UNIVERSITY OF CAMBRIDGE

IfM MANAGEMENT TECHNOLOGY POLICY

UK-US workshop on manufacturing and innovation policy

Practices and lessons from advanced manufacturing innovation institutes

SUMMARY REPORT

The White House, Washington DC | 18 March 2015

This event was co-organised by:

- **Centre for Science, Technology & Innovation Policy (CSTI), Institute for Manufacturing (IfM), University of Cambridge, UK**
- **US Advanced Manufacturing National Program Office**

Rapporteur: Dr Carlos López-Gómez

UK Science & Innovation Network

"There were high expectations – which proved well exceeded - on learning potential for this joint UK-US workshop on manufacturing and innovation policy. We greatly appreciated the generosity of HVM Catapult in sharing lessons learned and best practices in establishing their Innovation Centres, and we trust that our progress has been similarly informative to the Catapult leaders. Our manufacturing innovation institutes leaders valued the candid and collegial discussions, and we look forward to additional conversations in the future."

- Mike Molnar, Director, US Advanced Manufacturing National Program Office

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WORKSHOP AIMS

The IfM/CSTI International Manufacturing Policy Workshop Series brings together manufacturing policy practitioners and relevant stakeholders (from academia, industry and society) to share lessons and effective practices in key policy areas, including:

- Manufacturing policy development
- Manufacturing policy evidence and foresight
- Manufacturing policy institutions

This first UK-US workshop on manufacturing and innovation policy focused on advanced manufacturing innovation institutes. In particular, the event explored the experiences of the recently formed UK High Value Manufacturing 'Catapult' and the US National Network for Manufacturing Innovation (NNMI).

The workshop brought together NNMI and Catapult Centre directors, agency officials and policymakers, industry representatives and academics, to share lessons learned and effective practices. Topics for discussion included: institute establishment and growth, governance and operations, project planning and key performance metrics, industry participation and other stakeholder engagement.

Valuable connections we made and participants welcomed the opportunity to compare and contrast experiences with international counterparts. There was an open dialogue about both the high-level strategies and the day-to-day running of the institutes that allowed for an effective exchange of insights and approaches.

Workshop attendees

Catapult Centres

The Catapult centres are a network of world-leading centres designed to transform the UK's capability for innovation in seven specific areas and help drive future economic growth.

In 2010 entrepreneur Hermann Hauser produced an influential report, 'The Current and Future Role of Technology & Innovation Centres in the UK', which identified best practice from around the world and made a robust case for long-term UK investment in a network of technology and innovation centres which would 'deliver a step change in the UK's ability to commercialise its research'. In autumn of that same year, the UK government provided additional funding to Innovate UK to establish seven Catapults over the four-year spending review period from 2011 to 2015.

The Catapults network provides access to expert technical capabilities, equipment, and other resources required to take innovative ideas from concept to reality. Each Catapult centre specialises in a different area of technology, but all offer a space with the facilities and expertise to enable businesses and researchers to collaboratively solve key problems and develop new products and services on a commercial scale.

There are currently nine catapult centres: Cell Therapy, Digital, Energy Systems, Future Cities, High Value Manufacturing (itself a network of seven centres), Offshore Renewal Energy, Precision Medicine, Satellite Applications, and Transport Systems.

US National Network for Manufacturing Innovation (NNMI).

In June 2011, the United States President's Council of Advisors on Science and Technology (PCAST) recommended that the federal government launch an advanced manufacturing initiative of public-private partnerships to support academia and industry for applied research on new technologies and design methodologies. In his 2013 and 2014 State of the Union Addresses, President Obama called for the creation of a Nationwide Network for Manufacturing Innovation (NNMI) to scale up advanced manufacturing technologies and processes. He asked Congress to authorize investment—to be matched by private and non-federal funds to create an initial network of up to 15 institutes. Over 10 years, he proposed that the NNMI encompass 45 institutes. On December 16, 2014, the President signed the Revitalize American Manufacturing Act, into law.

The NNMI is intended to create a competitive, effective, and sustainable manufacturing research-to-manufacturing infrastructure for U.S. industry and academia to solve industry-relevant problems. The NNMI consists of linked Institutes for Manufacturing Innovation (IMIs) with common goals, but unique concentrations. In an IMI industry, academia, and government partners are leveraging existing resources, collaborating, and co-investing to nurture manufacturing innovation and accelerate commercialization.

Five IMIs have been launched: America Makes (Additive manufacturing), Digital Manufacturing and Design Innovation Institute (DMDII), LIFT (Lightweight Innovations For Tomorrow), PowerAmerica (Wide Bandgap Semiconductors), and The Institute of Advanced Composites Manufacturing Innovation (IACMI).

KEY THEMES & OBSERVATIONS

The workshop brought together stakeholders from UK and US to compare and contrast experiences of the UK Catapult Centres and the US National Network for Manufacturing Innovation (NNMI). Clear themes of common interest emerged from the presentations and follow up discussions. Lessons were shared not only on high-level strategy development but also the on the day-to-day running of the institutes. A summary of key themes and observations is presented below. Opinions were expressed by participants in a personal capacity and therefore do not necessarily represent the views of their affiliated institutions.

Shared focus on advanced manufacturing capabilities and industry-relevant problems.

