

Institute for Manufacturing

People Projects and Activities

2012

FOREWORD



It has been another exciting year for manufacturing locally, nationally and internationally. It is now widely accepted that modern perceptions of manufacturing encompassing R&D, design, production, distribution, service and sustainability provide the basis for a much better understanding of the role of manufacturing in economies. Countries around the world are reassessing their current manufacturing capabilities and their future needs. Most now recognise however that manufacturing has a vital role in creating and capturing value and is an integral part of many successful innovations.

IfM has made good progress over the past year in all its key activities of education, research and practice and the synergies between them. Our research continues to be strong across the spectrum from production technology through manufacturing systems to technology management and policy. We are a partner in three of the twelve new EPSRC Centres for Innovative Manufacturing announced in 2011 including Crystalline Processes, Ultra-precision Manufacturing and Industrial Sustainability which IfM is leading in partnership with Imperial College, Loughborough and Cranfield universities. Perhaps one of the most significant activities of the year was a major study involving people from across the IfM to develop a 15 year 'Future Manufacturing Landscape' for the UK. Commissioned by the Technology Strategy Board the report has been endorsed by BIS and EPSRC and should provide some firm foundations for the development of company strategies and government policies towards industry.

So where next? With our new building providing a tremendous meeting place we are beginning to realise our ambition for the IfM to provide a strategic multi-disciplinary and industrially relevant hub in the increasingly complex global industrial landscape. We believe our initiatives in sustainability, service and technology policy address some of the major current themes and draw upon the academic breadth and industrial networks which the IfM enjoys. The future opportunities are legion as manufacturing returns to centre stage in the industrial and public policy debate. Should we provide more direct focus on particular industrial sectors? Should we use our opportunities to convene diverse groups to share and develop new ideas in key fields? Should we extend our international reach beyond our established links in Europe, Asia and the US?

Our aspiration is that the IfM becomes a partner of choice helping to understand and indeed 'engineer' the next generation of global industrial systems as well as supporting the growth of smaller businesses and start-ups. Visitors and partners from industry and government as well as academe are warmly welcome to join our community of enthusiasts!

Professor Sir Mike Gregory

Head, Institute for Manufacturing

CONTENTS

Foreword	1
Highlights of 2011	4
<hr/>	
RESEARCH	
Research centres	
Centre for Industry and Government	6
Centre for International Manufacturing	8
Centre for Strategy and Performance	10
Centre for Technology Management	12
Technology Enterprise Group	14
Design Management Group	16
Distributed Information and Automation Laboratory	18
Production Processes Group	20
Centre for Industrial Photonics	22
Interdisciplinary programmes	
Service research and the Cambridge Service Alliance	24
Industrial Sustainability	26
Emerging Industries Programme	28
High Value Production	29
Manufacturing Industry Education Research Group	30
Research degrees	32
<hr/>	
EDUCATION	
Undergraduate	34
Postgraduate	36
<hr/>	
WORKING WITH OTHERS	
IfM Education and Consultancy Services	38
Public engagement	45
<hr/>	
APPENDICES	
Publications and online resources	47
IfM people	50
IfM members and collaborators	52

Highlights of 2011

2011 was another excellent year for IfM across all its key activities of research, education and practice. Several new research activities were launched and many existing areas have seen exciting new developments. We have enjoyed increased applications for our mainstream undergraduate and postgraduate education programmes all of which are heavily oversubscribed. Our events for industry continue to attract substantial attendance and we are seeing a growing demand for tailored courses for major global corporations.

Education

The content and structure of our post graduate Masters programme in **Industrial Systems Manufacture and Management (ISMM)** has been extensively revised for the 2011/12 course to further enhance the attractiveness of the programme. The course has been extended from 39 to 45 weeks, with additional industrial and engineering systems content, to reflect the changing structures of manufacturing internationally. The number of applications for the programme has risen steadily over the last four years with an increase of 30% in the last year alone. Meanwhile the IfM's core undergraduate programme, the **Manufacturing Engineering Tripos (MET)** goes from strength to strength attracting high calibre candidates in increasingly numbers.

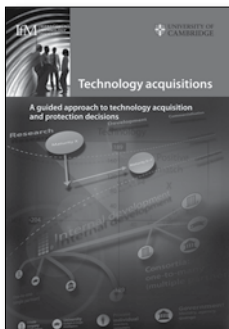
It is particularly pleasing that many of our cohort of over 80 PhD students are experienced professionals from a wide range of industries. They bring a wealth of expertise to the IfM and their backgrounds ensure that their work is focused on real industrial needs.

Research

IfM is a partner in three of the twelve new **EPSRC Centres for Innovative Manufacturing** announced in 2011 including **Crystalline Processes** led by Strathclyde University, **Ultra-precision Manufacturing** led by Cranfield University and **Industrial Sustainability** which IfM is leading in partnership with Imperial College, Loughborough and Cranfield universities.

Other research developments include growth of the **Cambridge Service Alliance** announced last year and a major new grant from the Gatsby Charitable Foundation to set up an applied research activity in Science, Technology and Innovation. The year also saw one of the largest ever **European Operations Management Association Conferences** here in Cambridge. IfM co-led the organisation of this major event, with the Judge Business School, with nearly 500 people attending from around the world.

The IfM has an established body of research in the area of **Open Innovation** – the collaborative approach to innovation and technology development – and last year saw the publication of two new reports in this area. **Organising for breakthrough innovation** investigated ways in which established firms can help to create an entrepreneurial environment and support radical new developments. **Technology acquisitions** provides a structure approach to acquiring new technologies from external sources.



Meanwhile, the **Open Innovation Forum**, now in its second year, is proving a significant resource for firms involved in the Food & Fast Moving Consumer Goods (FMCG) sector.

Education and consultancy services

The Technology Strategy Board commissioned a major study, involving several IfM research centres and IfM Education and Consultancy Services (IfM ECS), to develop a 15 year 'Future Manufacturing Landscape' for the UK. The resulting report, *A landscape for the future of high value manufacturing in the UK*, was announced at the Government's Growth Summit in Bristol in February 2012. The report identified important trends influencing the changing nature of manufacturing, whilst considering the greatest challenges and opportunities manufacturing firms are likely to face. Download the report at: www-priv.ifm.eng.cam.ac.uk/free/

In another major public sector project IfM ECS is helping to map out the next 30 years of the Australian rail industry following a similar exercise with the Automotive Australia 2020 Roadmap in 2009. The project aims create a roadmap to support an effective and efficient rail supply network well into the 21st Century.

Nearly 80 companies in the Essex region took part in the Essex Manufacturing Innovation & Growth Programme (EMIG), led by IfM ECS during 2010 and 2011. The programme was delivered free of charge thanks to funding from Essex County Council and followed a similar approach to that used in the West Midlands. Meanwhile we continued to work with major international companies on a variety of different projects including roadmapping and manufacturing footprint strategy.

There is a growing demand for IfM ECS bespoke executive education programmes with three courses delivered in 2011 for major international companies in a variety of sectors.

IfM ECS manages the ideaSpace Enterprise Accelerator (iEA), part of the University of Cambridge Hauser Forum, and a hub for early stage innovation. The iEA flourished in 2011 with 65 companies now using its co-working facility and 20 companies who have graduated from ideaSpace to find offices of their own. Through the iEA event and funding programmes over 2,000 individuals in over 400 companies have been helped to develop their enterprise and innovation skills.

Public engagement

Hundreds of families flocked to the IfM's Science Festival event in March 2011 – the second year we have taken part in this university-wide celebration of science, technology and engineering. Visitors were treated to talks, demos and hands-on activities including laser rocket racing, talking robots and 3D product printing! We are looking forward to opening our doors once again for the 2012 event on 24 March.

Once again we were pleased to host a number of visits by school children to the IfM – helping to showcase modern manufacturing to the next generation's potential engineers, scientists and technologists. In June 2011 we welcomed the cream of European engineering students as part of the European Society for Precision Engineering and Nanotechnology (EUSPEN) Challenge event.





Centre for Industry and Government (CIG)

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

cig-enquiries@eng.cam.ac.uk

The Centre for Industry and Government provides research to underpin developments in industrial and innovation policy, as well as working directly with governments in order to support ongoing efforts to improve economic growth. CIG brings together a diverse set of disciplines which are required to address these challenging issues, from economics to policy analysis. The Centre is developing a better understanding of the role of production; new frameworks to capture the growing move towards product-based services; and new options for policy makers to support industrial growth.

PEOPLE

Director: Finbarr Livesey

Advisers: Mike Gregory

Affiliates: Eoin O'Sullivan, Bill Wicksteed

Researchers: Laure Dodin, Ilaria Frau, Carlos Lopez-Gomez, Vivian Tsai

Industrial practitioners: Bill Colquhoun, Jonathan Hughes

SELECTED PROJECTS

Assessing the multinationality-performance relationship

The importance of production to company performance across various sectors has been widely debated. Recent events in financial markets have re-opened these conversations, specifically on how a balanced economy is achieved, both in terms of sectoral differences and in terms of activities across the value chain from research, through production and on to service provision.

This project is attempting to further our understanding of when and how production structure is linked to company outcomes. By looking at how companies are structured in terms of their value chain and linking this to their outcomes (in terms of profitability and turnover

growth) we hope to understand which patterns of production ownership and location provide the best returns.

Defining modern industrial policy frameworks

The use of industrial policy in developed economies such as the United Kingdom has gone in and out of favour over the past thirty years. There is a current resurgence in both the use of the term industrial policy and the potential for interventions which will impact the structure of industry. However the foundation for industrial policy, especially in a developed economy, has become unclear. The existing rationales based on market failure and system failure struggle to explain or guide the policy maker.

The project is developing a framework for thinking

about industrial policy for leading economies, based on the maturity of a given industry in a particular country and contrasted to the maturity of that industry globally. This provides a framework for analysis which recognises the relative maturities of a number of industries in a given country as compared to the world. This will allow a more nuanced discussion on the rationales for intervention, beyond standard market failure arguments.

The public perception of manufacturing

An ongoing debate in the UK is whether the public's perception of manufacturing is overly negative, hampering efforts to grow the sector. However, much of this debate is based on anecdote with no large scale data on what the public's view of manufacturing actually is. This project, supported by YouGov-Cambridge, is developing a nationally represented survey of public perception of manufacturing, which we believe will inform the debate on the image of manufacturing and the need or otherwise for government action in this area.

ACTIVITIES

CIG regularly works directly with government agencies and other public sector bodies to support policy making and to ensure the policy relevance of our research work. Examples include the definition of high value manufacturing (HVM), which helped to shape policy towards HVM in central government and as part of the Technology Strategy Board's HVM strategy, and research on policies to support the development of the regenerative medicine sector in the UK. Other organisations we have worked with in the past year include the British Standards Institute (BSI), the National Endowment for Science, Technology and the Arts (NESTA) and the Intellectual Property Office (IPO).

As well as project based work, CIG provides input to government through meetings and briefings. This past year has included hosting an industry and government delegation to the UK led by the Governor of Massachusetts and providing a briefing day on high value manufacturing for policy makers from the Department of Business, Innovation and Skills (BIS) and HM Treasury.

FUTURE PLANS

The Centre is developing a multi-year project investigating the evolution of industrial organisation, bringing together our experience of futures techniques with a firm based view of how production networks may evolve under various pressures and trends. Our aim is to understand for a number of industries how localised production will become in the coming 20 to 30 years, and what implications this has for national economies, global trade and government policy in support of industrial growth.

Bringing together our research and outreach activities, CIG aims to host a number of events in the coming year on the nature of public leadership for industrial growth in developed economies. This is intended to be a collaborative activity, reaching out to academic, industrial and public sector partners in the UK and other countries.



Centre for International Manufacturing (CIM)

www.ifm.eng.cam.ac.uk/cim
cim-enquiries@eng.cam.ac.uk

CIM focuses on applied research in close collaboration with industrial partners. The centre has developed a strong academic-industrial community and provides expertise and a range of industrial services in the areas of international manufacturing and supply networks, particularly factory/plant management, network configuration and design and the development of system capabilities.

