THE OECD SCIENCE, TECHNOLOGY AND INNOVATION OUTLOOK 2018: MAIN MESSAGES AND KNOWLEDGE MANAGEMENT BUILDING BLOCKS

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BETTER POLICIES FOR BETTER LIVES

Outline

Three parts:

- General introduction to the STI Outlook 2018 and the synthesis chapter
- Building blocks: the STIP Compass knowledge management system for information on countries' STI policies
- Towards a general digitalization of STI policy making and the evidence base on which it draws?

1. STI OUTLOOK 2018

STI Outlook – an introduction

- An OECD flagship publication
- Asks: “What’s new in the field of science, technology and innovation policy?”
- Provides an international review based on latest policy information and indicators
- Draws upon the STIP Compass database
- Published every 2 years, for the last 20 years

Launched 19 November at OECD by SG
Global Strategy Group Meeting

Our starting point for STIO 2018

- Future-oriented and wide-ranging in scope, a place for melding a variety of contributions
- Also a potentially important bridge between past, present and future PWBs – a tool to take stock of what we know and test new knowledge leads
- In practice, this means:
  - Building on existing resources (projects and data), preferably integrating several of these in a transversal way
  - Articulating an original angle on existing issues and/or address new emerging/future issues that respond to delegates' needs and questions
  - Presenting the analysis in an attractive and engaging way, making extensive use of infographics, charts and boxes

The STI Outlook 2018 has 14 chapters

- Covering a wide range of topics

Synthesis: key trends and drivers

I.

Megatrends: emerging economies, globalization, climate change, etc.

II.

Digital transformation of science and innovation processes and practices

III.

Greater directionality in STI policy to meet particular goals/challenges

IV.

Decline in proportion of government funding of national R&D expenditures

V.

Digital transformation of government itself, affecting STI policy design and delivery

TRENDS AND CONTEXTS

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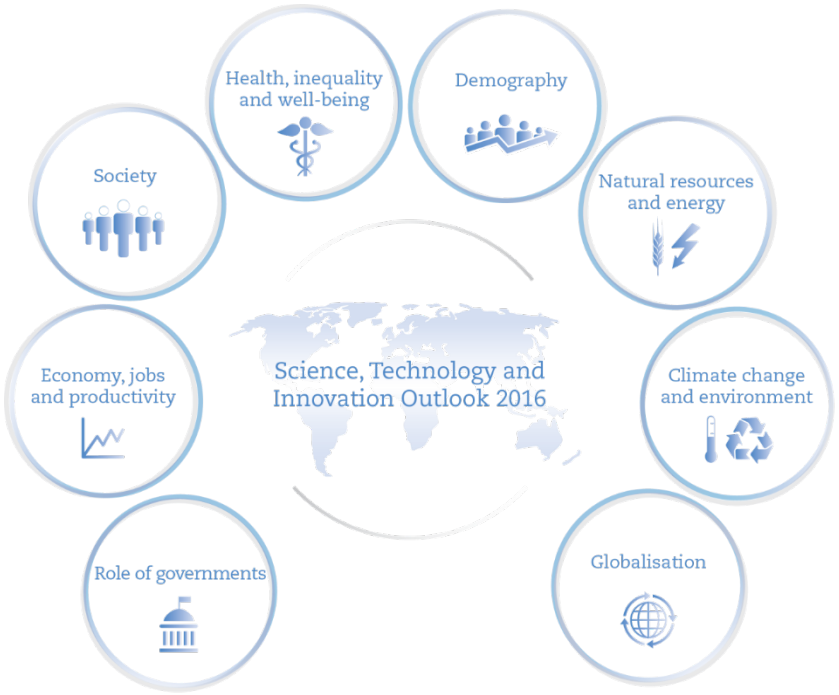
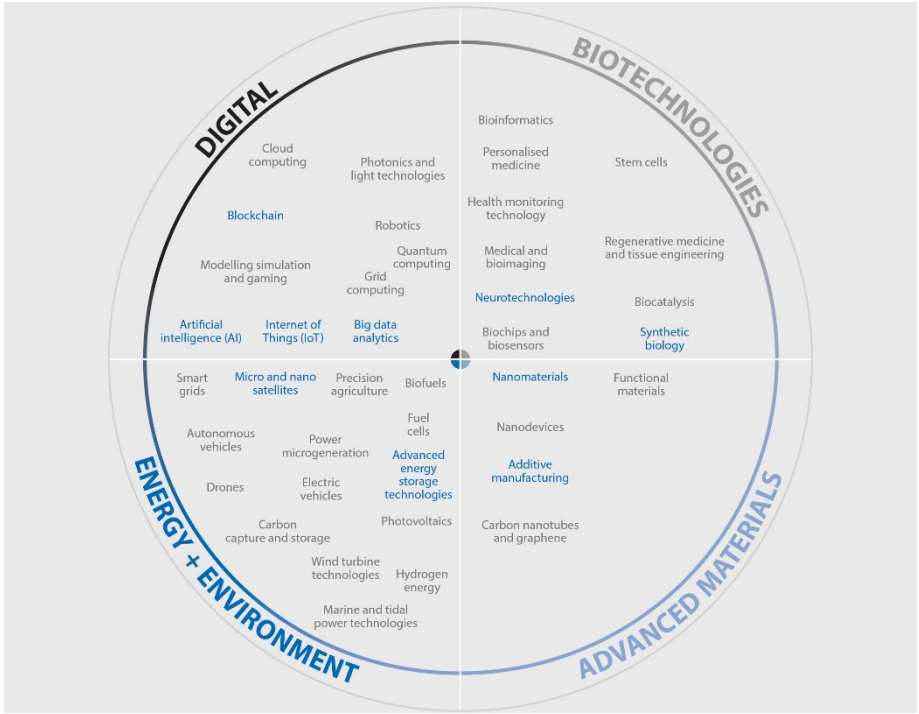
Drivers of change – 2016 STIO analysis



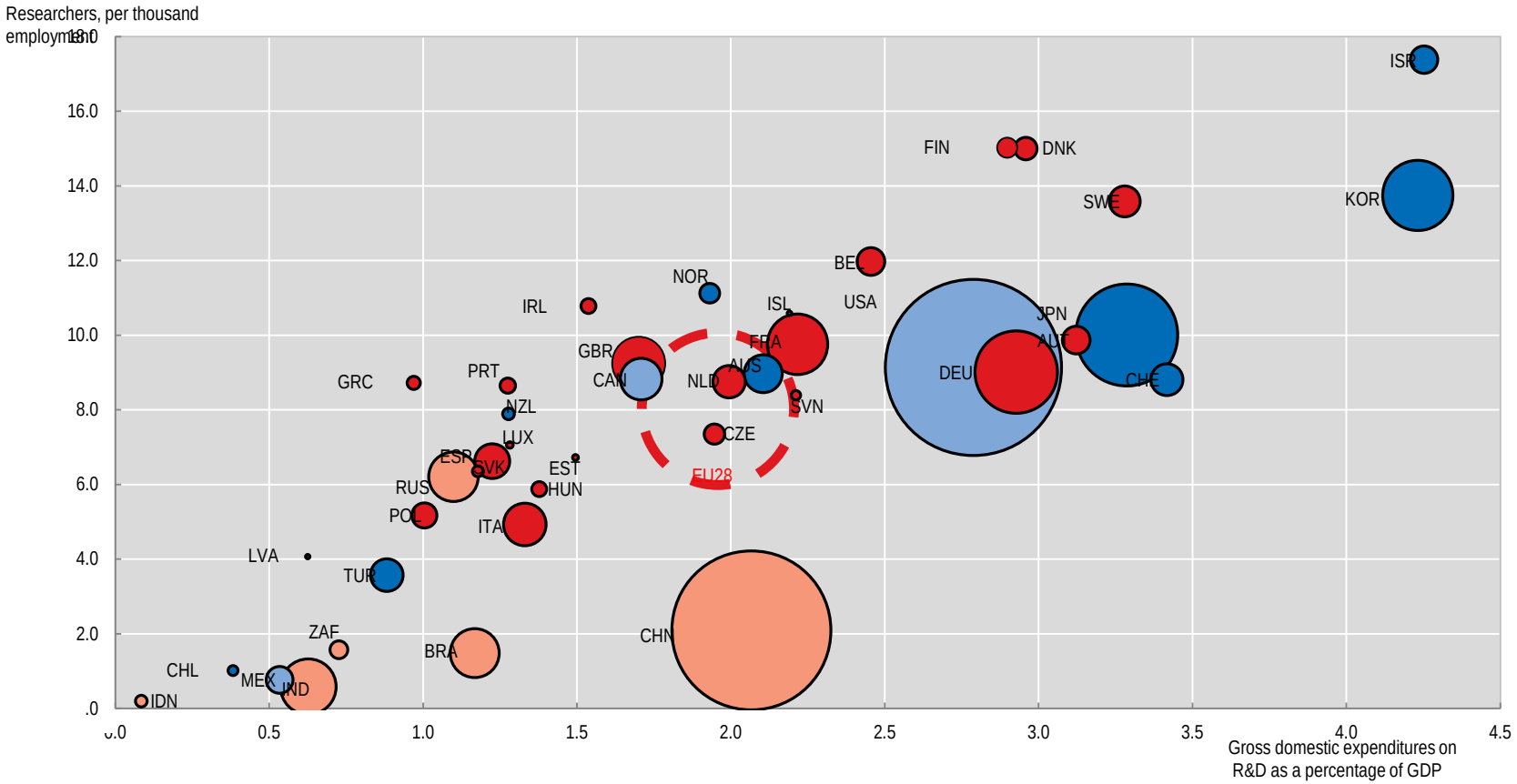


The Future of Public Research

- R&D agendas
- R&D investments
- Distribution of R&D
- Organisation & management of R&D
- Digitalisation of R&D
- R&D outputs
- R&D careers
- R&D policy practices

