CSTI Science Technology Innovation Policy

International Approaches to Industrial-Innovation Policy:
A Focus on UK and Japan

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The 40th Policy Platform (PoP) Seminar; Science, Technology, and Innovation Governance (STIG) Program; University of Tokyo

Tokyo, Japan, 17 December 2015

IfM MANAGEMENT TECHNOLOGY POLICY

UNIVERSITY OF CAMBRIDGE

Overview

This presentation will draw from the work of the Centre for Science, Technology & Innovation Policy (CSTI), University of Cambridge, as well as from recent fieldwork conducted in Japan.

The presentation will argue that:

1. **Manufacturing-based growth is a key target in the innovation policy agenda around the world**
2. **Emerging trends such as the 'digitisation of manufacturing' are changing manufacturing as we know it**
3. **'Technology & Innovation Centres' are considered a key mechanism for supporting industrial innovation in UK and Japan**

Agenda

Introduction to CSTI

Background – Why Industrial-Innovation Policy?

‘Digitisation of Manufacturing’ – New Drivers of Value in Manufacturing

Recent Policy Responses in UK and Japan

Conclusions

Comments / Feedback

Introduction to CSTI

Institute for Manufacturing

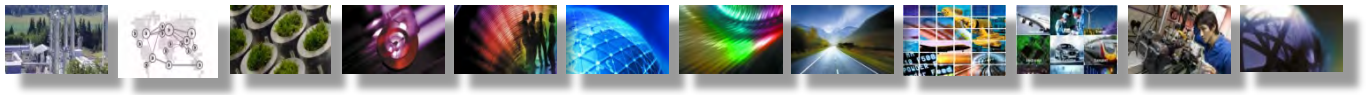
University of Cambridge

Manufacturing

The full cycle from understanding markets and technologies through product and process design to operations, distribution and related services

Institute for Manufacturing

RESEARCH



Management — Technology — Policy

EDUCATION

Undergraduate — Postgraduate — PhD — Open courses — Executive education

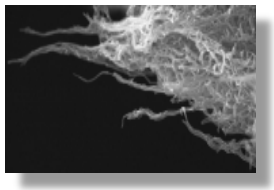
PRACTICE

Research

"Brings together expertise in management, economics and technology to address the **full spectrum of manufacturing** issues"

Inkjet Research

Industrial Photonics



NanoTechnology

Fluids in Advanced Manufacturing

Distributed Information & Automation Laboratory

Technology Management

Technology Enterprise

Design Management

Cambridge Service Alliance

Business Model Innovation

Manufacturing Industry Education Research

Industrial Sustainability

Strategy and Performance

International Manufacturing

Babbage Industrial Policy Network

Science, Technology & Innovation Policy

Centre for Science, Technology & Innovation Policy

An engineering contribution to STI policy

Centre for Science, Technology & Innovation Policy

Engagement with ‘implementation agencies’

BIS
Department for Business Innovation & Skills

Innovate UK

Foresight
Government Office for Science

UNIDO

bsi.

hefce

EPSRC
Engineering and Physical Sciences Research Council

Studies & reports

Research projects

Support for programme strategy development

UK-Japan Workshop

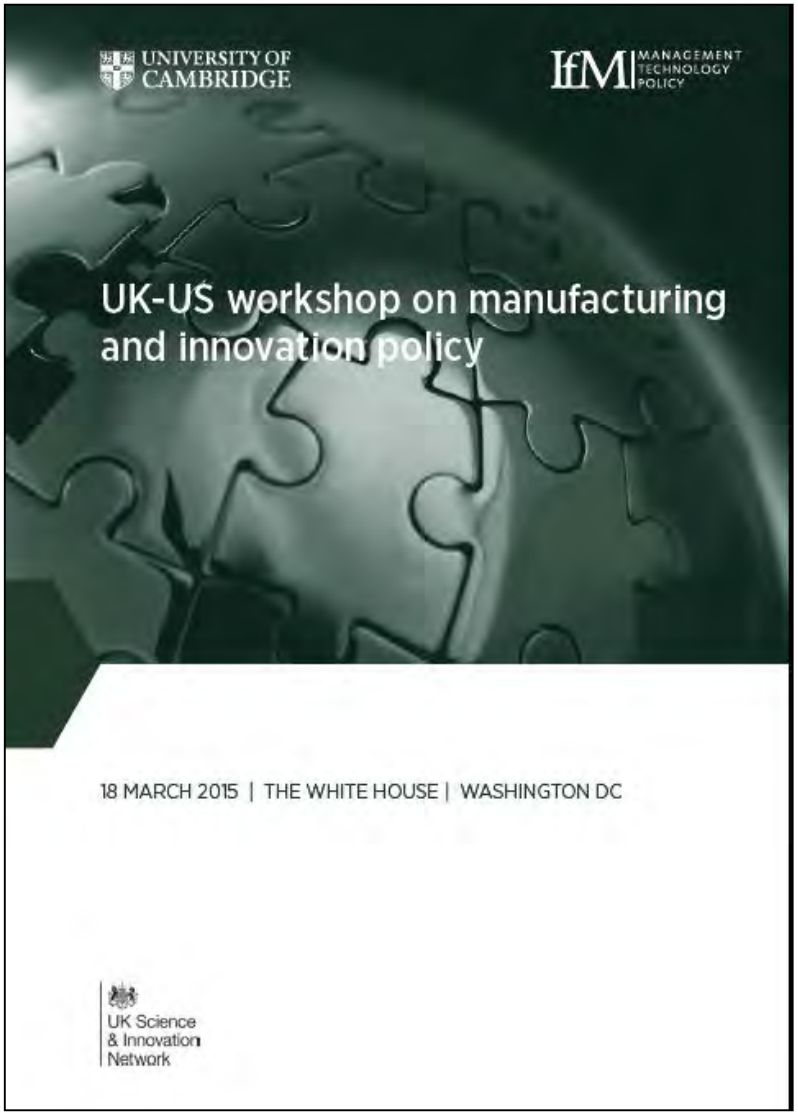
Manufacturing & Industrial Policy (2014)

Workshop aims:

- Gain mutual understanding of national manufacturing policy landscapes
- Share processes and findings concerning manufacturing futures
- Discuss frameworks to enable continuing dialogue between UK and Japan

UK-US Workshop

Manufacturing & Innovation Policy (March 2015)

