UNIVERSITY OF CAMBRIDGE

CSTI Science Technology Innovation Policy

Roles of National Institutions in Supporting Innovation:

Examples from the 'Digitisation of Manufacturing' Agenda

SUMMARY REPORT

The British Embassy, Berlin | 20 January 2016

This event was co-organised by:

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

Rapporteurs: Dr Carlos López-Gómez and Ella Whellams

UK Science & Innovation Network

IfM MANAGEMENT TECHNOLOGY POLICY

“The digital revolution has already changed business models in the media and retail industries. In manufacturing, how things are made and where they are made will also profoundly change. Fostering a dialogue between policymakers and businesses is very important to create the right environment for industrial innovation. This workshop was also an opportunity to share experiences between German and British Ministries”.

Agnes Estibals, Deputy Director for Innovation at the Department for Business, Innovation & Skills

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BACKGROUND

CSTI/POLICY LINKS INTERNATIONAL MANUFACTURING POLICY WORKSHOP SERIES

The International Manufacturing Policy Workshop Series is part of an ongoing collaboration between the Centre for Science, Technology & Innovation Policy (CSTI), its 'Policy Links' knowledge exchange unit, and the UK Science & Innovation Network.

The series brings together 'paired' institutions from UK and partner countries to share experiences and jointly identify potential solutions to the challenges faced in promoting innovation and manufacturing-based growth. In particular, the workshop series offers an opportunity for policy officials to, together with other relevant stakeholders from academia, industry and society, share lessons and effective practices related to:

Manufacturing policy development – latest industrial and sector strategies, key national policy priorities, practical lessons in developing cross-agency strategies.

Manufacturing policy evidence and foresight – key sources of 'industrial intelligence', key trends and drivers affecting industrial competitiveness and value capture, manufacturing futures.

Manufacturing policy institutions – roles and functions of key manufacturing policy-related institutions, including: technology and innovation centres, national academies, university-industry collaborative R&D organisations, industry associations.d jointly identify effective practices for the development and implementation of innovation policies.

PAST EVENTS IN THE SERIES

Towards a New Industrial Structure Vision? Issues on Japan's Industrial Policy, November 2013 (Institute for Manufacturing, University of Cambridge, UK)

UK-Japan Workshop on Manufacturing and Industrial Policy, June 2014 (University of Tokyo, Japan)

Turning a Goldfish into Dragon: Issues on Singapore's Industrial Policy, July 2014 (Institute for Manufacturing, University of Cambridge, UK)

UK-US Workshop on Manufacturing and Innovation Policy, March 2015 (White House, Washington, US)

Hidden Regional Champions – Issues on Germany's Industrial Policy, June 2015 (Institute for Manufacturing, University of Cambridge, UK)

WORKSHOP REPORTS

www.manufacturing-policy.eng.cam.ac.uk/resources/workshop-reports

CONTEXT OF THE WORKSHOP: FOCUS ON NATIONAL INSTITUTIONS

Innovation holds a central place in the policy agenda in Germany, UK and countries all over the world. There is therefore significant interest in understanding how national and regional institutions can support innovation policy development and implementation in an effective manner. In particular, there is interest in the ways institutions can help ensure that public investments result not only in new technologies but also in more competitive industries, a vibrant SME ecosystem, and increased national socio-economic value.

The debate in academia and practice, however, has largely focused on the role of government institutions in supporting knowledge generation primarily through R&D funding programmes. Relatively little attention has been paid to additional roles that public institutions could provide to support the diffusion and application of new R&D-based knowledge which are critical to ensuring efficient translation into industry.

Manufacturing innovation – including disruptive innovation – relates to the manufacture of new products based on new advanced technologies but also, critically, to new ways to manufacture existing products. Similarly, a country's innovation performance is defined by its ability to nurture new technology-based firms but also, critically, by the ability of existing firms to quickly absorb and apply new knowledge to upgrade, diversify and gain competitive advantage.

A range of institutions – from universities and science and economic ministries to intermediate R&D organisations and standard development bodies – may therefore play critical roles in policy development and implementation, both individually and collectively. The range of challenges is diverse: not only performing R&D and supporting the scale up of disruptive/emerging technologies but also promoting commercialisation by business, adoption by SMES as well as supporting regional specialisation.

The diverse but complementary roles of institutions can play is particularly evident in themes such as the 'digitisation of manufacturing' that cut across industries, technologies and geographies. The 'digitisation of manufacturing' is already driving new challenges and creating new opportunities across industries and, if fully realised, has the potential to drastically reshape manufacturing as we know it. However, it is still unclear who the winners (and losers) across industries and nations will be. There is therefore significant interest in the roles and functions that national institutions can play in determining this balance.

GERMAN INSTITUTIONS

Federal Ministry for Economic Affairs and Energy (BMWi)

The central task of the Ministry for Economic Affairs and Energy is to reinvigorate the social market economy, stay innovative in the long term and strengthen the social fabric in Germany.

The Federal Ministry for Economic Affairs and Energy needs to constantly guarantee competitiveness and a high level of employment. The Ministry has the necessary legal, administrative and coordinating mandate to fulfil this mission, e.g. in the area of energy, industry and innovation policies as well as in the area of competition, SMEs and European politics.

BMWi's policy is guided by the principles of social market economy and has proved its worth over many years, particularly so during the difficult periods of economic development. BMWi recognises the need a forward-looking economic policy in order to secure higher employment and better conditions for the industry and small and medium-sized enterprises in Germany on a lasting basis.

Federal Ministry of Education and Research (BMBF)

The Federal Ministry of Education and Research supports people and their ideas by funding research institutions and higher education institutions, by awarding scholarships and prizes and by organizing competitions in education and research.

The BMBF performs tasks under its terms of reference under the German Basic Law, The most important tasks include:

- Funding science and research (from basic research to cutting-edge technology);
- Providing support for the gifted – at school, during training and in higher education;
- Fostering young research talent and promoting international exchanges in training and further training studies and science;
- Working in association with the Lander to shape vocational training provided outside of schools, continuing education and training as well as training grants.

Fraunhofer-Gesellschaft

The Fraunhofer-Gesellschaft promotes and conducts applied research in an international context to benefit private and public enterprise and is an asset to society as a whole.