Emerging economies have joined the global innovation scene…

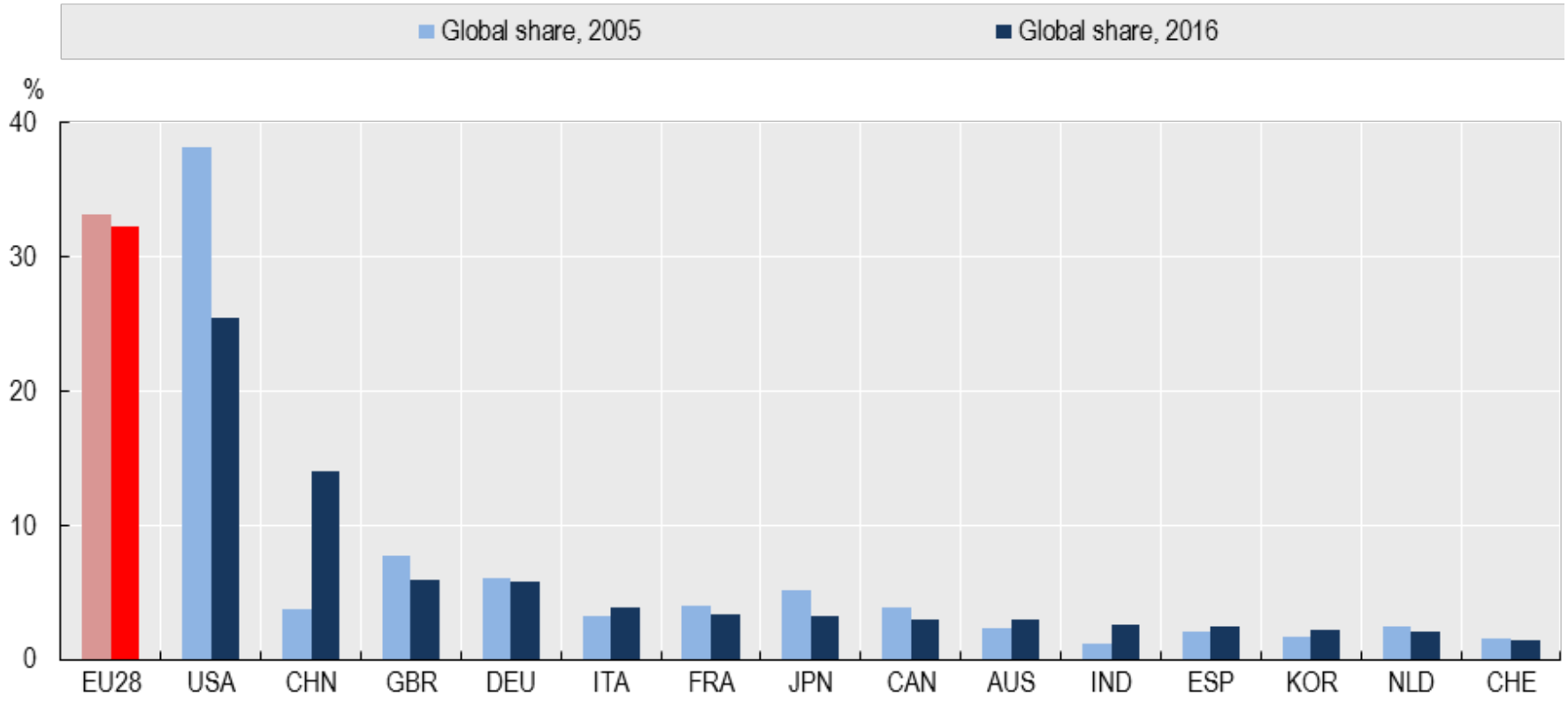
R&D in OECD and key partner countries, 2015



…but scientific excellence is still mainly OECD

Economies with the largest volume of top-cited scientific publications, 2005 and 2016

As a percentage of the world's top 10% most-cited publications



Source: OECD Science, Technology and Industry Scoreboard 2017,
StatLink: *http://dx.doi.org/10.1787/888933617054*

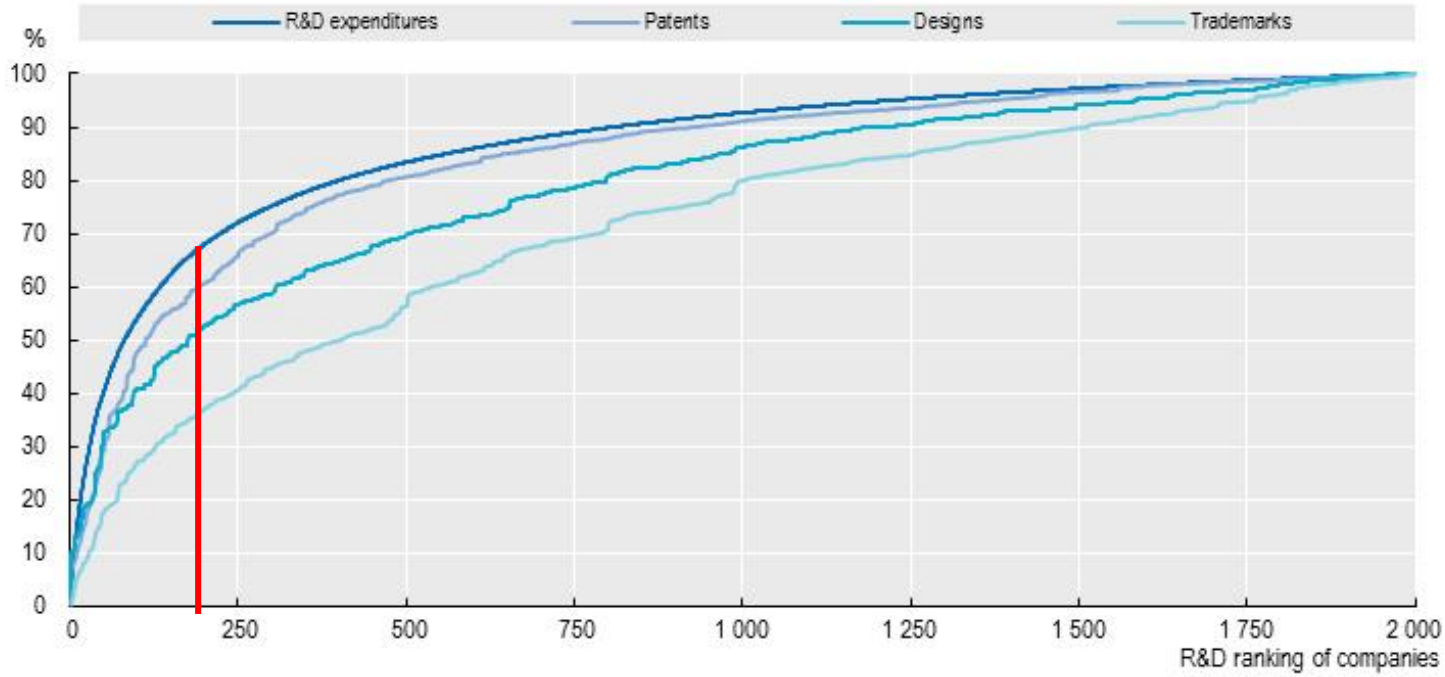
R&D expenditures and IP are highly concentrated in firms

R&D expenditures and the IP bundle of the top R&D companies, 2014

At the technology frontier: Top 200 (Top 2000) global R&D corporations

- 42% (60%) of global R&D
- 38% (60%) of patents worldwide
- 51% (75%) of ICT patents
- 52% (75%) of IA patents

Cumulative percentage shares within the top 2000 R&D companies



Source: OECD Science, Technology and Industry Scoreboard 2017,
StatLink: *http://dx.doi.org/10.1787/888933617225*

DIGITALISATION AND ITS IMPACTS ON STI

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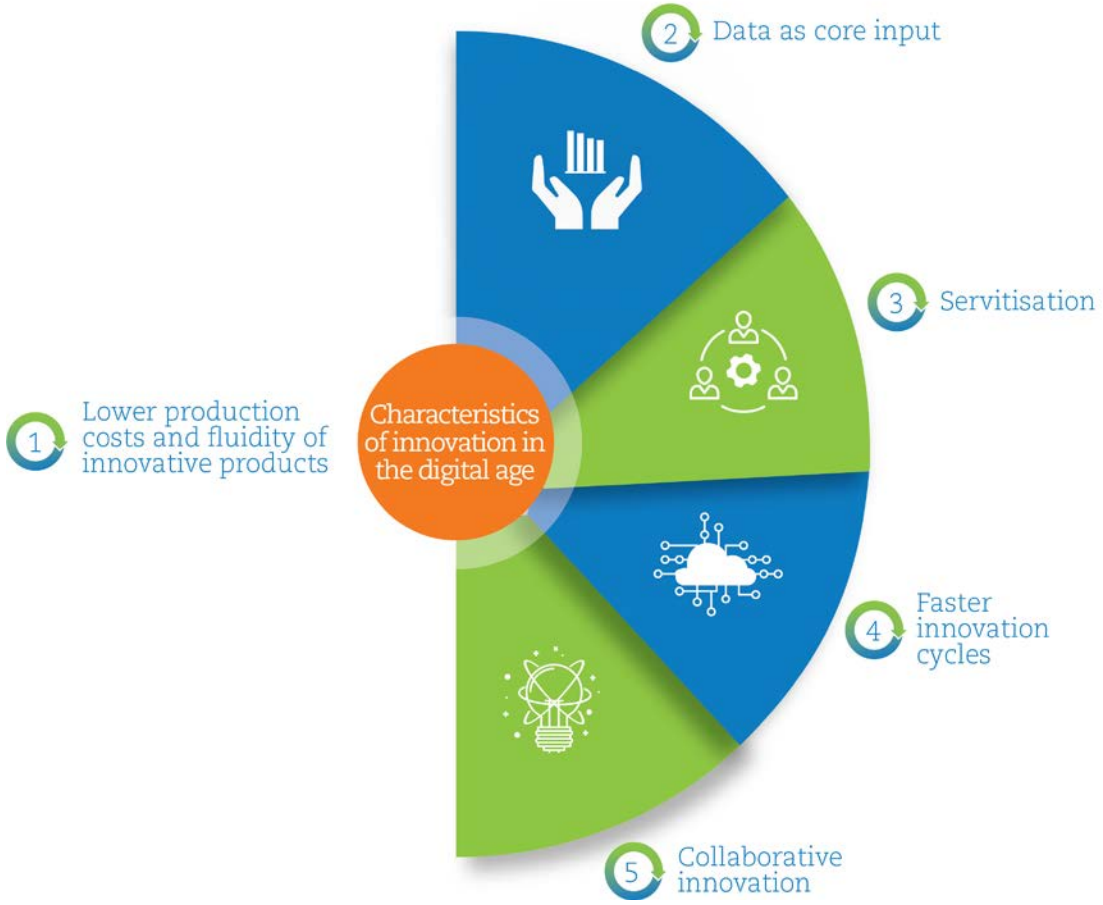
Characteristics of innovation in the digital age

Digitalisation is creating new opportunities for innovation, e.g.