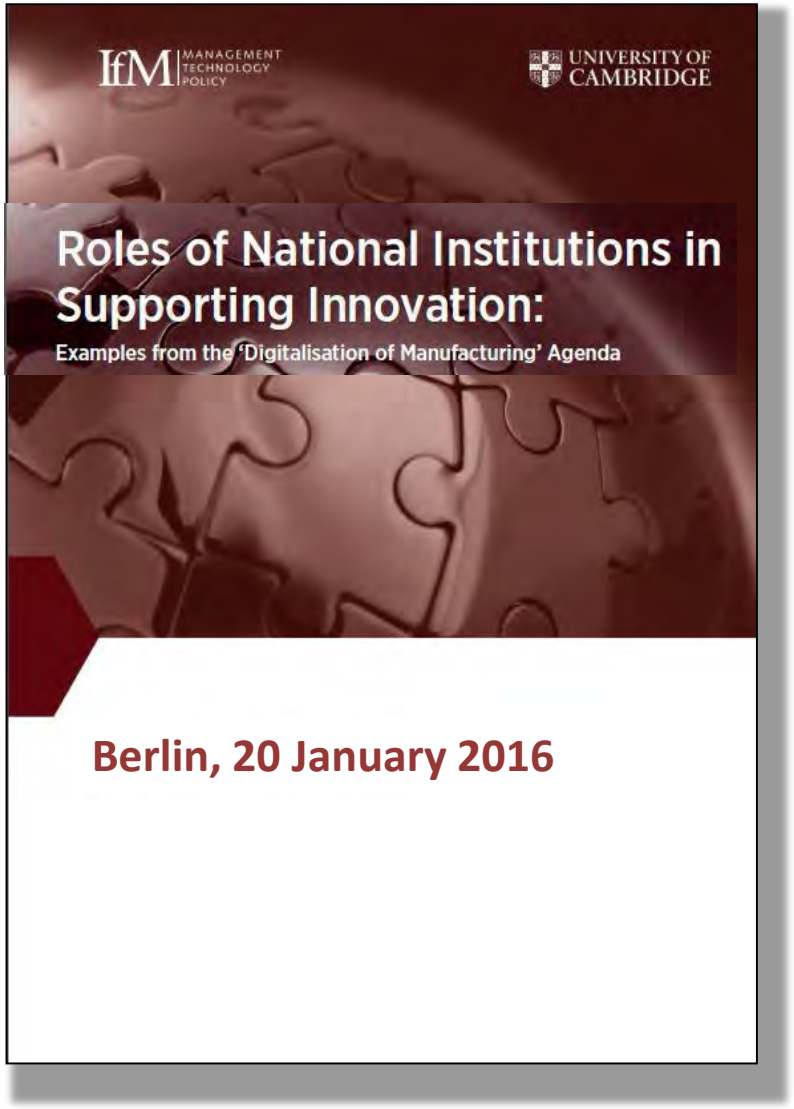


Focused on advanced manufacturing innovation institutes, in particular, the recently formed:

- UK High Value Manufacturing 'Catapult'
- US National Network for Manufacturing Innovation

UK-Germany Workshop

Manufacturing & Innovation Policy (January 2016)



'Paired' national institutions:

- BMWi – BIS
- Fraunhofers – Catapults
- DIN – BSI

Case study: 'Digitisation of Manufacturing'

Background
Why Industrial-Innovation Policy?

Re-evaluation of the importance of manufacturing in national economies

Why Manufacturing Matters

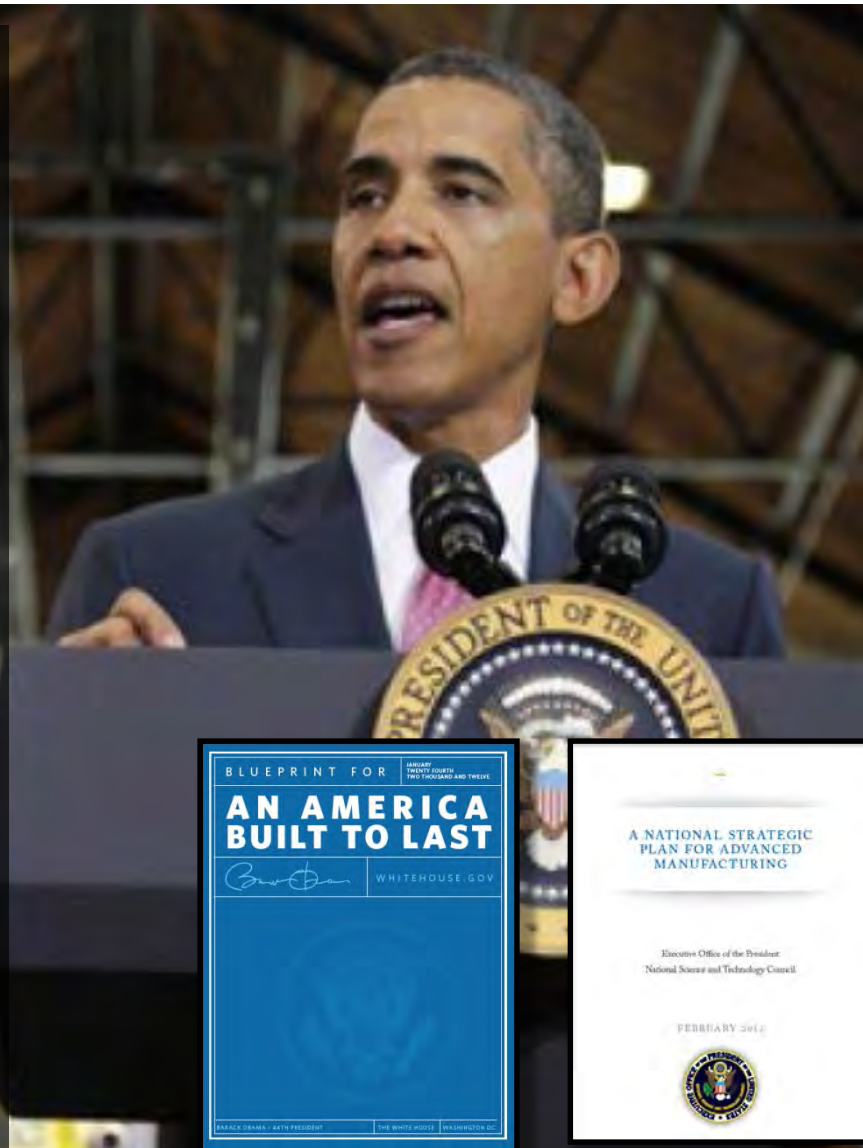
A key policy theme in all countries

"**Advanced Manufacturing is of fundamental importance to the economic strength and national security of the United States.**

Advanced manufacturing provides high-quality **jobs**.

It is an important source of **exports**.

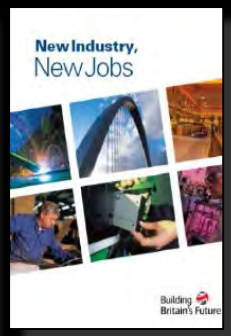
It is a key source of technological **innovation**."

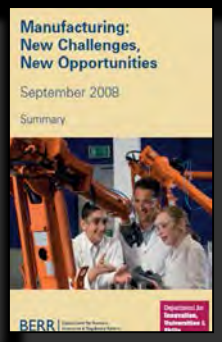


UK Focus: 'Rebalancing the Economy'

"**Our economy has become more and more <u>unbalanced</u>**, with our fortunes hitched to a few industries in one corner of the country, **while we let other sectors like manufacturing slide.**"

David Cameron, May 2010





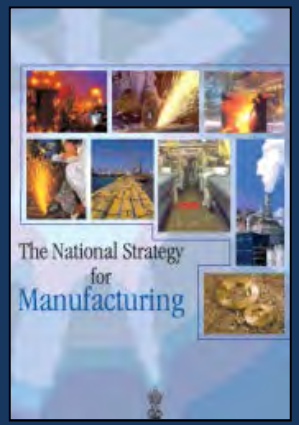
“

I do not accept the proposition that India can skip the manufacturing stage and go from being an agrarian society directly to becoming a services & knowledge-based society.

This is a mistaken view.

A substantial manufacturing base is essential to absorb the workforce & ensure sustainable growth of the economy.

