IfM Distributed Information and Automation Laboratory

UNIVERSITY OF CAMBRIDGE

DIAL Quarterly July 2012

Welcome from Professor Duncan McFarlane:

From Factory to Airport

Although our research into automation and information systems was originally focused on the industrial supply chain, in recent years we have become increasingly interested in the operations of airports and other service environments. In addition to Alan Thorne's enthusiasm for anything to do with flying, this work has been motivated by an opportunity to apply our tools and techniques in another domain. Examples of the airport work include extensive bottleneck and disruption analysis of aircraft turnaround with Flybe at Luton Airport, RFID impact and information sharing at Heathrow and Manchester airports and RFID and bar code baggage tracking trials at Kuala Lumpur Airport. Not only have we been able to readily adapt existing tools in this new domain, but the work also provides new developments which we in this seek to apply to our other industrial research.

CAMBRIDGE SERVICE WEEK

Future Event: Big Data in Complex Services

As a part of Cambridge Service Week, we are pleased to announce a one day conference for senior industrials and policy makers Big Data: an Innovation Opportunity for Complex Services?

This event is organised by DIAL's research partner, the Cambridge Service Alliance, and will be held on Tuesday 18th September 2012 at the Moller Centre, Cambridge, UK.

There is currently a great deal of discussion about 'big data' and its potential to generate dramatically new approaches to service provision. However, many people struggle even to define the term, so the possible implications are far from clear. This one-day conference will explore the truth behind these issues:

- What implications does big data have for the public and private sectors?
- What is its potential to increase competitiveness and revenue?
- Can big data be used to drive innovation in complex services?
- Practical examples of services innovation.

The event will provide unique insights from leading service providers and policymakers and offers a valuable opportunity to hear the latest developments in service thinking. It will showcase new research from the Cambridge Service Alliance, a global alliance of leading companies and universities established to develop new understanding and approaches to complex service provision.

Speakers include:

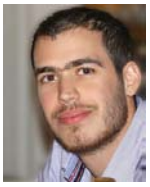
- Mr Will Cavendish, Cabinet Office, "Public Service Reform an Innovation: What Role for Data?"
- Mr Matt McNeill, Google, "Big Data – Changing the Game, Enabling and New Approach to Service"

As well as thinking about the future of services, you will also hear practical examples of today's service innovations in leading firms. For more information contact event organiser Nick Mann at the IFM at: events@cambridgeservicealliance.org

Positions Available in DIAL

DIAL is currently recruiting 2-3 Research Associates to work on automation and information projects in aerospace, construction and transportation areas. If you would like more information please contact Petra Kasmanova at dial-admin@eng.cam.ac.uk

Meet the Team: Vaggelis Giannikas



Vaggelis joined DIAL in October 2010 as a PhD researcher under the supervision of Duncan McFarlane. He is currently working on product intelligence and its benefits in supply chain operations and logistics. Prior to this, Vaggelis completed his undergraduate degree at Athens University of Economics and Business in Greece, where he specialised in enterprise information systems and e-business. Vaggelis completed his undergraduate studies with a first class degree and then worked as a research assistant investigating information systems for supply chain management and e-commerce, as well as organisational adoption of open source software platforms. He also worked in industry as a freelance consultant with a leading software and integrated IT solutions group in Greece. Since April 2010, he has been a member of the editorial board and a regular author of XRDS, the ACM (Association for Computing Machinery) magazine for students, of which he is currently editor in chief. Vaggelis also teaches music theory and plays classical guitar.

Meet IIT Students, Indian Institute of Technology:

Sushant Agarwal is a 4th year Aerospace engineering student from the Indian Institute of Technology in Bombay. Mr Agarwal is also pursuing a degree in Management. During his two month internship, Sushant worked on "Date Quality Assessment" for the Aladdin project with Boeing, under the supervision of Mark Harrison and Philip Woodall. Sushant assisted with developing an automated framework through which data quality problems can be resolved or automatically repaired. To achieve this, Sushant had to categorise the data quality problems according to the data types and the data fields. In order to develop an automated system, he prepared an algorithm in JAVA to assess the major data quality problems.

Abhinav Prakash is a final year undergraduate engineering student at the Indian Institute of Technology in Kanpur, department of Materials Science and Engineering. Abhinav held an internship in DIAL from May to July 2012. Whilst at the IfM, Abhinav worked on project DisTAL under the supervision of Alan Thorne and Duncan McFarlane. As part of his work, Abhinav experimented with existing distributed intelligent control architectures in the field of manufacturing by simulating them and examining their benefits. Abhinav used a simulated model of the DIAL as a framework for implementing the various architectures. He also tried to identify the benefits of various simulation tools.

