UNIVERSITY OF CAMBRIDGE

Cambridge Industrial Innovation Policy

Comparing the UK's Response to Industry 4.0: An International Perspective

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This draft note offers a brief overview of the UK's approach to supporting Industry 4.0 and contrasts it with that of other selected countries, including Germany, the United States, Singapore, Korea, and Taiwan. The note was prepared by the Policy Links Unit, IfM Engage, University of Cambridge.

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1. The UK's Made Smarter programme

'Made Smarter' is the UK's main national Industry 4.0 programme. It aims to drive "innovation, rapid adoption and stronger leadership" in industrial digitalisation to support the UK's ambition of becoming a world leader in the Fourth Industrial Revolution by 2030[1]. The *Made Smarter Review,*[2]an industry-led study that informed the design of the initiative, estimated that over the course of 10 years, industrial digitalisation could boost UK manufacturing by £455bn, boost productivity by up to 30%, and create a net gain of 175,000 jobs.

The two main strands of work of the Made Smarter initiative so far have been the *North West Made Smarter Adoption Pilot,* which focuses on adoption of Industry 4.0 technologies, and the *Manufacturing Made Smarter Challenge Programme*, which focuses on innovation.

£20m North West Made Smarter Adoption Pilot

The North West Pilot is a 30-month pilot programme launched in November 2018. It is aimed at helping up to 3,000 manufacturing SMEs based in North West England to adopt digital technologies by offering specialist technology advice, management leadership training, and access to match funding. 480 of these SMEs will be given access to a grant of up to £20k to purchase specialist services and equipment.

There have been discussions of a potential national rollout to provide this type of support to firms outside the North West, but this has not been confirmed.

Made Smarter is being delivered by the regional Growth Hubs across the North West and coordinated by The Growth Company in Manchester. As described on The Growth Company's website: "Over 30 months, the pilot will test out the most effective ways to engage manufacturers and encourage them to adopt industrial digital technology so that they can improve competitiveness, increase exports, and raise regional productivity."[3]

£147m Manufacturing Made Smarter Challenge Programme

The Innovation strand aims to increase the UK manufacturing sector's investment in industrial digitalisation R&D and the adoption of these new digital technologies. An initial £30m fast start competition was established in summer 2019 to identify "early success and credibility of the challenge". It focuses on rapid technology development and deployment across a variety of projects, from feasibility studies to large innovation and demonstrator projects. Lead applicants are required to be UK-based manufacturing businesses of any size.

In a second stage of the project, in 2021, the Manufacturing Made Smarter programme will also support technology SMEs through growth accelerators – "partnerships between the government and the private sector where experts will work with businesses to identify barriers to growth and ways to overcome them"[4]. It will also create a national network of innovation 'hubs' where businesses can partner or share advice, to help spur growth and creative ideas.

[1] Made Smarter website: https://www.madesmarter.uk/
[2] Made Smarter Review 2017. Available at: https://www.madesmarter.uk/media/y12d3ywe/20171027_madesmarter_final_digital.pdf
[3] The Growth Company. Available at: https://www.growthco.uk/what-we-do/made-smarter/
[4] https://www.gov.uk/government/news/300-million-to-boost-uk-manufacturing-productivity-by-30

2. Main differences with international Industry 4.0 programmes

A number of differences can be highlighted between the UK approach and that of other countries reviewed for this note.

1) Focus on technology diffusion

Other countries' Industry 4.0 initiatives have put a stronger emphasis on the diffusion of technologies and best practice.

There are two main reasons for this. First, there is awareness that Industry 4.0 technologies are not yet being used by the majority of firms[5]. Second, it is recognised that many digital technologies are already available in the market and becoming cheaper. As a result, the rationale for government support to diffusion is more widely accepted. Technology diffusion initiatives typically involve the provision of 'hands-on' business support – providing firms with access to advisory services, demonstration facilities, and training.

For example, the German approach puts emphasis on supporting SMEs to become more aware of Industry 4.0 and provide them with information, training and opportunities to test their digital applications. Demonstration and learning factories help companies try out new things with the support of industry experts and put their own technologies, product or customer interfaces to the test before making an investment.[6] Similarly, Korea's President Moon Jae-in launched a *Ministry for SMEs and Startups* which specifically focuses on supporting SMEs' innovation capacity, across all industries, with a focus on the uptake of digital manufacturing.[7]

2) Programme scale/coverage

Industry 4.0 initiatives in countries like Germany, Taiwan, and Korea have a national mandate and are funded accordingly. In the US, Industry 4.0 support is deployed nationally through the Manufacturing Extension Partnership (MEP), a national network of technology institutions providing industrial advisory services (see below), rather than by a national umbrella initiative. In contrast, the UK approach has been to establish a regional pilot through which only firms in the North West region are eligible for support. There have been discussions of a potential national rollout of the Made Smarter Programme but this has not been confirmed.