”



- Manmohan Singh
India's former Prime Minister

Why Manufacturing Matters

IMPORTANCE OF MANUFACTURING

Today

JOBS

"Jobs in manufacturing can provide a career path to the middle class" [1]

MULTIPLIER EFFECT

"For every job in manufacturing a further complementary job is needed in related business services" [2]

Tomorrow

INNOVATION

"Responsible for 70% of all R&D spending performed by industry" [3]

'REBALANCING'

"Key role in the U.S. trade balance" [4]

"Well-paid jobs in a number of UK's less prosperous regions" [5]

[1] White House. (2009). *A Framework for Revitalizing American Manufacturing*. Washington D.C.: Executive Office of the President.
[2] European Commission. (2012). *A Stronger European Industry for Growth and Economic Recovery* (No. COM(2012) 582 final). Brussels
[3] White House. (2009). *A Framework for Revitalizing American Manufacturing*. Washington D.C.: Executive Office of the President.
[4] Ezell, S. J., & Atkinson, R. D. (2011). *The Case for a National Manufacturing Strategy*. ITIF.
[5] DTI. (2002). *The Government's Manufacturing Strategy*

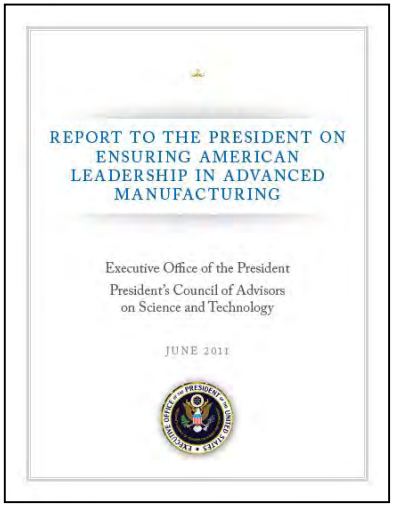
‘Digitisation of Manufacturing’

New Drivers of Value in Manufacturing

Advanced manufacturing

Where will **value** come from and who will **capture** it?

> **Advanced manufacturing is a family of activities that:**
>
> **a) depend on the use and coordination of information, automation, computation, software, sensing, and networking, and/or**
>
> **b) make use of cutting-edge materials and emerging capabilities enabled by the physical and biological sciences, e.g. nanotechnology, chemistry, and biology.**



PCAST (2011), Report to the President on Ensuring American Leadership in Advanced Manufacturing.

Advanced manufacturing

Where will **value** come from and who will **capture** it?

> **This involves both new ways to manufacture existing products, and especially the manufacture of new products emerging from new advanced technologies.**