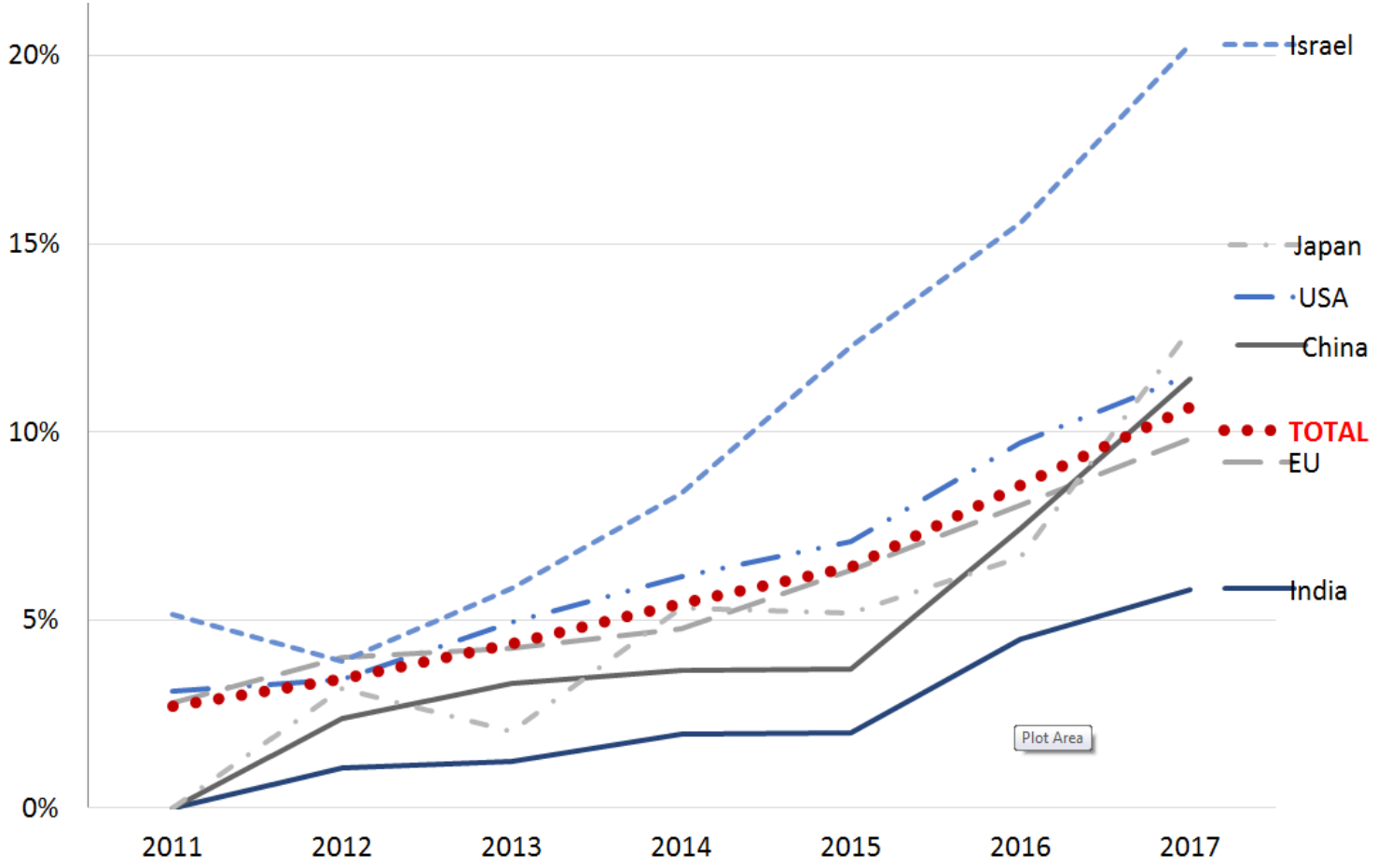
- Innovation cycle is becoming faster and some phases, e.g. design and testing, are becoming cheaper. This impacts the dynamics of competition
- Growing availability of data on customers permits more personalisation of products and services
- Access to data has become a key parameter in business strategies



Opportunities for entrepreneurship

AI as a share of financial investments in start-ups, 2011-2017

As a percentage of all investment deals

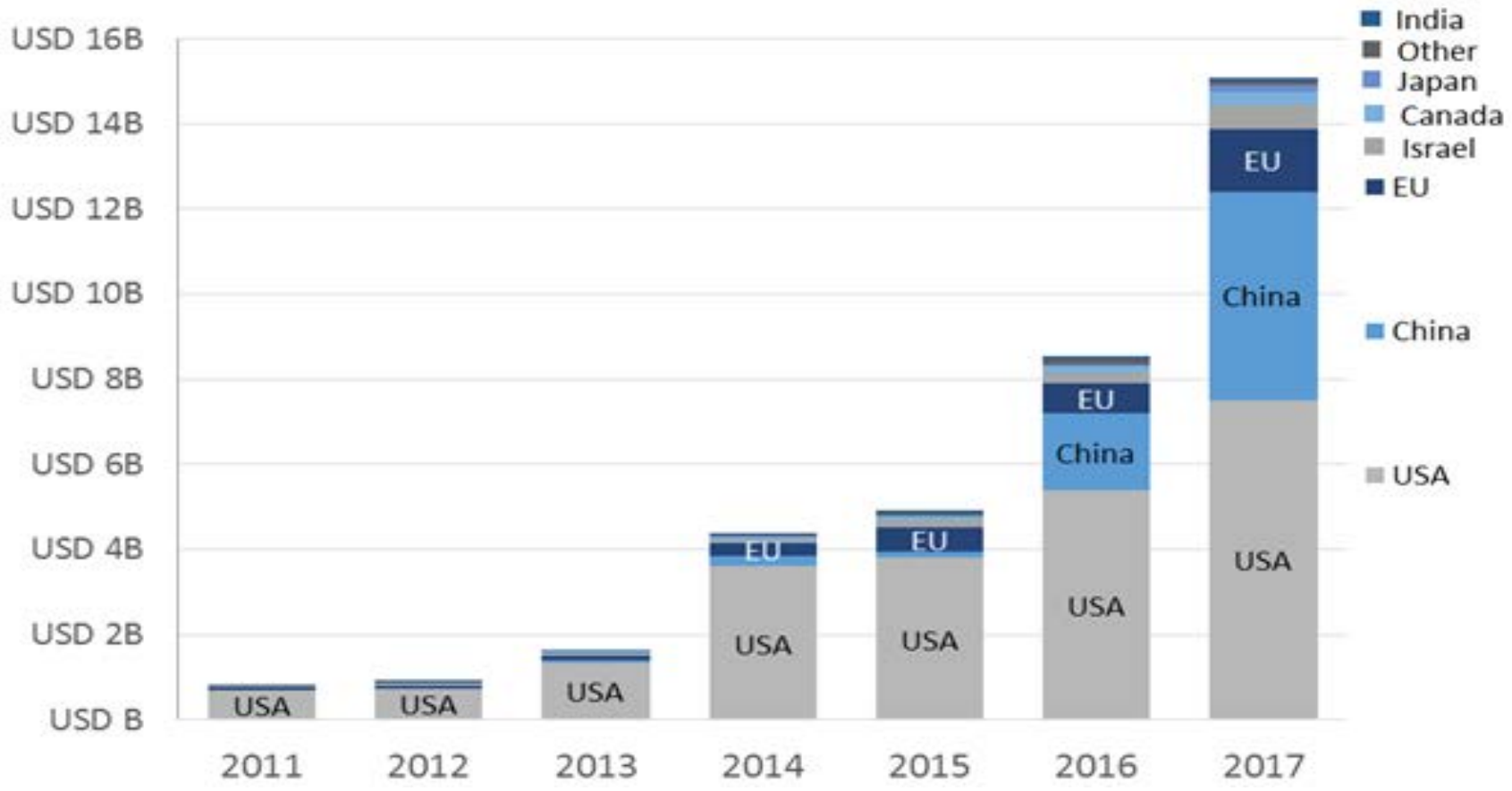


Source: OECD estimates based on Crunchbase (April 2018), www.crunchbase.com,

Private investment in AI start-ups is growing, mainly in the US and China …

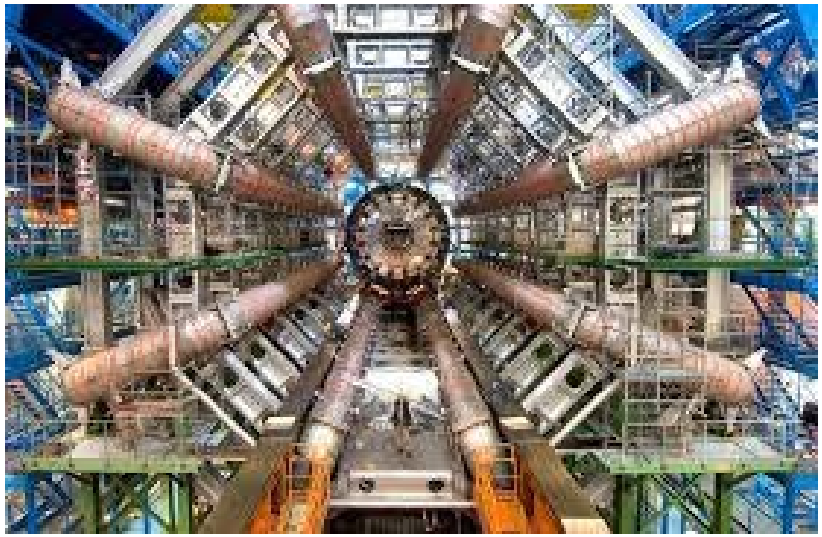
Total estimated investments in AI start-ups (USD billion), 2011-2017

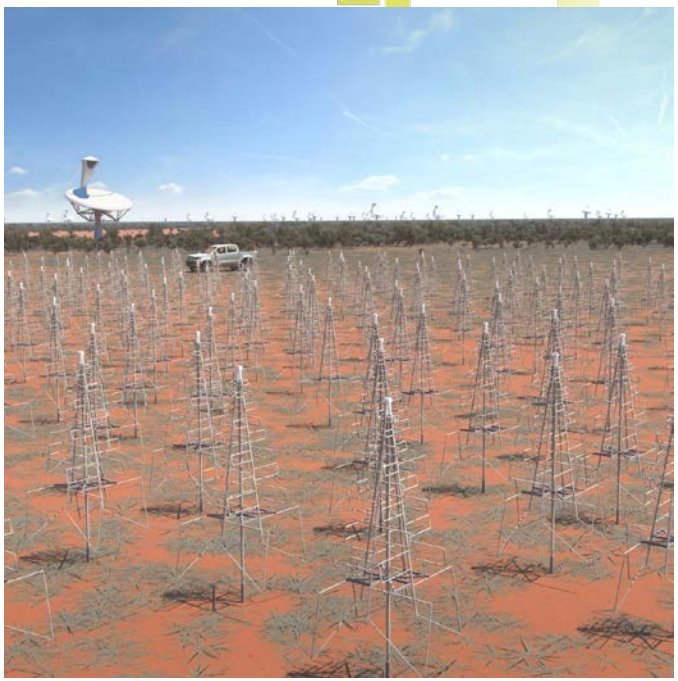
By start-up location



Source: OECD estimates based on Crunchbase (April 2018), www.crunchbase.com,

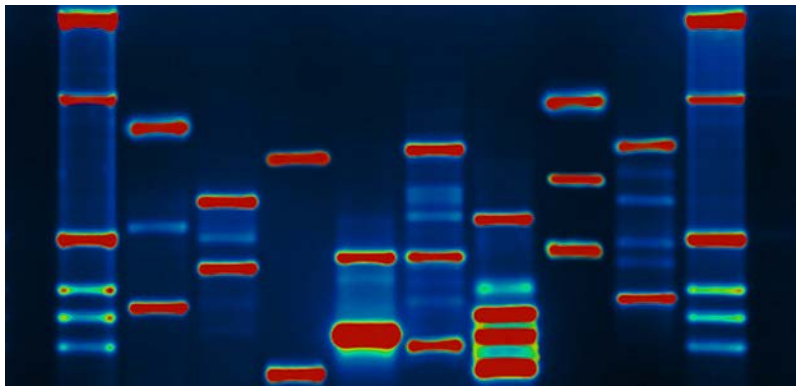
Public science has always been at the forefront of “big data”