Both the UK Catapult Centres and the US National Network for Manufacturing Innovation (NNMI) have been conceived with the aim of strengthening the national infrastructure supporting advanced manufacturing. Both initiatives aim at tackling market failures that prevent the rapid development and commercialisation of advanced product and manufacturing-process innovations and share the common goal of tackling industry-relevant problems.

The whole is greater than the sum of parts

The workshop provided an opportunity for participants to reflect on the advantages of belonging to a network opposed to operating in isolation. Being associated a network 'brand' sends a strong 'statement of accessibility' to the industrial community. Opportunities are created to share technical expertise and capabilities among network members, particularly in cross-cutting areas such as metrology. Looking forward, opportunities exist to more systematically share practices among network members.

Stakeholder engagement: a key challenge for continued success

There was general agreement on the importance of establishing long-lasting collaborations with industrial partners. In order to achieve that, a key task is gain institutional recognition among industry, which is particularly challenging for those institutes that were established only recently.

The continued success of the institutes will depend on their ability to demonstrate their value proposition to industry. One way to do that is to mirror the operations of customers in order to simplify interaction. It is also important to communicate with stakeholders outside manufacturing functions. Some of the institutes have seen advantages in offering manufacturing training courses for non-experts to help them understand the technologies that they might be implementing. Similarly, some institutes have been successfully liaised with financial institutes who have encouraged their customers, particularly SMEs, to take advantage of the opportunities available to them.

Variety of market failures, variety of functions

Participants engaged in a rich discussion on the variety of roles that advanced manufacturing innovation institutes can and should play in order to address market failures that affect the manufacturing innovation process. There was broad agreement on the fundamental role of innovation institutes in helping fill in the 'missing middle' between basic research and private sector commercialisation. Innovation institutes can assume a co-ordination role de-risk innovation projects: acting as a bridge between businesses and the research and academic communities to enable projects that no single actor would be able to perform by itself.

Furthermore, gaps in the national institutional infrastructure highlight the potential for innovation institutes to make a contribution beyond R&D in areas including: skills development, access to facilities and expert advice, provision of test beds for new production processes and products, stakeholder engagement and network formation, and FDI attraction.

Defining a technology focus: what is in and what is out?

A traditional way to position institute activities is in terms of technology readiness levels (TRLs). While TRLs are useful communication tools, some participants expressed that in practice is very hard to measure TRLs accurately. Moreover, it is important to also consider Manufacturing Readiness Levels (MRLs), which pay particular attention to risks and readiness for manufacture.

An important choice that innovation institutes face is the selection of technology domains to focus on. The diversity of technologies (including 'platform', production and infra-technologies) underpinning manufacturing systems needs to be recognised. In defining a technology focus, institutes need to identify potential gaps across all types of technology – as well as taking into account the activities of other actors in the innovation system, national and industrial strengths as well as policy priorities.

Measuring success: beyond traditional KPIs

An area of concern for both countries is the selection of key performance indicators (KPIs). Given differences in the industrial-innovation system in which institutes are expected to make a difference, defining a common set of KPIs becomes problematic. The resource commitment involved in adopting multiple KPIs (e.g. in terms of data gathering) needs to be properly accounted for.

Beyond traditional knowledge- and financial-related KPIs such as patents and business performance, a number of alternative indicators can provide insights into how successfully the institutes are working: satisfied and engaged members, repeat business, access of SMEs to supply chains, retention of staff, production of skilled technicians and engineers, etc.

Manufacturing skills of the future

The role of innovation institutes in addressing skill gaps faced by industries in both countries received particular attention. Institutes' expertise and capabilities can be leveraged to develop workers with competencies required to compete in the advanced manufacturing industries of the future. Interesting institute experiences were shared, including the funding of apprenticeship training through bank sponsorships.

AGENDA

08.00	Call to order (Co-chairs Mike Molnar and Mike Gregory)
08.05	**Welcome – workshop aims and objectives** John Holdren, Director, Office of Science and Technology Policy Rosalind Campion, Global Issues Counsellor, British Embassy Washington
08.20	**US Manufacturing Innovation Policy** Jason Miller, Deputy Director, National Economic Council
08.35	**National Network for Manufacturing Innovation – mission and architecture** Mike Molnar, Director, Advanced Manufacturing National Program Office
08.55	**UK Manufacturing Innovation Policy** Chris Carr, Head of Manufacturing Policy, Department for Business, Innovation & Skills
09.05	**UK Manufacturing Strategy and Catapult Institutes – mission and architecture** David Wright, Head of Manufacturing, Innovate UK
09.15	**Framing the Discussion** Eoin O'Sullivan, Director, Centre for Science, Technology and Innovation Policy, University of Cambridge
09.20	Discussion
09.30	Break
09.45	PANEL ONE | **UK Experiences in Institute Establishment and Growth** Adrian Allen, Commercial Director, Advanced Manufacturing Research Centre Peter Chivers, Chief Executive, National Composites Centre Clive Hickman, Chief Executive, Manufacturing Technology Centre David Wright, Head of Manufacturing, Innovate UK **Moderated by Mike Gregory**
11.00	PANEL TWO | **US Experiences in Institute Establishment and Growth** Dean Bartles, Director, Digital Manufacturing & Design Innovation Institute (National Digital Manufacturing Institute) Larry Brown, Director, Lightweight Innovations for Tomorrow (National Lightweight Metals Institute) MG Nicholas G. Justice (USA, ret.), Director, PowerAmerica (National Power Electronics Institute) Ed Morris, Director, America Makes (National Additive Manufacturing Institute) **Moderated by Adele Ratcliff**
12.15	Wrap-up discussion, refinement of focus topics
12.30	Lunch
13.30	ROUNDTABLE ONE | **Excellence in Institute Operations** Each institute leader is invited to present one best practice related to institute operations, such as Performance Metrics/KPIs, governance, project planning, facilities strategy (additional handout materials welcome, presentation limit of two slides per institute) **All US and UK institute leaders. Moderated by Chris Carr**
15.00	Break
15.15	ROUNDTABLE TWO | **Excellence in Stakeholder Engagement** Each institute leader is invited to present one best practice related to institute engagement of key stakeholders, including Large Industries, small/medium enterprises, academic institutions, industry trade associations and other organizations (additional handout materials welcome, presentation limit of two slides per institute) **All US and UK institute leaders. Moderated by Mark Johnson**
16.45	Wrap-up discussion - next steps
17.00	Close of workshop
18.00	**Reception: British Deputy Head of Mission's Residence**