Process Innovation & Today's Quality Jobs

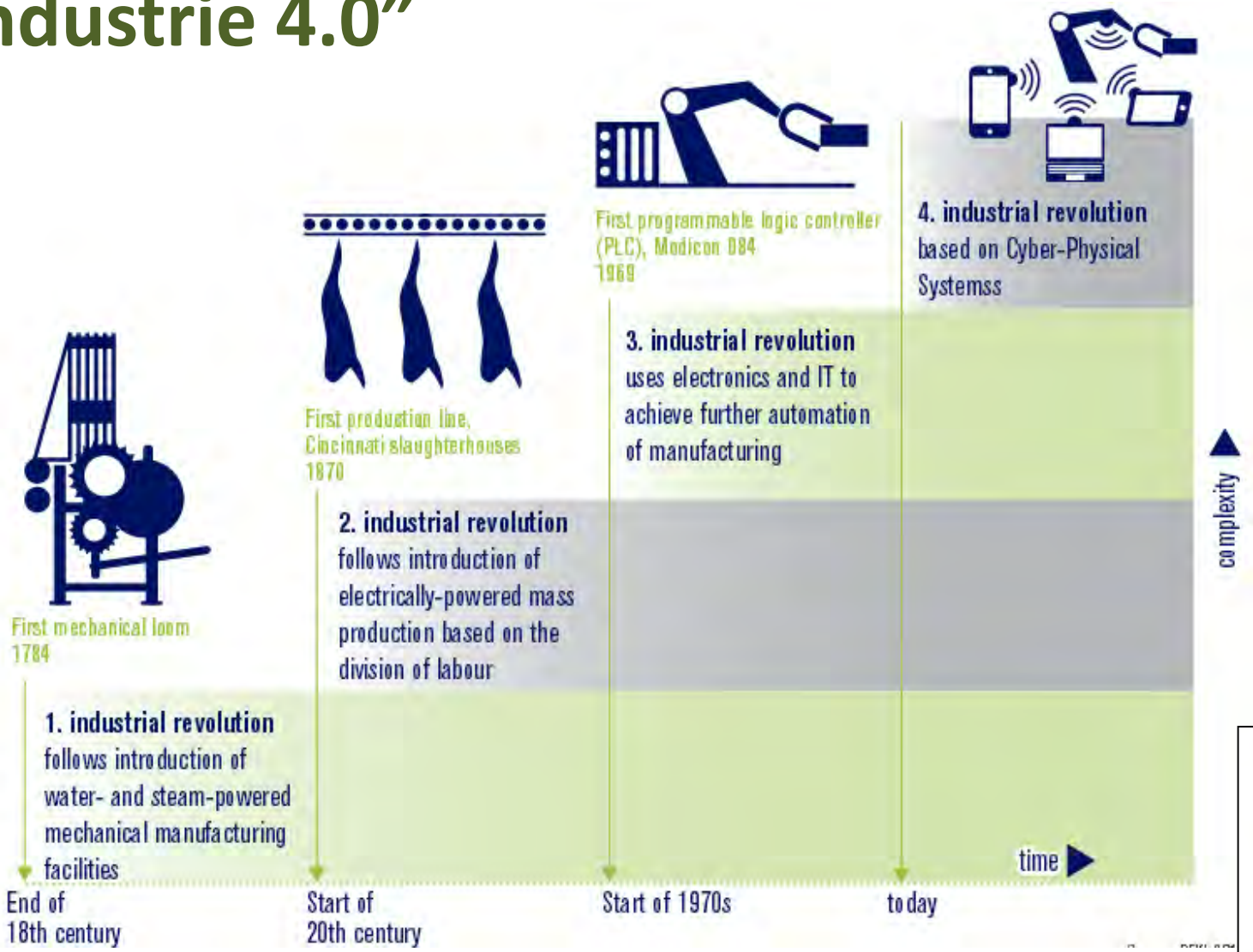
Hybrid machine tool systems

Emerging Technologies & Tomorrow's Quality Jobs

Regenerative medicine scale-up

German perspective on advanced manufacturing

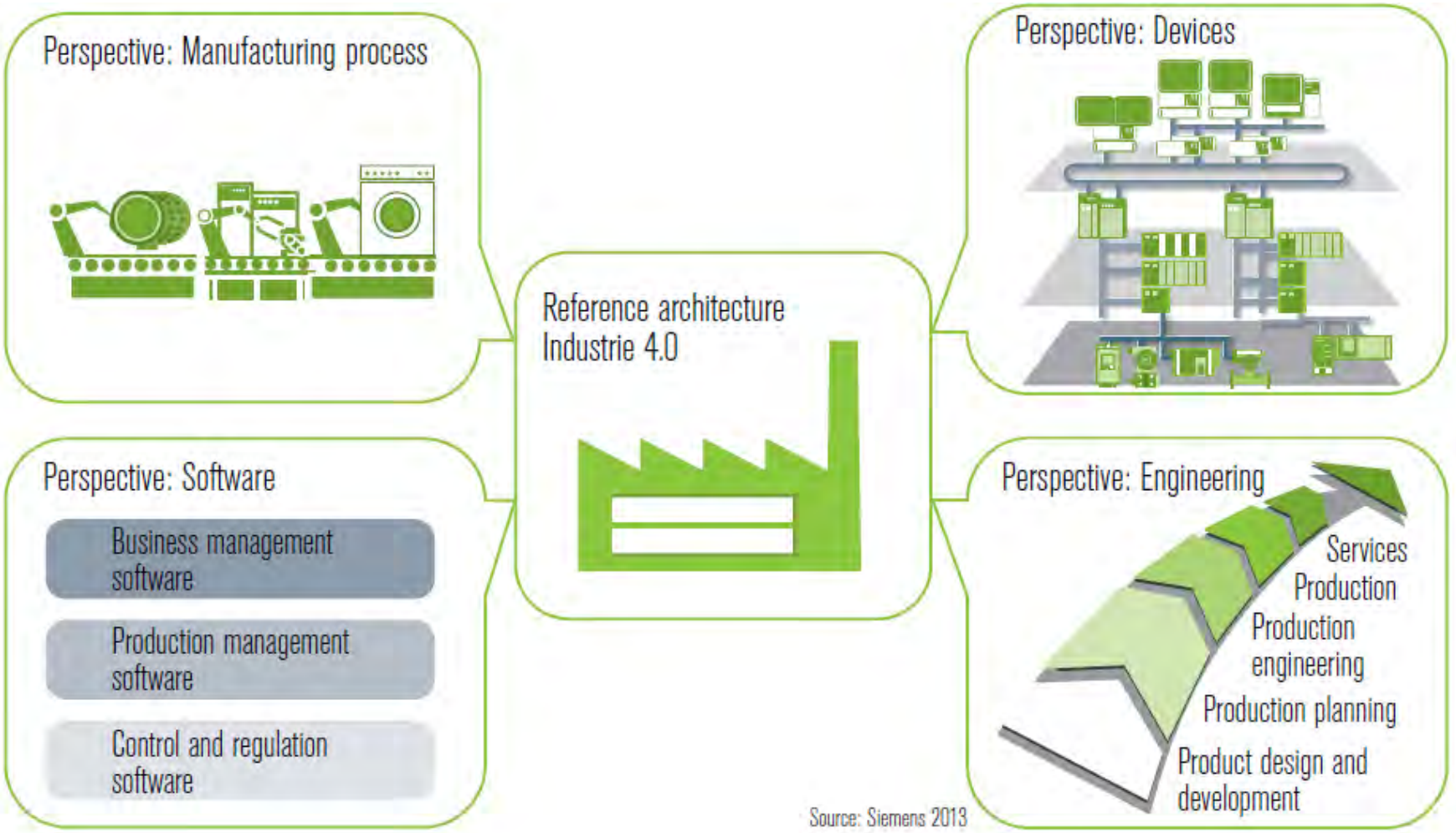
"Industrie 4.0"



"The four stages of the Industrial Revolution"

Industrie 4.0:

Industrial revolution based on Cyber Physical Systems

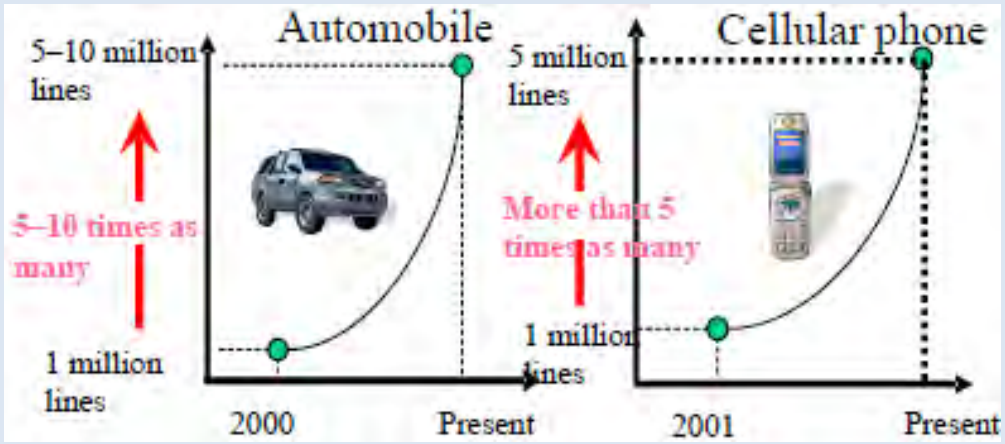


Advanced manufacturing

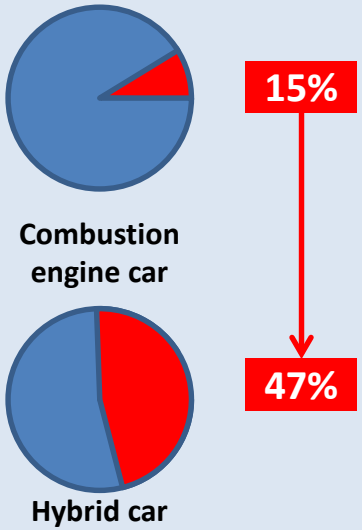
Where will **value** come from and who will **capture** it?

Embedded systems in electronics, automotive

Number of software lines



IT-related development costs in a car

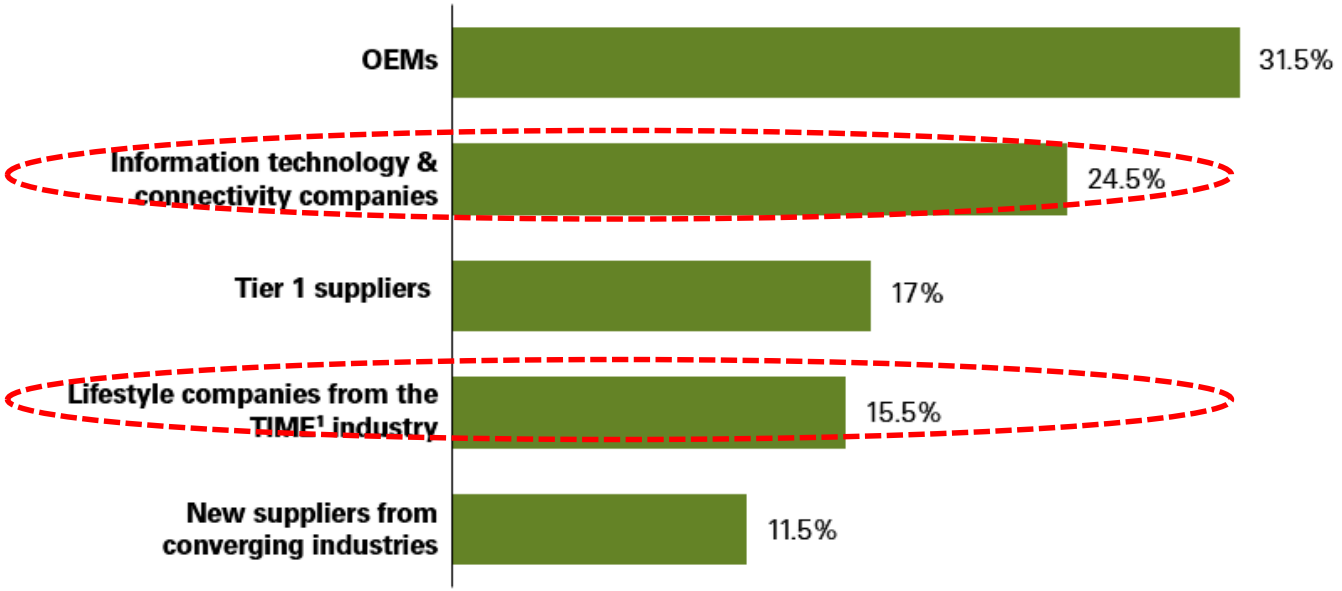


Source: METI(2012) *Industrial Structure Vision*. Industrial Structure Council.