Enhanced access to research data

- Promise of new scientific breakthroughs, less duplication, better reproducibility, improved trust in science, and more innovation
- Several challenges, incl. the lack of recognition and rewards to encourage researchers to share data



https://www.atlasobscura.com/places/cern; https://www.fastcompany.com/1752569/human-genome-project-how-23-chromosomes-made-800-billion-economic-impact; https://www.industry.gov.au/strategies-for-the-future/co-hosting-the-square-kilometre-array

AI and ML promise to transform science

- Promise to increase productivity of science, enable novel forms of discovery, and enhance reproducibility

- Several challenges, e.g. limits of current approaches to noisy data, costs and competition with the private sector for resources

STI POLICY RESPONSES TO MEGATRENDS AND DIGITALISATION

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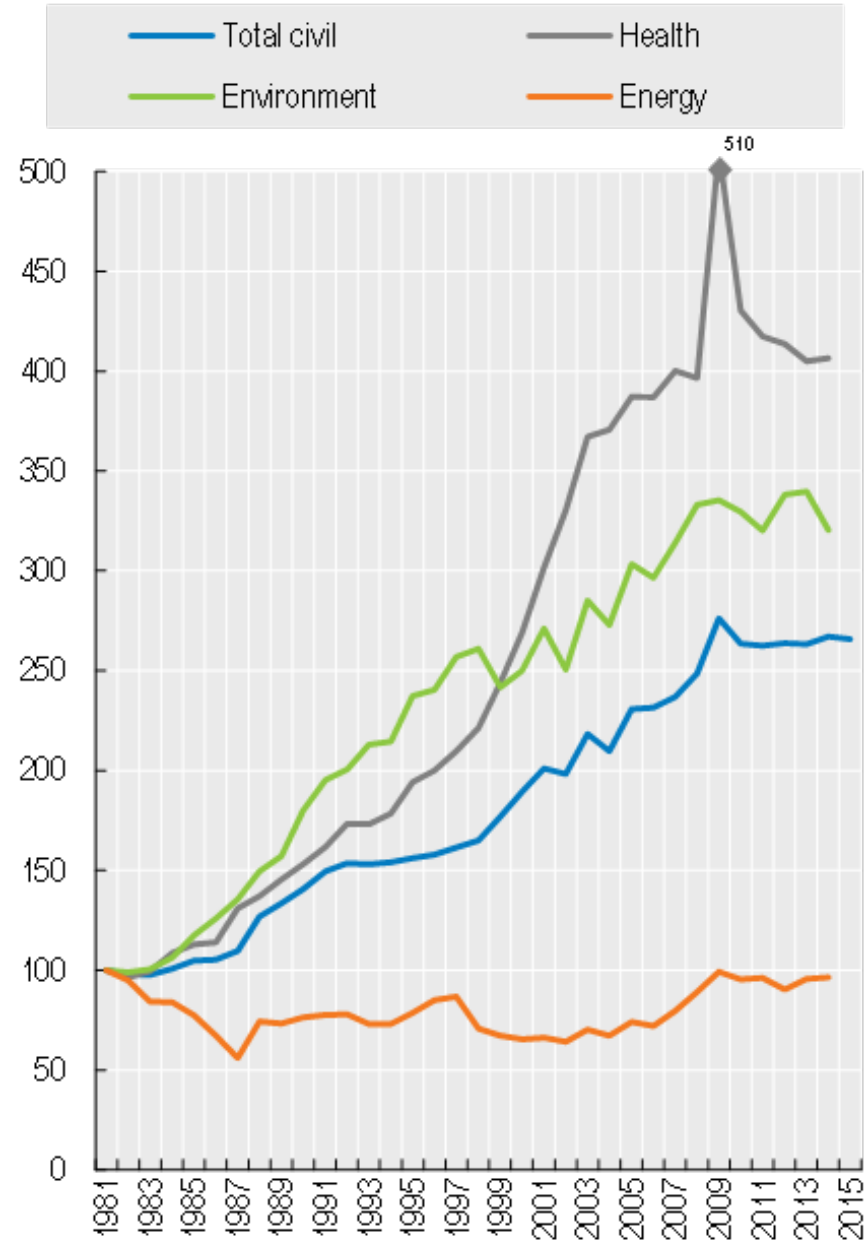
Growing societal concerns are changing balances in public R&D budgets



If well-managed and used in conjunction with social innovation and policy reforms, scientific and technological advances can alleviate many of these challenge:

- Gene editing could revolutionise today's medical therapies,
- nanomaterials and bio-batteries could provide new clean energy solutions,
- artificial intelligence (AI) could become an important drug discovery tool over the next decade.

Shifts in STI policy: orientation towards SDGs

- The SDGs are an increasingly prominent political framework for STI policy agenda-setting
  - But they have yet to have a big impact at the operational level of funding
  - And the challenge of international cooperation on the SDGs remains

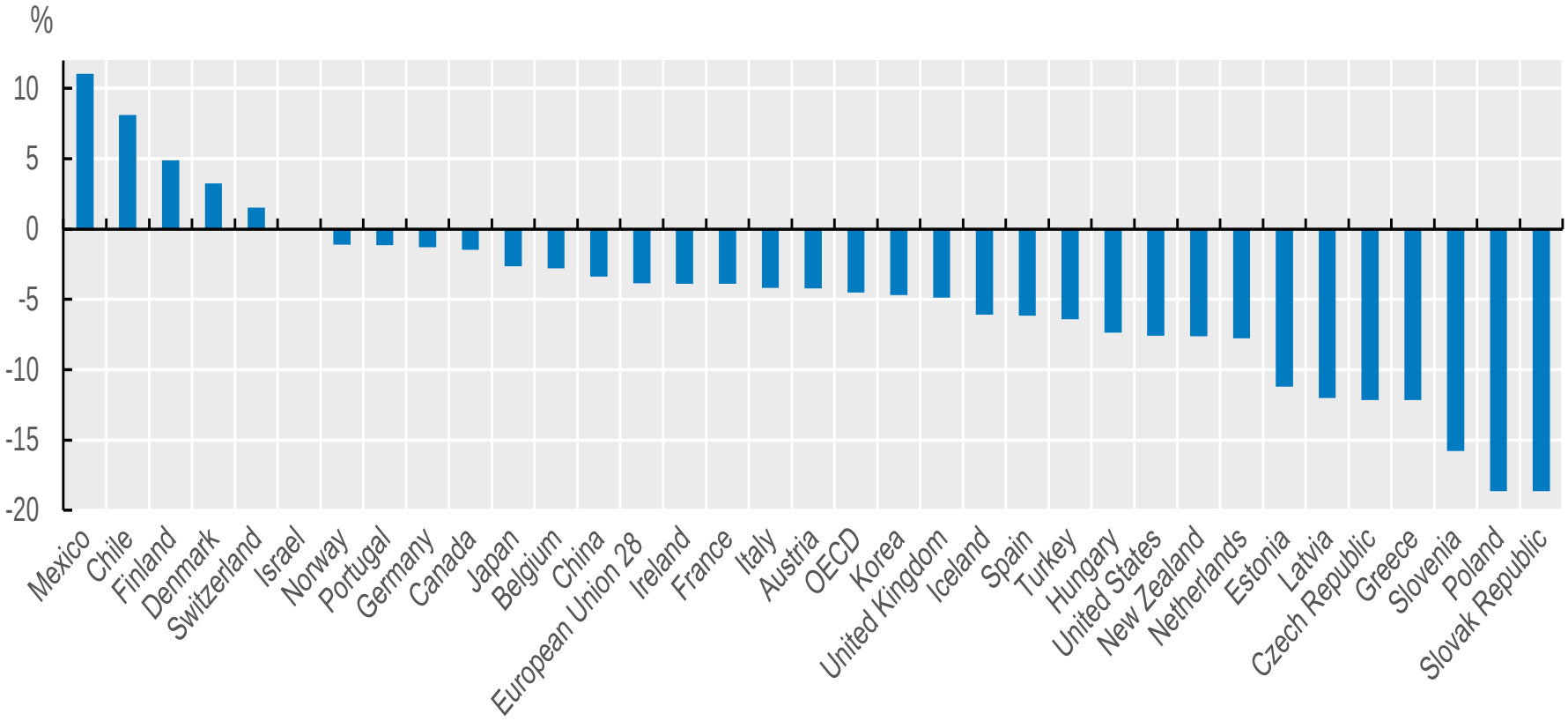
The turn to mission-oriented policy

- Many governments are embarking on a **new era of mission-oriented** STI policies, often influenced by the SDGs
- Concrete and market-oriented, with **measurable goals** and defined time frames
- **Partnerships** with business and civil society are key, acknowledging the limits of govt as R&D performer, innovator and diffuser
- **Governments' capacity to set directions**?
  - Hollowing-out: do govts have the appropriate skills and organisational capabilities?
  - Decline in share of govt expenditures in R&D

Governments account for a decreasing share of national R&D expenditures

Change in the share of government in the direct funding of gross domestic expenditure on R&D, 2009-16

In percentage points

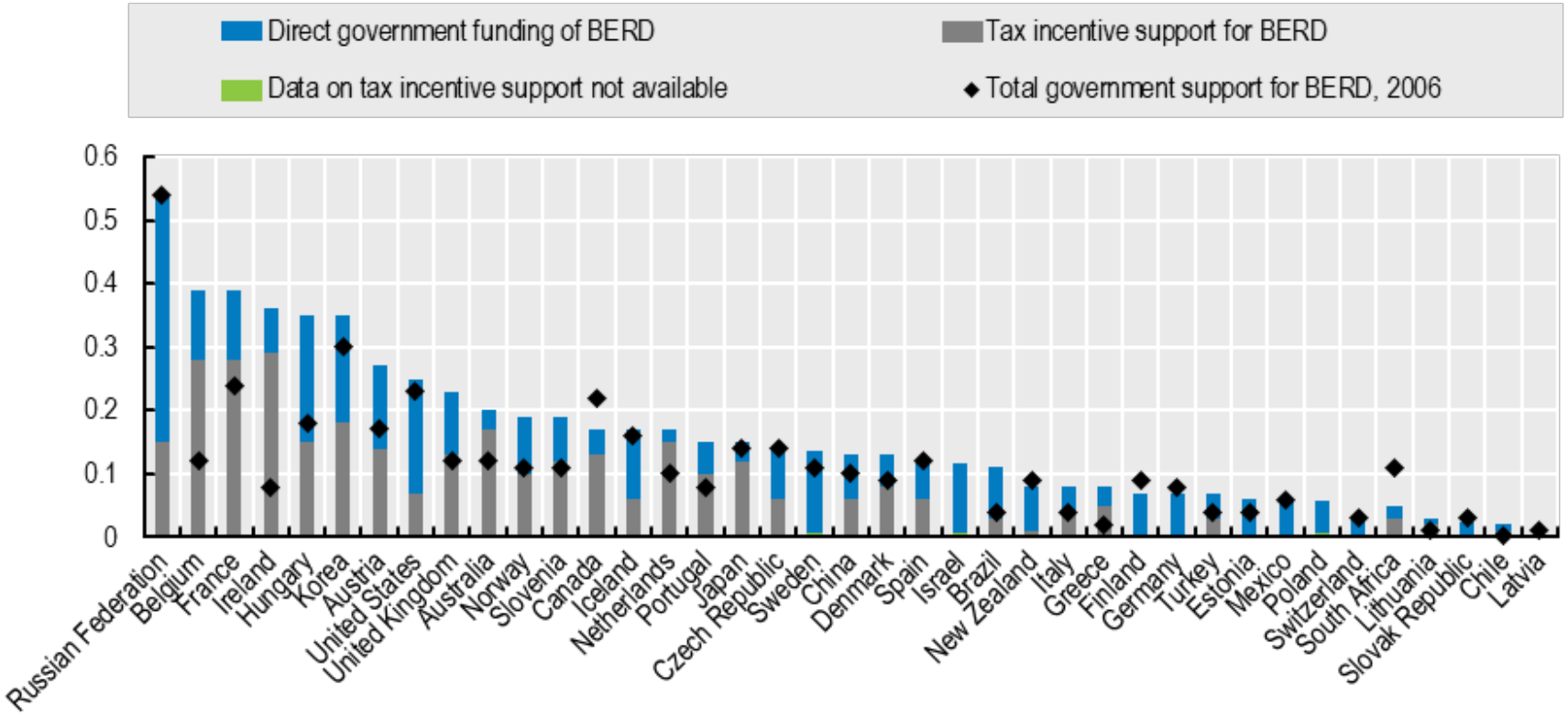


Source: OECD Science, Technology and Industry Outlook 2018

Direct government funding of business R&D has declined, with the growth of tax credits