PEOPLE

Head of Centre: Jag Srari

Research Director: Yongjiang Shi; **Staff Researchers:** Tomás Harrington, Mukesh Kumar

Research students: Jialun Hu, Xin Jin, Wenwen Zhao, Arsalan Ghani, Kurt Liu, Leila Alinaghian, Amy Shang, Rasha Rezk, Helen Zhang, Yang Liu, Feifan Chang

Industrial practitioners: Paul Christodoulou, Don Fleet, Andrew Gill, Dennis Lewis.

Administrator: Elizabeth Barrington-Light.

SELECTED PROJECTS

Mapping global value chains

Integrating research on firm networks, supply networks and global value-chains. Projects study the dynamics of industry structures at international, national and regional levels. In 2012, the work will focus on sector industrial landscape mapping techniques, building on previous studies in industrial biotech in the UK, photovoltaics, plastic electronics, Norwegian maritime and UK automotive, and integrate research on industrial network risk and resilience. A particular focus is on networks involving more 'open' manufacturing systems building on work initially developed in mature sectors, and more recently applied within new technology based projects (as part of the Cambridge Integrated Knowledge Centre). Future activities will focus on disaggregated value chains increasingly found in health care and food sectors, and as part of the new **EPSRC Centre**

for Innovative Manufacturing in Continuous Manufacturing and Crystallisation, on value chain implications of changes from batch to continuous processing.

Effective post M&A integration

In 2012 we will develop an application process guide and tools for effective post M&A integration, building on the recently completed research council funded research programme.

Sustainable supply networks

A programme funded by a major MNC seeks to develop new methods and tools for enabling the design and configuration of sustainable industrial networks. Two Technology Strategy Board projects, developed by the Centre, on Last Mile Logistics aimed at reducing urban congestion through item consolidation, flexible customer choice, and traceable green supply through for example Electric Vehicles. Research in this area will build on the new Centre for Innovative Manufacturing in industrial sustainability.

Global supply networks

New forms of supply network are emerging to support novel business models and exploit emerging technologies. The research builds on previous research examining the influence of supply network configuration, network capabilities and the adoption of advanced supply chain processes. The identification and development of core competences in the supply chain to support faster growth is examined at a cross-sector level.

Production networks

A company's international 'manufacturing footprint' – the locations and roles of its plants around the world. Projects include: the internationalisation process of MNCs including reasons to pursue cross-border production; production network configuration, development and coordination; and risk and reward management in overseas investments.

Service in multi-organisational networks

Projects include: service business development in manufacturing companies in terms of strategic context, capability development, service supply chain performance metrics, and network organisation design and configuration methodologies. Tools have been extensively exploited with further development through the industrially partnered KT Box programme.

Global engineering networks

How companies manage their globally dispersed engineering operations in changing business environments. This activity also includes a number of industrial projects and benchmarking activities with peer groups. A new international research collaboration seeks to share research in this area.

Internationalisation – developed and emerging country multinationals

Research in this area seeks to explore

how emerging country multinationals are internationalising and how their evolution paths differ from developed world multinationals, contrasting models from more established firms and those beginning to develop their international manufacturing and sourcing footprints. Within this research strand, initiatives include the setting up of a Chinese Industry Studies Group (CISG) with ongoing research on Shanzhai manufacturing models and the emergence of the low-speed electric vehicle ecosystem. Similarly, in India, as part of the UKIERI programme, working closely with Indian Institutes, a two-year research programme has commenced on Optimising Food Supply Chains, with particular focus on seed-to-shelf network integration.

ACTIVITIES AND FUTURE PLANS

CIM Symposium

CIM's 16th International Symposium in 2012 focuses on 'Capturing value in International manufacturing and supply networks'. It examines how firms are responding to changing industry structures, continuing economic uncertainty in world markets, the growing involvement of multi-nationals from emerging economies and the need for more sustainable supply chains.

Academic and Industry networks

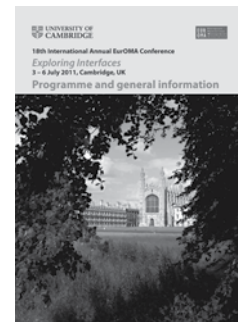
CIM co-hosted, with the Judge Business School, the 18th European Operations Management Association (EurOMA) annual conference in 2011 on the theme of 'Exploring Interfaces', the largest event in its history with over 700 delegates. The International Manufacturing Symposium normally held in September was therefore remodelled this year into a series of academic workshops on 'International Operations', 'Supply Network Evolution in Emerging Industries', and a Practitioner workshop involving 12 MNCs exploring industry challenges and future research opportunities.

UK university collaborations

Birmingham
Brunel
Leeds
Nottingham
Strathclyde

International

Copenhagen
Business School
Indian Institute of
Management
Karlsruhe
Munich
Sao Paulo
Tokyo
Trinity College Dublin
Zhejiang





Centre for Strategy and Performance (CSP)

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

csp-enquiries@eng.cam.ac.uk

CSP combines academic objectivity with industrial know-how to help companies tackle their strategy and performance management. It aims to understand and improve the way strategic choices are made, plans are developed and implemented, and performance is measured and achieved. CSP has an established track record of advancing academic theory through successful participation with industry to ensure industrial relevance.

PEOPLE

Director: Ken Platts

Researchers: Carmina Buzuloiu, Tanya Edwards, Anna Elert, Gerry Frizelle, , Mohamed Khater, Sarah Lubik, John Mills, Rich Morales, Andy Neely, Hans-Georg Mundhenke, Tomasz Szejner, Claus Weidinger, Mike Wood, Yue Zhao. **Industrial practitioners:** Nicky Athanassopoulou, Derek Ford, Dominic Oughton

SELECTED PROJECTS

Strategy modelling and visualisation

Developing visual approaches to support strategy development that help companies deal with the large amounts of complex information involved.

Strategic decision making

Building structured approaches that support strategic decision making in businesses.

Developing strategy for start-ups

Developing strategy in start-up companies when bringing a new technology, product or service to market.

Technological innovation in consumer goods firms

The strategic process of identifying and commercially exploiting technological innovation in large scale firms in the Fast Moving Consumer Goods industry in large scale global firms.

Business strategy process

Developing a facilitated process that helps identify markets and competences, and create vision and action in small and medium manufacturers.

Capability and resource analysis

Studying the way companies co-ordinate resources to improve capabilities and performance.

Production system choices

Studying the impact that global manufacturing strategies have on the choice of production system. Initially studying the variation in production systems used by global operating companies in the automotive supply chain.

Strategies in high-growth SMEs

Identifying the catalysts and hurdles in strategy formulation, definition and implementation in high-growth SMEs and developing a framework of factors instrumental to the development of such firms.

Servitization

Developing tools to support 'availability contracting' – enhanced service contracts covering a product's entire life. Cultural, organisational and risk factors involved in moving from manufacturing to service provision. A particular focus is the application in the defence Industry.

Business excellence model for transitional economies

Modification of business excellence models to measure organisational performance in companies in countries changing from a centrally planned to a free-market economy.

Performance measurement

Developing a tool for the evaluation of performance measurement systems.

The future of performance measurement

A multi-university study in conjunction with partners in Europe and the USA to identify key challenges in performance measurement over the next 5-10 years, with a view to setting a forward research agenda.

Strategic Performance Information Lab

Working with the IfM's Distributed Information and Automation Laboratory, we are creating a state-of-the-art strategic performance information facility.

ACTIVITIES**Executive education**

The Centre offers executive education programmes on strategy and performance. Recent programmes focused on:

- Business and operations strategy for Caterpillar
- Operations Excellence for Marell

Centre Associates Programme

This programme is establishing more formal and closer working relationships with a number of alumni who are now reaching senior positions in organisations, in order to provide a mechanism for improved dialogue and technology transfer.

Business strategy tool

Working in collaboration with IfM Education and Consultancy Services (IfM ECS), the Centre offers a business strategy tool based on a series of four facilitated workshops that help companies to: analyse their operational environment; assess their capabilities; develop a clear strategy and action plans for implementation.

Short courses

The Centre offers occasional one-day courses on topics related to strategy and performance. The most recent courses focused on the design of performance measurement systems and industrial make-buy decisions.

FUTURE PLANS**Company diagnostics and business planning**

Working with IfM Education and Consultancy Services, we will further develop the IfM's business diagnostic Prioritisation Tool.

Manufacturing strategy in construction

Working in conjunction with the Laing O'Rourke Centre for Construction Engineering and Technology, we plan to investigate new manufacturing strategies for the construction industry.



Centre for Technology Management (CTM)

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

ctm-enquiries@eng.cam.ac.uk

CTM focuses on helping companies to make the most appropriate use of current and future technological resources. It aims to provide comprehensive support to managers, based on an integrated understanding of science, engineering and business.

PEOPLE

Director: David Probert

Academic staff: Elizabeth Garnsey (Emeritus), Tim Minshall

Researchers: Nicola Dee, Clare Farrukh, Simon Ford, Clive Kerr, Rick Mitchell, Letizia Mortara, Robert Phaal, Michèle Routley, Judith Shawcross.

Research students: Joonmo Ahn, Bettina Blasini Clemens Chaskel, Laurens Chaskel, Keith Cotterill, Lee Liang Ge, Daniel He, Julia Fan Li, Imohiosen Ilevbare, Jan-Niklas Keltsch, Elliot More, Victor Ortiz, Harald Overholm, Luzselene Rincon, Val Thorn, Manjusha Thorpe, Chung Lin-Tsai, Carol Walton, David Weiss, Man Hang Yip.

Affiliates: Marcel Dissel, Eoin O'Sullivan, Sarah Lubik, David Gill.

Visitors: Neil Gregory, Changyong Lee, Patrik Schmithausen, Ricardo Gonzalez Nakazawa, Taro Sugihara, Ruth Thomson.

Industrial practitioners: Nicky Athanassopoulou, Bill Colquhoun, Andrew Gill, Steve Mann, Dominic Oughton, Derek Ford. **Support:** Geraldine Guceri.

SELECTED PROJECTS

Strategic roadmapping

CTM's broad engagement with roadmapping techniques continues to stimulate new research approaches which now include:

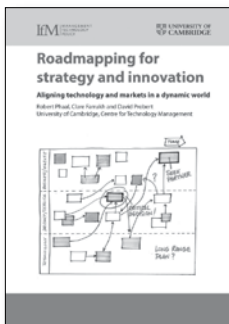
- Mapping industrial emergence, based on a diverse set of historical case studies, as a foundation for developing improved strategic management tools for navigating current and future emergence. A set of four related tools has been produced.
- Integration of risk and uncertainty assessment into roadmapping.
- Depiction of strategy using visual objects. This

work explores the key role of graphical and visual techniques that are central to effective roadmapping and other strategy development methods.

- Workshop practice. Interactive and participative workshops are increasingly used as a way to engage all stakeholders in strategic change. This project focuses on understanding and improving the group dynamics of roadmapping workshops.

Collaborations in 'open innovation'

Organisations at all stages of the FMCG value chain are meeting regularly to exchange good practice in open innovation and review the outcomes from



current CTM and other related research. The Forum is an example of the extended reach that a joint project between CTM and ECS can produce.

Strategic technology management toolkit

Investigating the design and application of a practical toolset which brings an integrated and systematic approach to strategic management of technology, building on a firm's existing practice.

Technology acquisition and protection

Collaborative development of early-stage technologies can share cost and risk but may limit free use of the resulting IP. Practical guidelines to technology acquisition have been produced and work continues to explore the technology protection issues.

Service and support

'Delivering thorough life capability – making the business case' develops a decision making toolset to support upgrade options analysis. Key collaborator: Ministry of Defence, The Royal Navy.

Other research investigates the engagement of stakeholders in the early stages of PSS (product service system) development in the healthcare environment.

Cambridge Integrated Knowledge Centre

Applying technology roadmapping and developing technology and innovation management education and training in the context of this cross-university project.