By developing technological innovations and novel systems solutions for their customers, the Fraunhofer Institutes help to reinforce the competitive strength of the economy in their region, throughout Germany and in Europe. Their research activities are aimed at promoting the economic development of our industrial society, with particular regard for social welfare and environmental compatibility.

German Institute for Standardization (DIN)

DIN is a privately organized non-profit provider of standardization services with nearly 100 years' experience. More than 30,000 external experts from industry, research, consumer protection and the public sector come together at DIN to develop market-oriented standards and specifications that promote global trade and innovations, assure efficiency and quality, and help protect the environment and society as a whole.

DIN deals with subjects ranging from A as in Acoustics to Z as in Zinc. A focus is also placed on trending topics such as Industry 4.0 and smart cities. According to an agreement with the German Federal Government, DIN is the acknowledged national standards body that represents German interests in European and international standards work.

Department for Business, Innovation & Skills (BIS)

The Department for Business, Innovation & Skills (BIS) is the department for economic growth. The department invests in skills and education to promote trade, boost innovation and help people to start and grow a business. BIS also protects consumers and reduces the impact of regulation. We are responsible for:

- working with further and higher education providers to give students the skills they need to compete in a global employment market
- supporting innovation and developing the UK's science and research industry, which is important to help economic growth
- making sure consumer law is fair for both consumers and businesses, and that consumers know their rights and are able to use them effectively
- supporting British businesses to increase productivity and compete anywhere in the world
- better regulation - by cutting the amount of regulation and making it easy to understand we can help businesses cut time, save money and be more efficient

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.

British Standards Institute (BSI)

BSI is the business standards company that helps organizations all over the world make excellence a habit. For more than a century we have been challenging mediocrity and complacency to help embed excellence into the way people and products work. That means showing businesses how to improve performance, reduce risk and achieve sustainable growth. As a global leader in helping organizations improve, our clients range from high profile brands to small, local companies in 172 countries worldwide.

KEY THEMES & OBSERVATIONS

The workshop, held at the British Embassy in Berlin, analysed the innovation agenda in the UK and Germany, with emphasis on the 'digitisation of manufacturing'. Designed and facilitated by 'Policy Links', the knowledge transfer unit of the Centre for Science, Technology & Innovation Policy (CSTI), University of Cambridge and the UK Science and Innovation Network team in Berlin, the event brought together senior officials from the German Federal Ministry for Economic Affairs and Energy (BMWi), the Ministry of Education and Research (BMBF), and the UK Department for Business, Innovation & Skills (BIS). Representatives from the Fraunhofer institutes and Innovate UK's Catapult programme discussed the challenges that intermediate institutions face in translating innovations to industry, particularly SMEs. Participants also discussed the critical role of standards development organisations in supporting innovation in manufacturing, with insights from both the German Institute for Standardization (DIN) and the British Standards Institute (BSI). Industry was represented by senior representatives from Airbus and Siemens. Academics from UK and German universities also joined the discussions.

Key themes and observations emerging from the one-day workshop are summarised in this section. Opinions were expressed by participants in a personal capacity and therefore do not necessarily represent the views of their affiliated institutions.

The need to integrate SMEs into the national innovation system

There was broad agreement the potential of countries to enhance industrial competitiveness and increase value capture is being constrained by the inability of SMEs to participate in the transformations made possible through innovations in manufacturing. SMEs lack the required expertise and resources to actively engage in innovation and therefore tend to have weak internal R&D capabilities.

Recent industrial strategies and manufacturing policies in both the UK and Germany put emphasis on the need of institutional support to allow SMEs become full participants of the national innovations system. Both British and German institutions recognise, however, that engaging SMEs in a challenging tasks. SMEs are often unaware of the potential of new technologies and given their limited time and resources, have a 'fear to innovate'. Institutional support needs to be made available to SMEs locally and efforts need to be made to prove the impact of innovation on business outcome more quickly.

The 'fourth industrial revolution': more of an 'evolution'?

There was a sense among participants that despite the significant attention that the 'fourth industrial revolution' has received in government and academia, the adoption of digital technologies in industry is likely to occur at a slower pace than expected. Efforts are required to develop new manufacturing solutions based in novel applications of digital product, services and business models. Many of the challenges around the 'digitisation of manufacturing', however, are related to the diffusion and integration of existing technologies across the value chain in a cost-effective manner. Low-cost sensors, modelling and monitoring solutions are required to engage SMEs in future models of digitalised production.

Standards as critical link for innovation that is often missing

Standards play a central role in making the next generation of digitised manufacturing a reality. Standards are required at different 'system levels' of relevance to manufacturing: software, devices, production processes, supply networks and the internet-of-things.

Opportunities for collaboration between the UK and Germany

There was a broad recognition that, rather than a driver of increasing competition between the two countries, the digitisation of manufacturing provides opportunities for British and German industries to exploit complementary strengths to compete globally.

Participants engaged in a rich discussion on where the strengths of British and Germany manufacturing lie. Common strengths were identified around engineering-based technical competencies in companies in both countries.

It is expected that the workshop is part of a series of international policy forums at which senior governmental, academic and industrial representatives from the UK can build closer links with counterparts in key manufacturing countries.

AGENDA

WELCOME

09.00 **Nick Leake,** Counsellor, EU and Economic Affairs, British Embassy
09.05 **Mike Gregory,** University of Cambridge and Royal Academy of Engineering

FRAMING THE DISCUSSION

09.10 **Carlos López-Gómez,** Head of Knowledge Exchange, POLICY LINKS, University of Cambridge

SESSION ONE | **PERSPECTIVES FROM NATIONAL MINISTRIES: RECENT INNOVATION POLICIES AND THE ROLE OF KEY INSTITUTIONS**

09.15 **Stefan Schnorr**, Director-General, Innovation and Technology, BMWi
09.30 **Matthias Graf von Kielmannsegg**, Director-General, BMBF
09.45 **Agnès Estibals**, Deputy Director for Innovation, UK Department for Business, Innovation & Skills

10.00 **PANEL DISCUSSION** Moderated by Mike Gregory

- What are the main challenges to achieving a coherent implementation of innovation policies across ministries and agencies?
- What are the main barriers to the commercialisation of the science and engineering research base by the business community? What is the role of institutions in overcoming these barriers?
- What are the challenges to diffusing high potential innovations to SMEs? What is the role of institutions in overcoming these challenges?

