

Technology Management

The newsletter of the Centre for Technology Management (CTM)

November 2015

Professor Sir Mike Gregory retires as Manufacturing at Cambridge reaches its 50th anniversary

On Wednesday 30 September, the IfM gathered to wish **Professor Sir Mike Gregory** all the best for a long and happy retirement, as he handed leadership of the Institute over to **Professor Andy Neely**.

Mike has been central to the growth of manufacturing-related education and research at the Engineering Department since he came back to the University in 1975, having earlier been a student on the ACPMM course (now ISMM). During that time, amongst many other achievements, he helped to set up the Manufacturing Engineering Tripos, founded the IfM and initiated many of the research activities that now characterise its work.

We in CTM were fortunate to build on one of Mike's early papers*, as a core foundation. His ISAEP (identification, selection, acquisition, exploitation and protection) process model has provided a holistic framework for much of our later research and teaching.

As with many at the IfM, we are indebted to Mike for his inspiration and enthusiasm over many years and look forward to continuing in the tradition of industrial engagement that he established.



*Gregory, M.J. (1995) "Technology management - a process approach", *Proc Instn Mech Engrs*, Vol. 209, pp.347-356

3D printing projects update

3DP-RDM: Defining the research agenda for 3D printing-enabled re-distributed manufacturing

Following the scoping workshop in January and the feasibility study competition, four studies are currently receiving funding as part of the 3DP-RDM network:

- 1. Investigating the Impact of CAD Data Transfer Standards for 3DP-RDM** - understanding how CAD data transfer standards are being developed and used within the 3DP-RDM landscape, and the opportunities and requirements for open architecture data transfer standards.
- 2. OPTIMOS PRIME: Organising Production Technology Into Most Responsive States – 3D PRInt Machine Enabled Networks** - developing (1) a simple control architecture that integrates multiple production sites including 3D printing systems and (2) a 3DP demonstration system for supporting late customisation, spares and repairs requests and small batch orders in different industrial contexts.
- 3. The enabling role of 3DP in redistributed manufacturing: A total cost model** - developing cost models to establish an understanding of 3DP as a parallel digitally integrated

manufacturing technology capable of operating in a re-distributed setting.

- 4. Redistributing Material Supply Chains for 3D printing** - Understanding how 3DP can be embedded in local material economies and how such developments may gradually alter the global landscape of materials supply and manufacturing.

These four studies address the research issues identified in the scoping workshop, covering economic modelling, production systems, materials, supply chains, software and standards.

The projects will be completed at the end of 2015, with their insights providing inputs into the emerging RDM agenda and the second round of feasibility studies.

A dissemination workshop and a second scoping workshop will be held on 14-15 January 2016. For more information contact **Simon Ford** sjf39@cam.ac.uk

Bit by Bit project

As reported in earlier CTM newsletters, the Technology Enterprise Group has been studying the advent and impact in industry of digital fabrication technologies, in particular Additive Manufacturing (also known as 3D printing) technologies. These technologies offer the prospects of on-demand, mass personalisation, with more localised, flexible and sustainable production. As a result, they have the potential to disrupt the organisation of manufacturing and the ways in which companies

– both incumbents and new entrants – create and capture value. Many technology management issues can be investigated by studying this current phenomenon and, thanks to funding from the EPSRC and the ESRC, we are pursuing several research directions in collaboration with a broad range of industry and academic partners.

We are very pleased to announce that **Dr Mélanie Despeisse** has joined our team having recently completed a number of projects at the Centre for Industrial Sustainability. She is working closely with **Dr Simon Ford** investigating the potential impact of additive manufacturing technologies on the sustainability of manufacturing processes and industrial systems.

Dr Letizia Mortara has hosted a series of research student projects including:

- **Serena Flammini** from the University of Roma 3 is visiting CTM for the next six months, and will investigate how the availability and emergence of additive manufacturing technologies impact the development of business models.
- **Karsten Schöer**, from this year's MPhil in Industrial Systems, Manufacture and Management (ISMM) cohort, studied the business models within the additive manufacturing equipment industry, identifying six key archetypes.
- **Johnson Pak**, a second year undergraduate from the Engineering Department, spent two months with us as part of his industrial placement scheme studying the diffusion of additive manufacturing technologies in the aerospace industry.