A recent report by Make UK[8] recognises: "*There is widespread enthusiasm for, and commitment to, increasing the pace and scope of our national efforts to promote industrial digitalisation. But to deliver, we need to build on the Made Smarter North West pilot, and replicate its success in other regions".*

3) Delivery institutions across regions

Other countries are able to use their regional institutions (e.g. Japan's prefectural technology centres and Korea's regional technology institutes) and manufacturing extension services (e.g. the US Manufacturing Extension Partnership) to deliver digital diffusion initiatives. In the UK, significant efforts (and time) have been necessary to build regional capabilities for the delivery of the North West Pilot, and it is not clear what regional institutions could support a national rollout of the Made Smarter programme.

A recent report by Make UK highlights the challenges faced in the UK in terms of delivery institutions: *"Outside the North West of England there is no integrated model for [providing technical, process and change management expertise] in relation to industrial digitalisation. Growth hubs in other parts of the*

[5] A 2015 survey in Germany, for example, found that only 4% of German businesses have implemented digitalised and networked production processes (ZEW Mannnheim 2015 survey of 4,500 German businesses).
[6] https://www.bmwi.de/Redaktion/EN/Dossier/industrie-40.html
[7] ITIF (2018). Why Manufacturing Digitalization Matters and How Countries Are Supporting It.
[8] https://www.makeuk.org/-/media/files/insights/reports/make-uk---make-it-smart.pdf

country said that they didn't have the ability to provide sufficiently expert advice to support this work. Elsewhere a patchwork of local authorities, LEPs, universities and others are trying their best, but with limited resources. They often struggle to locate SMEs who need their help and to interact meaningfully with them".

4) Emphasis on training

Another striking difference is that Industry 4.0 initiatives in other countries reviewed involve funding for education and workforce training. In Korea and Singapore, for example, demonstration facilities are used to deliver practical training courses on Industry 4.0 to industry personnel. In particular, Singapore's Economic Development Board (EDB) created the *Skills Future Series for Advanced Manufacturing*, which provides modular courses aimed at helping the manufacturing workforce acquire new skills and accelerate Industry 4.0's development. In the US, the MxD Institute (one of the Manufacturing USA Institutes) has developed Digital Manufacturing Jobs, which identifies 165 roles in manufacturing that will be created or transformed by the introduction of digital technology.

3. Overview of selected national Industry 4.0 initiatives

Germany

Overview

- The high-profile "Platform Industrie 4.0" initiative is steered by Germany's Federal Ministry for Economic Affairs and Energy (BMWi) and Federal Ministry of Education and Research (BMBF) as well as high-ranking representatives from industry, science, and trade unions.
- Emphasis is given to the integration of digital technologies into industrial production machinery and "smart factories"
- The strategic goal is maintaining Germany's traditionally strong position in manufacturing and mechanical engineering
- The Mittelstand-Digital Initiative aims to show SMEs the importance of software for business processes and to provide support for digitalising their businesses
- Essentially, Germany wants to create a centre of gravity in Industry 4.0 standards development, forging a trilateral cooperation that seeks to bring together the key digitalising manufacturing initiatives of France, Germany, and Italy
- The initiative aims to "use China as a multiplier for German standards", implementing German beta standards into Sino-German cooperation initiatives in order to improve their chances of being adopted on the global market
- A 2016 study by the German Academy of Engineering concluded that "Germany is currently around two to three years ahead of other countries in the field of Industry 4.0"

Funding

- The German government has pledged more than €500 million to help industry associations, research institutes, and companies implement Industry 4.0

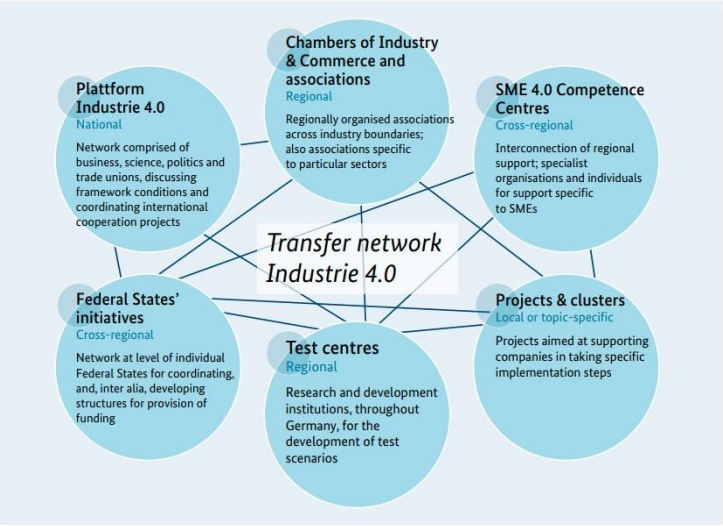
Geographical coverage (national/regional)