11.00 Refreshments

11.30 SESSION TWO | **CONTRIBUTIONS OF INTERMEDIATE R&D INSTITUTIONS: TRANSLATING INNOVATIONS TO THE REAL INDUSTRIAL WORLD**
Eckart Uhlmann, Director, Fraunhofer IPK
Mike Oldham, Head of Catapult Centres Programme, Innovate UK

12.30 **PANEL DISCUSSION** Moderated by Mike Gregory

- What key innovations will SMEs need to adopt to successfully participate in digitised manufacturing systems? How do intermediate R&D organisations help address this challenge?
- What strategies, practices, mechanisms can help ensure broader industrial reach and impact in particular to support SMEs? To what extent is the challenge about developing new technologies and to what extend is it about transferring existing ones?
- What other important innovation functions are carried out by intermediate R&D organisations beyond technology R&D, e.g. skills, standard development, foresight, etc.?

13.00 Lunch

14.00 SESSION THREE | **CONTRIBUTIONS OF STANDARDS DEVELOPMENT ORGANISATIONS: WHO SHOULD WORRY ABOUT STANDARDS?**
Rüdiger Marquardt, Executive Board Member, DIN
Scott Steedman, Director of Standards, BSI
Daniel Palmer, Head of Manufacturing, BSI

15.00 **PANEL DISCUSSION** Moderated by Mike Gregory

- What strategies should standard development organisations adopt to support rather than hinder innovation in manufacturing, in particular around the 'digitisation of manufacturing' agenda?
- What is necessary to achieve the right mix of standards and regulations?
- What other institutions in the innovation system should support, or participate in, standard development in a way that is conducive to innovation?

15.30 Refreshments

16.00 **SUMMARY PANEL |** Respondents include: **Thomas Hahn**, Siemens; **Harald Egner**, MTC (tbc); **Günter Hörcher,** Fraunhofer IPA

17.00 Close of workshop

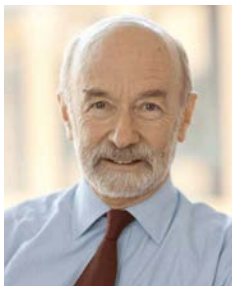
17.00 **Reception**

WELCOME

NICK LEAKE

Counsellor, EU and Economic Affairs, British Embassy

Nick Leake welcomed the group to the workshop on behalf of Ambassador Sebastian Wood, and expressed thanks to the team from the Science and Innovation Network for their work in setting up the meeting. Mr Leake gave reference to a recent study commissioned by the federal research ministry in Germany which highlighted the importance of innovation in countries like the UK and Germany, and raised questions about how national governments should do more to support innovation. The high level of expertise gathered at the event would offer an excellent opportunity to discuss these questions, and in particular focus on how Industry 4.0 fits into the environment and how innovation in manufacturing can be better supported. He hoped that these discussions would lead to further exchange and collaboration.



MIKE GREGORY

University of Cambridge and Royal Academy of Engineering

Professor Sir Mike Gregory chaired the workshop and discussions. He also reflected on his experiences as former Head of the Institute for Manufacturing at the University of Cambridge, and previous to that, as a production engineer.

VIEWS FROM THE FEDERAL MINSTRY OF ECONOMIC AFFAIRS AND ENERGY

Wolfgang Crasemann | Innovation and Technology, BMWi

Innovation performance and policy in Germany

Germany has more than 100,000 innovative companies, and in-line with European Commission recommendations around two thirds of innovation research is done in industry. The country has manufacturing strengths in machinery and automotive industries, excellent value chains and world-class research institutions.

Germany has a high volume of 'hidden champions': typically midsized companies based in lesser-known regions with a local workforce and are mostly family-owned. They have a very long perspective in terms of their business plans and finances, making them extremely strong companies. They are mostly able to withstand crisis and many of them are world-leaders in niche markets.

One of the main challenges for the future of manufacturing in Germany is digitization: how can we integrate new digital technologies into the traditional manufacturing process, and in particular how can SMEs do this? We have to boost innovative activities in small and medium-sized companies, we have to improve technology transfer from research to business. The number of technology start-ups also needs to be increased, but when large corporations are able to offer such competitive salaries, there is little incentive for young people to take the risk of being self-employed.

Digitisation of the economy / Industrie 4.0

Seven main fields of action of the digital agenda:

1. Digital infrastructure
2. The digital economy and digital workplace
3. Innovative public administration
4. Shaping digital environments in society
5. Education, science, research, culture and media
6. Building security, protection and trust within society and the economy
7. European and international dimensions of the Digital Agenda

Each field has associated working groups including people from government, businesses, research, business associations and trade unions leading to a complex structure of people who need to be integrated into the digital agenda in order for it to progress.

Policy for innovative SMEs / technology transfer

We aim to raise awareness of the importance of digitization for small and medium sized companies. During a booming economy these companies may not recognise that there is any need for change. The concern is that without change they will be gone from the market in the next few years.

Initiatives to address this include:

Centres of Excellence launched in September 2015. There are 10 centres based in 10 different regions in Germany designed to help SMEs to understand the importance of digitizing their processes.

Digital vouchers allow SMEs access to individual expert counselling.

The Alliance for Industry

THE NEW HIGH-TECH STRATEGY

Matthias Graf von Kielmannsegg | Director-General, BMBF

The New High-Tech Strategy: Challenges and solutions for German innovation policy

The hi-tech strategy was started in 2006, and we are constantly developing it further. It's a comprehensive and interdepartmental innovation strategy of the government, used to coordinate and focus their efforts and we use it to give our invitation to other participants in the innovation system.

We decided not only to focus on technological innovation, but also what we call social innovation (changes to our working system, the way we organize our revenue processes and the collaboration within the companies).

A common question is how we coordinate this strategy within German government. There is no unified single policy approach when it comes to instruments, to needs. We work with different platforms and alliances depending upon the particular topic, and the number and range of participants differs from topic to topic. The new hi-tech strategy aims to bring this together to look at Germany's approach to innovation.

