A REVIEW OF INTERNATIONAL APPROACHES TO INDUSTRIAL INNOVATION: LESSONS TO INFORM BRAZIL’S “I2027” STRATEGY

A report for the Brazilian Industrial Board (CNI)

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Meeting at Brazil’s Confederação Nacional da Indústria (CNI)
Dialogues MEI

9 April 2018, São Paulo, Brazil
AGENDA

- About us
- Overview of the report
- Key insights from international policy efforts
- Policy implications
- Q&A
POLICY LINKS

Research-based advice and education services for technology and innovation policy makers

- **Mission**: help governments develop more effective industrial innovation policies
- **Not-for-profit knowledge transfer unit** of the Centre for Science, Technology & Innovation Policy (CSTI), University of Cambridge
- Informed by leading academic thinking, engineering know-how, and the study of the latest international practices

http://www.ifm.eng.cam.ac.uk/policy-links/
RECENT WORK ON DISRUPTIVE TECHNOLOGIES

- Next Production Revolution (NPR) Book – **OECD**
- Review of Global Advanced Manufacturing Trends – **UNIDO**
- Workshop at White House on Advanced Manufacturing RTOs – **UK HVMC and Innovate UK**
- Input to UK’s Industrial Digitalisation Review (IDR) – **UK BEIS**
AIMS OF THE PROJECT

To help identify the policy implications and challenges for Brazil that are associated with disruptive technologies and their impact on national industries

FOCUS ON:

- Programmes, mechanisms and initiatives aimed at supporting industrial innovation identified in selected countries

- International approaches to supporting the generation, diffusion and deployment of advanced technologies in industry.
**IMPORTANT CONSIDERATIONS**

- **International practice:** many programmes / initiatives / mechanisms established in countries around the world to support industrial innovation.

- **Variety of innovation policy missions and local contexts:** approaches adopted internationally reflect diversity of goals and local contexts – important to avoid quick conclusions on effectiveness.

- **Potential to provide a useful international context to efforts in Brazil:** review of international practice can provide ideas, help stimulate discussion, offer insights into what competitor countries are doing – but cannot by itself provide ‘the answer’.

While the Policy Links team did not join the I2027 project from the start, it received continuous guidance from I2027 delivery team.
OPPORTUNITY AREAS

1. **Agency coordination** and formation of a **common national vision** around new technologies

2. **Scale-up** and “**manufacturability**” of emerging technologies

3. **SME capability-building**

4. **R&D collaborative networks**

5. **Skills development** in disruptive technologies

**Informed by:**
- Emerging outputs from the I2027 project
- Consultations with the I2027’s project team
- Inputs from stakeholders captured during workshop in Brasilia
We analysed the *why, what, how* and *who* of selected programmes, mechanisms and initiatives.

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<th>WHY</th>
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<tr>
<td>Policy rationale</td>
<td>Information failures</td>
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<td>Network failures</td>
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<td>Coordination failures</td>
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<td>Existence of public good</td>
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<th>WHAT</th>
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<tr>
<td>Policy goal</td>
<td>Technology development</td>
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<td>Industrial competitiveness</td>
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<td>Societal challenges/needs</td>
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<th>HOW</th>
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<tr>
<td>Types of intervention supported</td>
<td>Knowledge generation (basic and applied R&amp;D)</td>
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<td>Knowledge diffusion (linkages &amp; institutions)</td>
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<td>Knowledge deployment (firm capability)</td>
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<th>WHO</th>
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<td>Key delivery stakeholders</td>
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<td>Municipal/local</td>
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Defining a “national vision” can help to navigate the complexity and uncertainty of emerging technological and industrial systems.

**Systemic nature of modern industries and technologies**
Need to bring together expertise in different technological domains and research disciplines

**Critical mass**
Need for joint efforts from multiple government agencies and the private sector

**Uncertainty of impacts**
Difficult for relevant actors to agree on common visions, priorities and actions

**Government challenge:**
To reconcile a mix of policy goals with the needs of different public bodies, and the objectives of their agendas
The National Nanotechnology Initiative (NNI) is a research and development (R&D) strategy involving the nanotechnology-related activities of 20 US departments and independent agencies.
# Scale-up and “Manufacturability” of Emerging Technologies

Scale-up has to do with the translation of an innovation into the market.