JOHN HOLDREN

Director, Office of Science and Technology Policy

Dr. John P. Holdren is Assistant to the President for Science and Technology, Director of the White House Office of Science and Technology Policy, and Co-Chair of the President's Council of Advisors on Science and Technology (PCAST). Prior to joining the Obama administration Dr. Holdren was Teresa and John Heinz Professor of Environmental Policy and Director of the Program on Science, Technology, and Public Policy at Harvard University's Kennedy School of Government, as well as professor in Harvard's Department of Earth and Planetary Sciences and Director of the independent, nonprofit Woods Hole Research Center. Previously he was on the faculty of the University of California, Berkeley, where he co-founded in 1973 and co-led until 1996 the interdisciplinary graduate-degree program in energy and resources. During the Clinton administration Dr. Holdren served as a member of PCAST through both terms and in that capacity chaired studies requested by President Clinton on preventing theft of nuclear materials, disposition of surplus weapon plutonium, the prospects of fusion energy, U.S. energy R&D strategy, and international cooperation on energy-technology innovation.

Dr. Holdren holds advanced degrees in aerospace engineering and theoretical plasma physics from MIT and Stanford. He is a member of the National Academy of Sciences, the National Academy of Engineering, and the American Academy of Arts and Sciences, as well as a foreign member of the Royal Society of London and former president of the American Association for the Advancement of Science. He served as a member of the MacArthur Foundation's Board of Trustees from 1991 to 2005, as Chair of the National Academy of Sciences Committee on International Security and Arms Control from 1994 to 2005, and as Co-Chair of the independent, bipartisan National Commission on Energy Policy from 2002 to 2009. His awards include a MacArthur Foundation Prize Fellowship, the John Heinz Prize in Public Policy, the Tyler Prize for Environmental Achievement, and the Volvo Environment Prize. In December 1995 he gave the acceptance lecture for the Nobel Peace Prize on behalf of the Pugwash Conferences on Science and World Affairs, an international organization of scientists and public figures in which he held leadership positions from 1982 to 1997.

JASON MILLER

Deputy Director, National Economic Council

Jason Miller is the special assistant to the president and deputy director of National Economic Council (NEC) in the White House. Mr Miller leads economic policy coordination on manufacturing and innovation, energy, small business, international investment, and economic development for the White House. He also serves as the director of the White House Office of Manufacturing Policy at the NEC, and in that role he serves as the White House point person on the President's manufacturing agenda, coordinating implementation efforts across US Federal agencies.

Mr. Miller has led the effort in developing the President's comprehensive manufacturing agenda, played a key role in initiatives including the launch of the National Network for Manufacturing Innovation, the President's Advanced Manufacturing Partnership, SelectUSA – the first ever federal effort to bring job-creating investment to the US, and the successful and industry-supported light-duty vehicle fuel efficiency standards through 2025.

Prior to joining the administration, Mr Miller was a management consultant with The Boston Consulting Group in San Francisco and at Marakon Associates, a boutique consulting firm. Mr Miller received a BA from the University of Pennsylvania, a MBA from the Kellogg School of Management at Northwestern University, and a MPA from Harvard's Kennedy School of Government.

MICHAEL F. MOLNAR

Director, Advanced Manufacturing National Program Office

Mike Molnar is the founding director of the interagency Advanced Manufacturing National Program Office (AMNPO), with a mission to foster industry-led partnerships and to form a "whole of government" approach to strengthen competitiveness and innovation in U.S. manufacturing. This interagency team is responsible for designing and establishing the National Network for Manufacturing Innovation (NNMI), a Presidential and Congressionally authorized initiative with now eight institutes under formation.

Mike likes to be known simply as "a manufacturing guy from industry" with nearly 30 years industry experience in advanced manufacturing and technology development. His engineering passion is with "designing and building things" – with a career in creating flexible automation, assembly and test systems and launching state-of-the-art manufacturing plants. His corporate career in manufacturing research emphasized industry consortia and partnering with academia and federal agencies. He has served as a federal fellow in the White House Office of Science and Technology Policy, and was elected a fellow of both the American Society of Mechanical Engineers (ASME) and the Society of Manufacturing Engineers (SME). He's very active in professional societies with over 30 years of leadership roles with ASME and SME – most recently as the 2014 president of SME.