ACTIVITIES

Education and events

CTM has a growing portfolio of workshops, short courses, teaching modules and executive education linked to its research findings in

technology and innovation management. Key courses cover strategic roadmapping, technology and innovation management, valuing and selecting technology projects, and technology intelligence.

New courses this year will focus particularly on early stage technology and innovation management, and visual methods for strategy and innovation.

Courses can either be open or tailored to the needs of the sponsoring organisation.

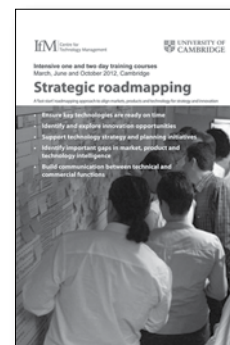
European Institute for Technology and Innovation Management (EITIM)

EITIM is a collaboration of ten leading technology-based universities across Europe that aims to improve wealth creation from science and technology. See: www.eitim.org

This organisation also supports an active research student community, EITIMdoc, with workshops on research practice and conferences.

FUTURE PLANS

The resilience of industrial systems is a subject of increasing interest. New research will address emerging issues relating to the management of technology and innovation under conditions of increasing uncertainty (technical, environmental, economic and political) and also where pressures to collaborate intensify.





Technology Enterprise Group (TEG)

www.ifm.eng.cam.ac.uk/ctm/teg/

thwm100@eng.cam.ac.uk

The Technology Enterprise Group (TEG) is a network of researchers and associates focused on research and education relating to the origins, start-up and growth of technology-based ventures and their impact upon the economy.

PEOPLE

Head of Group: Tim Minshall

Researchers: Keith Cotterill, Nicola Dee, Lee Liang Ge, Finbarr Livesey, Sarah Lubik, Letizia Mortara, Luzselene Rincon, David Weiss. **Associates:** David Gill, Neil Gregory, Peter Hiscocks, Stewart McTavish, Amy Mokady.

SELECTED PROJECTS

TEG research is focused around three themes: open innovation, investment and university-industry knowledge exchange. Examples of projects in each of these areas are given below.

Open innovation

Current projects in this area are investigating the role intermediary organisations play in helping firms implement open innovation, the influence of location on open innovation, and the changing strategies of universities within an open innovation ecosystem. The outputs of completed TEG research on open innovation have been converted into teaching and training materials to support firms in implementing open innovation.

Investment

TEG research on investment is currently focused on how entrepreneurs learn from prior failure when setting up new ventures, the linkages between business incubation and the need for start-ups to raise investment, and the availability of investment for new firms in emerging industries.

University-industry knowledge exchange

Projects in this area are focused on a range of issues relating to the establishment, operation and impact of long-term partnerships between engineering firms and universities. This work has strong links to TEG projects on open innovation and location.

ACTIVITIES

TEG members are involved in coordinating a range of activities that support the core research projects. Examples of some of these activities are given below.

Open Innovation Research Forum (OIRF)

TEG coordinates the Open Innovation Research Forum (OIRF), an international network of researchers focused on identifying, understanding and addressing the challenges of implementing open innovation. The work of OIRF has been supported by the UK Innovation Research Centre (UKIRC) and the Institute for Technology, Enterprise and Competitiveness (ITEC) at Doshisha University in Japan. For more information see www.oirf.net.



Cambridge Technopole

TEG has run several projects examining aspects of the growth of the Cambridge high tech business cluster, and manages a website and blog providing access to resources to help support informed debate about past, present and future developments of the Cambridge high technology business cluster. For more information see cambridgetechnopole.blogspot.com.

University enterprise activities

TEG supports university-based enterprise programmes including: the University Enterprise Network, Cambridge University Entrepreneurs, and the i-Teams programme. Information on these activities is brought together at: www.enterprisenetwork.group.cam.ac.uk.

FUTURE WORK

In the coming twelve months new research projects will be examining the role that innovation journalism can play in channelling or slowing investment towards technology based start-ups, and the ways in which product-based start-ups can access the resources they need to build prototypes to attract investment.





Design Management Group (DMG)

www.ifm.eng.cam.ac.uk/dmg/
jm329@cam.ac.uk

Effective and sustainable management of design and new product development (NPD) is critical to the success of firms, and also the wider economy. The Group seeks to understand and improve the ways in which design and NPD are managed.

PEOPLE

Director: James Moultrie

Current researchers: Bernard Dusch, Jonathan Johnson, Krista Keranen, Karen Miller, Jae-Hwan Park, Carlos Peralta-Mahecha, Laura Sutcliffe **Recent researchers:** Nani Brunini, Alex Driver, Burcu Felekoglu, Andrew Muir Wood

SELECTED PROJECTS

Design in science

Little research has been carried out looking at the role of design in the early stages of technology development. The Design in Science study aimed to address this gap, by involving designers in live scientific research projects at the University of Cambridge. The research has demonstrated that early involvement by process designers can challenge the research direction and support scientists in demonstrating, communicating and exploring potential future applications. The project team worked with scientists to develop a design concept for a table incorporating moss which could be used to produce energy by photosynthesis to power a lamp. A book about the project is due to be published by IfM in Spring 2012.



Sustainable product design

Sustainable design of medical devices: This project has produced a simple assessment tool for designers of medical devices that enables them to build sustainable dimensions into their products. The tool takes a life cycle approach, and aims to address environmental and social concerns,

without the need for a costly and time consuming life cycle analysis.

A tool to support sustainable design: This project is seeking to understand the different design strategies that might be employed to improve the sustainability of products. An original sustainable design toolkit has been developed, including a detailed set of over 100 cards which individually contain specific design strategies. Each strategy is targeted at a specific stage of the product lifecycle. The tool is used in a workshop setting and helps to structure creative brainstorming with a view to improving the sustainability of products.

Managing New Product Development

Top management involvement in NPD: New product development (NPD) has long been considered a high priority strategic issue to sustain competitive advantage and growth. The involvement of top managers in NPD is seen as a critical factor affecting performance. This project investigates top management involvement in NPD at project level from the perspective of both top management and the development team.

Managing feasibility in the medical device

industry: Biotechnology and healthcare developments require huge investment and a complex multidisciplinary structure which is inherently full of risks and uncertainty. In this context early technology assessment and proof of principle is often sporadic and unstructured. Existing design process models for the medical healthcare industry are predominantly suited to the later phases of development. This research provides a theoretical framework which offers practical guidance in improving development efficiency within the front-end phases of healthcare development.

Design trends

Technology change and fashion theory in the mobile phone sector: this study is exploring how theories of fashion and technology evolution relate to the design of mobile phones. It offers a number of conceptual models to explain the complex interactions between aesthetics, functionality and technology over time.

Creating and using design trends reports: This study is investigating how designers both create and use trend reports in a variety of sectors.

Strategic design management

From co-production to co-creation (CoCo): In this research, co-creation means collaboration in the creation of value through shared inventiveness, design, and other activities. Co-production is more narrowly defined as participation in service production within parameters defined by the focal organisation. This research project aims to identify co-production/co-creation activities and roles in business to business service relationships and to develop models and management tools for effective and efficient co-creation of services.

Design Knowledge Transfer: This study is exploring the patterns of knowledge interaction between design academics and academics in other

disciplines, and between design academics and industry.

Design management in the retail industry: This project is investigating why there is a tension between the role and contribution of design management in large retailers in the UK, US and EU. It focuses on design management of own brand general merchandise products, where there are intensive design requirements and seeks to understand the barriers that exist within retail organisations.

ACTIVITIES**Cambridge Academic Design Management Conference 2011**

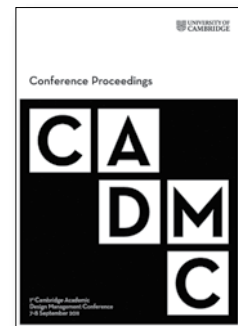
In September 2011, the Design Management Group hosted the first Cambridge Academic Design Management Conference. This international conference is supported by Creativity and Innovation Management Journal. It is anticipated that the conference will be biennial and a second conference will be held in 2013.

Tools for managing new product development

We are actively engaged in the development of new tools for the management of NPD. In partnership with IfM Education and Consultancy Services, this work seeks to develop simple visual tools for the improvement of product development management, especially in small firms.

FUTURE WORK

The 'Design in science' work has begun to provide some real benefits to scientists, and it is our intention to extend this work further. Work will also continue in all of the key themes outlined above, with an emphasis on strategic design, sustainable design, design trends, and NPD management.





Distributed Information and Automation Laboratory (DIAL)

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

dial-enquiries@eng.cam.ac.uk

DIAL studies ways in which advanced information and automation systems and automated identification technologies, such as radio-frequency identification (RFID) and software agents, can be used to create smart products, flexible, reconfigurable industrial operations and innovative services. DIAL incorporates the Cambridge Auto-ID Lab, which was a founding partner in the Auto-ID Centre project to bring affordable RFID to the consumer-packaged goods industry. DIAL is also a key partner in the Cambridge Centre for Smart Infrastructure and Construction (CSIC) and the Cambridge Service Alliance. DIAL's interests cover all aspects of automation and information management across the industrial supply chain.

PEOPLE

Director, DIAL: Duncan McFarlane

Deputy Director, DIAL: Ajith Parlikad **Director Cambridge Auto-ID Lab:** Mark Harrison **Associate Director Auto-ID Lab:** Alan Thorne **Business Manager:** Andy Shaw

Researchers: Alexander Borek, Rachel Cuthbert, Martin Floeck, Vaggelis Giannikas, Zhenglin Liang, Wenrong Lu, Yoshikazu Nojima, Nipat Rasmekomen, Joao Fonseca de Silva, Pankaj Sood, Raj Srinivasan, Maurizio Tomasella, Pascal Wichman, Alex Wong, Philip Woodall

Support: Sarah Brown, Simon Sennitt

SELECTED PROJECTS

Information quality for asset management

A three year research council-funded project seeking to determine the impact of improving information quality on managing assets, throughout their life cycle.

Centre for Smart Infrastructure and Construction

This Centre brings together leading research groups across the University of Cambridge.

Research focuses on the innovative use of emerging technologies in sensor and data management, coupled with emerging best practice in the form of the latest manufacturing and supply chain management approaches applied to construction and infrastructure. It aims to develop completely new markets and achieve breakthroughs in performance. DIAL's work involves asset management, value of sensing and future proofing of information. Industrial partners include: Arup, IBM, Laing O'Rourke and Redbite.



GS1/EPCglobal

DIAL was an initiator of a set of global standards associated with RFID (Radio Frequency Identifications). Current work is supporting technical standards development at GS1 EPCglobal on Discovery Services and a Network-centric approach to Electronic Pedigree. These are both concerned with serial-level traceability/visibility of uniquely identified objects as they move through supply chains.

Maintenance of complex engineering systems: feasibility study

A 6-month scoping activity with Cranfield University working on improving knowledge of the behaviour of the production system and its maintenance.

Achieving Leveraged Advantage from Distributed Information (ALADDIN)

This project, sponsored by Boeing Company, is examining novel ways to support automated exchange of critical data between organisations. The main notion is that data can be enabled so as to determine where and to whom it should be sent.

**Hitachi Rail – incident management systems**

A project with Hitachi Rail aiming to develop a methodology and solution for Hitachi to integrate FMEA and sensor data and provide systematic fault diagnosis and guidance to maintenance staff.

Industrial uses of internet of things

DIAL was one of the early initiators of the 'internet of things' concept. Current work is examining the role of the internet of things in manufacturing.

Value of information

A series of PhD projects has evaluated the value and numerical benefit of improved information in a range of areas from supply chain to recycling and

maintenance. Current efforts focus on services and infrastructure.

Airport performance

A sequence of projects involving the main UK airport operators have examined the role and value of better IT systems and new technologies such as RFID in airports.

ACTIVITIES**Defence industry forum**

Working with a defence industry forum on the use and adoption of automated ID technologies. Partners include: MoD, BAE Systems, Rolls-Royce, Agusta Westland.