We are also delighted that the team has in the past few months been working on a special issue of Technology Forecasting and Social Change on additive manufacturing and its implications in industry. This volume is now in its final stages of production and soon will be available via www.journals.elsevier.com/technological-forecasting-and-social-change

Over the next 18 months, we will continue exploring how the advent and establishment of additive manufacturing is changing industry. Themes which are being explored include:

- How do additive manufacturing technologies enable mass customisation? (*Dominik Deradjat, Tim Minshall*)
- How do additive manufacturing technologies enable sustainability in industrial systems? (*Simon Ford, Mélanie Despeisse*)
- How do additive manufacturing technologies impact on business models change? (*Letizia Mortara, Serena Flammini, Chander Velu*)

- What are the skills required for additive manufacturing that will enable the diffusion of these technologies to support economic growth? (*Tim Minshall*)

Recent publications based on the results of this work can be found on the last page of this newsletter.

Developing a UK National Strategy for Additive Manufacturing/3D printing (AM-3DP)

Issue	Summary of common perceived barriers
Materials	Understanding properties in different processes / machines / applications, QA, costs, availability (IP constraints, independent suppliers), use of mixed materials, recyclability, biocompatibility.
Design	Need for guides and education programmes on design for AM – better understanding of design for AM constraints, availability of AM-skilled designers, security of design data.
Skills / Education	Lack of appropriate skills (design, production, materials, testing) preventing adoption, up-skilling current workforce vs. training of next generation, education of consumers, awareness in schools.
Cost / Investment / Financing	Funding to increase awareness and reduce risk of adoption (testing, scale-up, machine purchase) – especially for SMEs, understanding of full costs (including post-processing, testing), cost of materials.
Standards / Regulation	Perceived or actual lack of standards – all sectors / sector specific (especially aero / health / motorsport), for processes / materials / software / products / applications.
Measurement / Inspection / Testing	Need data libraries, standards for tests (general and sector specific), materials / in-process / final part, tests for higher volumes, non-destructive testing, QA through lock-in c.f. open access to data.
IP / Protection / Secrecy	Balancing need for openness to share knowledge with need for commercial protection to capture value from investments, enforcement of IP rights.

CTM researchers are helping to coordinate the gathering of evidence to support the development of a UK National Strategy for Additive Manufacturing/3D printing (AM-3DP).

With guidance from the IfM's Centre for Science, Technology and Innovation Policy, and working with Professor Phill Dickens from the University of Nottingham, a series of workshops and an on-line call for evidence have been run. The evidence gathered through these channels has highlighted the major areas of concern, and is now helping to structure the activities of working groups who will be exploring sector specific issues in more detail.

Key issues identified so far can be seen in the following table:

Updates on the progress of the development of the National Strategy are available here: www.amnationalstrategy.uk

STIM 2016 Launch

The Strategic Technology & Innovation Management (STIM) Consortium is an annual rolling programme, now in its third year. It brings together managers from a range of sectors and CTM researchers to support industrially-relevant research, networking and knowledge exchange.

The 2016 programme launch meeting will be hosted in Cambridge on Wednesday 18 November, providing interested companies with an opportunity to shape the programme for next year.

For more information about the STIM programme, or to reserve a place at the launch event, please contact:

Dr Rob Phaal

rp108@cam.ac.uk

+44 (0)1223 765824

www.ifm.eng.cam.ac.uk/research/ctm/stim

Polish scientists learn about Innovation and Technology Management

CTM (through IfM ECS) shared its knowledge and experience of innovation and technology management with a group of 75 Polish scientists as part of Poland's 'Top 500 Innovators' programme, set up by the Polish government to help bridge the gap between academia and business.

The nine-week stay was organised by Cambridge Enterprise as part of the University's International Outreach Programme (IOP). The scientists learnt about roadmapping, choosing the right technology projects and managing them effectively from **Dr Nicky Athanassopoulou**, and about marketing and making the business case for new technologies from **Dr Imoh Ilevbare**, while **Dr Letizia Mortara** shared tools and techniques on technology intelligence for identifying threats and opportunities presented by new technologies.

People news

We welcome:

Dr Mélanie Despeisse, previously researcher at the Centre for Industrial Sustainability, has joined CTM as a Research Associate working on the "Bit by Bit" project, investigating the potential role of additive manufacturing in transitioning towards a more sustainable society.



Serena Flammini has joined as an academic visitor as part of a PhD at the Department of Business Studies at Roma Tre University. She will contribute to Letizia Mortara's research within the Bit by Bit project in the fields of additive manufacturing, technology commercialization and business model innovation.