CHRIS CARR

Head of Manufacturing Policy, Department for Business, Innovation & Skills

Chris Carr is a career civil servant with experience across the public sector, having worked in four departments, an independent review, a local council and a quango. He has also worked at a big-name consultancy firm and at a very small one.

His expertise is in the area of organisational development – variously called continuous improvement, change management, business process re-engineering, Lean, Six Sigma and various other lucrative brands. He combines this with a classic policy skillset and is therefore doomed forever as a "generalist" – old-fashioned, unimaginative and lacking in drive. Nothing could be further from the truth.

His current role is to lead policy on Manufacturing, Services and Electronics – combining sponsorship of the UK electronics and professional & business services sectors with a wide-ranging manufacturing brief covering technology, financing and skills.

EOIN O'SULLIVAN

Centre for Science, Technology and Innovation Policy, University of Cambridge

Eoin joined the Institute for Manufacturing as a Senior Policy Fellow in 2007. Since then Eoin has carried out research on the ways science and engineering R&D is translated in new technologies, industries and economic wealth. Eoin's policy-related activities have included studies for the UK Department of Business, Innovation & Skills; the Engineering & Physical Sciences Research Council; the UK Government Office of Science; the Technology Strategy Board; and the Higher Education Funding Council of England.

Eoin is one of the organisers of the Babbage Industrial Policy Network, and is on the governance committee of the Alimentary Pharmabiotic Centre, University College Cork / Teagasc.

Before joining the IfM, Eoin was Special Advisor to the Director General of Science Foundation Ireland external link. At SFI, Eoin managed several university-industry initiatives including the national Centres for Science, Engineering & Technology (CSET) programme. Eoin was part of the original team that set up SFI. He was both a Senior Policy Advisor at Forfas, The Irish National Policy & Advisory Board for Enterprise, Trade, Science, Technology & Innovation and a Senior Programme Officer for Information & Communications Technologies at the Foundation.

ADRIAN ALLEN

Commercial Director, Advanced Manufacturing Research Centre

Adrian Allen is an industrialist and time served graduate engineer. He has created and sold successful engineering and consultancy companies prior to changing direction and becoming co-founder and director of the Advanced Manufacturing Research Centre (AMRC) with Boeing - based in his home town of Sheffield England. He conceived the AMRC concept in 1999 with Professor Keith Ridgway, motivated by a mutual frustration to make sense of and overcome the difficulty small enterprises (like his) endured in 'selling' their truly revolutionary inventions into industry and large corporations in particular.

Keith and Adrian followed a dream of building a radical research centre dedicated to helping companies develop and make better products, faster quicker and greener. They pitched their idea for an unbiased, neutral, expert decision making manufacturing research centre to the world famous Boeing Company to back them in their vision. In 2004 the AMRC with Boeing's first centre was opened. Just 10 years on, its capacity, capability and commitment to change have made it widely regarded by its peers as the world's foremost centre for advanced machining research. It's unique 'collaborative approach is globally recognised as an exemplar of academic, industrial and governmental collaboration.

PETER CHIVERS

Chief Executive, National Composites Centre

Peter has extensive experience in composites and technology leadership, having held a number of senior engineering and business leadership positions in large multinational companies and SMEs in the aerospace industry.

He has been involved in composite technology and capability development for over 20 years and is a passionate believer in using new technology to bring value. He is committed to supporting UK composite manufacturing industry's growth and increasing its contribution to the economy.

Peter was Executive Director of the National Composite Centre from May 2010, leading the setup of the centre, and from June 2011 took up the permanent position as Chief Executive.

CLIVE HICKMAN

Chief Executive, Manufacturing Technology Centre

Dr. Hickman established the MTC business, which now employs over 350 engineers and scientists, in 2010 and in addition to the Manufacturing Technology Centre he has successfully created an Aerospace Research Centre, and Advanced Manufacturing Training Centre (announced by the British Governments Minister for Skills as the First National College and the framework for future National Colleges) and a Business Launch Centre (to exploit technology developed by MTC and young entrepreneurs).

Prior to joining MTC, he held numerous positions in the automotive industry, including Chief Executive of Tata Motors European Technical Centre plc and Head of Engineering for Tata Motors India; Managing Director of Ricardo UK Ltd; Engineering Director at MIRA and Executive Engineer with Rover Group.

During this time he was responsible for several vehicle and powertrain programmes including the development of the Queens Golden Jubilee Bentley (whilst with Ricardo), and for all engineering development on passenger car and commercial vehicles, including the people's car 'Nano' and the Vista Electric Vehicle (whilst at Tata Motors).

Clive obtained a BSc in Mechanical Engineering from Wolverhampton, a PhD in Mechanical Engineering from Aston and an MBA from Loughborough. He is a Fellow of the Institution of Mechanical Engineers and a Chartered Engineer.