- National

Key efforts and institutions supporting technology transfer / diffusion

More than 300 players from 159 (state and federal) business, science, association, and union organisations are involved in the delivery of Industry 4.0 in Germany.

Platform Industrie 4.0 works together with the Chambers of Industry and Commerce locally, developing professional practice and workshops on knowledge transfer, aimed at addressing specific company needs. Information is exchanged in an existing network, consisting of contacts in the federal states and the regional initiatives, as well as in the local trade associations specific to particular business sectors.



Sources: Plattform Industrie 4.0 (2018). *Progress Report 2017*; Plattform Industrie 4.0 (2020). *Structure and Organisation of the Plattform Industrie 4.0*.

United States
Overview • Advisory support on Industry 4.0 delivered through existing institutions with presence in every state of the country.
Funding • In 2020, the budget assigned to Manufacturing Extension Partnership Centers is $126.7 million. For every dollar of federal investment in FY 2019, the MEP Centers as part of the MEP National Network generated $33.80 in new sales growth and $32.20 in new client investment. • Through 2018, Manufacturing USA institutes attracted more than $2 billion in private investment leveraging $1 billion in federal funds.
Geographical coverage (national/regional) • National
Key efforts and institutions supporting technology transfer / diffusion **NIST Manufacturing Extension Partnership (MEP):** While its scope extends beyond Industry 4.0, all of its 51 centres have adopted digital manufacturing as a key theme. For example, the National Institute of Standards and Technology (NIST)'s Smart Manufacturing Systems (SMS) Test Bed enables smart manufacturing research and development across the product lifecycle. **Manufacturing USA:** A network of 14 manufacturing institutes each with a distinct technology focus. **Four institutes** (America Makes, ARM, MxD and CESMII) provide digital manufacturing support. Examples of services include: • Technology roadmaps • Test beds • Open platform and marketplace for secure, real-time data analytics, industrial applications, and manufacturing solutions • Future Factory – a physical and digital manufacturing shop leveraging data and cutting-edge manufacturing tools • Education and workforce training

Source: Manufacturing Extension Partnership (2020). *Annual Report 2019*; Manufacturing USA. *Institutes*; NIST (2019). *Smart Manufacturing Systems (SMS) Test Bed*; The White House Office of Science and Technology Policy (2020). *Advancing America's Global Leadership in Science & Technology*.

Singapore

Overview
• Variety of programmes related to Industry 4.0
• Four key initiatives:
  ○ **The Singapore Smart Industry Readiness Index:** designed as a comprehensive self-assessment tool for companies to evaluate their digitalisation level, regardless of their size or the industry that they are operating in
  ○ **Model Factories:** allow SMEs to test new technologies with help of public sector researchers before adopting into their factories.
  ○ **Tech Access:** access to advanced equipment & facilities; learning, experimenting, prototyping "with the primary aim of eventual deployment of advanced technologies in the firms"
  ○ **Tech Depot:** suite of plug-and-play technologies that are easy to use; training grants
  ○ **Hyper-Personalisation Line Programme**: IoT-enabled and machine learning solutions; physical testbeds for piloting cyber-physical systems and technologies
  ○ **Digital Ecosystem of Model Factories Initiative**: learning platform to share Industry 4.0 best practices.
• Emphasis is on digital skills formation through their **SkillsFuture** programme, which has reached around 10% of all the population above 25 years old.

Funding • N/A
Geographical coverage (national/regional) • National
Key efforts and institutions supporting technology transfer / diffusion • Multi-agency approach involving the Agency for Science, Technology & Research (A*STAR), Ministry of Trade and Industry (MTI), Economic Development Board (EDB), and SME Agency (Enterprise Singapore)

Source: Agency for Science, Technology and Research, A*STAR (2018). *A*STAR's Future of Manufacturing Initiative (FoM)*. A*STAR. *Annual Report Apr 2019-Mar 2020*.