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<tr>
<th>Category</th>
<th>Description</th>
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<tr>
<td><strong>Value capture</strong></td>
<td>Increasing focus on capturing, delivering and exchanging value from the generation and absorption of innovations</td>
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<td><strong>Manufacturability</strong></td>
<td>Global races to manufacture at industrial scale with same level of performance</td>
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<td><strong>Convergence</strong></td>
<td>Convergence of key enabling technologies underpinning the ‘Fourth Industrial Revolution’ imply new challenges to scale-up</td>
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**Government challenge:** Ensuring availability of mechanisms and support infrastructures to move from laboratory to industrial scale.
Products invented here, now made elsewhere - not driven by labor cost
MADE IN CHINA 2025 – INNOVATION CENTRES

- Established innovation centres:
  1) National Power Battery Innovation Centre
  2) National High-speed Train Technology Innovation Centre
  3) National Additive Manufacturing Innovation Centre
  4) Changshu Innovation Centre for Green & Intelligent Manufacturing
  5) National Information Photoelectron Innovation Centre
  6) National Innovation Centre for New Energy Vehicles
  7) Henan Agricultural Machinery Innovation Centre

Paying attention to **manufacturing scale-up**, focusing on building a critical mass of multidisciplinary engineering R&D capabilities to accelerate the industrialisation of key generic industrial technologies with a focus on:

*Building stronger linkages and alliances between universities, firms and public research institutes.*
Many SMEs find difficult to fully engage and exploit the advantages of the National Innovation System.

**Absorptive capacity**
- The ability to recognise, acquire, assimilate, transform and exploit knowledge and technologies.

**Existing technologies**
- Small firms find it difficult to use the latest technologies available in the market.

**Contextual enablers**
- Contextual enablers are the institutional and macro-environmental features which shape businesses’ performance.

**Government challenge:**
- Boost the ability of companies to generate and deploy technologies by incentivising contextual enablers.
SIMTech

**Priority high-growth industries**
(e.g. aerospace, oil & gas, MedTech)

**Precision engineering firms**
(machinery & systems; precision modules & components)

- Shaping of Inconel, Ti,
- Gun Drill of offset holes
- Vacuum Brazing
- Silicon Moulding
- Etc.

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### SMEs CAPABILITY

**PLC/SME**
- Hup Futt
- ViQuest Technologies
- CEL Coating
- CFM
- Yong Chang Molding
- Sulzer Chemtech
- Disk Precision
- Long Tech
- Bashini
- Metaplaz
- Wah Son
- CW Advanced Tech
- Sunny Metal
- Sanwa Plastic
- Sunningdale
- Fong's Engineering
- Douyee
- Unisteel
- First Engineering
- Speedy Tech
- Jubilee Industries
- Yeakin Plastics
- Swiftronic
- Map Plastics
- Racer Tech
- Taiyo Technology
- Vigor Precision
- Disk Precision
- Long Tech
- Spindex
- MMI
- Meiban Group
- Component Tech

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### Industries:

**MNC**
- Halliburton
- Schlumberger
- Baker Hughes
- Cameron
- Applied Materials
- AMEC
- Medtronic
- Rolls-Royce
- Siltronic

- Seagate
- Maxtor
- HP
- Philips
- BD
- Baxter
- Shimano
- Dynacast
- Delphi
- Seiko
- Makino
- Infineon
- Sony
- NXP
- Panasonic
- ASM

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**Industries:**
- Oil & Gas
- MedTech Devices
- Aerospace
- Complex Equipment
- Hard disk drive
- Consumer electronic
- Semicon
- MedTech consumables
- Precision Modules
- General Manufacturing
- Machinery

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**Education and Consultancy Services**
R&D COLLABORATIVE NETWORKS

The generation and deployment of different kinds of innovation require systematic incentives for public and private R&D

<table>
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<th>Low levels of R&amp;D</th>
<th>A significant proportion of firms do not engage in R&amp;D activities</th>
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<td>R&amp;D networks</td>
<td>R&amp;D collaborative networks can help SMEs identify relevant research projects in synergy with other SMEs and larger firms</td>
</tr>
<tr>
<td>R&amp;D linkages &amp; Infrastructures</td>
<td>R&amp;D infrastructures are conformed by facilities, resources and related services that can catalyse innovation</td>
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Government challenge

Policy-makers face the challenge of leveraging diverse R&D priorities among organisations
AiF is Germany’s leading national organisation for the promotion of applied R&D in SMEs

- The AiF concentrates on “application-oriented research and development for SMEs”
- Focus on increasing the competitive strength of SMEs by supporting the efficient application and advancement of R&D programmes
- Innovation network that involves 100 industrial research associations with approximately 50,000 companies (mainly SMEs)

‘Industrial Collective Research’: Research associations collect ideas for research projects and identify common research needs within an industrial branch or field of technology.