DAVID WRIGHT

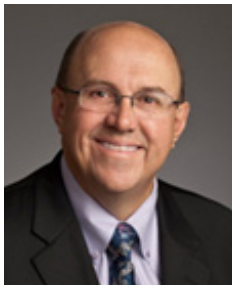
Head of Manufacturing, Innovate UK

David joined Innovate UK in April 2014 as Head of Manufacturing, looking after Innovate UK's activity in this area, including collaborative R&D and close liaison with the High Value Manufacturing Catapult.

His manufacturing career has been primarily in the automotive sector, both at OEM – Land Rover and Morgan Motor Company – and in tier 1 - Brico Engineering and Gillet Exhaust Manufacturing.

After a spell in management consulting, as regional director for Wales and head of the manufacturing practice for a national firm, David joined the Manufacturing Advisory Service – West Midlands in 2002 as its first Chief Executive, a position he held for almost 7 years, delivering significant business improvement to hundreds of manufacturing SMEs in the West Midlands.

David joined Coventry University in 2009 as Director, Strategic Developments, in which role he led both the Low Carbon Vehicles and Metrology Grand Challenge Initiatives, as well as being responsible for the university's SME Engagement programme. Most recently before joining Innovate UK, he was Associate Pro-Vice-Chancellor, Major Initiatives. David also holds the position of Non-Executive Chairman of Made in the Midlands, a membership organisation of manufacturing companies in the midlands, with almost 300 members.



DEAN BARTLES

Executive Director, Digital Manufacturing & Design Innovation Institute (National Digital Manufacturing Institute)

Dr. Dean L. Bartles was recently announced as the Executive Director of the newly awarded "Digital Manufacturing & Design Innovation Institute" in Chicago which was won by a large collaborative team of 23 Universities/Colleges, 41 companies, state and local government support and strong support from the city of Chicago and led by UI LABS. Prior to this new position, Dr. Bartles spent over 35 years in the defense and aerospace industry and recently announced his retirement from General Dynamics Corporation in order to assume his new position with UI LABS.

LARRY BROWN

Director, Lightweight Innovations for Tomorrow (National Lightweight Metals Institute)

Mr. Brown has more than 30 years of aerospace and marine experience in materials joining. Throughout this time he has gained a working knowledge in various joining processes for metal alloys – both lightweight and high temperature superalloys. His efforts have led to advanced joining methodologies for fabrication of advanced military and commercial engine hardware, and have yielded six patents as co-inventor.

As the Executive Director of LiFT, Mr. Brown is responsible for day-to-day management and leadership of the organization, including interface with the ONR Contracting Officer's Technical Representative (COTR). Mr. Brown has been employed by EWI for over 13 years, and most recently served as that organization's Director of Government Technology Programs. Prior to this role he held leadership positions as Director of the Project Management Office and Director of Engineering. He also has served as the Director of the Navy Joining Center (NJC) where his responsibilities included planning and control of NJC technology development projects in support of the Office of Naval Research (ONR) ManTech Program. Prior to joining EWI, Mr. Brown worked for Rolls-Royce Corporation as Senior Materials Joining Developing Engineer in the Materials and Processes Laboratory. He also worked for Allied Signal, Energy Controls Division, as a Manufacturing Welding Engineer.

MG NICHOLAS G. JUSTICE (USA, RET.)

Director, PowerAmerica (National Power Electronics Institute)

Gen. Nick Justice, a retired U.S. Army major general, capped a 41-year Army career in 2012 as commanding General of the Army Research, Development and Engineering Command (RDECOM) headquartered at the Aberdeen Proving Ground in Maryland who commanded the United States Army Research, Development and Engineering Command and Aberdeen Proving Ground, Maryland. He previously led the Program Executive Office Command, Control and Communications Tactical at Fort Monmouth, New Jersey, and served in both Operation Desert Storm and Operation Iraqi Freedom. Gen. Justice earned numerous military awards and decorations, including the Legion of Merit and the Bronze Star. He was inducted into the Officer Candidate School Hall of Fame in 2009.

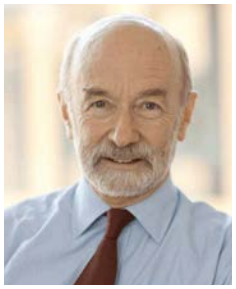
In January 2015, Gen Justice was named at the Executive Director for PowerAmerica, a National Network for Manufacturing Innovation institute focused on revolutionizing energy efficiently by developing innovative ways to power next-generation electronics.

ED MORRIS

Director, America Makes (National Additive Manufacturing Institute)

Operated by the National Center for Defense Manufacturing and Machining (NCDMM), America Makes – National Additive Manufacturing Innovation Institute serves as a nationally recognized additive manufacturing center of innovation excellence. Under Ed's leadership, America Makes is focused on accelerating the adoption of additive manufacturing design and production technologies in the U.S. by bridging the gap between basic research and technology development and deployment.

Previously Mr. Morris was the Director of Mechanical Engineering & Manufacturing on the Lockheed Martin Corporate Engineering & Technology team. Mr. Morris is an active member of the National Defense Industrial Association's Manufacturing Division. He represents industry on the DoD ManTech Program Strategic Planning Working Group and the Joint Defense Manufacturing Technology Panel's Electronics Subpanel and Advanced Manufacturing Engineering Subpanel. He is also a member of the National Academies' National Materials and Manufacturing Board.