New PhD students:

Mingjin Guo is starting her PhD study under the supervision of Dr Frank Tietze. Her research interests include IP (Intellectual Property) strategies and Product Service Systems. She obtained a bachelor's degree in civil engineering in Tsinghua University and a bachelor's degree (double major degree) in economics in Peking University in 2014. Then she studied in MPhil in Energy Technologies in University of Cambridge during 2014-2015.



Zhenyu Liu (Lisa) is starting her PhD under the supervision of Dr Letizia Mortara. Her research interests focus on open innovation. Lisa obtained a bachelor's degree in Accounting and Financial Management at Loughborough University. During her placement year, she worked at Accenture in China and participated in an exchange student programme at Curtin University in Perth, Australia. She did a Master's Degree in Business Consulting at Warwick Business School, Warwick University.



Yong Bang Ming will be working with Dr Tim Minshall. He obtained a B.Eng in Electronic Engineering from Universiti Sains Malaysia in 2013 and briefly worked in manufacturing and construction industries prior to pursuing his graduate studies. He is currently interested in researching the geographical impact on innovation.



We say goodbye to:

Tom Oberquelle who was a visitor from Kiel University, Institute for Innovation Research and **Thorsten Peiper** from Hamburg University of Technology (TUHH), Institute for Technology and Innovation Management who were here working with Frank Tietze.

Realising the Potential of Early Stage Technologies

In September, CTM ran its "Realising the Potential of Early Stage Technologies" executive education course for the third time. The course covered the front end of innovation, opportunity identification, tools for decision-support and early stage technology valuation. Participants included individuals from Sharp Laboratories, Subsea 7 and Suntory. Anyone interested in attending the 2016 course should get in touch with Jo Griffiths jg393@cam.ac.uk

APMS Conference



CTM researchers, **Simon Ford** and **Mélanie Despeisse** attended the "Advances in Production Management Systems" (APMS) Conference in Tokyo in September. Simon presented work on the processes used in the 3DP-RDM project, while Mélanie shared their work on the sustainability implications of additive manufacturing. Among the 200 participants, Mélanie's presentation was selected as the best of the conference.

Rob Phaal visits Beijing

Dr Rob Phaal visited Beijing to attend the final meeting of the Europe-China High Value Engineering Network (EC-HVEN), funded by the European Commission's Marie Curie programme, to foster researcher exchange and collaboration. The programme is led by Prof Yufeng Zhang from the University of Birmingham, an alumnus of IfM. The trip to Beijing provided an opportunity for some other interesting visits, to the Tsinghua-BP Clean Energy Research and Education Center and the Chinese Academy of Engineering, facilitated by Prof Yuan Zhou, also an alumnus of IfM. Time was spent with the International Cooperation Center of the National Development and Reform Commission, a government agency responsible for coordinating international industrial collaboration and investment. The trip finished with a very interesting visit to BOE, the second largest manufacturer of display systems in the world - expect to see the BOE brand in UK retail outlets soon.

IP Management and Innovation activities

Different activities are under way to strengthen CTM's new research initiative on Intellectual Property Management and Innovation led by **Dr Frank Tietze**.

Launch of event series: Strategic Intellectual Property Forum (SIPF)

More than 50 participants attended the first Strategic IP Forum (SIPF) on 7 July. Four speakers shared insights into the relevance of IP for innovation, covering the academic perspective on university spin-outs, a medical technology company grown out of the university, the venture capital perspective and the UK Intellectual Property Office (UKIPO). SIPF provides an opportunity to engage in an expert network to discuss IP in a business context. The second SIPF on Tuesday 8 December will focus on IP and portfolio valuations - register for the free event here: bit.ly/1Pa9Fiu



Intellectual Property Interest Group (IPIG) launched

Following a kick-off meeting in July, IPIG convened in September for a first session. In contrast to the SIPF, IPIG provides a closed platform for senior managers to discuss IP topics in relation to innovation and technology development in confidence. Current members include multinationals, large Cambridge-based high-tech firms and a manufacturing research institute. To balance the discussion we are looking for smaller companies to join. If you would like to become involved please e-mail Frank Tietze frank.tietze@eng.cam.ac.uk

European Institute for Technology and Innovation Management (EITIM): into the future with a new generation

EITIM was established in 2000 by a group of senior academics including **David Probert** from CTM, with the aim to facilitate academic collaboration in our field across national European boundaries. The group recently prepared the handover to a new generation. The new group met for the first time for a two-day workshop in Cambridge on 2-3 October. CTM is represented by **Frank Tietze** and **Simon Ford**.