Meet our visitor: Dr Valeriy Vyatkin

Valeriy Vyatkin joined DIAL in July 2012 as a visiting scholar for 1 year. He is an Associate Professor (Reader) at the University of Auckland in New Zealand. Valeriy leads an Industrial Informatics lab with main research focus in distributed automation concepts. In particular, Valeriy and his team of seven PhD students investigate software engineering methods for future automation systems based on the concept of distributed intelligence. Main drivers of this are flexibility and reconfigurability, but also insufficient computational performance and scalability of the current PLC based automation solutions.

The challenge is to bring the advanced agent based design methods into the engineering practice. One of the promising technologies helping to merge agents with PLC realities is function block technology of IEC 61499 standard being in focus of research at Auckland. This technology combines model-based design features of block diagrams, state charts and PLC languages.

The research interests of Valeriy's group and DIAL have a great deal in common. For example, the group at Auckland University has been investigating distributed control of airport baggage handling systems, which has been proven to bring higher flexibility of operation. Another promising area for distributed intelligent automation is SmartGrid – future energy infrastructure.

Valeriy is also very keen on developing new verification and validation methods for distributed systems based on a combination of simulation and formal verification. Valeriy has developed several software tools for this purpose.

Recent DIAL Seminars

Fredy Joao Valente (CTO – COSS Consulting – Brazil), "Tracking the Coffee Supply Chain with EPC RFID "– a real case, 24th July 2012, IfM Seminar Room 3.

Zhenglin Liang (DIAL), "Top down model of condition based maintenance for complex asset", 5th July 2012, IfM Seminar Room 3.

Dr Maurizio Tomasella (DIAL) and Dr Simon Ford (Centre for Technology Management), "Towards the resilient firm", 28th June 2012, IfM Seminar Room 3.

Nipat Rasmekomen (DIAL), "Asset Management Decisions and Performance Measurement", 31st May 2012, IfM Seminar Room 3.

Prof Duncan McFarlane (DIAL), "Product Intelligence: Theory and Practice", 21st June 2012, IfM
Review: *On June 21st, Prof Duncan McFarlane gave a talk on product intelligence in today's business environment at the Institute for Manufacturing. This talk aimed to review the notion of product intelligence, the rationales for its use and the practicality of their implementation. Using a number of industrial scenarios and some trial deployments, Prof McFarlane showed how product intelligence can provide an order or a customer-orientated approach, as opposed to a more conventional organisation-orientated approach to managing operations. Such an approach can be particularly beneficial in situations where the nature of the processing of the product might change or where the customer and supplier may have either different perspectives or where the supplier may have a limited ability to access information or influence the progress of an order.* (Review by Vaggelis Giannikas)

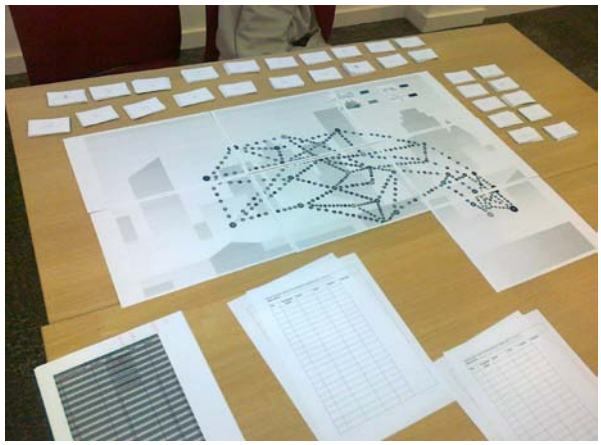
Vaggelis Ginnikas (DIAL), "Product Intelligence in Intermodal Transportation: The Dynamic Routing Problem", 17th May 2012, IfM Seminar Room 3.

Dr Jing Gao (Senior Lecturer, University of South Australia), "Information quality research at the University of South Australia", 10th May 2012, IfM Seminar Room 3.

Valeria Klassen (Karlsruhe Institute of Technology), "Assessing Information Risks in Engineering Asset Management", 9th May 2012, IfM Seminar Room 3.
Review: *Valeria Klassen gave a talk on how to quantify the business impact of poor data and information. Decisions that are derived from data analytics depend however on the quality of the data itself. As we have collected masses of data over recent decades, companies have to be able to understand where to set their priorities in data quality and analytics improvements. Valeria presented a risk based model that helps to calculate and identify where poor data bring the biggest risks to an organisation which, in turn, helps companies to focus on the biggest data pain points from a business perspective. Valeria graduated from Karlsruhe Institute of Technology with a Masters Degree in Business Engineering and Management earlier this year. Valeria did her final thesis at DIAL last year. Her project was supervised by Alexander Borek and Ajith Parlikad.* (Review by Alexander Borek)