- In 2015, the AiF disbursed around €525 million of public funding
The effective adoption of new technologies requires firms to acquire new skills.

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<th>Skill sets</th>
<th>Skill sets will increasingly incorporate interdisciplinary knowledge, requiring lifelong upgrading of abilities</th>
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<tbody>
<tr>
<td>Specialised skills</td>
<td>Skills needed beyond scientific and engineering occupations, including technicians, production workers, marketing</td>
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<tr>
<td>SMEs</td>
<td>SMEs might also struggle to deploy new technologies, since the scope of the manufacturing workforce is likely to change</td>
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<tr>
<td>Shortage of skilled workers</td>
<td>Technological advancements coupled with an ageing workforce could lead to a shortage of skilled workers</td>
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*Need of anticipating the development of skills needed for technological deployment, since job requirements of the future can change abruptly.*
The National Institute for Bioprocessing Research and Training (NIBRT) is a global centre for training and research in bioprocessing.

**Partnership** between University College Dublin, Trinity College Dublin, Dublin City University & the Institute of Technology, Sligo
A first obvious concern is the effect that digitalisation may have on general levels of employment.

**JOBS**

- WEF estimates potential global job losses to digitalisation could range from **2 million to as high as 2 billion by 2030**
- However, it is also believed that digitalisation can be a **net job creator in some industries** (UK Made Smarter - Potential **net gain of 175,000 jobs** in the UK over the next decade)

**SKILLS**

- Changing needs of national manufacturing workforces driven by digitalisation
- Implications for the level and type of skills required in the manufacturing workforce of the future
- Both pre-employment and post-employment training required
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Policy implications

- Q&A
THE NEED TO ENHANCE THE COORDINATION

The international experience reveals increased emphasis on the need to ensure better coordination of government actors, technical expertise, and R&D infrastructure

Key observations:

- The creation of national frameworks of cooperation and communication
- Importance of stimulating collaboration among different actors of the innovation system, including companies, universities, colleges, research centres, the public sector and civil society
- Formation of a common national vision around new technologies through national strategic programmes
DESIGNING INSTITUTIONS FOR SCALE-UP

For policy-makers, a central concern is the design of institutions, programmes and initiatives to ensure that research output is ultimately deployed in increasingly complex industrial systems

Key observations:

- A number of countries are investing in applied technology centres and pilot production facilities focused on taking innovations out of the laboratories

- In times of budget constraints, countries should be able to capture value from their investments in science and innovation and ensure “value for money”

- Technology scale-up requires the right combinations of tools and facilities such as advanced metrology, real-time monitoring technologies, characterisation, analysis and testing technologies, shared databases, and modelling and simulation tools
ENSURING SME ENGAGEMENT IN INNOVATION

Many firms, in particular (SMEs), are unable to exploit the opportunities offered by new technologies, even when those technologies are readily available in the market

Key observations:

- For building SME capabilities, decentralised facilities are necessary to reach firms throughout the country
- SME capability building requires a range of support services, both “soft support” and “hard support”
- Government-supported information dissemination mechanisms can play a key role in providing information about particular technologies
PROMOTION OF R&D NETWORKS

Increased international emphasis on promoting collaboration among firms and institutions through R&D networks

Key observations:

- Efforts to engage more firms in R&D, creating multidisciplinary teams, ensuring aligned investments in technology areas that depend upon one another and ensuring critical mass

- Role of industrial research associations in bringing together groups of firms to identify their common needs with the support of experts from

- The importance of industrial networks, involving SMEs and large firms, for identifying opportunity areas to be exploited, as well as areas where policy action might be required

- Participation in international R&D networks
SKILLS DEVELOPMENT

Advances in new technologies require workers with new multidisciplinary competencies, combining different types of knowledge and skills

- Comprehensive strategy for skills development, including awareness-raising, mentoring and training on digital skills for different career stages, focusing on people’s careers, rather than solely on industry demands

- Collaborations with industry to create and deliver curricula and courses that are industry-led and mainly specialised on precision engineering

- Approaches to replicate state-of-the-art manufacturing facilities to provide the right environment for quality training in collaboration with industry

- Vocational schools that can deliver training on emerging technologies, adapted to the particular needs of SMEs