The close cooperation between the two ministries of Economics and Energy, and Research and Education is essential. The two have to work closely together otherwise it would not work. The Industry 4.0 platform is co-chaired by these two ministries in order to clearly demonstrate this close cooperation.

There are six major goals of the hi-tech strategy:

1. Implement a coherent, focused innovation policy, in coordinated action of different governmental departments towards common goals
2. Include all stakeholders of the innovation system for a common approach in developing and implementing the strategy (science, economic sector/industry, civil society)
3. Strengthen innovative SME and support the German "Mittelstand"
4. Build strong acceptance for and transparency of the innovation strategy in close interaction with society
5. Take into account the complex interrelationships of different topics, goals, and framework conditions of the innovation strategy
6. Implement a more coherent, systematic evaluation approach

In addressing these challenges, one of the major tasks is including the many stakeholders of the innovation system. To improve the cooperation between science and industry, and research and development, we need to understand how both the economic system and the scientific system are working. We try to foster this by encouraging collaborative research projects through our funding mechanisms.

A further challenge for us is the integration of SMEs to the innovation system. We have tried to make our programmes more accessible for SMEs – we understand that they do not necessarily have the resources to make applications, and they need some help with this...

CHALLENGES OF DEVELOPING INNOVATION STRATEGIES

Agnès Estibals | Deputy Director for Innovation, UK Department for Business, Innovation & Skills

Challenges of developing innovation strategies

Economic research shows that the performance of our businesses is shaped by a number of organisations and institutions which make up the UK innovation system. Universities, research centres and digital infrastructure are already a part of the system but given the high cost and uncertainties involved with innovation perhaps more key actors from the financial and banking industries need to be included.

The UK government is committed to building dialogues within the innovation system in order to identify its strengths and weaknesses. We recognise that we have lower research and development capabilities than comparative countries such as Germany, France, and the US. We also have low SME innovation in terms of introduction of new products, especially industrial products, compared with these nations. However strengths lie in the UK's excellent academic research base, and also the willingness to invest in 'intangible' and services innovation, including digital, branding, marketing and business models. According to early data, the UK SMEs are one of the strongest in the world in this area.

Challenges for UK policymakers:

- How should the innovation system be funded? What proportion should be funded privately and how much by the public sector.
- Is the structure of the innovation system adequate? Do the linkages between the organisations work or does it need to change?
- How do they develop a coherent dialogue within the system when some organisation's main focus might not be innovation. How do policymakers convince certain organisations to invest in innovation when it may not be part of their core mission.
- Competing local and national interests. Local Enterprise Partnerships seek funding to create clusters or support clusters, in order to create quality jobs, but at the national level, where should you invest?
- Lack of understanding about the return on investment, for example funding via R&D tax credits vs. funding directly through a grant

Steps taken to address these challenges:

- Simplification of the system: for example the UK have now merged the seven research councils into one institution with the objective to develop an interdisciplinary team to carry out and fund scientific research.
- Calling for regulators to produce innovation plans. So you are supporting competition to drive off innovation. But what are you doing to support innovation when you look at cases?
- A science and innovation audit. Announced in 2015, the audit will help local enterprise partnerships use data to argue their cases and show evidence that they have competitive advantage in one technology or the other.
- Support for innovation from the financial market to increase venture capital.

Innovation in the UK is a key driver of competitiveness and growth. No matter the macroeconomic context and fiscal objectives, government will continue to play an important role in the innovation system. The system poses many challenges because the organisations within the system constantly change, linkages between them change, and the dynamics change. But it has to change if it is to support innovation.

In looking at the digitalization of manufacturing, we know that ICT has already changed profoundly the business models of media and retail industries, and the UK has a number of very dynamic innovative companies in these fields. In manufacturing, these changes will present many challenges in the coming years and this is something of high interest to our ministers. The issue is how we are going to adapt and how we are going to create the right environment for industry and innovation. It is difficult to say whether this next industrial revolution is a catch word, or whether it's real because at the moment it is not in the productivity field. The question is can industry 4.0 boost the productivity and the further growth of our countries?

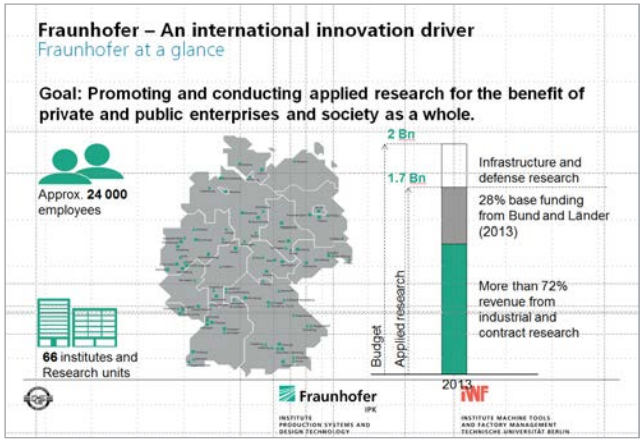
SESSION TWO | **CONTRIBUTIONS OF INTERMEDIATE R&D INSTITUTIONS: TRANSLATING INNOVATIONS TO THE REAL INDUSTRIAL WORLD**

FRAUNHOFER-GESELLSCHAFT - MISSION, ORGANIZATION AND STRATEGY FOR APPLICATION-ORIENTED RESEARCH AND DEVELOPMENT

Holger Kohl | Director, Corporate Management, Fraunhofer IPK

Fraunhofer is the leading and largest applied research organization in Europe, and it mainly focusses on delivering services and technologies to industries, particularly small and medium sized enterprises. Fraunhofer currently has 24,000 employees spread over cities and research institutes all over Germany, and the research budget is 2 billion Euros, of which 1,7 billion is generated via contract research.

The organization was founded in 1949, at the same time the Federal Republic of Germany was founded, and the idea was to have an applied research organization in place to help German industry to change from war manufacturing to civil manufacturing. Fraunhofer has continually grown throughout these decades, even during periods of economic crisis.