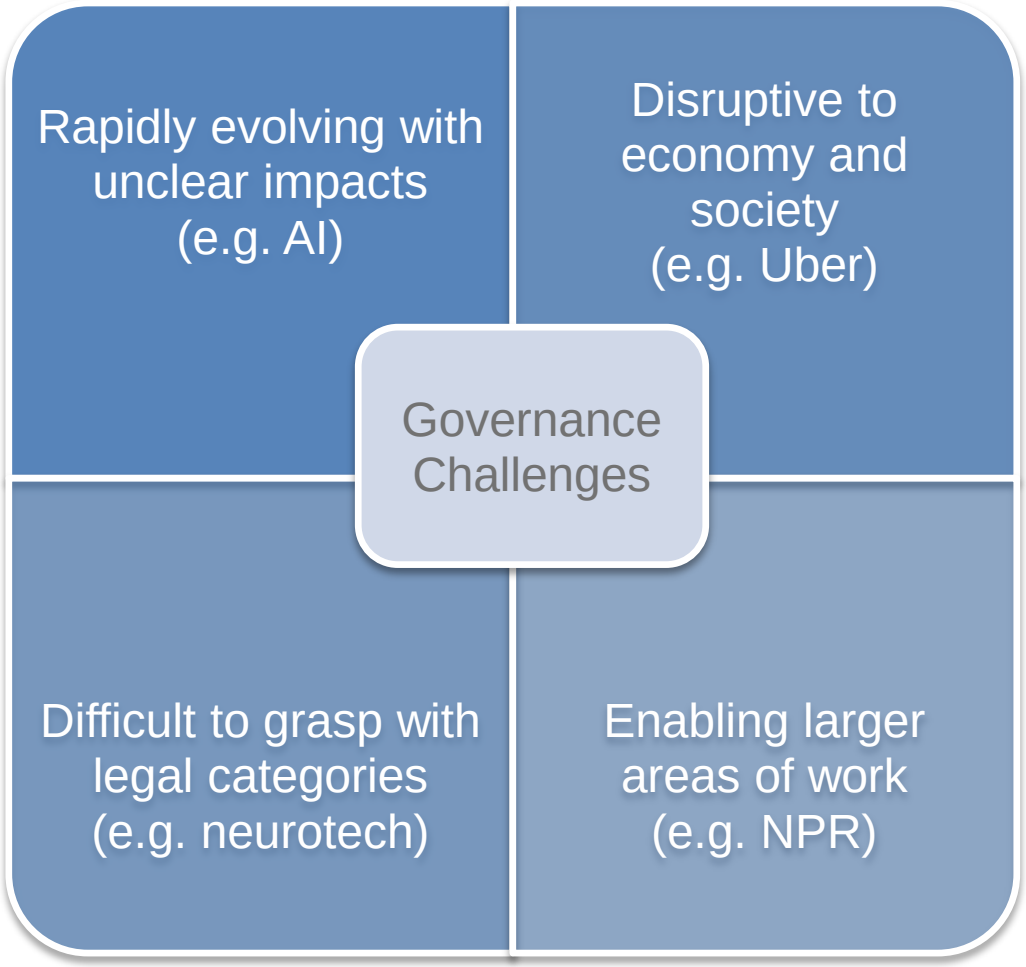
Direct government funding and tax support for business R&D, 2015 and 2006

As a percentage of GDP



Source: OECD (2017e), *OECD Science, Technology and Industry Scoreboard 2017: The digital transformation*

The speed and uncertainty of technological change challenge policymakers



A turning point for innovation policy? From de-regulation to the “right” regulation

Preventing, correcting or mitigating potential negative effects of innovation while still allowing for entrepreneurial activity to flourish and reaping the benefits of innovation is a key challenge facing policy makers today.

- Do not separate the facilitation of innovation from governance question
- Adjust innovation systems to include governance dimensions
- Moving governance concerns “upstream” (not “end-of-pipe”)
- Increasing resonances with private sector

My position is not that there should be no regulation. [..] I think the real question, as the Internet becomes more important in people's lives, is what is the right regulation, not whether there should be or not.

- Mark Zuckerberg, Facebook before U.S. Congress

New modes of STI governance are emerging, but are not yet widely adopted

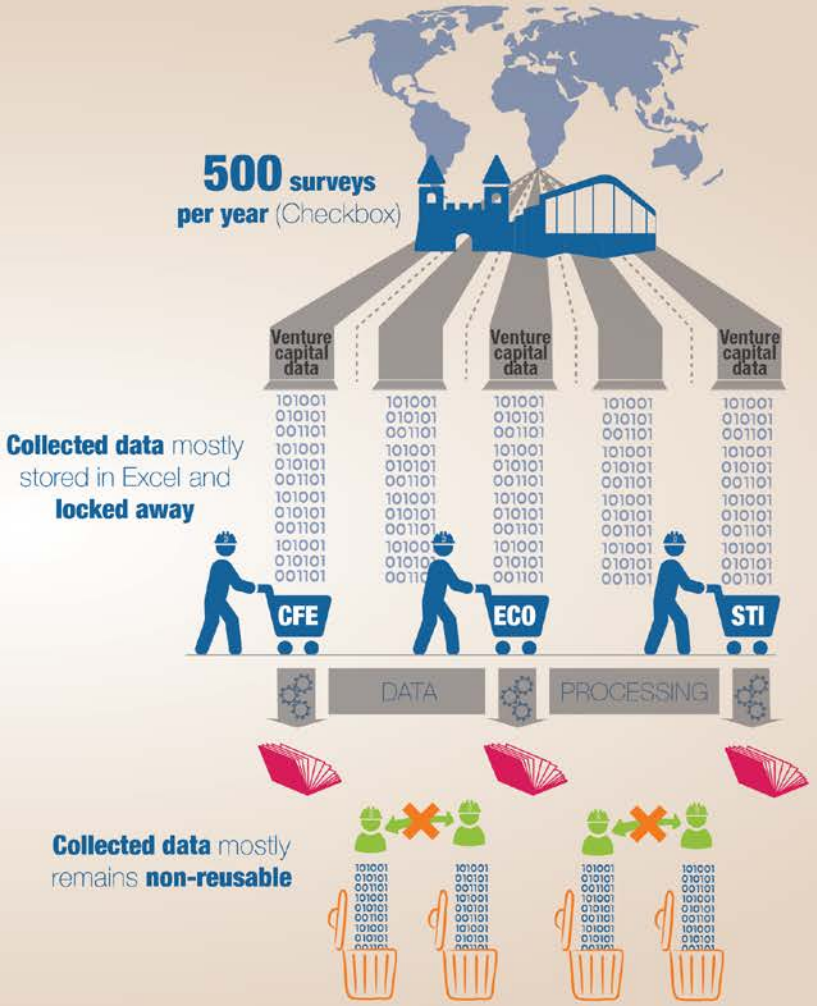
2. STIP COMPASS INFRASTRUCTURE

Knowledge management needs re: information about countries' policies

- We need to regularly collect **high-quality harmonised information on countries STI policies** for our policy analysis
- We want data collection to be as **efficient** and effective as possible:
  - **Light reporting burden** on countries
  - Easy for OECD analysts to **manage data** (and data quality)
- We want the data to be structured and easy to browse, to **facilitate the work of OECD analysts**
- We want to **link data** on countries' policy initiatives with OECD reports and statistical indicators that bring additional context and insights
- We want the **data to be fully open** for countries and others to use – an incentive for countries to provide good quality data and an additional service provided by the OECD

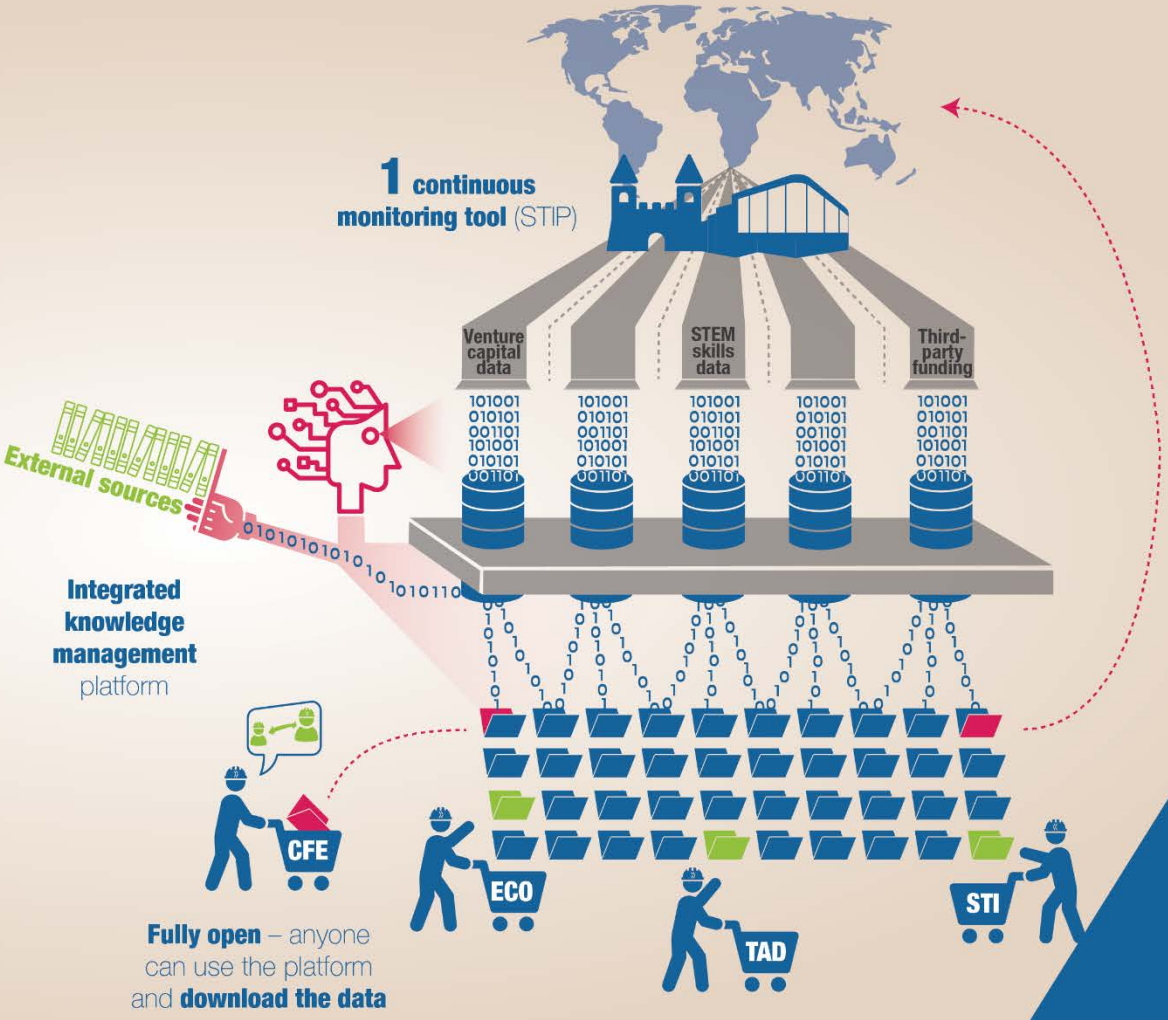
The OECD's arrangements for collecting, storing and accessing qualitative need updating