Auto-ID Labs

A global network of universities working on common RFID challenges.

FUTURE PLANS**Energy and information**

Seeking new approaches to reducing energy consumption and greenhouse gas emissions through better use of information and automation in industrial environments.

Tools for industrial reconfigurability

System reconfigurability is a key way of future-proofing industrial systems against changes to their operating environment. This work considers reconfigurability challenges in manufacturing, construction and airport environments.



Production Processes Group (PPG)

www.ifm.eng.cam.ac.uk/ppg
ppg-enquiries@eng.cam.ac.uk

Members of PPG carry out research into manufacturing processes at the component level, with an emphasis on understanding and applying the underlying science. Topics include the development of better models for traditional processes, as well as of innovative processes based on emerging technologies. Throughout, there is a strong emphasis on the commercial priorities and on the transfer of technology to industry.

PEOPLE

Head of Group: Ian Hutchings

Director of Inkjet Research Centre: Graham Martin

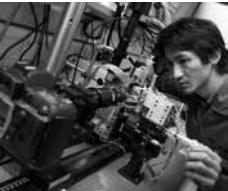
Academic staff: Roger Baker, Claire Barlow, Jim Platts

Researchers: Alfonso Castrejon-Pita, Rafa Castrejon-Pita, Ronan Daly, Steve Hoath, Wen-Kai Hsiao.

Research students: Daniel Nevius, Madeleine Yates.

Support: Jenny Hornett

SELECTED PROJECTS



Inkjet printing for digital fabrication

This project commencing in February 2012 is investigating the use of inkjet technology for the fabrication of 3-D components for solar energy harvesting.

Innovation in industrial inkjet technology: I4T

This project, supported by an EPSRC programme grant, involves collaboration with the Universities of Durham and Leeds as well as a consortium of ten companies. The three major research themes involve the development of printing fluids with higher solids content, a study of the impact, spreading and post-impact behaviour of small liquid drops, and the development of an overall process model for industrial inkjet printing.

Glassjet printing

This EPSRC-funded project has been investigating the possibility of creating glass microstructures down to the sub-micron level by ink-jet printing.

High precision flowmeter manufacture

New levels of reliability are required in flowmeters to meet the demands of high value liquids and gases, environmental conservation and ensured calibration, quality and operational dependability. The aims of this project are to reduce instrument uncertainty, increase range, reduce manufacturing cost, reduce manufacturing variation, reduce or eliminate need for post-manufacture calibration.

www.ifm.eng.cam.ac.uk/pp/projects/flow.html

Biognostix

As a partner in this EU FP7 project, we are developing a manufacturing route involving



inkjet printing for paper-based, low cost medical diagnostic devices.

Sustainable materials selection

The aim of this project is to look into the potential for introducing biodegradable plastic disposables to create a more sustainable healthcare system.

ACTIVITIES

Inkjet Interest Group

This group, open to all, meets at six-monthly intervals and brings together industrialists and academics to hear presentations on inkjet related subjects.

Cambridge Tribology Course

This highly successful three-day course is now in its 20th year. The 2012 event will run in September with lectures, informal discussion periods, illustrative case studies and a workshop session, covering the key elements of the subject.

European Students of Industrial Engineering and Management (ESTIEM)

In 2011 PPG Lecturer Jim Platts ran a two-week course for ESTIEM's Summer Academy, an annual programme for international students to gain new ideas and perspectives.

<https://www.estiem.org/>

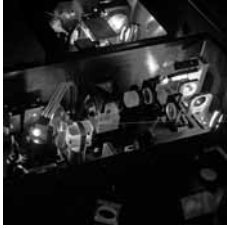
EPIEM European Professors of Industrial Engineering and Management

This recently formed network aims to provide a platform for professors and assistant professors from around Europe to engage in discussions on how to educate the industrial leaders of tomorrow

FUTURE PLANS

Inkjet technology

We have developed internationally-leading diagnostic techniques for studying both the formation and deposition of tiny fluid droplets, and are currently exploring new research opportunities which will build on this expertise. Applications include conventional graphics printing and direct-write manufacturing of functional components.



Centre for Industrial Photonics (CIP)

www.ifm.eng.cam.ac.uk/cip
cip-enquiries@eng.cam.ac.uk

CIP studies the application of industrial laser technologies in manufacturing enterprises. It aims to enhance laser based manufacturing capabilities in a wide range of industrial sectors through research, development and application of advanced, high-power lasers and system technologies. The Centre is multidisciplinary and supports industry through R&D, technology transfer activities and training.

PEOPLE

Director: Bill O'Neill

Researchers: Andrew Cockburn, Rocco Lupoi, Chris Forman

Research students: Sina Habibi, Kun Li, Pallant Ramasundar, Kryste Pngovski, Caroline Earl, David Hopkinson. **Visitor:** Masakazu Shiozawa (Japan Patent Office) **Support:** Sophie Gough **Technician:** Mike Herring

SELECTED PROJECTS

Laser assisted cold spray

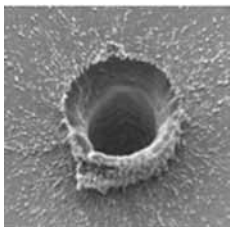
Laser assisted cold spray is a Cambridge developed production process that enables novel combinations of materials and metals to be deposited on a substrate for the production of 3D components. The technique involves accelerating micron-sized powders to velocities of around Mach 2.0, and impacting them onto a laser illuminated surface. The whole process occurs in the solid state which means that micro structural properties can be controlled, with localised deposition, and metals with differing melting points combined. The process is capable of depositing several kg per hour. Current applications include the deposition of Ti based bio-medical coatings, hard facing materials such as WC, and thin layers of stainless steel on low C-Mn steel substrates for low cost anticorrosion solutions. The research project has been supported through investments from the EPSRC through the Cranfield/Cambridge Integrated Knowledge Centre on Precision Engineering.



The process is in its final stages of commercial development, and is being taken to market by a new university spin-out company, Laser Fusion Technologies Ltd.

3D micromanufacturing

Current micro-engineering manufacturing methods developed over the last 50 years for Si semiconductors lack sophistication for today's applications. Contact lithographic methods and new nano-particle pastes are being employed to create a low cost, high performance fabrication route for micro-electronics fabrication. Applications include the manufacture of micro-CMM probes, micro-fluidic plates, simple transistor elements and printed ZnO light emitting diodes. The current work will see application developments in the production of new nanomagnetic materials (Nd-Fe-B) for the creation of high performance magnets with a lower consumption of rare earth elements such as Nd, or Sm.



High power fibre lasers

High power fibre lasers have offered industry unparalleled levels of efficiency, brightness, and power. CIP research aims to understand the interaction of intense optical fields with matter in order to engineer new production processes. CIP has established extensive fibre laser laboratories offering a number of processing capabilities and has a close working relationship with leading UK manufacturers of fibre lasers (SPI Lasers). Academic collaborators include: the Optoelectronics Research Centre, University of Southampton. A £1.3m TSB Project is currently developing the next generation of low cost high performance picosecond laser technology, in addition to realisation of in-process digital holographic process diagnostic tools.

Synthetic biology

Synthetic biology is a new area of research that crosses the border between engineering and biological science. One of the most interesting challenges ahead concerns the application of biological systems to solve such engineering problems as the generation of electrical power, the growing of fuel oil, the creation of hydrogen or the transport of components on the micro and nano-scale. Current research focuses on the development of nano structured glassy carbon surfaces (~10nm features size) using ultrafast plasmon etching for the self-organised attachment of specific proteins. This protein interface will serve as a precursor to the formation of higher-level bio-structures for new bio-sensor applications.

EPSRC Centre Ultra Precision

A new EPSRC Centre for Ultra Precision was launched in October. The joint Cambridge and Cranfield research centre is funded by the EPSRC and industry for 5 years in the first instance, and will lay the foundations of new ultra precision manufacturing capabilities for a wide range of industry sectors.

ACTIVITIES

Courses and events

CIP is a founding member of the EPSRC IKC in Ultra Precision Surfaces and Structures. A week-long series of lectures on Advanced Micro Machining runs every year. CIP also runs events and a series of open meetings for the Association of Industrial Laser Users to promote the use and best practice of laser manufacturing systems.

FUTURE PLANS

High brightness laser technology

CIP will further develop the research topic of high brightness laser technology through funding applications to the TSB and EU FP & for realisation of next generation light sources. This work will improve the capabilities of laser based manufacturing systems and the competitiveness of the user base through the advancement of a wide range of industrial laser technologies.

M.Res Postgraduate course

The joint Cambridge Cranfield EPSRC Centre in Ultra Precision will seek to develop a single PhD and Eng.D training programme in order to develop the precision engineers of tomorrow. Future industries will require a range of precision in their product manufacturing that stretches the capabilities of even the best manufacturing process technologies. The course will seek to fund around 50 PhD students over the next five years.



Inter-disciplinary programmes

www.ifm.eng.cam.ac.uk/research.html
ifm-enquiries@eng.cam.ac.uk

The IfM has established several inter-disciplinary research programmes focused on particular industrial challenges. These are often undertaken in collaboration with other academic institutions and cover a portfolio of activities.

SERVICE RESEARCH AND THE CAMBRIDGE SERVICE ALLIANCE

www.ifm.eng.cam.ac.uk/sse/
www.cambridgeservicealliance.org

RAEng Professor of Complex Services

Andy Neely (Director of Cambridge Service Alliance)

Professor of Industrial Information Engineering

Duncan McFarlane

Researchers: Ornella Benedettini, Alexander Borek, Rachel Cuthbert, Joao Fonseca da Silva, Tobias Graml, Jingchen Hou, Christopher Jackson, John Mills, Rich Morales, Irene Ng, Zied Ouertani, Ajith Parlikad, Chris Pearson, Nipat Rasmekomen, Giovanni Schiuma, Raj Srinivasan, Maurizio Tomasella, Taija Turunen, Ivanka Visnjic, Claire Weiller, Phil Woodall **Support:** Jacqueline Brown, Angela Walters

Service and support engineering is assuming an increasingly important role in the business models of technology-based and manufacturing companies as organisations shift from a product-based orientation to a more service-based focus. Services now represent over 75 per cent of employment in the UK, and are increasingly important in traditional product oriented industries such as aerospace, defence and transportation. The services provided (and used) in these industries

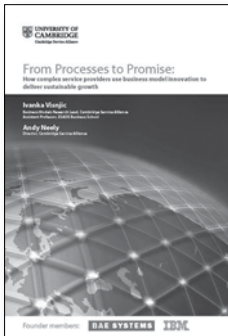
are examples of complex service systems, where organisations must manage several areas of complexity simultaneously.

The Institute for Manufacturing has worked with BAE Systems and IBM since 2005 to study manufacturers' provision of through-life and other complex services; the 'servitization' of manufacturing. While service provision potentially offers more stable revenue streams and strengthens relationships between suppliers and customers, the transition to service provision involves significant additional business risk.

Cambridge Service Alliance

The Alliance brings together some of the world's leading firms and academics devoted to delivering today the tools, education and insights needed for Complex Service Solutions tomorrow. In 2011 the Cambridge Service Alliance was pleased to welcome Caterpillar Inc. as a new alliance partner, joining founder members BAE Systems and IBM.

In September the Alliance hosted the annual Grand Challenge in Services Week, designed to push the boundaries of service knowledge. The industry one-day conference explored how leading organisations develop innovative business propositions to drive their competitive advantage through service innovation, and included keynote speakers from business leaders and policy-makers from across Europe. The two day academic



conference explored, analysed, and evaluated complex service systems through different functional lenses.

Alliance research focuses on three themes:

BUSINESS MODELS FOR SERVICE

Business model innovation involves service providers extending their 'value proposition'. They move from offering relatively simple services, such as IT support or equipment maintenance, towards more comprehensive service offerings such as guaranteeing equipment availability. In doing so, complex service providers position themselves as solution-providers, accountable for the delivery of service outcomes.