MIKE GREGORY

Head, Institute for Manufacturing, University of Cambridge

Mike Gregory is Head of the IfM. Following an early career in industry, he founded the Manufacturing Engineering Tripos, a senior undergraduate programme linking engineering, management and economics and with very close industrial engagement.

Subsequent developments in research and collaboration with industry reflected this broad view of manufacturing and led to the establishment of the IfM in 1998. Mike's work continues to be closely linked with industry and government and he has published in the areas of manufacturing strategy, technology management, international manufacturing and manufacturing policy.

He served as Executive Director of the Cambridge MIT Institute from 2005– 2008 and was Springer Visiting Professor at UC Berkeley in 2008/9. He chairs the UK Manufacturing Professors' Forum and is a member of the UK government's Manufacturing Analytical Group. He is a Fellow of Churchill College and the Royal Academy of Engineering.

MARK JOHNSON

Director, Advanced Manufacturing Office, Energy Efficiency and Renewable Energy, U.S. Department of Energy

Dr. Mark Johnson is Director of the Advanced Manufacturing Office (AMO), in DOE's Office of Energy Efficiency and Renewable Energy (EERE). Previously, Dr. Johnson was a Program Director in the Advanced Research Projects Agency – Energy (ARPA-E), where he started initiatives in energy storage and critical materials, as well as projects in small business, advanced semiconductors, novel wind architectures, superconductors, and electric machines. Prior to joining DOE, Dr. Johnson served as the director of the Industry and Innovation Programs for the Future Renewable Electric Energy Delivery and Management (FREEDM) Systems Center, a National Science Foundation Gen-III Engineering Research Center targeting the convergence of power electronics, energy storage, renewable resource integration, and information technology for electric power systems. At North Carolina State University, Dr. Johnson is an Associate Professor of Materials Science and Engineering with research interests including crystal growth and device fabrication of compound semiconductor materials with electronic and photonic application. He also served as the university's Director of Engineering for the Technology, Entrepreneurship and Commercialization (TEC) Program. His work focuses on the intersection between clean energy, materials science and advanced semiconductors; entrepreneurship; tech-transfer and public-private partnership formation.

Dr. Johnson has a bachelor's degree from the Massachusetts Institute of Technology and a Ph.D. from North Carolina State University, both in Materials Science and Engineering.

ADELE RATCLIFF

Director, Manufacturing Technology, Office of the Deputy Assistant Secretary of Defense for Manufacturing and Industrial Base Policy, U.S. Department of Defense

Ms. Adele Ratcliff is the Director of the DOD Manufacturing Technology (ManTech) Program, which is overseen by the Office of the Deputy Assistant Secretary of Defense for Manufacturing and Industrial Base Policy (ODASD(MIBP)). During her tenure in OSD, she has focused on building strong interagency partnerships to address broad transition of manufacturing issues such as manufacturing readiness and the Advanced Manufacturing Enterprise. Currently, Ms. Ratcliff leads the effort in establishing the DOD-led national Institutes for Manufacturing Innovation (IMIs) outlined in the President's 2013 State of the Union address. These currently include America Makes, Lightweight Innovations for Tomorrow (LIFT), the Digital Manufacturing and Design Innovation (DMDI) Institute, the Integrated Photonics IMI, and Flexible Hybrid Electronics Manufacturing Institute.

Ms. Ratcliff has a long acquisition career, including Program Manager for the congressionally mandated Defense Acquisition Challenge Program, Deputy Program Manager for the Foreign Comparative Test Program, and more than eleven years in Air Force Test and Evaluation at Eglin Air Force Base in Florida. As Test Manager, she guided the Air Force's Wind Corrected Munitions Dispenser test program (better known as WCMD), from prototype through the production and deployment phase of the Platform, earning her the Air Force Materiel Command Test Engineer of the Year Award. More importantly, her efforts transitioned this Platform to support the Warfighter in the initial phases of Operation Enduring Freedom. She received the SECDEF Award for Excellence for her support of the Pilot Institute for Additive Manufacturing in March 2013.

UK HVM CATAPULT CENTRES

Advanced Forming Research Centre

The Advanced Forming Research Centre (AFRC) is a collaborative venture between the University of Strathclyde, leading multinational engineering firms including Rolls-Royce, Boeing, TIMET, Aubert & Duval, and Barnes Aerospace, the Scottish Government and Scottish Enterprise.

The sole Scottish representative in the HVM Catapult, the AFRC is also part of 2 other global networks of industrially-focused research centres; AxRC and GlobalNet.

Located in a bespoke facility next to Glasgow International Airport, the AFRC focuses on developing forming and forging technologies to support the design and manufacture of products, across a range of sectors including Aerospace, Automotive, Energy, Medical Devices and Marine.

Advanced Manufacturing Research Centre

The University of Sheffield AMRC with Boeing focuses on advanced machining and materials research for aerospace and other high-value manufacturing sectors.

The AMRC with Boeing identifies, researches and resolves advanced manufacturing problems on behalf of its industrial partners. Around 70 companies have joined as members, from global aerospace giants such as Boeing, Rolls-Royce, BAE Systems and Messier-Bugatti-Dowty, to local small businesses. The centre also works with hundreds of other manufacturers on specific research projects.