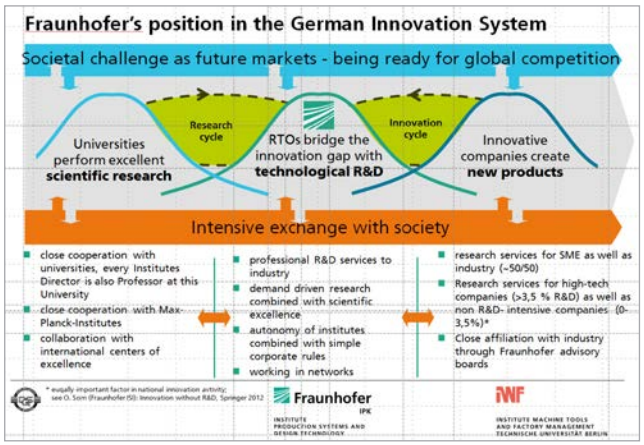
The 66 research institutes are structured into groups which have overlapping R&D topics. We have 6 groups working on ICT technologies, life sciences, microelectronics, light and surfaces, production of the material and components. Those institutes are supported mainly by the Federal Ministry of Education and Research, and a small percentage is funded by the state government in which the Fraunhofer Institute is located. Another group of institutes working in defence and security, they receive basic funding from the Federal Ministry of Defence.

Fraunhofer alliances enable collaboration between institutes - a group of institutes with similar interests but different technologies can work together to answer questions for industry. “One Fraunhofer institute cannot develop a car, but maybe 15 joined together can get quite close to it”.

My personal view on what makes Fraunhofer successful in Germany is that we have a very high level of structural freedom within the institutes. Fraunhofer as a whole is a registered association (not-for-profit organization). We are not able to have very high profits, nor are we allowed to have very high reserves. Therefore, each institute is more like a centre of excellence under the umbrella of Fraunhofer.

Fraunhofer in Germany is seen as the intermediary between industrial commercialisation, and basic research. Therefore Fraunhofer has very strong connections to universities, each Fraunhofer institute is directly connected to university. Fraunhofer headquarters develop a very strong cooperation with Max Planck institutes.

We also have the so called innovation cycle where Fraunhofer institute collaborates a lot with industry. Each Fraunhofer institute has an advisory board which mainly consists of high level German and international industrialists.



UK CATAPULT CENTRES

Mike Oldham | Head of Catapult Centres Programme, Innovate UK

The future of manufacturing can revolve around a vision of seamless connectivity, of creating intelligent decisions from massive amounts of data, turning those into intelligent decisions and applicability, working across supply chains and sectors, autonomous units working together to drive productivity and growth.

Innovate UK's vision is to fund and connect. It provides collaborative research and development funding, vouchers, and runs a knowledge transfer network (KTN) which facilitates business-to-business type interactions, bringing everything together. Innovate UK also funds the catapult centres.

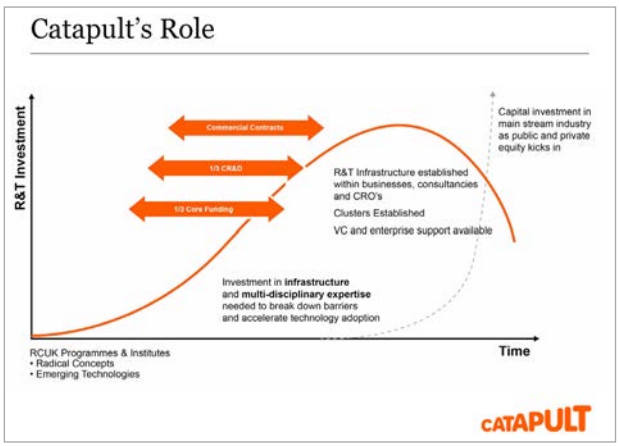
As a programme, the Catapults are very new. At the moment there are 10 catapult centres, and another one was announced last week by the Chancellor. Similarly to the Fraunhofer model, the Catapults are intermediate organizations to generate sustainable economic growth, to bridge the gap between industry and research.

When establishing the Catapult network, an important question was: "Will the industry pay for the research and development work?" And "Is industry money prepared to follow us?" There are key indicators to make sure that we're working with the right people.

Because we're putting the new institutions into the UK, a lot of the work they're doing is about adoption and take-up. The UK government has pushed universities further and further into industrial engagement so there is some capability there already. As they mature, the Catapults will probably reach a little bit further back into the R&D, and into the research basically.

But what the intention is not to replace the excellence that exists in the UK. And deciding where to locate new Catapults had complications. For the Cell Therapy Catapult, there was competition between leading research groups in the UK. The approach was to be positioned as a neutral organisation so that it could reach out to the expertise of all of those three groups and make them available to industry. This neutrality, alongside the technical capability, is the thing that everybody in the UK is really starting to trust

In the UK landscape, Catapults has interfaces with the UK research councils (RCUK). In a graph of research and technology investment against time, which can be seen as TRL scales, the Fraunhofer Centres and the Catapult Centres, have a role to play in the middle area where you investment in multidisciplinary expertise and production equipment is needed. The Catapult Centres operate three funding streams in a similar model than the Fraunhofer Centres. The aim is to push the know-how to the right hand side of that curve, the point at which the capital investment can flow into industry.



SESSION THREE | **CONTRIBUTIONS OF STANDARDS DEVELOPMENT ORGANISATIONS: WHO SHOULD WORRY ABOUT STANDARDS?**

STANDARDS AND INNOVATION

Rüdiger Marquardt | Executive Board Member, DIN

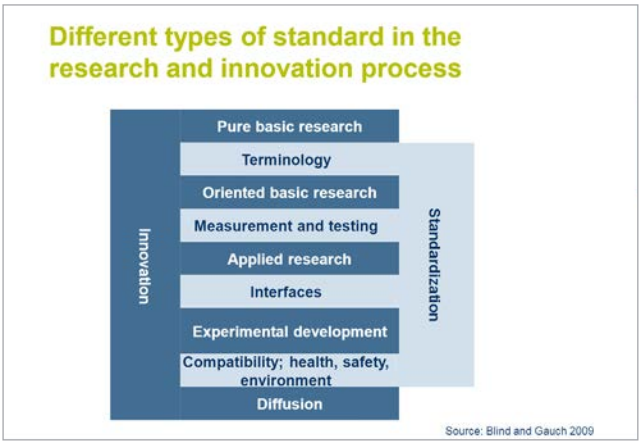
The role of standardisation has changed in recent years. While standards have been a source of technical know-how primarily supporting trade facilitation and technology transfer for decades, a value-added role for research and innovation has evolved. Nowadays, standards increasingly function as a starting point for innovation. They can support the innovation process by providing the required knowledge base and connecting innovation to the state of the art. Therefore it is inevitable to promote and develop specifications as a precursor for national, European and international standards.