Advanced manufacturing

Where will **value** come from?

Who will capture value from in-car connectivity by 2025?



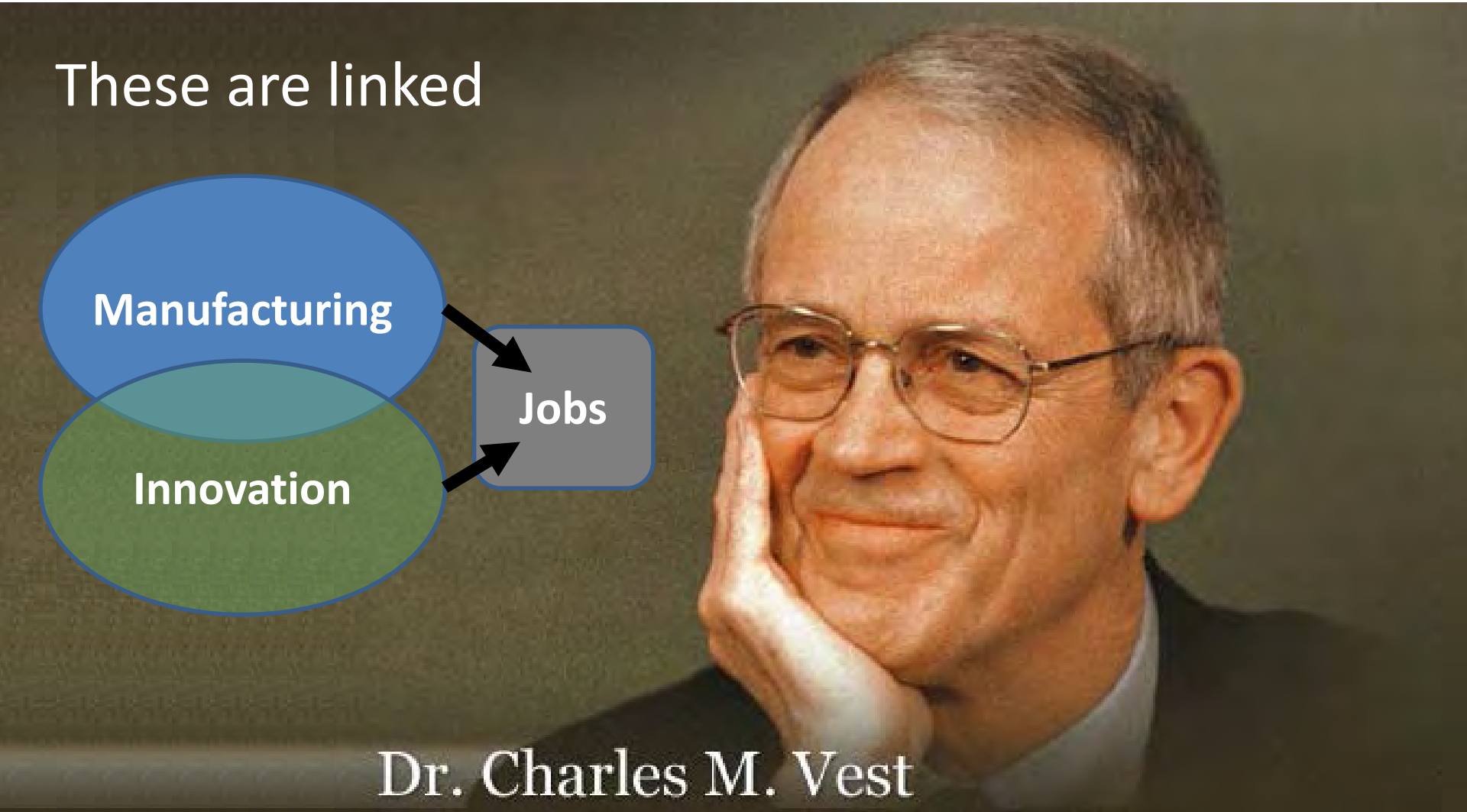
[1]TIME = Telecommunications, Information Technology, Media & Entertainment

Source: KPMG's Global Automotive Executive Survey 2012

"Engineering's Greatest Challenge:

Keeping our manufacturing systems capable of competing in the global marketplace"

NATIONAL ACADEMY OF ENGINEERING



In summary:

- **'Digitisation' is a game changer in manufacturing industries**
- **Advances in digital technology expected to change sources of value in manufacturing:**
  - Increasing efficiency and productivity
  - Shortening time to market
  - Enhancing flexibility
  - Enabling new levels of human-machine communication
  - Defining security
  - Enabling new business models
  - Etc.
- **Policy challenge: How to support industrial innovation in such a changing manufacturing environment?**

Recent Policy Responses in UK

UK Policy Context

Industrial [Sector] Strategies & 'Great Technologies'

Government Office for Science

Foresight

BIS Department for Business Innovation & Skills

BIS Department for Business Innovation & Skills

Recent UK Research & Innovation Support for Advanced Manufacturing

- **2011:** **High Value Manufacturing Catapult**
- **2011:** **Advanced Manufacturing Supply Chain Initiative:** R&D, skills training and capital investment to help UK supply chains achieve world-class standards and encourage major new suppliers to locate in UK
- **2011-2013:** 16 new **Centres for Innovative Manufacturing** (~£5M each over 5 years)
- **2012:** **Manufacturing Advisory Service** reformed
- **2013:** March announcement of 13 further successful bids to open **University Technical Colleges**, bringing total number of UTCs to 45
- **2013:** **Foresight Manufacturing report** published 2 year project investigating future of manufacturing to 2050, reporting Autumn 2013.

CATAPULT
High Value Manufacturing

EPSRC
Centres for Innovative Manufacturing

University Technical Colleges

Re-evaluation of technology & innovation centres

Example: **UK**

Technology entrepreneur Hermann Hauser 2010 report:

"I propose that the UK develops [capability that bridges research & technology commercialisation]…

attention should be focused on providing sustained and substantive support for ***an elite group of Technology and Innovation Centres…"***

2010 Hauser Report

Re-evaluation of technology & innovation centres

Example: **UK**

Market Failure – The Valley of Death

Basic Research

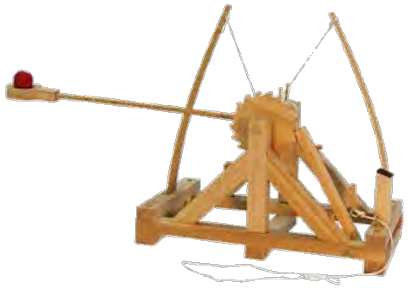
TRL 1 TRL 2 TRL 3 TRL 4 TRL 5 TRL 6 TRL 7 TRL 8 TRL 9