- Currently, the OECD runs **more than 500 surveys per year** to collect qualitative information using a basic version of Checkbox
- Most of the collected data is stored in Excel and mostly **locked away** on people's hard drives, where it remains **non-reusable**
- This is **inefficient and wasteful**
- STIP Compass provides an **integrated solution** for collecting, storing, accessing and linking qualitative data that is **scalable for reuse** across the OECD



What is STIP Compass?

- An **integrated knowledge management platform** for collecting, storing, linking, visualising, finding and analysing information on countries' STI policies
- **Fully open** – anyone can use the platform and download the data
- **Joint project** between OECD and EC, benefiting from 2M EUR H2020 funding over 5 years (2017-2022)
- Beta version launched in April 2018



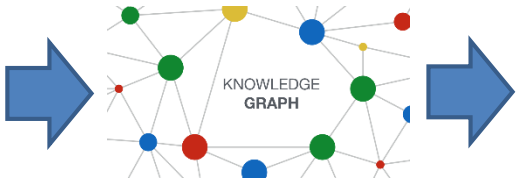
STIP Compass components

Components are seamlessly linked through the knowledge graph

Online survey / policy monitoring tool, based on open source LimeSurvey software

Knowledge graph for linking organising data and generating the survey structure specific to STI policy

Semantic database, re-purposing DKI's ONE Sight platform



Algorithmic robots for identifying and tagging relevant information collected through the survey, but also from other (internal and external) sources

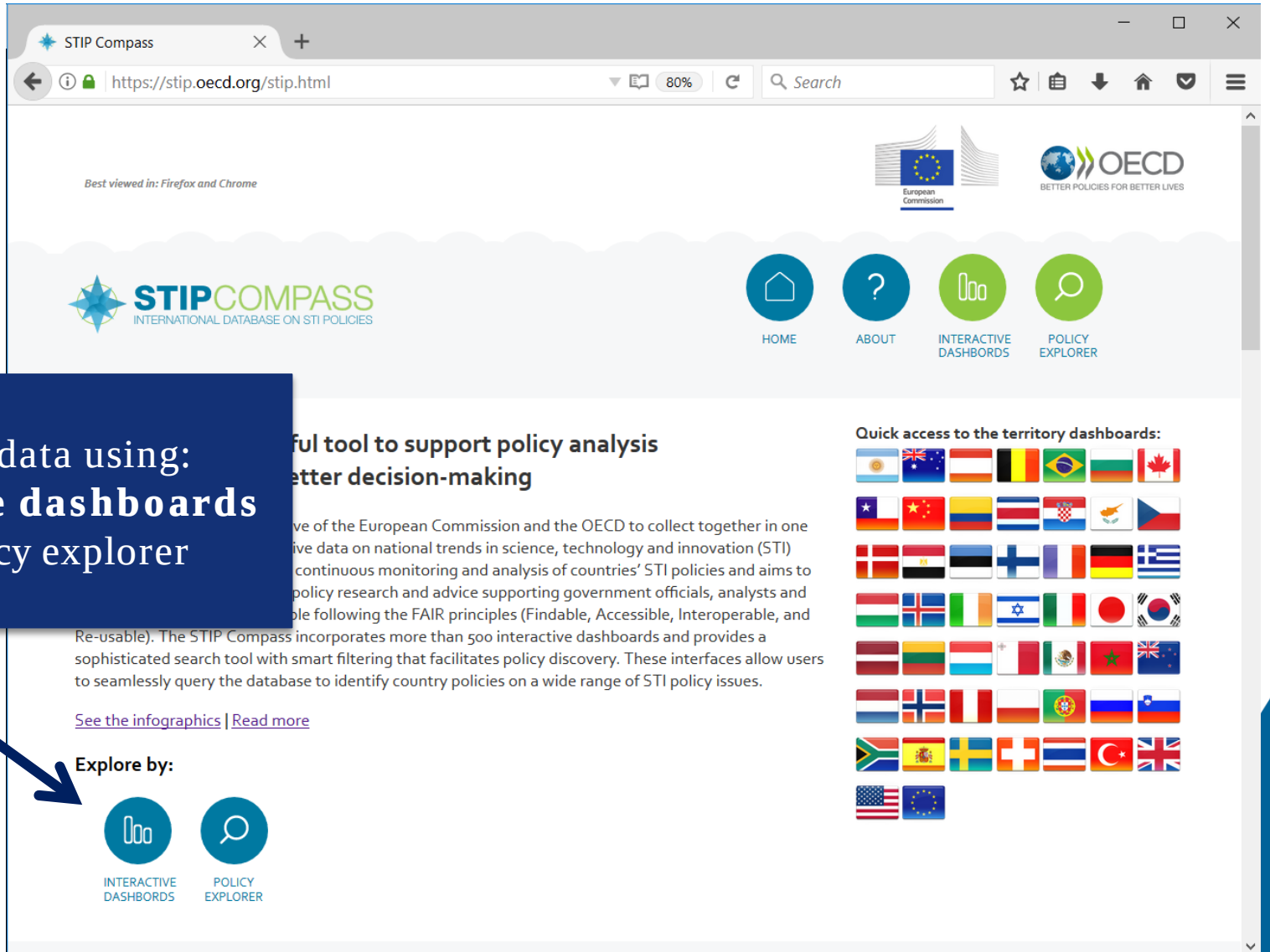
Graphical user interfaces, incl. >500 interactive dashboards

What data does STIP Compass integrate?

- The EC/OECD STI Policy **survey** is the main data source: +6000 policy initiatives from +50 countries (incl. G20, excl. Saudi Arabia)
- Semantic integration with **linked data**:
  - 2,000+ **OECD STI policy-related publications** (i-Library)
  - 2,000+ **EC publications**
  - 5,000+ **ScienceDirect** academic papers from relevant journals
  - Linking policy initiative data to **27 indicators** gathered in a semantic dataset
- Next steps:
  - Linking 400+ **indicators** to policy initiative data and adding a quantitative data visualisation tool
  - Embedding 100s of relevant **RSS and Twitter feeds** in country pages