Playing Games for Logistics Research

Dionysios Kola, an ISMM student, completed his thesis with the title "Understanding Travel Behaviour Using Game-Based Methodology" in June 2012. His project was supervised by Duncan McFarlane and Vaggelis Giannikas. The motivation for the research stemmed from the consequences imposed on a company's logistics because of potential disruptions to its shipping process due to unexpected events (natural disaster, strikes, closed terminals etc.) The aim of the research was to gain an insight into the way humans make decisions and act when unexpected events occur while they are travelling in multi modal transport networks. The work was carried out by designing and implementing a board game as an experimental research tool. The game represented an intermodal transportation network where each player had to "travel" through several terminals before he reached his final destination. The starting point and destination of the trip were common for all players. The objective of the game was for the players to reach their destination within a certain amount of time (number of days) using as few points as they could. Each round in



the game represented one day, whilst the points represented the cost of transport between terminals and varied depending on the trip duration and the mode of transport chosen. Moreover, random unexpected events disrupted players' journeys and in such cases each player recorded the strategy used in order to deal with the event. In the end, the winner was the player who managed to use the fewest points and arrive on time (by the deadline provided at the beginning of the game). The link between the research conducted and the industrial world is the potential exploitation of a human based approach to solving logistic problems by implementing human thinking process in automated systems.

DIAL PhD student, Pankaj Sood, attends The Internet of Things Conference in China

The China Council for the Promotion of International Trade, Shanghai Sub-Council, sponsored an Internet of Things conference in Shanghai in July. The Auto-ID lab in Cambridge was invited to participate and share their work on intelligent operations and transportation. The conference was well attended, with speakers coming from all parts of the world and reflected the fact that Internet of Things is a key strategic development in China at present. The key themes discussed included transportation, track and trace and the evolution of the internet of things.

DIAL has a strong interest in these areas and our previous work through the Auto-ID lab and other initiatives have provided us with an opportunity to stay at the forefront of some of these areas. The joint Boeing/DIAL project SAHNE (Self-Serving Assets in a Highly Networked Environment) is one of these projects and the one that our team had presented at the Internet of Things conference. The project looked at making products intelligent enough to be able to engage in replenishment processes through the use of software agents.

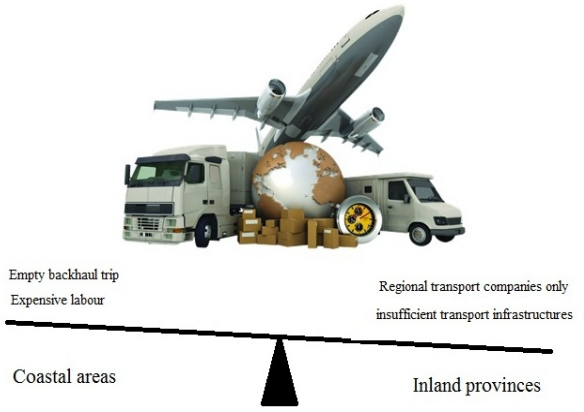
The Internet of Things conference was a great opportunity for our team to interact with other leading academics and practitioners in the area and also provided us with a key platform to disseminate information about some of our activities that pertain to the internet of things.

Logistics challenges in China – problems bring opportunities

DIAL PhD student, Wenrong Lu, brings us an insight into logistics problems in China.

The efficiency of China's logistics industry remains low in terms of the ratio of logistics expenditures to GDP (Gross Domestic Product). Despite the drop from 19.4% to 17.8% for the past decade, the figure remains double the % achieved in developed countries such as US, Japan and EU of which logistic spending accounted for 8.3%, 8.7% and 8.9% to GDP respectively.

Imbalanced development is a major cause for the low efficiency. For those companies or manufacturers based in the coastal area, significant increase of local labour costs and high percentage of empty backhaul trips to the relatively underdeveloped inland provinces are becoming a major concern. As a result, more



companies start moving to the inland provinces to take an advantage of low labour costs and an abundant labour force. However, such benefits can be quickly overshadowed by the insufficient transport infrastructure within inland provinces and the lack of national trucking companies, which results in higher transport costs, longer lead times, frequent delays, more transhipments, insecure stock in transit and lower transport service levels.

Such contradiction highlights the main challenges which could potentially bring opportunities for enhancing competitiveness for the third party logistics providers (3PL):

- To improve service to the firms located in the coastal region, the number of manual labourers is to be reduced, i.e. more integrated and advanced IT solutions and automated applications such as automated warehousing should be developed.
- For servicing the firms in the inland province, nationally integrated intermodal transport network needs to be provided. This would involve i.e. enhancing communication and coordination between departments in charge of organising shipments using highways, railways and airways so as to provide a more dynamic and resilient transport service.
- It won't be too long before China narrows the development gap between the coastal and inland provinces, which will consequently bring an end to cheap labour in China. In view of this, concepts of intelligent products and multi-agent platforms for trading and coordinating shipments automatically on a nationally integrated intermodal transport network basis would prove advantageous.

These challenges could become interesting research areas for the DIAL group, as by improving the logistics efficiency. A drop of 1% in China's logistics expenditure to GDP ratio means a £40 billion saving in logistics costs for Chinese supply chain.

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.

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