Commercialisation

Many innovations fail here

Universities, research organisations

Industry and companies



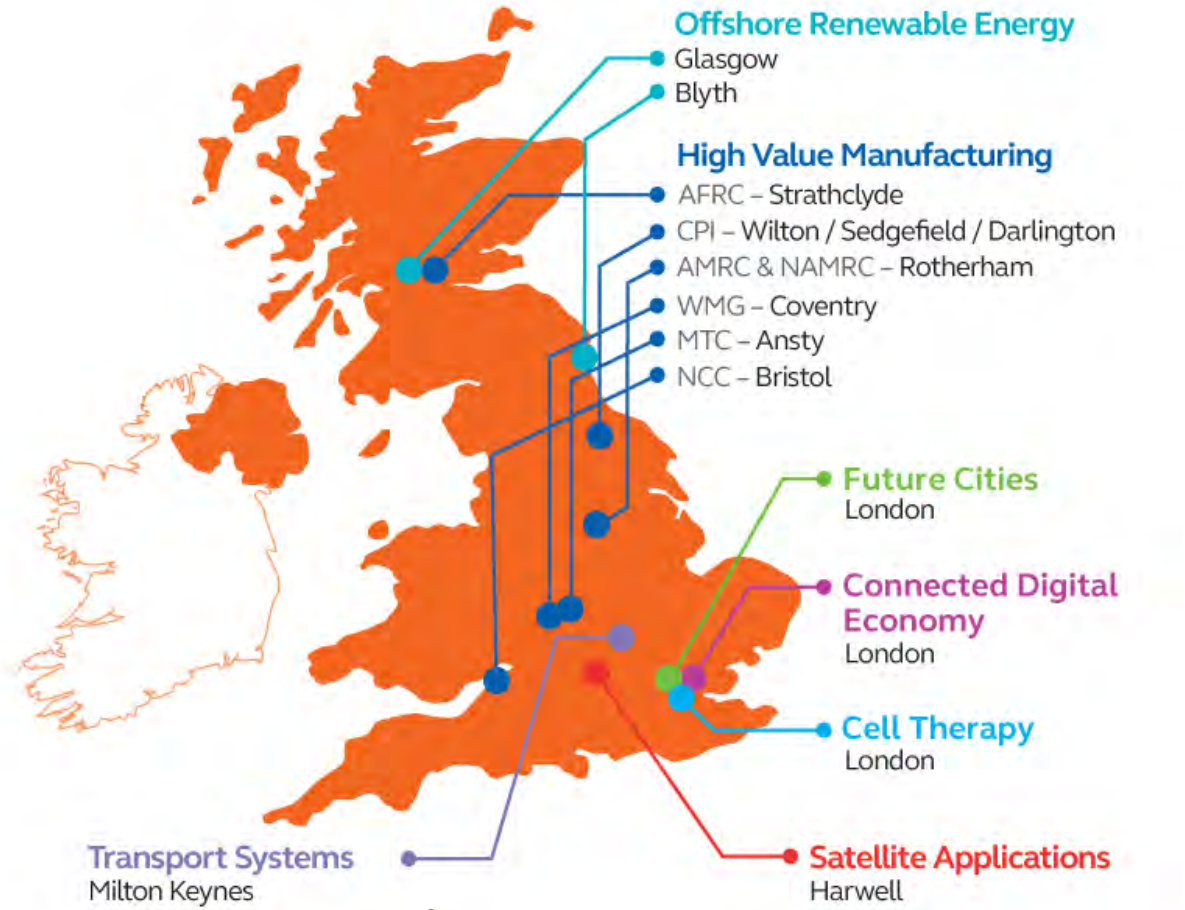
Catapult Focus

Slide from Innovate UK

Re-evaluation of technology & innovation centres

Example: **UK**

Catapult Centres



Source: Innovate UK

Re-evaluation of technology & innovation centres

Example: **UK**

High Value Manufacturing Catapult

Strathclyde

Advanced Forming Research Centre

Coventry

Manufacturing Technology Centre

Warwick Manufacturing Group

Bristol

National Composites Centre

Wilton/Sedgfield

Centre for Process Innovation

Rotherham

Advanced Manufacturing Research Centre

Nuclear Advanced Manufacturing Research Centre

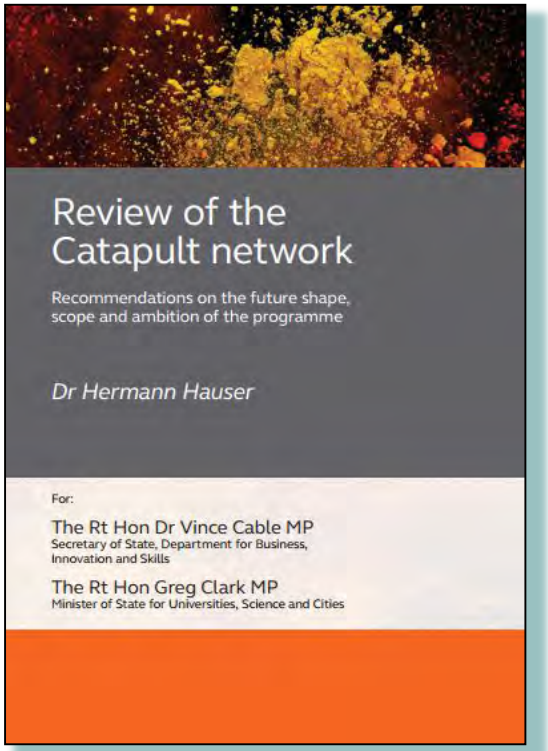
Source: Innovate UK

Re-evaluation of technology & innovation centres

Example: **UK**

2014 Hauser Review:

– *"I urge the Government to commit to expand the network in a measured way* ***adding up to one or two centres a year****."*



2014 Hauser Review

Recent Policy Responses in Japan

Background
Some issues in Japan

- **Significant manufacturing strengths**
  - Large global market share in key industries
  - Leaders in technological niches
  - Unique global manufacturing brand
  - …
- **But also big challenges**
  - **“Win in technology, lose in business”**
  - “One-legged industrial structure” based on automotive and electronics
  - Ageing population and barriers to ‘succession’
  - Energy shortages
  - Potential “hollowing out” of industrial capabilities
  - …

Source: METI, Monodzukuri White Papers, various years, and personal interviews.

Background
SMEs in Japan

- **SMEs represent the "<u>hidden strength of SMEs that underpins trust in Japanese products</u>".**
  - 99.7% of Japan's 4.2 million firms
  - ~60% of total employment
  - > 50% of manufacturing value added
  - Vital role in provincial development

Source: METI (2013). Japan's Policy on Small and Medium Enterprises (SMEs) and Micro Enterprises. Small and Medium Enterprise Agency.