STIP Compass Portal

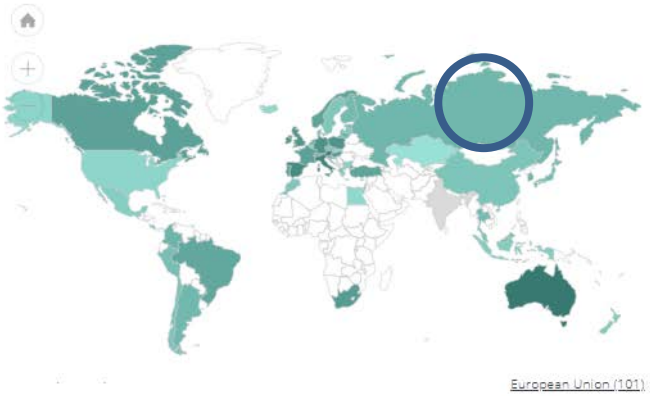
stip.oecd.org



Explore data using:
Interactive dashboards
and policy explorer

Interactive dashboards
Structured data → Semantic visualisation tools

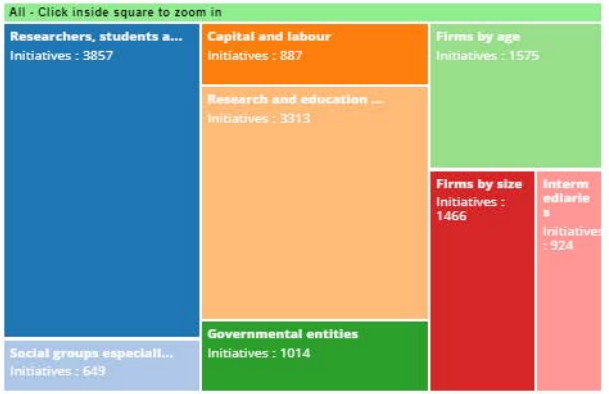
Territories



Themes

Policy instruments

Target groups



STIP Compass Portal

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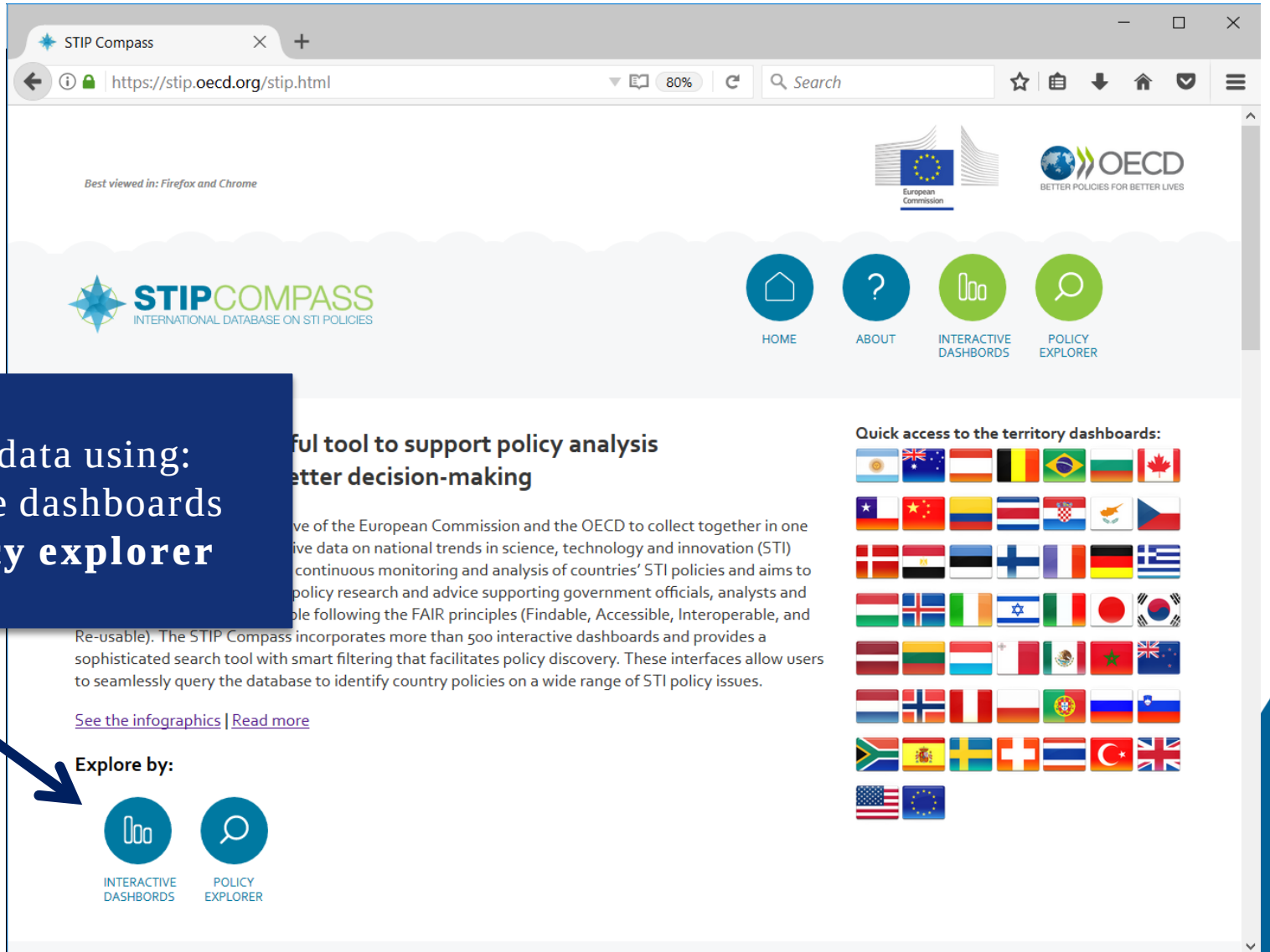
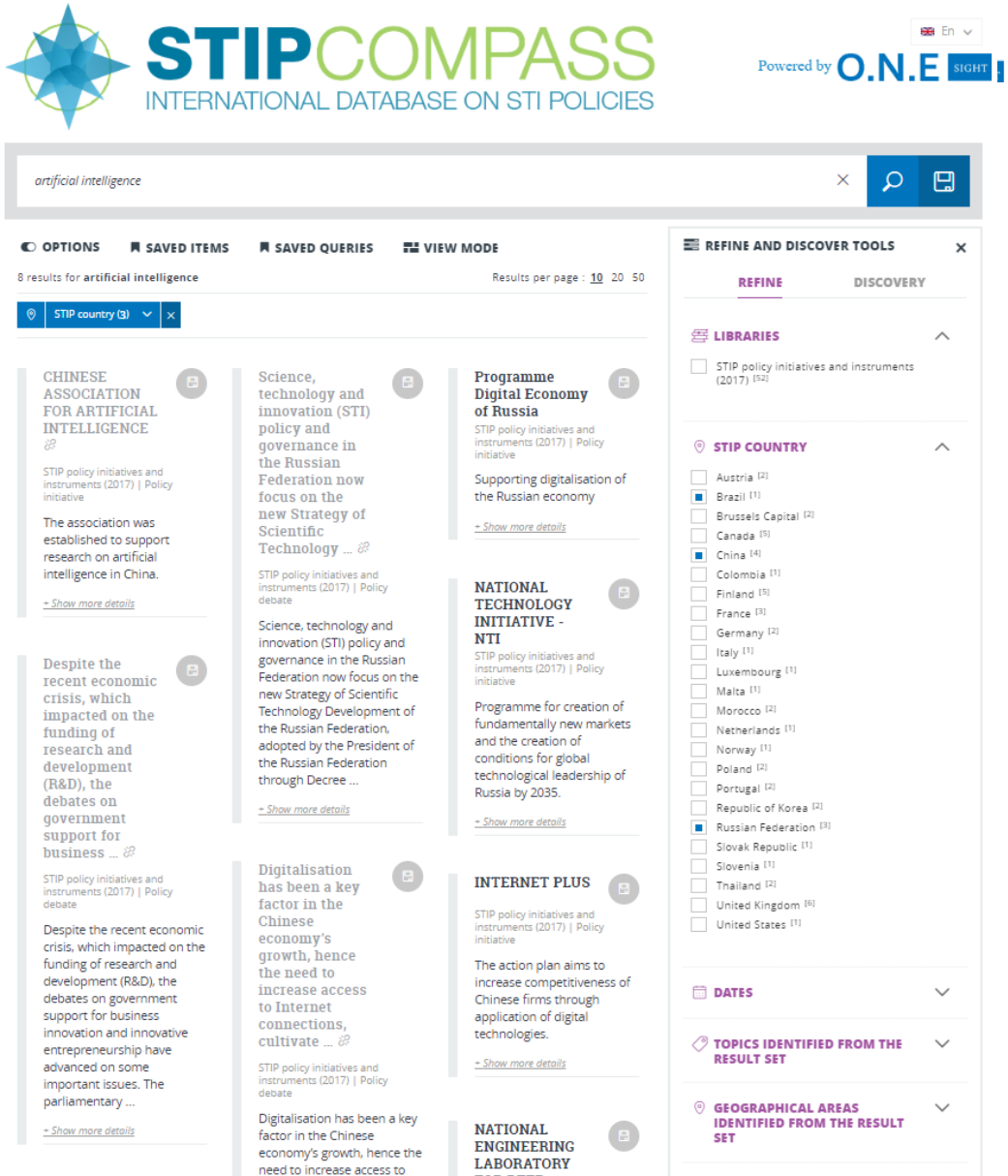


Explore data using:
Interactive dashboards
and **policy explorer**

Policy explorer: search and discovery



Download the data from the front page
stip.oecd.org

Explore by:

INTERACTIVE DASHBORDS

POLICY EXPLORER

There are two ways to access the data in STIP Compass:

(1) Interactive dashboards for viewing the data on countries, policy themes, policy instruments, and policy target groups. STIP Compass has more than 500 interactive dashboards, each incorporating several panels with related data.

(2) Policy explorer for searching the data, using keywords and refinement criteria.

Resources

The STI policy analysis community can also analyse the data to answer its own questions. The EC and OECD are committed to open data access and have made the 2017 EC-OECD STI Policy survey data available in Excel and in machine readable format. Since the EC and OECD are updating the dataset on a continuous basis, new versions will be regularly posted. The data model used to structure STIP Compass can also be viewed here and reused in other information management systems using this machine readable format.

2018-20 Plans: GUI improvements

- Refinements to **existing dashboard interfaces**
- The possibility to **generate print-outs**
- New design for **policy initiative fiches**
- New dashboards for main **responsible organisations**
  - Display visualisations based on their initiatives
  - Content coming from RSS feeds (if available)
- New panels for **linked data** (e.g. **statistics**)

3. OECD DIGITAL SCIENCE AND INNOVATION POLICY (DSIP) PROJECT

DSIP project introduction
Is STI policy and administration going digital?

- The DSIP project aims to
  - provide policy-makers and researchers with the means to make an **informed assessment** of the transformational potential and possible pitfalls of the use of digital tools and sources in science and innovation policy-making.
  - facilitate **mutual learning** between countries that are planning, developing or using DSIP systems.

- Part of the OECD-wide Going Digital project and carried out under the aegis of the CSTP in co-operation with NESTI.

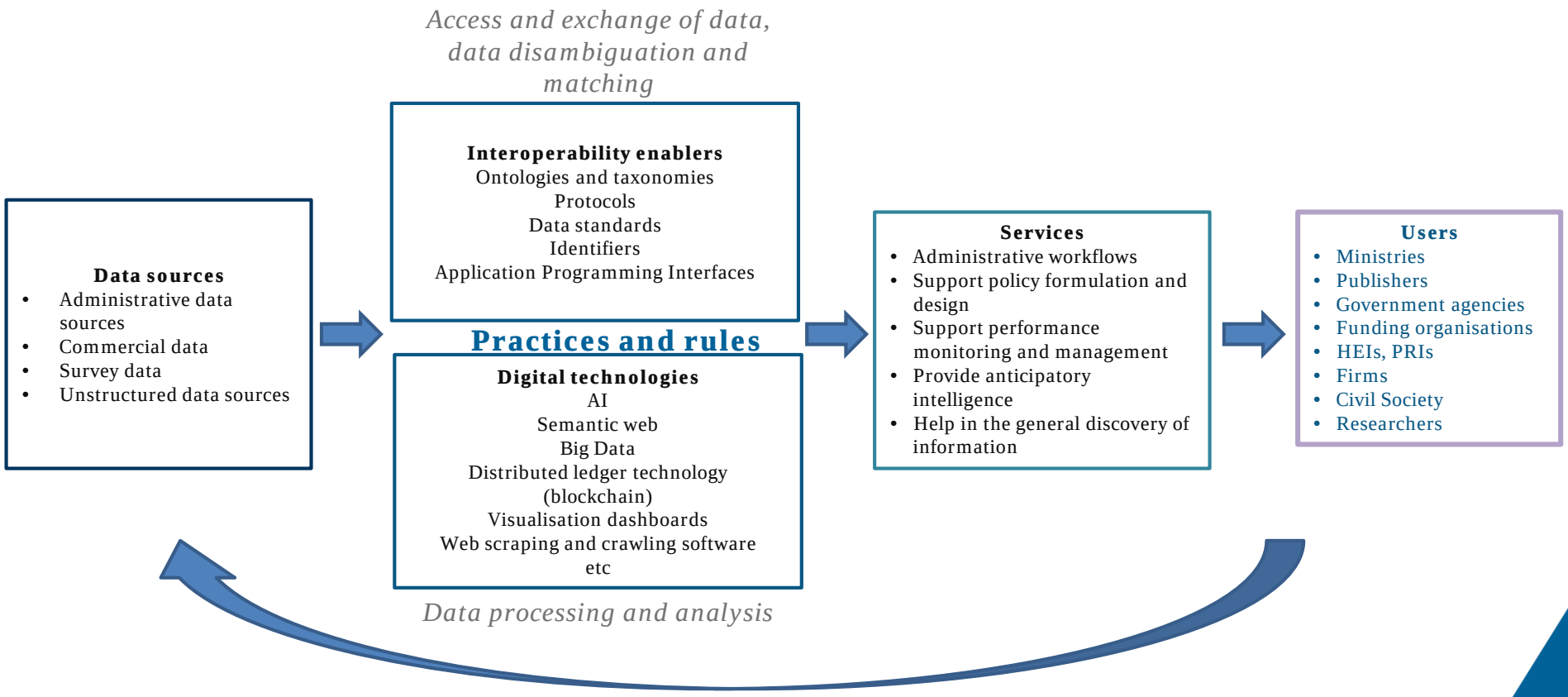
DSIP initiatives refer to

the adoption or implementation by public administrations →

of new (or re-used) procedures and infrastructures relying on an intensive use of digital technologies and data resources, →

to support the formulation and delivery of science and innovation policy.