In 2011 the Alliance published "From Processes to Promise" a white paper describing the challenges organisations face when developing new business models and the consequent spread of accountability.

SERVICE AND SUPPORT ENGINEERING

Many complex services are based on physical assets either directly or indirectly. In many industries, customers demand guaranteed service levels; equipment- aircraft, machine tools, construction machinery for example- must be available for use at a guaranteed price. Services such as e-commerce or digital media delivery rely on large and often diverse networks of computer servers and other IT equipment which must be effectively managed to deliver value for money. Effective asset management systems enable owners and users to increase value gained from their assets while reducing operating costs. Managing the assets required to deliver complex services is particularly challenging as they must deliver value to users across the supply chain- not just asset owners and operators. Assets must be managed differently if they are to respond to the changing demands of the organisations' customers and end-users.

This research theme builds on the IfM's work on data quality for asset management, and in 2012 we will work with the industrial members to develop a performance measurement architecture, supporting the development of systems to enable managers make better use of expensive assets by combining data from across the value chain.

SERVICE PERFORMANCE AND INFORMATION

To date much of the work on performance measurement and management has addressed the needs of separate, often goods based, organisations. As a result, current frameworks are inadequate for the highly partnered, collaborative networks required to deliver complex service solutions. These typically require partners to work together to define, share and establish agreed performance objectives, measures, communications and visualisations as well as meet their individual agendas.

In 2011 IfM researchers developed three frameworks describing different aspects of effective performance management systems; characterising the system being measured, the measurement system itself and the way the manager engage with the measurement data. In 2012 we will work with our industrial partners and develop a method of specifying systems suitable for measuring the performance of complex, multi-organisation service networks.

KT-BOX

Cambridge IfM leads the KT-Box project, a consortium of six universities converting recent service research into practical tools and techniques that can be applied by providers and users of complex services. The project is funded by a £2.2 million EPSRC Knowledge Transfer Award, with additional contributions from BAE Systems, Bombardier, IBM, Rolls-Royce, the MoD and many smaller companies and not-for-profit organisations.



KT-Box has developed a toolbox helping users improve their service offering;

- proposing new services (the value proposition)
- delivering services better (the value delivery)
- ensuring the services are valuable to the providers and users (value capture).

In 2012 we will be concentrating on helping users apply these tools to real situations, through secondments to industry and shorter engagements by researchers in firms.

INDUSTRIAL SUSTAINABILITY

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

Programme coordinators: Claire Barlow, Steve Evans

Researchers: Nancy Bocken, Nicky Dee, David Delamore, Bernhard Dusch, Clare Farrukh, Simon Ford, Chris Forman, Elizabeth Garnsey, Jialun Hu, Kurt Liu, Ioaniis Mastoris, Maryam Masood, David Morgan, Harald Overholm, Jae-Hwan Park, Ajith Parlikad, Rob Phaal, Jim Platts, Padmakshi Rana, Yongjiang Shi, Samuel Short, Jag Srari, Laura Sutcliffe, Gregory Theyel, Manjusha Thorpe, Miying Yang, Madeleine Yates, Helen Zhang.

This programme is developing technology and operational solutions to deliver products with reduced greenhouse gas emissions, reduced levels of consumption of non-renewable resources, reduced waste and improved social conditions.

These 'cross-centre' activities are embedded in a broad collection of research projects across the IfM, including activities in the Production Processes Group, the Centre for Technology Management, the Centre for International Manufacturing, the Design Management Group, the Centre for Industrial Photonics, the Distributed Information and Automation Laboratory and the newly formed Centre for Industrial Sustainability.

The IfM is also the lead partner in a new EPSRC funded Centre for Innovative Manufacturing, focussing on Industrial Sustainability, whilst IfM ECS practitioners regularly engage with companies on issues associated with sustainability.

Activities

EPSRC CENTRE FOR INNOVATIVE MANUFACTURING IN INDUSTRIAL SUSTAINABILITY

A five year project, between four universities and multiple companies and agencies. The aim is to develop knowledge, tools and techniques with industry and it's stakeholders that help us move towards a sustainable industrial system. More details can be found at www.industrialsustainability.org

ACADEMICS VISIT JAPAN

IfM members joined other UK academics on a trip to Japan in February 2011 to find out more about the country's approach to industrial sustainability. The visit was designed to help share experience and expertise.

TOWARDS A SUSTAINABLE INDUSTRIAL SYSTEM

A report discussing ways to create a more sustainable industrial system was published in September 2009 with contributions from leading international academics and industrialists. Download from: www.ifm.eng.cam.ac.uk/sis/

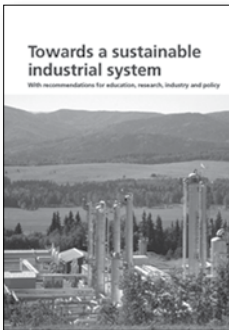
INDUSTRIAL SYMBIOSIS

We are part of the academic community which supports the National Industrial Symbiosis Programme (NISP), brokering partnerships between those who produce waste and those who can use it as their input raw material.

Current and recent projects

PRODUCT RECOVERY MANAGEMENT

Using automated ID technologies to connect



tagged items to a computerised network to support improved decision making about disposal or reuse of products at the end of their life cycle.

ASSET MANAGEMENT

Looking at ways to reduce the impact of physical assets on the environment throughout their life cycle by improved decision-making supported by better quality information, and developing tools to quantify the ecological impact of information.

CLEANTECH INNOVATION

Understanding how the uptake of cleantech innovations (an innovation delivering the same service as a conventional alternative, but with less resource usage) is hampered by up-front costs and how this can be mitigated by financing solutions.

BUILDINGS FROM WASTE PAPER

Developing structural panels based on waste paper for low-cost housing.

WIND TURBINES

Use of bamboo for wind turbine manufacture in China. Improving the carbon footprint and cost effectiveness of wind turbines. Design of new generation of flexible wind turbines.

LANDFILL MINING

The use of landfills as a resource in developing countries and the technical, economic and social considerations of whether the contents of landfill sites can be excavated and materials reclaimed from them.

NATURAL MATERIALS

Developing materials selection and processing routes to create high tech materials from sustainable resources such as bamboo, flax and stinging nettles. Quantitative assessment of the 'green' credentials of such materials.

DAYLIGHT SAVING, ELECTRICITY DEMAND AND EMISSIONS

Investigating whether changing the UK's clock policy and time-zone would result in a reduction of electricity demand and carbon emissions. In collaboration with the Department of Engineering and the Centre for Sustainable Development.

SYNTHETIC BIOLOGY

Investigating whether biological material, such as enzymes, can be introduced into mainstream technology, such as microelectronics, in specific and controllable ways using rapid, pollutant free and energy efficient processes.

CORPORATE SOCIAL RESPONSIBILITY (CSR) IN FOOD MANUFACTURING COMPANIES

Focusing on the social dimension of sustainability in food manufacturing companies, where CSR is part of the business contribution towards sustainability.

POLYMER RECYCLING

Investigating novel, localised processes to transform polymer waste which is currently considered to be un-recyclable, into valuable, sustainable products.

SUSTAINABILITY DATABASE

Forming a knowledge share database of useful tools, frameworks and resources in sustainable business and manufacturing practices.

SUSTAINABLE DESIGN AND MEDICAL DEVICES

Producing a tool for designers of medical devices to incorporate sustainability issues into their work.

SUSTAINABLE MEDICAL DISPOSABLES

Examining the potential for introducing biodegradable plastic disposables to create a more sustainable healthcare system

ASSET MANAGEMENT INCORPORATING ENVIRONMENTAL VALUE

Developing frameworks to help determine combined environmental and economic impacts of asset decisions.

SUSTAINABLE DESIGN AND MANUFACTURE OF DOMESTIC APPLIANCES

Understanding the role that design can play in improving the social and environmental sustainability of domestic appliances.

SUSTAINABLE SUPPLY NETWORKS FOR INDUSTRIAL SYSTEMS

Extending the methodology of supply network configuration and design to the sustainability domain, enabling a holistic picture of the environmental, social and economic impacts of industrial systems to be evaluated.

SUSTAINABLE VALUE

A collaborative European research project on new industrial models for sustainable and efficient production

LIFECYCLE MANAGEMENT

Developing a strategic framework to assist industry in moving towards more sustainable product development, production and use of products.

DIRECT MEASUREMENT OF CO₂(G) EMISSIONS

Using a method of direct measurement to monitor CO₂(g) emissions from airports ground operations.

EMERGING INDUSTRIES PROGRAMME

Programme Director: Paul Heffernan
<http://www.ifm.eng.cam.ac.uk/imrc/eip/>

Researchers: Nicky Dee, Laure Dodin, Alex Driver, Simon Ford, Mike Gregory, Paul Heffernan, David Kirkwood, Sirirat Lim, Finbarr Livesey, Tim Minshall, James Moultrie, Eoin O'Sullivan, Rob Phaal, Ken Platts, David Probert, Michele Routley, Jag Srail, Gregory Theyel.

The Emerging Industries Programme (EIP) is concerned with understanding the translation of scientific ideas and opportunities into products and services. It addresses the creation of substantial new industries and the infrastructure needed to support them. It integrates and develops new knowledge about the elements and dynamics of emerging industrial systems, particularly those with a significant scientific and technological component, and provides guidance for industrialists and policy makers.

The programme embodies three interrelated research strands:

- Mapping the dynamics of a broad cross section of existing industries, building on well-established mapping techniques to reveal patterns and issues of emergence in a variety of contexts
- Studying the structure, characteristics, and dynamics of key 'value network' elements and their interfaces
- Developing novel tools and techniques for the representation, analysis, and measurement of the full range of industrial activities.

Outputs

Frameworks provide a common language to underpin more realistic, practical and accessible models of emerging industrial systems. Tools

and techniques have been created for use by industrialists and policy makers in order to understand emerging industries and to develop strategies for intervention, promotion and action. The outputs of the programme enable better informed policy and investment decisions, improved awareness and engagement with standards and regulation, and the creation of successful evolution strategies at the firm, sector, and industry-level.

Projects

MANAGING CREATION AND TRANSITIONS

This project uses mapping techniques to identify the enablers and barriers that occur at the transition points during the emergence of an industry. It draws lessons from past examples and develops guidelines for organisations seeking to create and capture value from emerging, technology-based industries.

DESIGN IN SCIENCE

This project offers understanding of the potential for interactions between scientists and designers to accelerate the application of scientific discoveries. It explores how the involvement of professional (industrial) design expertise early in scientific research can improve the potential for its future application.

MANUFACTURING STRATEGY FOR START-UPS

This project has developed a strategy formulation framework and implementation process to support start-ups in emerging industries in developing and implementing their manufacturing activities.

INVESTMENT FRAMEWORKS

This project assesses the influence of public and private investment on emerging industries. It is developing new models for public investment and offers insight into future investment policy for emerging industries in the UK.

POLICY AND REGULATION

The focus of this project is on understanding the role of policy and regulation in the emergence of industries. The project is exploring the effects regulation and policies have during different phases of emerging industries.

SUPPLY NETWORKS

This project is about the development and operation of supply networks as an industry emerges. It offers insights for firms and policy makers about the opportunities for involvement during this process.

INTEGRATING CORE PROJECT

This project is developing a common theoretical framework for the whole EIP programme, integrating insights derived from the other projects and providing a coherent narrative of industry emergence.

HIGH VALUE PRODUCTION

Programme coordinator: Mike Gregory

mjg@eng.cam.ac.uk

Researchers: Mike Gregory, Paul Heffernan, Walter Herriott, Finbarr Livesey, Jag Srari, Gregory Theyel, Bill Wicksteed

Are firms and policy makers paying sufficient attention to the strategic importance of production – for firms as a means of enhancing and capturing value right along the value chain; and for policy makers as a crucial element in regional and national industrial systems? These are the two central issues being explored in this major research project, supported by the Gatsby Charitable Foundation.