International Approaches to Industrial Policy

Japan

Recent national government policy agenda has involved a range of measures focused, in particular, on:

- **Japan as manufacturing hub:** Improving Japan's overall attractiveness as a manufacturing hub
- **Accessing world markets:** Supporting the deployment of Japan's technologies, products, engineering services to world market (in particular SMEs)
- **Addressing energy supply** shortages

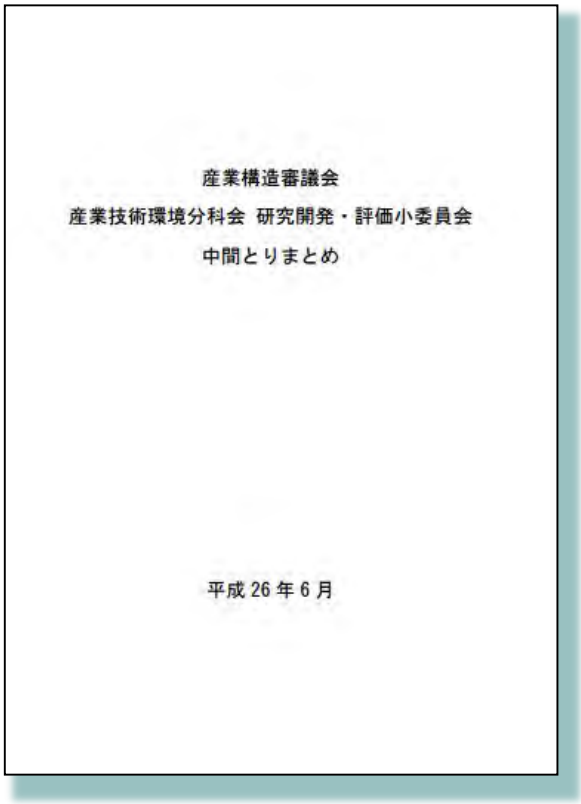
THE INDUSTRIAL STRUCTURE VISION

JAPAN'S NEW GROWTH STRATEGY

Calls for AIST 'Bridge' Reform

Challenges to networking of institutions

- Recent calls for a 'reform' in Japan's innovation system to build '**a system that allows the realization of innovation**'
- Focus on building **'bridges'** from 'technology seeds' to commercialisation
- It calls **AIST to play a 'bridging' role**, through 'municipal networking between companies and between universities and other related institutions'
- References the German Fraunhofer Society


産業構造審議会
産業技術環境分科会 研究開発・評価小委員会
中間とりまとめ
平成 26 年 6 月

Industrial Structure Council (2014)

Technology & Innovation Centres in Japan

A range of national and regional institutions

- **Significant private activity**
- **National research institutes (e.g. AIST, JAXA, RIKEN) and their regional research bases**
- **Non-profit industrial organisations (NPOs)**
- **'SME Universities'**
- ***Kohsetsushi* prefectural centres**
- **…**

Interesting contrast to UK experience

RESEARCH STAY IN JAPAN

Tuning a high-performance engine: Investigating the role of technology & innovation centres in the competitiveness of manufacturing SMEs in Japan

Kohsetsushi centres

A national network of regional technology & innovation centres

Sapporo Ag. College students, 1881 [1]

Agricultural colleges, 1899 law, "forced extension"

Around the turn of 20th century, extension concept extended to manufacturing

After WWII, operation of testing centres spread to all 47 prefectures

Source: Izushi, H. (2005). Creation of relational assets through the 'library of equipment' model: An industrial modernization approach of Japan's local technology centres. Entrepreneurship & Regional Development, 17(3), 183–204; Jones, G. and Garforth, C. (1997). The history, development, and future of agricultural extension. FAO. Illustrations from http://scua.library.umass.edu/umarmot/category/asia/japan/ and http://www.jcwa.or.jp/en/etc/history01.html

Kohsetsushi centres

A national network of regional technology & innovation centres

- **Over 600 public local technology centres**
- **~ 100 manufacturing-related, at least one in each prefecture**
- **Number of employees range from less than 10 to over 200**
- **Around ¼ of staff with doctoral degree**
- **Around $1.62 bn in funding in FY 2009**

公設試験研究機関 - Kousetsushikenkenkyukikan

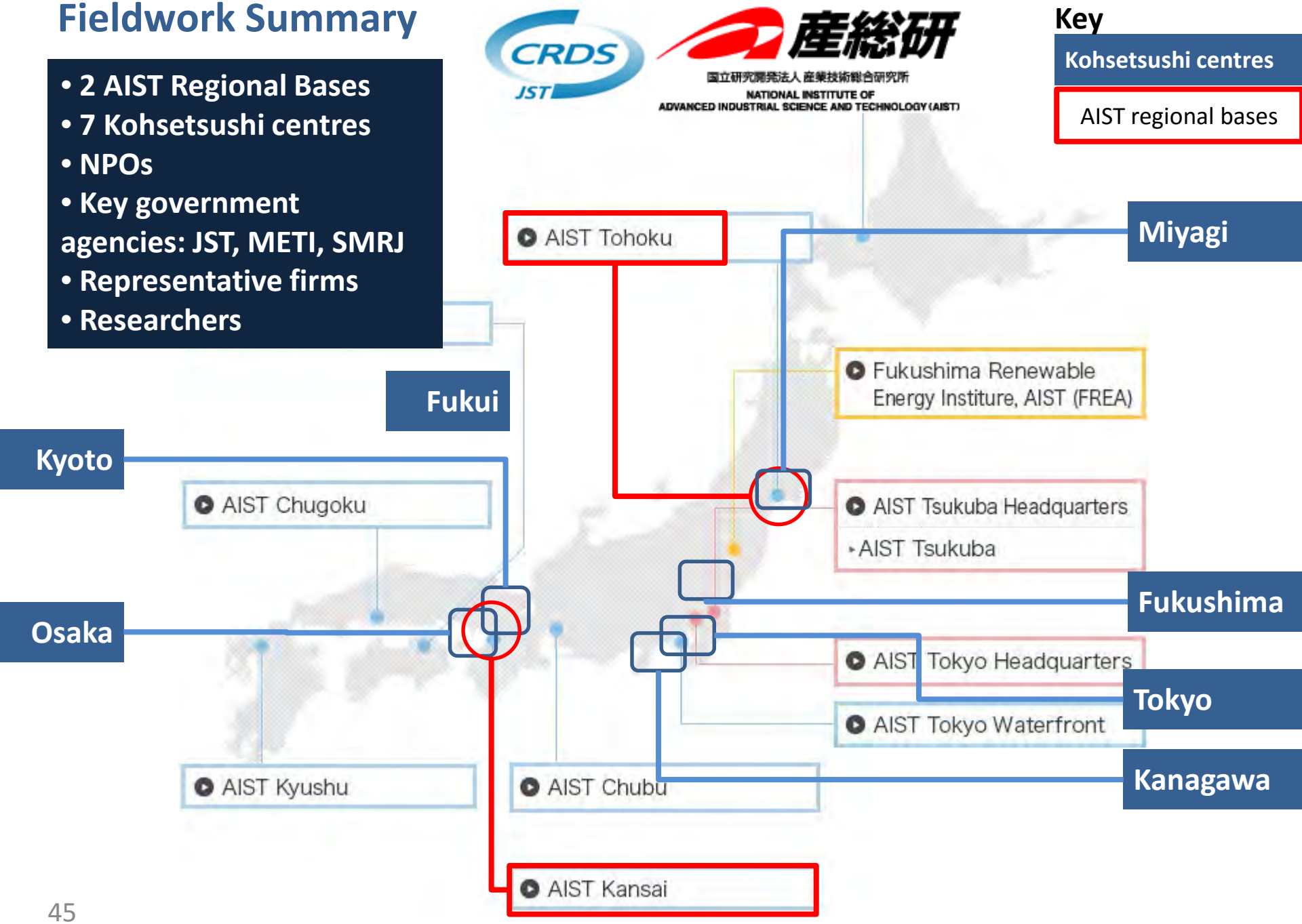
Kohsetsushi

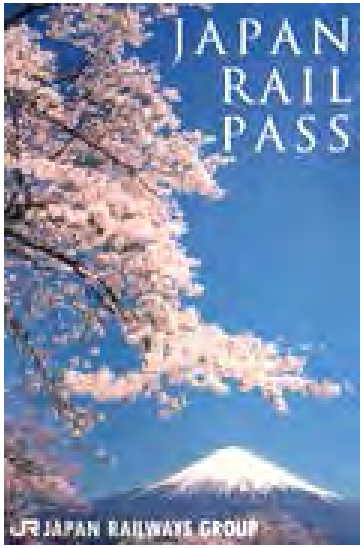
'public testing and research institutes'

