research phase, automated solutions have been developed to:

Wang, J., Hou, D., Parlikad, A.K., "Evaluating the effectiveness of performance measurement systems for engineering asset management using performance data," In Proc. 21st EurOMA Conference, Palermo, June 2014

Dheedan, A., Parlikad, A.K., "Fault Diagnosis and Fault Data Management Technique for Intelligent Asset Maintenance," In Proc. 9th World Congress on Engineering Asset Management, Pretoria, Oct 2014

Urmetzer, F., Parlikad, A.K., Pearson, C., Neely, A., "Design Considerations for Engineering Asset Management Systems," In Proc. 9th World Congress on Engineering Asset Management, Pretoria, Oct 2014

Srinivasan, R., Parlikad, A.K., "Semi Markov decision process with partial information for optimum maintenance decisions," IEEE Transactions on Reliability, Volume 63, Issue 4, 2014, pp. 891-989

Rasmekomen, N., Parlikad, A.K., "Optimising maintenance of multi-component systems with degradation interactions," In Proc. 19th IFAC World Congress, Cape Town, August 2014

Successful 12 months for JQ

In the last twelve months JQ Wang successfully continued his

- • Correct data quality issues,
- • Determine what data is most valuable for decision making,
- • Identify data integration opportunities, and
- • Understand the meaning of the data when it is shared between business units without supporting documentation / metadata.

Software applications were developed during the project which address these issues, and currently these are being transitioned into Boeing.

The solutions developed in ALADDIN are domain agnostic and can address data issues in all areas, such as production, logistics, and through-life support. However, part of ALADDIN focussed on the data associated with procurement which suffers from high levels of inconsistency, with the same part often described in a multitude of different ways by Boeing's many thousands of suppliers. In a fast-paced manufacturing environment, this inconsistency has the potential to cause problems with shortages and disruptions which can only be averted by labour-intensive (and, therefore, costly) data management processes.

But this could be avoided altogether if the data were intelligent enough to 'have organic awareness of its own value' and be able to predict potential problems. The associated benefit would be that the many people who currently spend their time sifting through and improving data could be deployed on more strategically useful tasks.

Bill Krechel, Technical Lead Engineer in Lean Production System Technology for Boeing Research & Technology, explained: "ALADDIN technologies represent a paradigm shift for us at Boeing: with the completely new and innovative industrial data management ideas and technologies developed by DIAL, many of our day-to-day data issues – which disrupt our operational staff – will be a thing of the past."

Sohoma 2014

Duncan McFarlane, Vaggelis Giannikas and Torben Jess attended the 4th Workshop on Service Orientation in Holonic and Multi-Agent Manufacturing (SOHOMA) in Nancy, France, in November 2014. Duncan was one of the keynote speakers and Torben and Vaggelis presented two of their papers.

Duncan's keynote speech gave an overview of DIAL's recent and future work on intelligent products in logistics. More specifically, Duncan discussed different ways a logistics customer can get "closer" to his order via automated software which represents his needs and preferences to the logistics provider dealing with his order. In this way, changing customer preferences such as customisation of the order, changing delivery details or priorities will automatically be conveyed to the warehouse and the

PhD study. First of all, he published and presented a paper at the EUROMA 2014 conference in Sicily, Italy. JQ then changed his PhD topic from "Evaluating the effectiveness of performance measures for asset management systems" to "Designing performance measures for asset management systems", and the changed topic attracted the collaboration from an engineering consultancy company, Costain. Eventually there was a paper authored jointly for the IET/IAM asset management 2014 conference in London. This paper described an asset management performance map to understand all essential activities and processes of an effective asset management system.

Furthermore, he focused his PhD study particularly in asset intensive manufacturing, and he conducted his first case study in an international leading vehicle glass manufacturer. The findings were very constructive and the case study tested and refined his preliminary frameworks. These frameworks describe the process for guiding organisations to help identify their performance measures as well as the perspectives which organisations should consider when selected performance measures, and frameworks have been initially proved to be feasible and usable. Currently JQ is writing another conference paper for WCEAM 2015 in Finland based on his first case study.

management of the order amended. In the last few years DIAL has carried out various types of work around further optimizing logistics operations by developing techniques to make them more customer-oriented and flexible.

Vaggelis presented DIAL's research in collaboration with a former IfM ISMM student, Nikolaos Tsamis. In his dissertation Nikolaos worked on approaches for adaptive storage location assignment in warehouses using intelligent products. Order picking in warehouses has become the bottleneck in fulfilling the orders of suppliers. In this talk, DIAL's approach for reducing the time of order picking by appropriately storing products when they arrive in the warehouse was presented. Current approaches only focus on the static placement of products but do not consider future changes in customer preferences. DIAL's approach enabled a more dynamic consideration of customer preferences and therefore an improved placement of new incoming products to the warehouse. Torben introduced his paper about evaluating the applicability of Multi-Agent Systems for distributed data management. Various companies are struggling with the application of Multi-Agent systems and identifying the clear benefits of Multi-Agent Systems. One of the main reasons for this problem is to distinguish between benefits created by distributed problem solving and the benefits created by applying Multi-Agent Software. Torben presented his analysis of the benefits of applying a Multi-Agent Software vs. an alternative bespoke approach in a distributed data management problem.

Congratulations to Dr Giannikas and Dr Rasmekomen!

Vaggelis Giannikas

Nipat Rasmekomen

Congratulations to Vaggelis and Nipat who have successfully defended their thesis. Vaggelis defended his thesis titled "Benefiting from product intelligence: the case of customer-oriented logistics" on the 18th December 2014. Nipat's defence took place on the 16th January 2015. The title of his thesis is Condition-based maintenance for multi-component systems with degradation interactions. Their degrees will be presented to them later this year. Vaggelis has been working as a research assistant in DIAL since October 2014. Nipat will resume his job with PTT Plc in Thailand.

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.