Korea
Overview • High-level "Manufacturing Industry Innovation 3.0" programme inspired by Germany's Industry 4.0 initiative • R&D roadmaps developed for several key Industry 4.0 technologies • Factories participating in the "Korea Smart Factory Initiative" are reporting 25% productivity improvements at the factory level • Industrial Digital Transformation Alliance announced on 28 October 2020 support for digital transformation projects in various industrial sectors including: automotive, electronics, healthcare and shipbuilding. Measures include support to knowledge generation, diffusion and deployment.
Funding • Korea's government has committed to investing $189.3 million through 2020 into R&D projects developing technologies related to smart factories, with research and testbed projects sponsored with federal funds • In 2020, the budget of the Department of Smart Manufacturing Innovation is around $4.1 billion.
Geographical coverage (national/regional) • National.
Key efforts and institutions supporting technology transfer / diffusion • The **Ministry of Trade, Industry and Energy** (MOTIE) is leading government efforts. • Includes the "Korea Smart Factory Initiative" launched in 2014 as part of the Manufacturing Industry Innovation 3.0 strategy with a goal to build 30,000 Smart Factory sites for Korean SMEs by 2025. This included providing training to 40,000 workers to operate fully-automated manufacturing sites. • The **Ministry for SMEs and Startups,** through its **Department of Smart Manufacturing Innovation**, provides smart manufacturing-related services. • The **Smart Manufacturing Innovation Center (SMIC)** provides support in building proof of concept production lines, interoperability testbeds, technical verification and consulting, and training. • The **Smart Factory Standard Research Council** was formed within the private sector to standardise regulations.

Source: Ministry of Trade, Industry and Energy (2020). *Press release (EN)*; Ministry of SMEs and Startups (2020). *Smart Manufacturing Innovation Team*; SMIC. *Introduction to Demo Factory*; US International Trade Administration (2020). *Korea - Manufacturing Technology - Smart Factory*.

Taiwan

Overview
• The **Smart Machinery Development Programme** is one of Taiwan's main industrial innovation policies (under the 5+2 Innovative Industries initiative). Its main purpose is to upgrade Taiwan from precision machinery to smart machinery and to promote the adoption of smart machines.
• Taiwan's Smart Manufacturing Strategy involves three main pillars:
  o Digitalised production management, from Industry 2.0 to 3.0 (Manufacturing Enterprise Solutions, MES and Enterprise Resource Planning, ERP)
  o Develop Network Service Platform (PaaS) and testbed for SMEs.
  o Develop industry's software model (SaaS)
• The Smart Machinery Promotion Office was established in February 2017 to help create a new ecosystem for Taiwan's smart machinery industry.

Funding • The government has invested NT$15 billion (US$508.5 million) in the past four years (2016-2020) to upgrade Taiwan's machinery industry from precision machinery to smart machinery. • In 2019, the budget of the Industrial Technology Research Institute (ITRI) was NT$25 billion (US$276 million).
Geographical coverage (national/regional) • National
Key institutions supporting technology transfer / diffusion • The Smart Machinery Development Programme is led by the **Ministry of Economic Affairs (MOEA)** and the **Ministry of Science and Technology (MOST)**. • The **Smart Machinery Promotion Office** assists companies in achieving smart manufacturing through: (i) a smart manufacturing consultant team that makes on-site visits and provides consulting, diagnosis, and technical services; (ii) establishing test sites for plumbing hardware and hand tools, aerospace machine tools, auto parts and components, and semiconductor equipment; and (iii) linking together domestic and overseas platforms to help companies build partnerships.The **Smart Manufacturing Pilot Production Site,** established by **ITRI,** serves as the domestic smart manufacturing planning centre, and shows the Industry 4.0 applications of domestic equipment to the industry. • The **Smart Manufacturing Pilot Production Site,** established by **ITRI,** serves as the domestic smart manufacturing planning centre, and shows the Industry 4.0 applications of domestic equipment to the industry. • Support activities also include human resources development in collaboration with the **Ministry of Education** and the **Ministry of Labour**.

Sources: American Chamber of Commerce in Taipei (2019). *Smart Manufacturing Gains Ground in Taiwan*; InvesTaiwan. *Smart Machinery*; InvesTaiwan (2020). *Government committed to making Taiwan high-end manufacturing hub for Asia*; ITRI. *Annual Report*.

About us

Cambridge Industrial Innovation Policy is based at the Institute for Manufacturing (IfM), a division of the University of Cambridge's Department of Engineering. CIIP brings together the Centre for Science, Technology & Innovation Policy (CSTI) at the Institute for Manufacturing, the Policy Links Unit from IfM Engage, and the Babbage Policy Forum.

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