Sources: Shapira, 1996; Small and Medium Enterprise Agency, METI; ITIF (2011)

Fieldwork Summary

- 2 AIST Regional Bases
- 7 Kohsetsushi centres
- NPOs
- Key government agencies: JST, METI, SMRJ
- Representative firms
- Researchers





Main Japan Rail Pass Price (JPY)

Type	Ordinary		Green Car (1st Class)	
Duration	**Adult**	**Child**	**Adult**	**Child**
7-day	¥29,110	¥14,550	¥38,880	¥19,440
14-day	¥46,390	¥23,190	¥62,950	¥31,470
21-day	¥59,350	¥29,670	¥81,870	¥40,930

(correct as of 01 April 2014)

OVERVIEW OF JAPAN'S *KOHSETSUSHI* CENTRES

A national network of regional technology & innovation centres

Main Missions

Quality assurance	Promotion of R&D in SMEs	Industrial diversification
Productivity improvement	Regional development	Investment attraction

Key Services

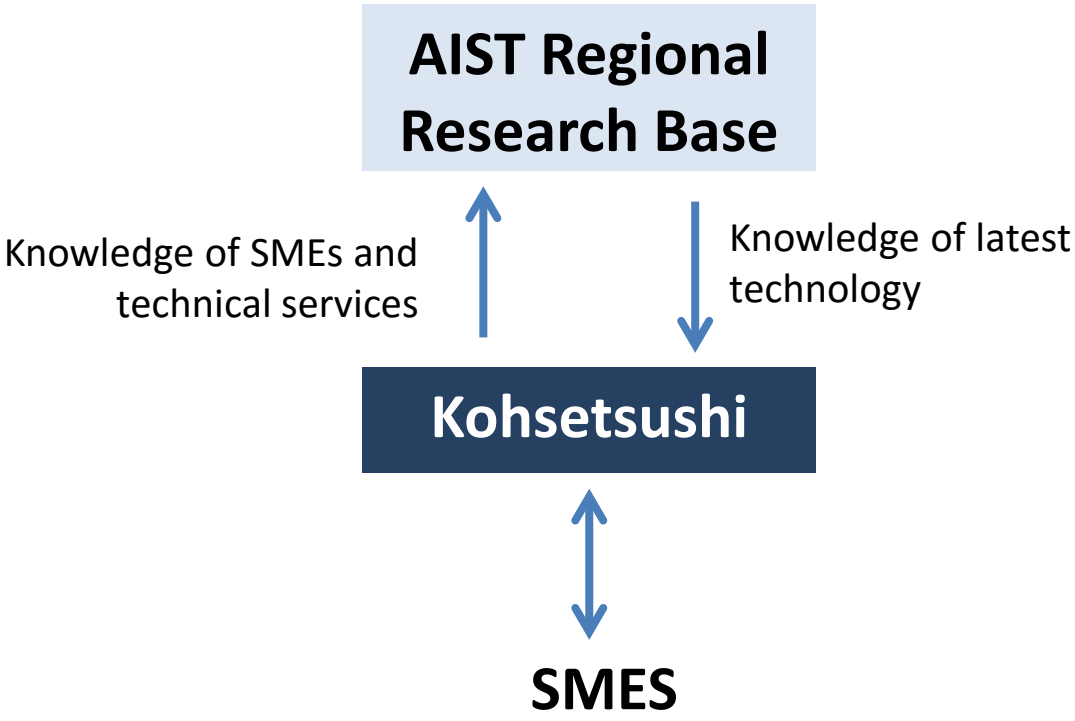
- Equipment leasing
- Technical advice
- Analysis & testing
- Workforce training
- Commissioned research

Sources of legitimacy

- Presence in all 47 prefectures (geographical proximity)
- Knowledge of and focus on needs of local industries
- Knowledge of production processes
- Knowledge of sources of technical know-how/expertise
- Knowledge of sources of funding

Interfaces with AIST

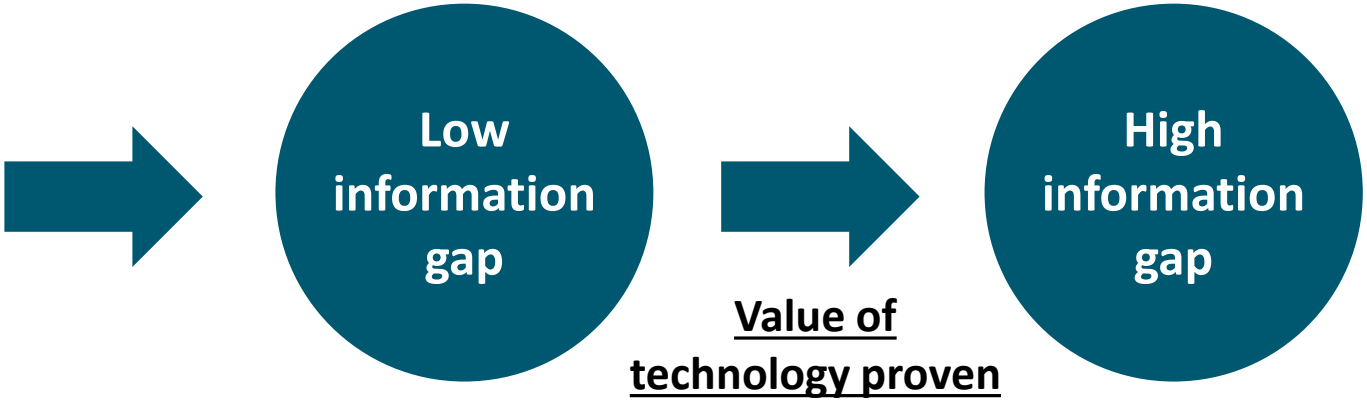
Use of *kohsetsushi* as AIST's middleman



Source: AIST Osaka, personal interview

How *kohsetsushi* engaged SMEs in innovation

From low to high 'information gap' services



From Simpler activities: Equipment leasing, technical advice

Typically free or almost free

To more advanced activities: New product development, R&D

Typically involves company investment

Strategy to overcome "innovation fear"

Kohsetsushi – Open Questions & Standing Challenges

- **Ensure "pathways to impact" to "win in business"**
  - Technology-business-market synergies
  - Advisory role on market opportunities through alternative technology applications (cf. Fraunhofer)?
- **Capitalise legitimacy in, and knowledge of, industry**
  - Coordination with national and regional institutions for effective programme delivery
  - Role of kohsetsushi in reform promoted by Industrial Structure Council
- **Incentivise innovation investment and reduce financial dependency**
  - **Business-minded** approach while ensuring industry engagement – *"if you don't value yourself"*
  - Incentive to prove "value for money"

Conclusions

Conclusions

- **Manufacturing-based growth is a key target in the innovation policy agenda around the world**

  - efforts to enhance policy making and implementation capabilities

- **Emerging trends such as the 'digitisation of manufacturing' are changing manufacturing as we know it**

  - still unclear who the winners (and losers) will be

- **'Technology & Innovation Centres' are considered a key mechanism for supporting industrial innovation in UK and Japan**

  - critical roles in supporting technology diffusion to small firms

Comments / Feedback

ありがとうございます

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