Research and development is the basis for creating innovative solutions for present and future challenges. Standards developing organisations, like DIN, engage in research projects at an early stage in order to identify standardisation potentials, integrate practitioners and experts from research and development in the standardisation environment and transfer relevant content into national, European and international standards.

The Germany New High-Tech Strategy, published in 2014, emphasises the role of internationally harmonised rules, norms and standards to eliminate trade-barriers. Harmonisation shall be carried out at early phases and in connection with pertinent development which means throughout the innovation process already. Taking standardisation aspects into account in relevant research, norms and standards can accelerate the acceptance of innovation in the market.

The ongoing revolution introducing the new approach of Industry 4.0 is the major challenge and chance industry is facing at the moment. With digitisation of industrial production, it is essential for extremely divergent systems from various manufacturers to interact reliably and efficiently. The users, operating globally, expect to be able to source their accustomed products and systems everywhere in the world. In order to ensure the global usability and cross-system consistency, international standardisation in industrial automation has always been regarded as especially important and pursued as a matter of high priority. Nowadays, standards are available or at least being drafted to cover important issues in industrial automation, but new technologies and new requirements repeatedly create a new demand for standardization. This demand needs to be filled appropriately with support of standards developing organisations.

In order to foster the future cooperation between the UK and Germany, BSI and DIN in particular, it is envisaged to held joint workshops and promote collaborative projects under the umbrella of HORIZON 2020 as well as mutual recognised standards.



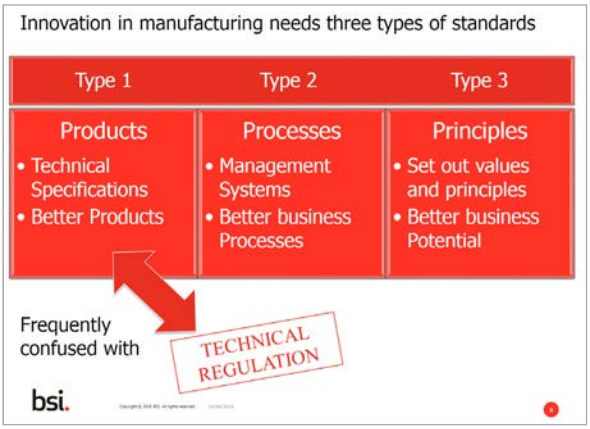
STANDARDS AND INNOVATION

Scott Steedman | Director of Standards, BSI

The British Standards Institute (BSI) combines both the function of the national standards body, with about 350 people, with a global business operation with around 3,500 people working advisory services, certification assurance, compliance, business consulting around the world. This is exactly what DIN' s Royal Charter establishes. BSI' s standards knowledge information solutions from the business support activity are strictly separated. Both Germany and the UK have a very strong historical legacy in the development of industry knowledge through standards. As the two of the most powerful standards countries in the world, UK and Germany, have a shared an opportunity and responsibility to exploit this legacy as a source of competitive advantage in this new and very challenging world.

At the international scale our industries and governments wish that we should seek to the gate access and opportunities for industry that are coordinated through the development of standards as an enablers around the world. DIN and BSI support the work of international organizations. 95 per cent of the work that DIN does is international. The reason why we have CENELEC in Europe is to coordinate the working of our experts in the development of the harmonized European standards for use within the single market. That' s a cooperative activity between many countries in relation to the European Commission.

CEO' s should ask themselves: "What is the strategy for using international standards to drive productivity growth? Or drive innovation?" Unfortunately, not many companies have one. However, in an era of growing competition and fast change, companies ignore the contribution of standards at their own peril.



Innovation in manufacturing requires three types of standards: Products, Processes and Principles. A standard strategy for innovators needs to consider all three types of knowledge for industry, not just the technical specifications. We see a lot of advantages for innovators to think about their process, but particularly also the principles by which they are trying to become more innovative companies.

BSI is working in fields such as smart cities work, cyber security, building information modelling, etc. With the Catapults, BIS has worked for pioneering areas chosen precisely because they were in different stages of maturity and different needs for their innovation, offshore renewables, assisted living, cell therapy and synthetic biology.

An example of collaboration with Innovate UK is in the area of health and wellness apps. How do doctors know whether software are reliable? Our National Health Service board started prescribing apps to patients but they wanted a standard, to help manage the development of software and ensure that the devices are trustworthy.

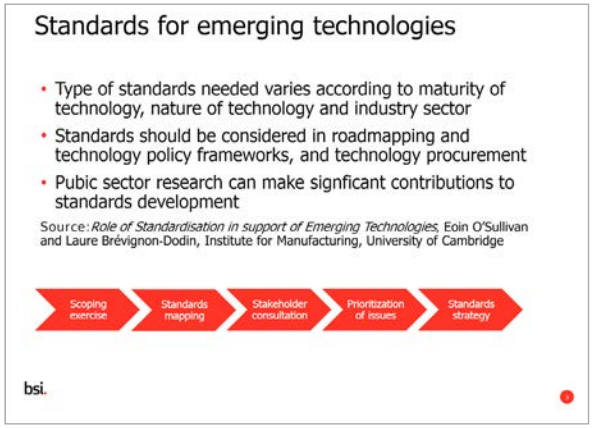
BSI feels compelled to support innovators to understand what is happening out there anyway. If you are trying to create plastic electronics what else is going on in Korea or China or Germany, can we help bring more information to you? Can we help the chief executive develop a roadmap for their use of standards to accelerate their company performance? Can we help them demonstrate that to their investors to accelerate the translation and increase market access?

SESSION THREE | **CONTRIBUTIONS OF STANDARDS DEVELOPMENT ORGANISATIONS: WHO SHOULD WORRY ABOUT STANDARDS?**

CONTRIBUTION OF STANDARDS DEVELOPMENT ORGANISATIONS: WHO SHOULD WORRY ABOUT STANDARDS?