AMRC researchers work with individual companies on specific projects, and collaborate on generic projects for the benefit of all members, using the centre's array of state-of-the-art manufacturing equipment. R&D topics at the AMRC with Boeing are determined by the board of industrial partners. This ensures that work is focused on industrial commercial requirements, and provides lasting value to members.

Centre for Process Innovation

The Centre for Process Innovation is a UK-based technology innovation centre and part of the High Value Manufacturing Catapult. We use applied knowledge in science and engineering combined with state of the art development facilities to enable our clients to develop, prove, prototype and scale up the next generation of products and processes.

Our open innovation model enables clients to develop products and prove processes with minimal risk. We provide assets and expertise so our customers can demonstrate the process before investing substantial amounts of money in capital equipment and training. New products and processes can be shown to be feasible; on paper, in the lab and in the plant before being manufactured at an industrial scale.

By utilising our proven assets and expertise companies can take their products and processes to market faster. There is no down time in production as all of the process development is completed offsite and our technology transfer and engineering teams can help you to transfer the product or process into full scale production at speed.

Manufacturing Technology Centre

The Manufacturing Technology Centre (MTC) represents one of the largest public sector investments in manufacturing for many years and is housed in a 12,000 square metre purpose built facility at Ansty Park, Coventry.

It is a partnership between some of the UK's major global manufacturers and the universities of Birmingham, Nottingham and Loughborough, and TWI Ltd. The MTC now has more than 50 industrial members representing large OEMs, Tier 1 suppliers and SMEs from across a wide range of industry sectors.

The MTC specialises in a range of manufacturing technologies and processes that are particularly important to the high value manufacturing sector: Intelligent Automation, Advanced Tooling and Fixturing, Electronics Manufacturing, High Integrity Fabrication, Manufacturing Simulation and Informatics, Metrology and NDT and Net Shape and Additive Manufacturing.

The MTC provides a flexible approach to working with both large and small companies and offers a tailored service designed to meet the needs of individual companies which ranges from consultancy support for specific problems to a long-term relationship for programme based projects through MTC membership.

National Composites Centre

Our mission is to be the world leading centre of excellence and innovation in composite technology, with over 100 specialist composite engineers, designers and technicians working on innovative composite applications.

The National Composites Centre (NCC) provides industrial scale Research and Technology Development facilities to meet the needs of all sectors wishing to capitalise on the high-strength, low weight, corrosion-resistant qualities of composites materials.

The NCC has a broad range of technology capability including: pre-preg and dry fibre solutions, with thermoset and thermoplastic resin systems, a wide range of manufacturing technologies and equipment including hand lay-up, robotic fibre placement, tri robot cell, resin infusion, hot drape forming, press forming, with both in and out of autoclave curing. The manufacturing capabilities are supported by component finishing and quality validation through ultrasonic NDT and a fully equipped material laboratory. These services are available to UK composites companies on a pay per use basis.

Only 20 months after opening the NCC has more than 25 industrial members of all sizes, drawn from across a variety of sectors including: renewables, aerospace, motorsport, marine and satellite. The £28m NCC Phase II project now underway will double the size of the centre to enhance our ability to include skills, training and further development opportunities for the UK Composites Industry.

The NCC is hosted by the University of Bristol and works closely with EPSRC Centre for Innovative Manufacturing in Composites to evolve and mature emerging composite manufacturing technologies from the laboratory through to commercial maturity.

Nuclear AMRC

The Nuclear Advanced Manufacturing Research Centre (Nuclear AMRC) aims to enhance the capabilities and competitiveness of the UK civil nuclear manufacturing industry, and help British manufacturing companies compete for nuclear contracts worldwide.

The Nuclear AMRC is led by the University of Sheffield, with the backing of government and industry. Over 40 companies have joined the Nuclear AMRC as full members, from global reactor providers to specialist suppliers.

The Nuclear AMRC is based in bespoke facilities on the Advanced Manufacturing Park in South Yorkshire. The centre's workshop contains a range of state-of-the-art manufacturing equipment tailored for nuclear industry applications.

WMG

WMG centre HVM Catapult, University of Warwick. For more than 30 years WMG has engaged with industrial partners in collaborative R&D based on the successful fusion of fundamental and applied research, coupled with leading knowledge transfer expertise.

The WMG centre High Value Manufacturing Catapult will build on this pedigree. Through industrial collaboration the global challenge of Low Carbon Mobility is being addressed, driven by priorities in the automotive, commercial (truck and bus), off-road (agricultural and construction), rail and marine transport sectors.

Our focus is on Lightweight Technologies and Energy Storage and Management. These are underpinned by developments in Digital Validation and Verification, with the aim of reducing time to market and the cost of prototyping new solutions

US INSTITUTES

America Makes

America Makes focuses on helping the United States grow capabilities and strength in 3D printing, also known as additive manufacturing. America Makes facilitates collaboration among leaders from business, academia, nonprofit organizations and government agencies, focusing on areas that include design, materials, technology and workforce and help our nation's three-dimensional (3D) printing industry become more globally competitive.