Technology management research at Cambridge

- Strategic technology management
- R&D project selection
- Software sourcing in manufacturing
- Enhancing creativity in new product development
- New product introduction collaboration
- Technology management: a process approach
- Technology selection
- Technology evolution in hi-tech firms
- Innovation management in hi-tech firms
- Emergence of technology based industry
- Technology scanning and intelligence
- Technology acquisition
- Intellectual property management
- Strategic make-or-buy
- Industrial make-or-buy decisions
- Sustainability and technology insertion
- Technology valuation
- Technology foresight

Congratulations

The paper "*Stakeholder Engagement in Early Stage Product-Service System Development for Healthcare Informatics*" authored by **Man Hang Yip, Rob Phaal** and **David Probert**, has been selected as the winner of the American Society for Engineering Management - Eschenbarch Award 2014. This award recognises the best journal article of 2014 in the Engineering Management Journal.

"*The industrial emergence of commercial inkjet printing*" by **Simon Ford, Michèle Routley, Rob Phaal** and **David Probert** has been selected as the best paper of 2014 in the European Journal of Innovation Management. The paper was an output from the Emerging Industries Programme and describes how entrepreneurial agency and demonstrators are central to the emergence of new industrial activity. The paper is currently free to download here: dfab.it/industrialemergence

In July, **Letizia Mortara** joined the Editorial team of the R&D management Journal as an Associate Editor. R&D Management publishes articles addressing the interests of both practising managers and academic researchers in R&D and innovation management.

CTM PhD student **Chung-Lin Tsai** has passed his viva. His thesis 'Orchestrating complementary innovation in the ICT industry: a conceptual framework for industry platform implementation' elicited good praise from his examiners, Dr Khaleel Malik at MIOIR Manchester and Dr Yongjiang Shi.

New publications

Despeisse, M. and Ford, S.J. (2015), 'The Role of Additive Manufacturing in Improving Resource Efficiency and Sustainability', In: Umeda, S., Nakano, M., Mizuyama, H., Hibino, H., Kiritsis, D., von Cieminski, G. (Eds.), *Advances in Production Management Systems: Innovative Production Management Towards Sustainable Growth*, Volume 460 of the series IFIP Advances in Information and Communication Technology, pp. 129-136.

Ford, S.J., Despeisse, M. and Viljakainen, A.M. (2015), 'Extending Product Life Through Additive Manufacturing: The Sustainability Implications', *Global Cleaner Production and Consumption Conference*, Sitges, Barcelona, Spain, 1-4 November 2015.

Ford, S.J. and Minshall, T. (2015), 'Defining the Research Agenda for 3D Printing-Enabled Re-Distributed Manufacturing', In: Umeda, S., Nakano, M., Mizuyama, H., Hibino, H., Kiritsis, D., von Cieminski, G. (Eds.), *Advances in Production Management Systems: Innovative Production Management Towards Sustainable Growth*, Volume 460 of the series IFIP Advances in Information and Communication Technology, pp. 156-164

Joon Mo Ahn, Tim Minshall, Letizia Mortara., 'Open innovation: a new classification and its impact on firm performance in innovative SMEs', *Journal of Innovation Management* 3, 2 (2015) 33-54

Yip M.H, Phaal R., Probert D.R., 'Characterising product-service systems in the healthcare industry', *Technology in Society* (2015), doi:10.1016/j.techsoc.2015.05.014.

Yip M.H, Juhola, T., 'Stakeholder involvement in software system development – insights into the influence of product-service ratio', *Technology in Society* (2015), doi:10.1016/j.techsoc.2015.05.006.

Diary 2015

www.ifm.eng.cam.ac.uk/events

November

10 *Visual Approaches for Strategy and Innovation Management Seminar* One-day course
IfM, Cambridge

December

8 *Strategic Intellectual Property Forum* Free event
IfM, Cambridge

Contact us

Centre for Technology Management
Institute for Manufacturing
Department of Engineering
17 Charles Babbage Road
Cambridge, CB3 0FS UK

Tel: +44 (0)1223 766141
Fax: +44 (0)1223 464217
ctm-enquiries@eng.cam.ac.uk
www.ifm.eng.cam.ac.uk/ctm