Daniel Palmer | Head of Manufacturing, BSI

A few years ago BIS carried out some work with the Centre for Science, Technology & Innovation Policy (CSTI) at Cambridge looking at the world of standards in emerging technologies. This study systematically looked at how things are done in countries including the UK, Germany and the US.



Among the study' s findings, three in particular are very crucial for this type of work. The first is that there is really no single solution; the type of standards needs vary according to the maturity of the technology but it also varies according to the nature of the technology and the industry sector. And we can see this in sort of number of ways, standards that you might need in, say, developing a new material may be very different form the standards approach that would be needed for digital innovation.

The second is that the innovation process works best if a strategic approach to the development of standards is in place. Very often, governments develop technology roadmaps and policies but they typically fail to include considerations about when standards should emerge. But when standards are considered, a real difference can be made in terms on how quickly an impact can be made in companies that are using the technology. And when governments strategically consider the role of standards in technology procurement, there is also a big difference to how companies can quickly begin to access the market.

The third finding was that public sector research programs can make a significant contribution to standards development. After the research is being done, standards can provide a means to translate some of that research into tools that companies can use. A lot of companies use standards but relatively fewer companies routinely go through the academic papers to see what new innovations they should be adopting. Based on this understanding, BSI has developed a new approach to developing standards in emerging technologies. Prior to this work, we have tended to wait for companies or government to come to us and say that they need standards in a particular area.

As a result, more efforts are being placed in ensuring that the discussions about standardization are being had at the same time as the discussion about the emerging Standards for emerging technologiy roadmap. And more efforts are being put into understanding what standards already exist before setting up a community and deciding on what the first standard will be. We need to understand what's already there, what the existing standard landscape is. For a lot of emerging technologies, the challenges aren' t just about the creation of new standards; they are about whether the existing standards are fit for purpose or whether they need to be adapted.

Another important point is the relationship between standards and other organizations in the innovation ecosystems. BSI, for instance, has just agreed a partnership with Innovate UK to collaborate on standards and development. This is very important for BSI because, as a standards' body, it needs to work on the areas where the UK is going to try and significantly exploit its research and development capabilities.

There is a great deal of international interest in this standards program, and a big strength in that is this coordination of activities across the innovation ecosystem in developing standards can provide competitive advantage to the UK as whole. In the area of Industry 4.0, there is a great deal of information about additive manufacturing, materials, robotics, drones, sensors and so forth. Industry 4.0 is not only about a digital strategy. All of these are the subjects of standards programs in their own right. And that points to another critical role for standards bodies, which is making the linkages between these technologies and ensuring that they could be developed in a way that is compatible.

NICK LEAKE

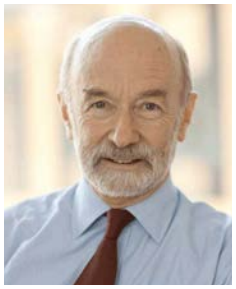
Counsellor, EU and Economic Affairs, British Embassy

Nick Leake started his Post as Counsellor and Head of the EU & Economic Section at the British Embassy Berlin in August 2014. Prior to his Post in Berlin he served as High Commissioner to the Republic of Mauritius 2010 - 2014. Nick was also non-resident Chargé d'Affaires in Madagascar and non-resident Ambassador to the Union of the Comoros.

Nick joined the Foreign and Commonwealth Office (FCO) in 1994 and started his career in the European Union Department in London, before serving in Budapest, Hungary (1996-2000) and at the UK Permanent Representation to the European Union in Brussels (2000-2002). Nick then left the FCO for a secondment with HM Treasury in London, and later worked for the Commission for Africa as part of the UK Presidency of the G8.

Returning to the FCO in January 2005, Nick was appointed Private Secretary to the Europe Minister (Denis MacShane) and then to the Minister for Trade and Asia (Ian Pearson). From 2006-2010 he served as Deputy Head of Mission at the British Embassy in Sofia, Bulgaria.

Nick comes from Newcastle in North-East England. He has a law degree from the University of Warwick, including study at the Universities of Saarbruecken (Germany) and Lille (France). He has an MBA from the Open University, and speaks German, Hungarian, French & Bulgarian.



MIKE GREGORY

University of Cambridge and Royal Academy of Engineering

Mike Gregory retired as Head of the Manufacturing and Management Division of the University of Cambridge Engineering Department and of the Institute for Manufacturing (IfM) in September 2015.

Following an early career in industry he was the founder member of the team which established the IfM in 1998. Linking science, engineering, management and policy and integrating education, research and practice the IfM now has over 230 staff and research students and a further 100 undergraduate and Masters students.

Mike Gregory's work is closely linked with industry and government and he has published in the areas of manufacturing strategy, technology management, international manufacturing and manufacturing policy.

External activities have included membership of various government and institutional committees. 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, co-chairs the Manufacturing Advisory Group of the UK Government's Department of Business Innovation and Skills (BIS), and is a member of the supervisory board of the High Value Manufacturing Catapult

He is a Fellow of Churchill College Cambridge and of the Royal Academy of Engineering where he is a trustee. He is currently serving as Acting Director of the University's Institute of Continuing Education (ICE).'

CARLOS LÓPEZ-GÓMEZ

Head of Knowledge Exchange, POLICY LINKS, University of Cambridge

Carlos López-Gómez is the head of POLICY LINKS, the knowledge exchange unit based at the Centre for Science, Technology and Innovation Policy (CSTI), University of Cambridge. POLICY LINKS' work explores the interfaces of industrial and innovation policy with emphasis on how countries capture value through manufacturing innovation.

Carlos has advised governments and international institutions including the UK Department for Business, Innovation and Skills (BIS), the United Nations Industrial Development Organisation (UNIDO), the European Commission as well as regional governments and cluster organisations in Mexico, Spain and UK. Carlos started his career with engineering roles at Toyota and GE and holds a PhD in industrial economics and policy (University of Cambridge). In 20015, Carlos was seconded at the Center for Research and Development Strategy (CRDS), Japan Science and Technology Agency (JST).

MATTHIAS GRAF VON KIELMANNSEGG

Director-General, BMBF

Born in 1965, married, three children. Studied law.