Location: Youngstown, OH
Focus Area: Additive manufacturing
Date Launched: 8/16/2012
Director: Ed Morris
Founding Organization: National Center for Defense Manufacturing and Machining
Federal Partner: Department of Defense
Funding: Federal $50M, Matching $39M

Digital Manufacturing and Design Innovation Institute (DMDII)

The DMDII is the nation's flagship research institute for applying cutting-edge digital technologies to reduce the time and cost of manufacturing, strengthen the capabilities of the U.S. supply chain and reduce acquisition costs for the U.S. Department of Defense (DoD). The DMDII develops and demonstrates digital manufacturing technologies, and deploys and commercializes these technologies across key manufacturing industries. The goal is to create product and manufacturing process definitions simultaneously. Design innovation is the ability to apply these technologies, tools and products to re-imagine the manufacturing process from end to end.

Location: Chicago, IL
Focus Area: Integrated digital design and manufacturing
Date Launched: 2/25/2014
Director: Dean Bartles
Founding Organization: UI Labs
Federal Partner: Department of Defense
Funding: Federal $70M, Matching $106M

LIFT: Lightweight Innovations For Tomorrow

LIFT is part of a national network of research institutions and industrial companies geared toward advancing America's leadership in manufacturing technology. The center will speed development of new lightweight metal manufacturing processes from laboratories to factories for products using lightweight metal, including aluminum, magnesium, titanium and advanced high-strength steel alloys. An equally important mission is to facilitate the training of the workers who will use these new processes in factories and maintenance facilitates around the country.

Location: Detroit, MI
Focus Area: Lightweight technology
Date Launched: 2/25/2014
Director: Larry Brown
Founding Organization: EWI Federal
Partner: Department of Defense
Funding: Federal $70M, Matching $78M

PowerAmerica

The mission of PowerAmerica is to develop advanced manufacturing processes that will enable large-scale production of wide bandgap (WBG) semiconductors, which allow electronic components to be smaller, faster and more efficient than semiconductors made from silicon. WBG semiconductor technology has the potential to reshape the American energy economy by increasing efficiency in everything that uses a semiconductor, from industrial motors and household appliances to military satellites.

Location: Raleigh, NC
Focus Area: Wide bandgap semiconductors
Date Announced: 1/15/2014
Director: Major General Nicholas G. Justice (USA, ret.)
Founding Organization: North Carolina State University
Federal Partner: Department of Energy
Funding: Federal $70M, Matching $70M

The Institute of Advanced Composites Manufacturing Innovation (IACMI)

Advanced composites are currently used for expensive applications like satellites and luxury cars. Researchers at IACMI will work to develop lower-cost, higher-speed, and more efficient manufacturing and recycling processes for them. Bringing these materials down the cost curve can enable their use for a broader range of products including lightweight vehicles with record-breaking fuel economy; lighter and longer wind turbine blades; high pressure tanks for natural gas-fueled cars; and lighter, more efficient industrial equipment. The Institute will focus on lowering the overall manufacturing costs of advanced composites by 50 percent, reducing the energy used to make composites by 75 percent and increasing the recyclability of composites to over 95 percent within the next decade.

Location: Knoxville, TN
Focus Area: Advanced fiber-reinforced polymer composites
Date Announced: 1/9/2015
Director: Craig Blue
Founding Organization: University of Tennessee, Knoxville
Federal Partner: Department of Energy
Funding: Federal $70M, Matching $180M

SUPPORT

UK Science and Innovation Network, USA

The UK Science and Innovation Network (SIN) is jointly funded by the Department for Business, Innovation and Skills and the Foreign & Commonwealth Office and consists of 90 offices based in 28 countries and 47 cities around the world. SIN's main objective is to promote international collaboration in science and technology to maintain the excellence of UK science with the ultimate goal of boosting UK prosperity.

In the US, SIN has offices based in Atlanta, Boston, Chicago, Houston, Los Angeles, San Francisco, and Washington DC. SIN officers work with the local science and innovation community in support of UK policy overseas and create important relationships to best use the value of science and innovation discoveries and investments overseas.

"We are really pleased to support this event and look forward to closer relationships in manufacturing innovation between the US and UK."

- Jack Westwood, UK Science and Innovation Network, USA

This event was co-organised by:

Centre for Science, Technology & Innovation Policy (CSTI), Institute for Manufacturing (IfM), University of Cambridge, UK

The Centre for Science, Technology &Innovation Policy (CSTI) is an applied policy research unit exploring what makes national innovation systems effective at translating new science and engineering ideas into novel technologies and emerging industries. CSTI research projects are designed to support the evidence needs of science, technology and innovation policymakers, in particular those officials in public agencies who are responsible for programme design, portfolio management and strategy development.

The Institute for Manufacturing (IfM) brings together expertise in management, technology and policy to address the full spectrum of issues which can help industry and governments create sustainable economic growth.

US Advanced Manufacturing National Program Office

Hosted by the National Institute of Standards and Technology (NIST) the AMNPO is staffed by representatives from federal agencies with manufacturing-related missions as well as fellows from manufacturing companies and universities.

The interagency office is charged with:

- Convening and enabling industry-led, private-public partnerships focused on manufacturing innovation and engaging U.S. universities, and
- Designing and implementing an integrated whole of government advanced manufacturing initiative to facilitate collaboration and information sharing across federal agencies.

By coordinating federal resources and programs, the Advanced Manufacturing NPO will enhance technology transfer in U.S. manufacturing industries and help companies overcome technical obstacles to scaling up production of new technologies.

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