This project focuses on refined definitions and better characterisations of high value production across a range of technologies, industries and company types, and from the perspective of a range of stakeholders. The project also addresses how managers make decisions about production

and value creation and is developing tools and techniques for assessing the significance of production capability.

The project involves the collection and analysis of in-depth interview data and production examples from companies across the UK, involving a comprehensive cross-section of industries including industrial biotech, oil and gas equipment, aerospace, pharmaceuticals, medical equipment and electronics. It is investigating the relationship of production with other activities in the value chain.

The study objectives are:

- refined definition(s) of high value production
- characterisations of high value production across a range of technologies, industries, company types and from the perspectives of a range of stakeholders
- understanding how managers make decisions about production and value creation,
- development of tools and techniques for assessing the significance of production capability
- guidelines for industrialists and policy makers for inclusion in strategy and policy formulation processes.

MANUFACTURING INDUSTRY EDUCATION RESEARCH GROUP

<http://www.ifm.eng.cam.ac.uk/mierg/>

Programme Co-ordinator: Judith Shawcross
jks45@cam.ac.uk

Researchers: Tim Minshall, Tom Ridgman, Judith Shawcross, Manjusha Thorpe, Helen Zhang

MIERG is a newly formed group that is interested in educational issues for existing and potential industrial practitioners. It aims to research areas where new knowledge will benefit the learning and development of:

- people in becoming effective and excellent practitioners in manufacturing industry roles
- manufacturing industry companies in developing and sustaining the capabilities needed to compete in the global industrial ecosystem

Projects

SCALE UP OF PROCESS INDUSTRIES

This project investigated the knowledge and capability required for effective scale-up with the aim of discovering how the tacit knowledge could be captured and transferred.

DEVELOPMENT OF INDUSTRIAL PROBLEM SOLVING SKILLS

A study of the postgraduates on the IfM's taught MPhil course in Industrial Systems, Manufacture and Management (ISMM) to examine how industrial problem solving skills are developed through a structured programme of exercises in the induction module.

INITIAL DEVELOPMENT NEEDS FOR TECHNICAL GRADUATES IN SMALL COMPANIES

A survey of small companies, mainly in the technology sector, to investigate their needs

for graduate training and their response to the different formats for part time education.

INTER-COUNTRY COMPARISON OF THE GRADUATE SKILLS GAP

This project is looking at the difference between the capability needs of industry for new graduates compared with the output of the university systems for the UK, China, India and the Middle East

UNDERSTANDING THE SKILLS GAP IN STARTING A MANUFACTURING ENTERPRISE

While there is a lot of research and literature looking at how to get to the business plan stage of a start-up and how to run a small company, the gap between getting funded and establishing a stable product supply is under explored. This project intends to investigate the skills needs for this period of business development.



Research degrees

www.ifm.eng.cam.ac.uk/phd
ifm-enquiries@eng.cam.ac.uk

The Department of Engineering offers both one-year MPhil and three-year PhD research degrees and welcomes applications from high-calibre UK and overseas candidates. Potential research topics within the IfM encompass the full range of management, technology and policy issues covered by our research centres and interdisciplinary programmes. Student research either builds upon work in existing areas or develops along new avenues. The IfM has around 180 graduate and post doctoral students.

PROGRAMME STRUCTURE

There are two main milestones during a PhD: the first-year report and submission of the final thesis at the end of three years. Students must demonstrate satisfactory progress at the end of the first year before they can continue with the final two years of the PhD. A supervisor is appointed for each student to provide direction and support throughout their research. Most students also benefit from the experience and knowledge of other members of the IfM. Students on the MPhil programme undertake a one-year period of supervised research, leading to submission of a thesis. Some MPhil students go on to complete a PhD.

Both PhD and MPhil students are given training in research methods. The IfM hosts the annual two-day Research Methodology Workshop for PhD researchers with interests in management or policy related disciplines. A small sample of current PhD projects is given below.

SELECTED PROJECTS

Manufacturing excellent engineers

IfM has been 'manufacturing' excellent engineers through its undergraduate and master level programmes for many years. A differentiating

feature is assumed to be the experience gained by the students via industry-based projects, visits and exercises. However, the contribution of these kinds of experience to a students' learning is not fully understood. This project investigates their contribution and the resource requirements to deliver them.

Judith Shawcross: jks45@cam.ac.uk

Identifying the business case for managing risks associated with sustainability

Long term impacts associated with sustainability issues (such as climate change and resource depletion) form a relatively marginal threat to most organisation's business strategy at present. However, evidence from some industries suggests that successful implementation of roadmapping and foresight tools to develop a long term strategy improves resilience from these risks and even enables them to capitalise on opportunities ahead of their competitors.

Elliott More: egm27@cam.ac.uk

Innovation management by global health entrepreneurs

Four billion people in the world live on less than \$2 per day and are often prevented from accessing

biomedical innovations in healthcare due to high prices and weak health systems. This research examines the role of the private sector and entrepreneurial firms in building the innovation value chain. Business models in discovery, development and delivery of global health innovations are examined.

Julia Fan Li: juliafanli@cantab.net

Investigation of laser matter interactions using high power tunable ultrafast Ytterbium fiber lasers

Laser manufacturing is dominated by several laser sources at traditional lasing wavelengths and long-pulse interactions. Industrial processes have been optimised using these available laser sources, but relatively little work has been undertaken to optimise the laser parameters to the process. In this project we aim to break beyond the bounds of current laser technology and investigate the performance of novel laser sources developed by a well-established consortium of academics and industrial partners.

Krste Pangovski: kp358@cam.ac.uk

The role of location in open innovation implementation in UK high-tech SMEs

Open innovation has emerged as a new paradigm in innovation research. How does a collaborative approach to innovation compare to more traditional closed-off, internal product development? This research focuses on open innovation in small and medium-sized enterprises, the role of location in innovation implementation and sources of openness in innovation activities, with a special focus on UK high-tech clusters.

David Weiss: dw368@cam.ac.uk

Impact of innovation management consultancy services on the R&D and marketing relationship

Consultants may promote organisational changes

inside companies they work for. But, how can the impact of management consultancy services be measured? This research aims to determine the potential impact of consultancy services on the relationship between R&D and marketing in large companies. The results will provide insights into the conditions under which consultancy services could improve the R&D/marketing relationship and ways to measure such improvement.

Luzselene Rincon: lr353@cam.ac.uk

Total Information risk management: A business-driven approach to information intelligence and data quality

Poor quality data and information can adversely affect decision making at all levels of an organisation, from setting the right strategy to operational process performance. But how can we understand the effects of poor data and information quality on a business better? And how can we measure its financial impact? This project applies risk management principles and methods to data and information quality to address these important questions.

Alexander Borek: ab865@cam.ac.uk

APPLICATIONS

Admission to Cambridge research degrees is managed by the university's Board of Graduate Studies. Full details of how to apply can be found on their website:

www.admin.cam.ac.uk/offices/gradstud/

Information specific to the Department of Engineering can be found at:

www.eng.cam.ac.uk/graduate/postgrad/

Applicants are encouraged to discuss their proposed research topic with the IfM research centre concerned. Some funded studentships are available but early application is strongly advised.



Undergraduate: Manufacturing Engineering Tripos (MET)

www.ifm.eng.cam.ac.uk/met
met-enquiries@eng.cam.ac.uk

MET is an option for the final two years of the Cambridge Engineering degree. The course develops and applies engineering knowledge in a business context and prepares students to be leaders of business and technology enterprises. It provides a thorough grounding in management and manufacturing technologies, together with an understanding of the full range of industrial activities – from market analysis, product design and production, right through to sales and distribution. MET recently underwent a full course review and update.

PEOPLE

Course Directors: Bill O'Neill

Academic staff: Claire Barlow, Mike Gregory, Paul Heffernan, Ian Hutchings, Duncan McFarlane, Tim Minshall, James Moultrie, Bill O'Neill, Ajith Parlikad, Jim Platts, Ken Platts, David Probert (on sabbatical), Alan Thorne

Support: Sinead Parker, Ann Grady

COURSE STRUCTURE

Students take a diverse set of modules that span all issues of relevance to manufacturing businesses, from market analysis, product design and production, right through to sales and distribution.

INDUSTRIAL PROJECTS

The programme's taught course is combined with repeated opportunities to put theory into practice via a series of industrial projects. Final-year students work in small teams on three company-based projects, tackling real industrial problems. In addition, a six-week individual project takes place

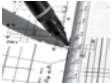

at the end of the year. Examples of recent industry projects include:

Redesign of high volume electric motor assembly facility. (Global consumer goods company)

Rationalising communication of shop-floor generated information (Multinational engineering company)

Streamlining of vendor supply chain processes (High performance engines manufacturer)

Developing a plan to introduce preventative maintenance for advanced drilling equipment (Aircraft manufacturer)

MET		Designing a product		Making components		Organising the factory		Managing the business		Business context
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Optimising product allocation to automated assembly (Lighting manufacturer)

Developing manufacturing strategy for new single crystal turbine blade facility (Global engineering company)

Customer satisfaction and new product pricing strategy (Independent energy company)

Implementation of inventory forecasting (High performance engines manufacturer)

Development of a visual management display system (Food equipment manufacturer)

MAJOR PROJECT

Students undertake a major design project during their first year. Students work in teams of three or four to research the market for a product, prepare a design and manufacturing plan and finally draw up a business plan for a company to produce the product. Each year these are displayed at a Design Show in June. Product ideas on display at the 2011 event included an automatic device to lower climbers safely to the ground in indoor climbing centres and an innovative design for mid-to-long-term housing for disaster victims and refugees.

www.ifm.eng.cam.ac.uk/met/design

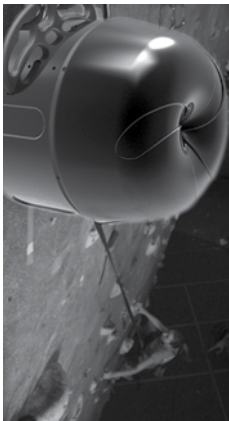
INTERNATIONAL RESEARCH PROJECT

Final year students travelled to Trinidad and Tobago in the summer of 2011. Issues investigated included the region's manufacturing and R&D capabilities; the development of FDI and effect on both countries of the global focus on sustainability.

www.ifm.eng.cam.ac.uk/met/tour11/

GRADUATE RECRUITMENT

MET graduates are well positioned for leadership roles in business and industry. MET graduates are employed across the whole value chain from design, operations, business development, consultancy and government.





Postgraduate: Industrial Systems, Manufacture and Management (ISMM)

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

ismm-enquiries@eng.cam.ac.uk

The MPhil in Industrial Systems, Manufacture and Management (ISMM) is a one-year postgraduate programme designed to provide graduates with the technical skills, personal development and industrial experience they need to become immediately effective in their early careers in industry. It consists of a mixture of taught course modules, around 40 company visits, a series of projects tackling real business and technical problems in industry and an in-depth, individual research project. ISMM also includes a 2-week study tour providing experience of industries outside the UK. The course is highly competitive and attracts five applicants for every place. Each cohort typically includes around 15 different nationalities.

PEOPLE

Course Director: Simon Pattinson

Tutors: Tom Ridgman, Yongjiang Shi

Associate Tutors: Derek Ford, Gerry Frizelle, Peter Hiscocks, Finbarr Livesey, Tim Minshall, Bill O'Neill, Dominic Oughton, David Probert, Judith Shawcross, David Schwarz

Support: Sue Gaw



COURSE STRUCTURE

ISMM runs for 45 weeks and comprises eight weeks of project work, sixteen weeks of taught modules, a two-week overseas study tour either in mainland Europe or further afield and a sixteen week dissertation project.

ISMM is not just an academic course – the emphasis is on learning by doing and on solving real problems in live industrial situations. Each cohort undertakes a total of 120 industrial projects.