1996-1999: Senate Chancellery, Berlin. 1999-2005: Planning group of the CDU/CSU parliamentary group in the Bundestag. 2001-2005: Chair of the planning group. From 2005: Federal Chancellery; Head of Staff for Policy Planning, Basic Issues and Special Tasks until 2010. 2010 to January 2014: Director at the Federal Chancellery for the areas: families, senior citizens, women and youth; education and research; affairs of the New Länder; demographic change; churches and religious communities. Since February 2014: Director-General for Strategies and Policy Issues at the Federal Ministry of Education and Research.

AGNÈS ESTIBALS

Deputy Director for Innovation, UK Department for Business, Innovation & Skills

Dr Agnes Estibals is Deputy Director for Innovation at the Department for Business, Innovation and Skills (BIS), which is responsible for innovation policy instruments, including Innovate UK and the Catapult network. Since 2010, she has been leading the development of economic frameworks and strategies in the fields of science, technology and innovation, such as 'Innovation and Research Strategy' (with Dr Keith Smith, December 2011) and more recently 'Our Plan for Growth: Science and Innovation' (December 2014).

She was previously a senior economic advisor in HM Treasury with responsibilities for the economics of growth and productivity. This included overseeing the production of key publications for fiscal events and responses to the financial crisis. She also advised on the fiscal and macroeconomic framework, especially tax forecasts and analysis to support the policy partnership between HM Treasury and HM Revenue and Customs, and on the European System of Accounts for the Office for National Statistics.

MIKE OLDHAM

Head of Catapult Centres Programme, Innovate UK

Mike is leading Innovate UK programme to establish and manage the network of eleven Catapult technology and innovation centres in the UK. Mike Oldham has been working on the initiative from our initial contribution to the Hauser Review right through to the current delivery phase.

Mike joined Innovate UK in 2008 following a twenty year career in engineering consultancy and major projects with Atkins and Arup. He moved into programme and project management building on his technical base of structural dynamics and seismic design.

RÜDIGER MARQUARDT

Executive Board Member, DIN

Born 7 August 1955 in Lüneburg/Lower Saxony

After completing his studies in automotive engineering in 1980 he became an editor for the "Verlag Handwerk und Technik" publishing house in Hamburg, working in the metallurgy section (literature for vocational training and study).

From 1984 to 2003 he worked for the Beuth Verlag publishing house, a subsidiary of DIN, holding various positions (Head of Editorial Office, Head of Sales, Publishing Director), most recently as Managing Director.

From 2003 to April 2007 he was responsible in DIN for work management in standardization activities, including process management, personnel planning, and the introduction of IT-supported tools.

From May 2007 on he has served as the Head of the Innovation and Standardization section in DIN.

Mr. Marquardt was also responsible for DIN's long-term project "Innovation with Norms and Standards" which is funded by the German Federal Ministry of Economics and Technology (BMWi).

Since July 2011, Mr. Marquardt has held the position of Member of the Executive Board.

SCOTT STEEDMAN

Director of Standards, BSI

Scott Steedman is Director of Standards at BSI where he is responsible for the National Standards Body, representing the UK internationally and advising industry and government on the role of standards in innovation and economic growth. He is Vice President of the European Standards Organisation (CEN) and a member of the Council of the International Organisation for Standardization (ISO).

Scott is committed to the value that consensus standards bring in accelerating innovation in new and emerging technologies. In this context, BSI has been working closely with Innovate UK to support the Catapults in their priority areas and Scott is currently working with countries such as China, Japan and Singapore on the role of standards in construction, smart cities, healthcare and ageing population.

Formerly an academic at Cambridge University, Scott spent twenty years working on major infrastructure and building projects in the UK and around the world. He is a former Vice President of the Royal Academy of Engineering and of the Institution of Civil Engineers and continues to be Editor-in-Chief of the Academy's flagship magazine, Ingenia, www.ingenia.org.uk He was appointed CBE in 2010 for services to engineering.

DAN PALMER

Head of Manufacturing, BSI

Dan Palmer is Head of Market Development at BSI, where he leads the manufacturing standards programme. He has a particular interest in the role of standards in promoting emerging technologies and innovative business models, developing standards programmes for areas such as smart cities and synthetic biology.

Prior to this role, he held a variety of management positions at BSI, working on change management, planning and publishing management. He began his career working in technical and scientific publishing for a range of journals and publishers

This workshop was co-organised by:

Centre for Science, Technology & Innovation Policy, 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.

Policy Links - linking policy principles and practice

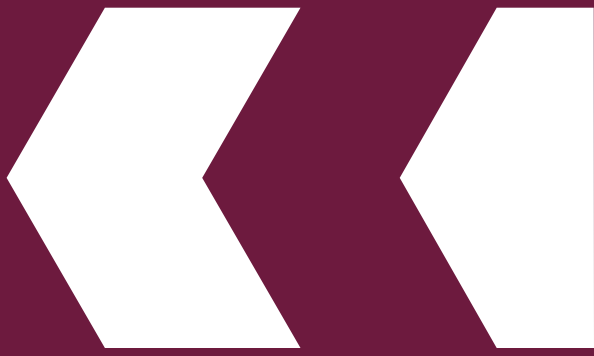
POLICY LINKS is the knowledge exchange unit of the Centre for Science, Technology & Innovation Policy (CSTI), University of Cambridge. It aims to provide professional advice and education services grounded in the latest academic research to address the needs of policy officials and civil servants working in the areas of technology, manufacturing and innovation policy.

UK Science & Innovation Network, Germany

The UK SIN is jointly funded by the Department for Business, Innovation and Skills and the Foreign & Commonwealth Office. SIN has 93 staff, based at diplomatic missions in 28 countries and 47 cities around the world. SIN teams work closely with UK stakeholders and partners to achieve the following global objectives:

- influence science and innovation policies of governments, industry and academia to benefit the UK
- improve UK policy based on international experience and emerging opportunities and issues
- encourage high level science co-operation to benefit the UK and achieve wider policy objectives
- make best use of international technology co-operation and investment to grow UK innovation potential

For more information about these workshops and other related research and events, please contact Carlos Lopez or Ella Whellams, or visit CSTI's website: www.ifm.eng.cam.ac.uk/research/csti



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