INDUSTRIAL PROJECTS

Small teams of students work on four, company-based projects, each lasting two-weeks, tackling real industrial problems. At the end of each project they present their findings to senior management. Recent projects have included:

Audit and evaluation of company's carbon footprint (Market leader in food/drink vending sector)

Factory layout for new concept single-seater light aircraft (Entrepreneur)



- Market research and analysis of a novel magnetic tagging platform technology** (High tech start-up)
- Hi-Fidelity playback of music in a 'streamed' world** (High-end market leader in the audio sector)
- Process improvement in television programme planning** (Specialist media company)
- Improved stock management for orthopaedic surgery** (Major teaching hospital)
- Further development of Lean Manufacturing Systems in a fast moving production environment** (Subsidiary of a multinational manufacturing business)
- Mapping the governance process for manufacturing technology programmes** (Major aerospace company)
- Global manufacturing strategy** (International wind turbine company)

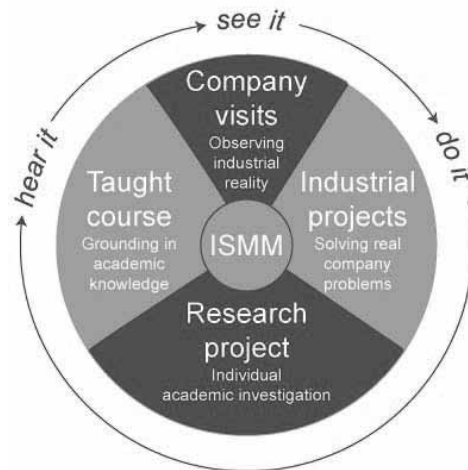
OVERSEAS STUDY TOURS

Each summer the students divide into two groups and go on two-week study tours. In 2011 one group visited Malaysia and Singapore, reviewing the evolution of manufacturing over the last 20 years and assessing how the area is facing up to the challenges of industrial sustainability.

The second group visited California studying the entrepreneurship and start-up culture of Silicon Valley and assessing the effectiveness of the supporting infrastructure.

LEADERSHIP DEVELOPMENT

ISMM students spend two weeks on the development of leadership and management skills, including outdoor team exercises in the Lake District. Teams collect points on successful completion of the tasks and individuals have the opportunity to lead the teams in numerous problem-solving activities.





IfM Education and Consultancy Services (IfM ECS)

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

ifm-enquiries@eng.cam.ac.uk

IfM Education and Consultancy Services provide a rapid dissemination route for new ideas and approaches developed at the IfM. Industrial practitioners, with many years of senior management experience, engage directly with industry, governments and other agencies via consultancy, executive education and events. Their approach is very different to conventional consultancy, involving working collaboratively to co-develop solutions and focusing on transferring knowledge as well as delivering business results. Their engagements help to both inform and fund future IfM research.

PEOPLE

Director: Peter Templeton

Industrial practitioners: John Archer, Nicky Athanassopoulou, Paul Christodoulou, Bill Colquhoun, Joe Davidson, Don Fleet, Derek Ford, Andrew Gill, Susan Grinsted, Jonathan Hughes, Duncan Hurlstone, David Learmond, Dennis Lewis, Steve Mann, David Marlow, John McManus, Dominic Oughton, Tony Prouse, Liz Salter, Martin Smith, Paul Tasker, John Thomas, Jim Trueman

Events management: Ella Davey, Jo Griffiths

Executive education and tool development: Alan Cousens, Tom Ridgman

Marketing: Nick Mann **PR & Communications:** Clare Gilmour, Jo Riches

Finance: Linda Gray, Neil Hickinson, Maija-Liisa Walker

Administration: Sharn Gray, Laura Mellusco, Kate Willsher

SELECTED PROJECTS

LARGE COMPANIES

www.ifm.eng.cam.ac.uk/working/large/

Roadmapping

The IfM has developed and deployed roadmapping techniques in a wide variety of situations to assist companies and industry sectors to develop business strategies which link to market trends and opportunities, product and technology developments. IfM ECS undertook a number of roadmapping projects in 2011. We worked with an international powder coating manufacturer to support the identification of medium and long

term technology opportunities and delivered a training module on roadmapping techniques to enable the company to run projects themselves in the future. Another project with a global insulation business was designed to help the company to build better links between its research activities and market opportunities and to be able to communicate these linkages to senior management.

IfM ECS ran roadmapping workshops for a large Malaysian agro-based business to identify medium and long term value streams and technology opportunities. Staff training in roadmapping techniques was also provided.



A consortium of technology groups in Valencia received training in roadmapping including a separate course for facilitators. Ongoing support will be provided by telephone and email.

Further roadmapping training programmes were delivered to a China-based healthcare company, a Mexican oil company and a Malaysian automotive manufacturer.



Manufacturing footprint strategy

IfM ECS has worked with two major international companies on their manufacturing footprint strategy – optimising the location and roles of their global manufacturing plants – in the last year. The companies concerned are in contrasting sectors of aerospace and plastic toys. Our in-depth approach has now been applied to 12 companies over the last 9 years. The recent projects have helped to expand two key tools into new areas. Firstly, we have extended the make-or-buy analysis approach to cover a long-term strategic view (even where no existing supply data is available). Secondly, we have refined the global network design methodology to improve the analysis of plant and partner roles within a network.

In November 2011, we held a ‘practitioner workshop’ involving our close industrial collaborators. As a result, we have identified a number of ‘radar’ topics for ongoing research and tool development that closely reflect the needs of our industrial partners. A team of senior researchers and practitioners is now working to develop new approaches in these areas.

Open Innovation Forum

www.ifm.eng.cam.ac.uk/ctm/teg/oi_forum.html

Now in its second year, the Open Innovation Forum has gone from strength to strength. Aimed at firms involved in the Food & Fast Moving Consumer Goods (FMCG) sector it is concerned with the

complete value chain, from raw materials and packaging suppliers to equipment manufacturers, through to logistics organisations and retailers. Forum members share best practice, explore ‘hot topics’ along the FMCG value stream and participate in optional, accelerated collaborations.

By the end of 2011 the Forum already had 13 members (out of a capped maximum of 20). Key topics explored during the first year were best practice and tools for exploring open innovation ‘wants’; managing risks in partnerships; developing open innovation ‘find’ capabilities; and measuring success.

International networks

The IfM’s Centre for International Manufacturing (CIM) has developed network configuration tools that support the design and operation of international networks spanning engineering, production, supply and service representing the critical functional activities of the manufacturing value chain. IfM ECS practitioners are working with CIM researchers on ways to develop network capabilities and reconfigure operations for improved strategic capability and performance. Examples of particular initiatives include:

- A team of practitioners and researchers has launched a major collaboration with several leading global manufacturers aimed at developing a long-term, integrated manufacturing and supply chain strategy
- Functional network optimisation studies with leading multinationals
- Collaborations with policy makers on competitive international manufacturing strategies

Service and support

IfM ECS practitioners have continued to work with major equipment and service providers during



2011 to support the development and adoption of service capabilities. These projects, which exploit emerging IfM research in this area, focused initially on the fields of aerospace and defence, and information and business systems. Interest in this work continues to expand into other sectors.

IfM research in the area of service and support has been used to develop tools enabling organisation structure to be linked explicitly to business strategy. We are also developing ways to assess the necessary functional 'depth' of engineering across independent business lines as the business model shifts from product centric, to market/customer centric; as well as from product to service orientation.

IfM ECS practitioners worked closely with IfM researchers on the KT-Box project, a government-sponsored academic consortium, designed to turn research findings into tools and techniques to support service and support for UK industry and the public sector.

Work will continue during 2012 on the development of a strategic workforce-planning programme for engineering-based industry on behalf of a major global equipment and services provider, linking with a number of UK based global manufacturing companies.

Industrial sustainability

In 2011 work was carried out with a major food supplier to identify conditions for success for innovation projects. This led to the development of a simple analytical tool used by the client to identify risks for future innovation activities. A hands-on training course has been delivered to the principle suppliers of a major retailer. This provided the necessary skills to analyse energy flows within a factory and identify mitigation strategies for cost reduction. Delegates were trained to analyse a Cambridge designed 'imaginary factory' containing common faults found in industry.

EXECUTIVE DEVELOPMENT

www.ifm.eng.cam.ac.uk/working/incompany/

IfM researchers and IfM ECS practitioners design and deliver bespoke programmes to meet strategic and capability development needs. They specialise in helping companies to implement strategies and action plans developed during the course of IfM consultancy projects.

Executive innovation programme

In 2011 IfM ECS delivered the second programme for a major mobile telecommunications company to develop an executive programme for senior staff. The programme was delivered in collaboration with colleagues from across the University of Cambridge network.

Managing technology development

IfM ECS collaborated with a Dutch Business School on a course for senior managers of a global manufacturing company which provides equipments to the meat processing industry. This course addressed the challenge of managing technology development and also excellence in operations.

Global partnership delivers new executive programme

In the Autumn of 2011 IfM ECS piloted a new programme for a leading international company which manufactures equipment for construction and power systems. This new programme forms a key element in an integrated management development initiative in which IfM ECS is partnered with leading universities in Asia and the USA. Managers attend courses in economics, finance, marketing, leadership and strategy at the IfM in Cambridge. The second presentation of the programme takes place in Spring 2012.

SELECTED PROJECTS

SMALL COMPANIES

www.ifm.eng.cam.ac.uk/working/sme/



UK-wide support programme

IfM ECS has worked with over 700 small and medium-sized manufacturing companies (SMEs) in the last 10 years, helping to develop strategy and build capabilities to improve competitiveness. We have developed an efficient, structured and results-orientated approach that is readily accessible to managers of smaller manufacturing companies. A typical engagement consists of three phases:

1. Prioritisation, which reveals the firm's priority areas leading to the development of a tailored plan to develop capabilities and achieve real improvement.
2. Business strategy, which typically identifies new market or product opportunities; how the firm should compete; and a prioritised action for executing the strategy.
3. Capability development, which helps the firm build its ability to win orders and manage the firm's resources more effectively to achieve its growth ambitions.

Following on from the positive impact of Business Link West Midlands and the Essex Manufacturing and Innovation and Growth Programme (see following sections), IfM ECS is now offering manufacturing SME support across the UK, with experienced facilitators based in the North and North West, the Midlands, Wales, southern England and East Anglia. A new guide to the programme is available from IfM ECS, entitled *Help for smaller manufacturers*. Please email for a free copy: ifm-enquiries@eng.cam.ac.uk

Business Link West Midlands

IfM ECS continued to work in partnership with Business Link West Midlands in 2011 to deliver a

highly successful programme of support for small and medium-sized manufacturing companies.

Over 100 companies took part in the programme during 2010 and 2011. The programme offers a comprehensive assessment of each business, identifying the priority areas where change will make a real difference to performance. It requires the minimum of time from management and involves expert facilitation by an experienced manufacturing practitioner, typically spread over several months.

CASE EXAMPLES

A manufacturer of **agricultural machinery** saw turnover grow from £1.4m to more than £3.5m within 18 months.

A manufacturer and refurbisher of machinery in the **laser sector** saw turnover double to £6m in 12 months, with turnover this year expected to reach £10m.

A **brewing company** is set to triple its output over a two-year period.

Essex Manufacturing Innovation and Growth Programme

Nearly 80 companies in the Essex region took part in the Essex Manufacturing Innovation & Growth Programme (EMIG), led by IfM ECS during 2010 and 2011. The programme was delivered free of charge thanks to funding from Essex County Council and followed a similar approach to that used in the West Midlands. By November 2011 over 60 companies had gone on to undertake a more in-depth engagement such as strategy (18) or other capability development (45).

CASE EXAMPLES

IfM ECS worked closely with an industrial **electronics manufacturer** to identify and exploit new market opportunities following a thorough review of its strategy. This allowed the business to

grow by 80% over a 12 month period with further growth opportunities planned.

A manufacturer of **metering equipment** was helped to halve its defect rate over a 4 month period, allowing the business to concentrate once again on growth rather than responding to dissatisfied customers.

Further work with a **premium food producer** enabled the company to recognise the various needs of its different market sectors and to plan separate strategies for each sector. This has led to 20% growth in the last nine months.

Planning and control

The IfM's Manufacturing Planning and Control Group provides a focus for companies interested in planning and control issues. The Group is holding a series of interactive workshops in April and May 2012 which will enable attendees to consider real-world problems in a game-play environment. Each of the workshops will consider different operational aspects that adversely impact on the manufacturing business. Workshops provide a meeting place for manufacturing professionals from different firms to discuss common problems and to share ideas in an open learning environment.



IFM MEMBERSHIP

<http://www.ifm.eng.cam.ac.uk/working/members/>

IfM corporate partnership scheme

The Corporate Partnership Scheme provides companies with access to research-based strategic, technical and business expertise, geared to the specific needs of large international companies. Twenty companies are currently members of the scheme.

SME membership

The IfM's membership scheme for small and

medium-sized companies currently has over 50 members. Membership provides access to operational, technical and strategic expertise, with support geared to the specific needs of small and medium-sized companies. Members pay a reduced charge for IfM services, training programmes and workshops.

The IfM Open Evening provides an opportunity for members to learn about the latest work of the Institute, and the annual members garden party, in one of the Cambridge College's, provides an opportunity to network with other members.

PUBLIC SECTOR

<http://www.ifm.eng.cam.ac.uk/working/public/>

Future of UK high value manufacturing

IfM ECS undertook a major study for the Technology Strategy Board into the future trends, challenges and opportunities for UK manufacturing. The report, *A landscape for the future of high value manufacturing in the UK* examines the global manufacturing environment and maps out the future of high value manufacturing in the UK over the next fifteen to twenty years.

The IfM study was announced at the Government's Growth Summit in Bristol in February 2012. It will be used to inform public policies, research strategies and investment programmes, particularly in the high value manufacturing Catapult centre, opened in October 2011.

Download the report at: <http://www-priv.ifm.eng.cam.ac.uk/free/>

Mapping the future of the Australian rail supply network

IfM ECS is helping to map out the next 30 years of the Australian rail industry following the great success of the Automotive Australia 2020 Roadmap undertaken in 2009. Working in collaboration with

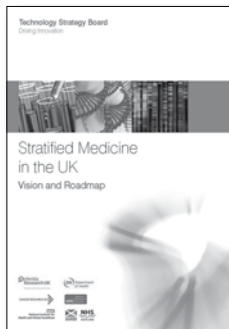


The Australian National University (led by ANU Edge), the Cooperative Research Centre for Rail Innovation and Strategic Connections Group, IfM ECS is helping to create a roadmap to support an effective and efficient rail supply network well into the 21st Century.

Stratified medicine in the UK

A consortium of government bodies and leading charities joined forces to accelerate the development and uptake of stratified medicine in the UK. Stratified medicine can be summarised as identifying the right therapy for the right patient at the right time in the right dose.

The Technology Strategy Board, Medical Research Council, Cancer Research UK, Arthritis Research UK, Department of Health, Scottish Government Health Directorate and National Institute for Clinical Health and Excellence formed a partnership to take forward the Stratified Medicine Innovation Platform. Together they will invest around £200m over five years in the area of stratified medicine. IfM ECS developed and facilitated the process to set out a shared vision for the UK to be the best place to develop, and adopt, stratified medicine. A technology roadmap was developed to describe nine thematic areas which will help accelerate the development and uptake of stratified medicine in the UK.



Living with Environmental Change

IfM has recently collaborated with Living with Environmental Change (LWEC) to set out future priorities. Roadmapping workshops were facilitated by the IfM resulting in a common theme: the importance of taking a holistic or systems approach to address the issue of environmental change. LWEC is an ambitious and innovative partnership of UK government departments and agencies, devolved administrations, local government and research councils. www.lwec.org.uk/challenges

UK marine industries roadmap and capability study

IfM ECS is facilitating the development of a roadmap to help prioritise future research support options to maximise economic growth of UK marine companies. A 'landscape' roadmap has been developed identifying some priority market opportunities, followed by a series of deep dive workshops to explore issues further.

The project is to help identify and shape the development of the industry over the next 20 years. It has been initiated by the UK's Technology Strategy Board, the Department for Business Innovation and Skills and the Transport Knowledge Transfer Network.

The initial workshop had input from over 50 external experts drawn from across industry, academia and other stakeholders. This was then developed further to identify priority trends and drivers and to characterise the 50+ opportunities that had been identified.

INTERNATIONAL DEVELOPMENT

<http://www.ifm.eng.cam.ac.uk/working/developing/>

Middle East Programme

The Programme for Management, Policy, and Innovation in the Middle East and North Africa (MENA) is studying innovation ecosystems in the MENA region. This project aims to develop a process for mapping innovation ecosystems in large MENA firms, and to understand how such firms can encourage innovation at a national level. The research also aims to gain insight into existing innovation ecosystems in the MENA region and understand how such ecosystems compare with others around the world.



COURSES AND EVENTS

<http://www.ifm.eng.cam.ac.uk/service/events/>

Workshops

Over 1000 people attended IfM events in 2011. The programme of workshops and courses presented research-based approaches on a range of manufacturing management themes. These included roadmapping, technology and innovation management, the make-or-buy issue, technology evaluation, performance management, technology intelligence and fundamentals of manufacturing management.

SME workshop series

This series of workshops, specially designed for senior managers of smaller manufacturing companies, is now in its third season. Each workshop focuses on an important issue related to winning orders or managing limited resources and attendees are encouraged to create actions plan for their companies.

The workshops are tailored to meet the needs of busy (and resource-constrained) managers, and are designed to stimulate lively discussion about practical steps that can be taken to strengthen and grow small businesses.

Industrial Briefing Day

Over 100 senior managers from industry attended a Briefing Day in May 2011. The event provided an opportunity to meet leading researchers in management, technology and policy areas and showcased some of the IfM's recent industrial collaborations. The Briefing Day was extremely popular and a similar event is planned for May 2012.



IDEASPACE ENTERPRISE ACCELERATOR

<http://www.ideaspace.cam.ac.uk/>

The ideaSpace Enterprise Accelerator (iEA), part of the University of Cambridge Hauser Forum, is a hub for early stage innovation, providing space and resource to a wide community of advisors, innovators and entrepreneurs. The four-year programme will support the identification and accelerated development of high potential business ventures arising from research and innovation and will enable the creation of new businesses across the Eastern region.

IfM ECS was chosen by East of England Development Agency (EEDA) to lead the initiative. iEA will assist the region's enterprise communities to start and grow new research and innovation-led businesses, as well as providing strategic direction for the region's technology enterprise and entrepreneurship activities. Early-stage start-up firms gain support and training to help them grow and create new jobs.

iEA currently hosts 65 companies in its co-working facility and has graduated 20 companies who have left ideaSpace to find offices of their own. Through the event and funding programmes over 2,000 individuals in over 400 companies have been helped to develop their enterprise and innovation skills.

The coming year will see ideaSpace develop its links with companies large and small alike as it looks to bring together different elements of the innovation eco-system around the UK to more effectively identify and take advantage of emerging market and technology needs.

Public engagement



Cambridge University Science Festival

The IfM took part in Cambridge University's annual Science Festival once again in March 2011. This highly popular event is now a firm fixture in our annual calendar. Over a thousand people visited the IfM's Alan Reece Building and enjoyed a host of interactive demos including high-powered lasers, rocket racing using laser 'guns', talking robots, ultra-high speed technology – and much more.

The 2012 Science Festival runs from 12-25 March. The IfM events will take place on the afternoon of Saturday 24 March, featuring some old favourites plus lots of new items as well.



School children get an introduction to manufacturing

Twenty-three children from a Chelmsford secondary school spent a day at the IfM in July 2011, having fun and learning about manufacturing engineering. The students from the specialist engineering college, Chelmer Valley High School, who are studying for their GCSEs, took part in a rocket building competition and also played the 'just-in-time' game – a fun session designed to teach operations management.

Suzanne Mycock, Head of Engineering at the school said: "We are very pleased that the students have been given the opportunity to see manufacturing in the real world. We are keen to inspire them to aim high and realise that a place at Cambridge is not beyond their grasp."

Sixth formers tour the IfM

Two award winning sixth form students visited the IfM in October 2011 as part of a week's placement with British Sugar. The pair won the placement as their prize in the Academy Award Excellence

competition. During their visit, the students, Ambi Ubhei of Sandwell Academy and Sam Exton of Darwen Aldridge Community Academy toured the IfM's automation labs and design studios and also had the chance to discuss industrial sustainability with IfM researchers and to contribute their ideas on outreach activities.

International visitors

The IfM welcomed a series of international visitors to the Alan Reece Building in 2011. A delegation of **Mexican government** officials paid a visit in January to find out more about the Institute's research on industrial policy and its role in assisting small businesses. The delegation, led by Bruno Ferrari, Mexico's Secretary of Economy, stopped off in Cambridge en route to Davos for the World Economic Forum meeting.

The **President of the European Commission**, José Manuel Barroso, visited the IfM in February. The President was in Cambridge to deliver this year's Alcuin Lecture. Mr Barroso, accompanied by the Vice-Chancellor Professor Sir Leszek Borysiewicz, was welcomed to the IfM by Professor Dame Ann Dowling, Head of the University's Department of Engineering and Professor Ian Hutchings, head of the IfM's Inkjet Research Centre.

Mr Liu Xiaoming, **Chinese Ambassador** to the UK, visited the IfM in March to discuss the Institute's connections with China and explore opportunities for future collaboration. Mr Liu Xiaoming, said: "I have been very impressed with the innovation and creativity demonstrated at the Institute. In particular I am pleased with the international approach taken by IfM and its continued commitment to forging strong links with China.

The **State Governor of Massachusetts**, Deval Patrick, and his Innovation Economy Partnership Mission team visited the IfM in March. The visit was part of a 10 day trade tour of Israel and Britain designed to strengthen links in manufacturing, social policy and life sciences.

European engineering students converge on IfM

The IfM hosted the European Society for Precision Engineering and Nanotechnology (EUSPEN) Challenge event in June 2011.

European engineering students took part in the annual international competition with teams from the UK, Belgium, Spain, Germany, Switzerland, Netherlands, Denmark, Italy, Croatia involved in the three day event.

The international competition is designed to identify outstanding students across Europe that have the potential to be future leaders in the field of Precision Engineering and Nanotechnology.

Supporting enterprise in Rwanda

IfM doctoral student Julia Fan Li has played a leading role in a project to support entrepreneurs in Rwanda. Julia helped to organise the African Innovation Prize business plan competition and Rwanda Entrepreneurship Week at the Kigali Institute for Science and Technology (KIST), Rwanda in July 2011. The competition for African students and the week-long conference grew out of Julia's experience of working in Rwanda and finding there was little structured support for would-be entrepreneurs. The organisers hope these initiatives will help students at KIST and other Rwandan universities to engage in product development, understand different business models, learn how to analyse a market, network, measure performance and fund their initiatives.

Publications and online resources

The IfM produces a range of publications and online resources based on its work with industry.



Practice guides and reports

Most of our practice guides and reports are available for free download. Reports and guides published in 2011 include:

- A review of international approaches to manufacturing research
- Organising for breakthrough innovation: Rejuvenating the established firm
- Who owns the Cambridge phenomenon? Acquisition and growth in a pioneering cluster of high tech firms
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The IfM publishes a range of practical workbooks and text books based on collaborative research with industry. Titles include:

- Roadmapping for strategy and innovation: Aligning technology and markets in a dynamic world
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- Technology intelligence: Identifying threats and opportunities from new technologies
- Making the business case for technologies: A five step process guide
- Make-or-Buy: A practical guide to industrial sourcing decisions
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Institute for Manufacturing
Department of Engineering
The Alan Reece Building
17 Charles Babbage Road
Cambridge CB3 0FS

Tel: +44 (0)1223 766141

Fax: +44 (0)1223 464217

Email: ifm-enquiries@eng.cam.ac.uk

www.ifm.eng.cam.ac.uk