A stylised conceptual view of a DSIP initiative



Project approach

- **Literature review** and material developed in related OECD and CSTP activities
- **Survey** of 39 DSIP systems in OECD member countries and partner economies, plus 20 follow-up interviews
- **Interviews** with leaders of global non profit DSIP relevant consortia, e.g. ORCID, CERIF
- **Interviews** with senior managers from corporate DSIP solutions providers from Elsevier, Holtzbrinck and Clarivate Analytics, Microsoft Academic, and others...
- **Country case studies** (general framework and studies, so far *Norway*)

Project outputs

- A chapter in **STI Outlook 2018**; *(Complete) DSTI/STP(2018)20/CHAP12*
- *A case study report on the **DSIP landscape in Norway**; (Draft)*
- ***The final DSIP report** (approx. 120 pages; to be published in the 1st quarter of 2019) with the following chapters: (Work in progress)*


Overview of DSIP

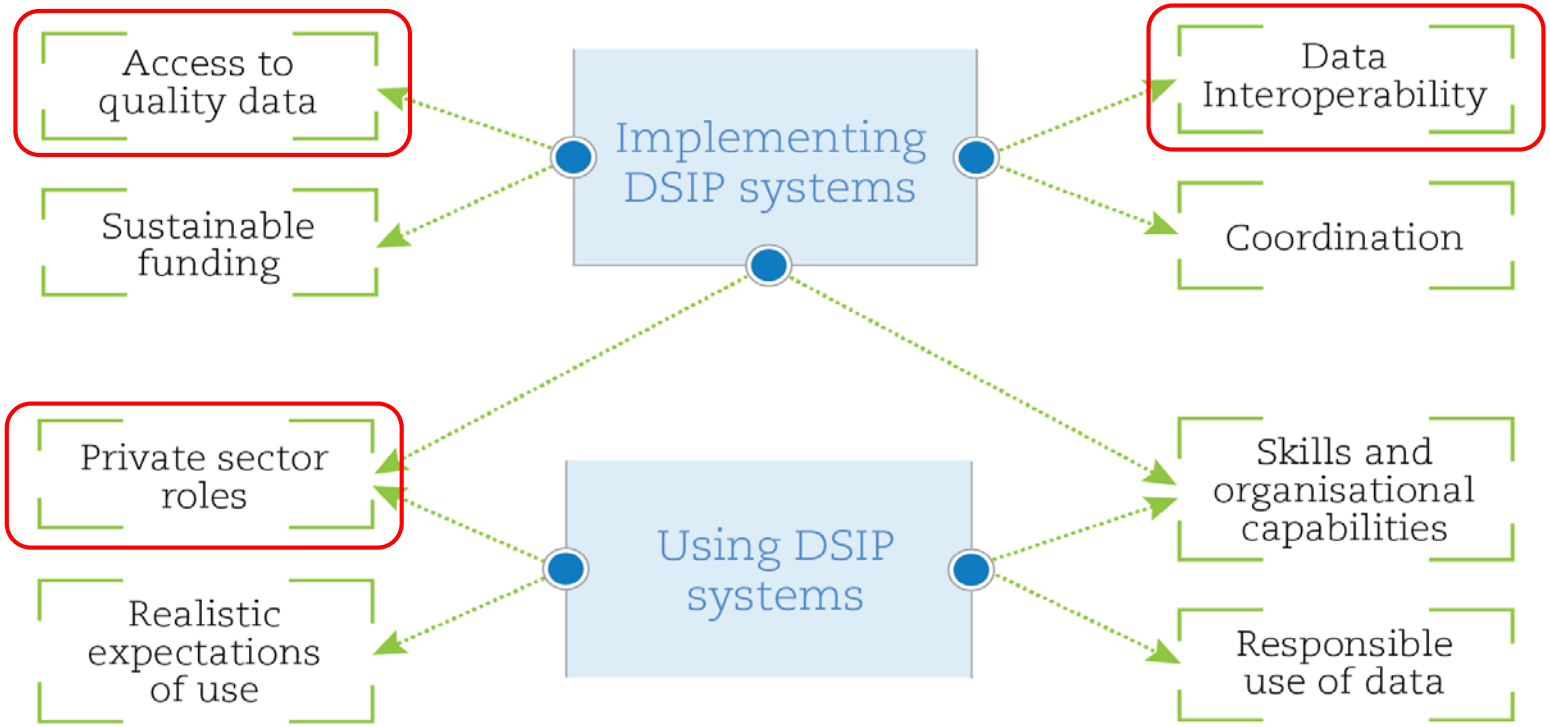

Meeting the interoperability challenge


DSIP and the future of research assessment


The private sector in DSIP

- *A contribution to the **CSTP synthesis report on digitalisation***

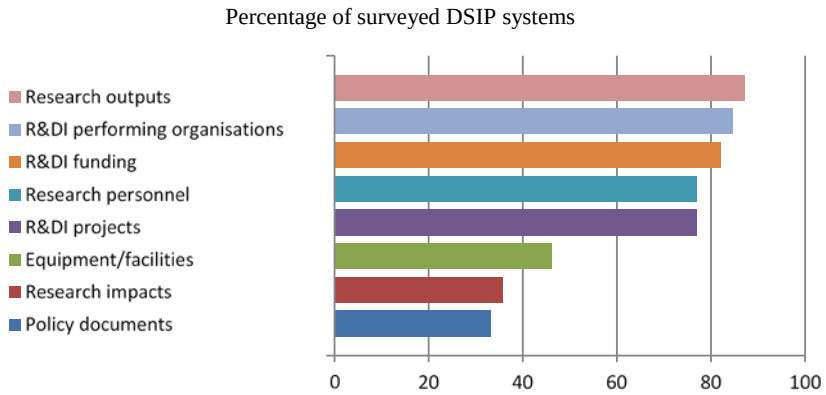
Issues in implementing and using DSIP systems



Featured issue: Access to quality data

- Linking different data sources can provide new insights – at relatively low cost – a key benefit of DSIP
- Data used in DSIP systems may have been generated for different or related purposes, meaning that users must assess quality factors for each intended application
- Available data may not capture precisely what is needed for the DSIP system; alternatively, they may be presented in an unstructured format that is complicated to process. Fixing this may require further complementary resources
- A lack of trust in the manner in which shared data will be used may hinder sharing
- Privacy and confidentiality are also major concerns when re-using data collected for other purposes

Figure 4. Types of information harnessed for DSIP systems



Note: Questionnaire respondents could select more than one type of information harnessed by their DSIP initiatives.
Source: OECD survey of administrators of 39 DSIP systems in OECD member countries and partner economies.

Featured issue: Data interoperability

- NSOs have long used systems of unique identifiers, often shared across multiple statistical domains e.g. via a central business register
  - Allow different datasets to be compared and combined
- With digitalisation, many other organisations now hold large, and relevant, datasets
  - Need to be able to match data relating to same entities across a wide range of data sources
- Benefits of interoperability
  - Allows quicker, cheaper and more accurate data matching, making existing analyses less costly and more robust, and facilitating new analyses
  - Enter once, reuse often – makes diffusion of updates across systems easier, reducing reporting and compliance burdens
- Increasing use of standards, vocabularies and protocols that connect and disambiguate research data and metadata to improve interoperability between silos
- Attempts have also been made to establish international standards and vocabularies to improve the international interoperability of DSIP infrastructures
- But still much to do . . .

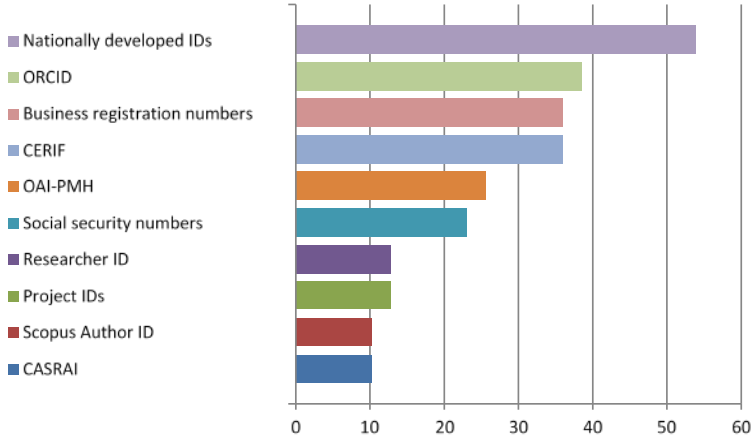
Featured issue: Data interoperability

Table 1. Examples of interoperability enablers in DSIP and related systems

Type	Examples
UPPIs for STI actors	ORCID Digital Object Identifier (DOI) Global Research Identifier Database (GRID) International Standard Name Identifier (ISNI) Ringgold ID
Author IDs generated by publishers/indexers	Researcher ID Scopus Author ID
Management standards for data about STI	Common European Research Information Format (CERIF) Consortia Advancing Standards in Research Administration Information (CASRAI) Dictionary VIVO ontology
Protocols	Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH)

Figure 5. Use of interoperability enablers in DSIP systems

Percentage of surveyed DSIP systems



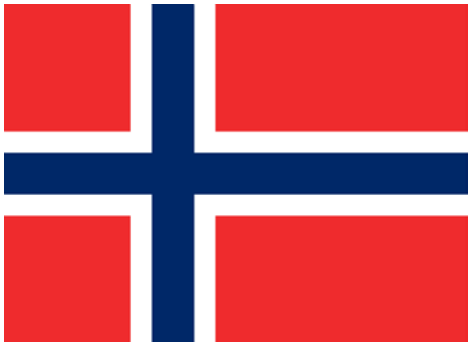
Note: Questionnaire respondents could select more than one type of interoperability enabler used in their DSIP initiatives.
Source: OECD survey of administrators of 39 DSIP systems in OECD member countries and partner economies.

Featured issue: Private sector roles in DSIP

- Private sector plays an increasingly prominent role in DSIP
  - Access to proprietary databases, digital analytical tools, unique identifiers . . .
- Big corporate players – (Digital) Google, Microsoft (Publishers) Elsevier, Holtzbrinck
- Academic publishers are particularly active
  - Transformation into digital data companies that are increasingly using big data, machine learning, semantic tools, etc. to exploit their data and offer new services
- Advantages of private sector involvement
  - Off-the-shelf, well-developed solutions; international interoperability standards; policy expectation that the private sector will develop services on top of public data
- Potential risks
  - Loss of control over future direction of DSIP developments; discriminatory access to data; secrecy around methods and algorithms; emergence of private platforms exhibiting network effects

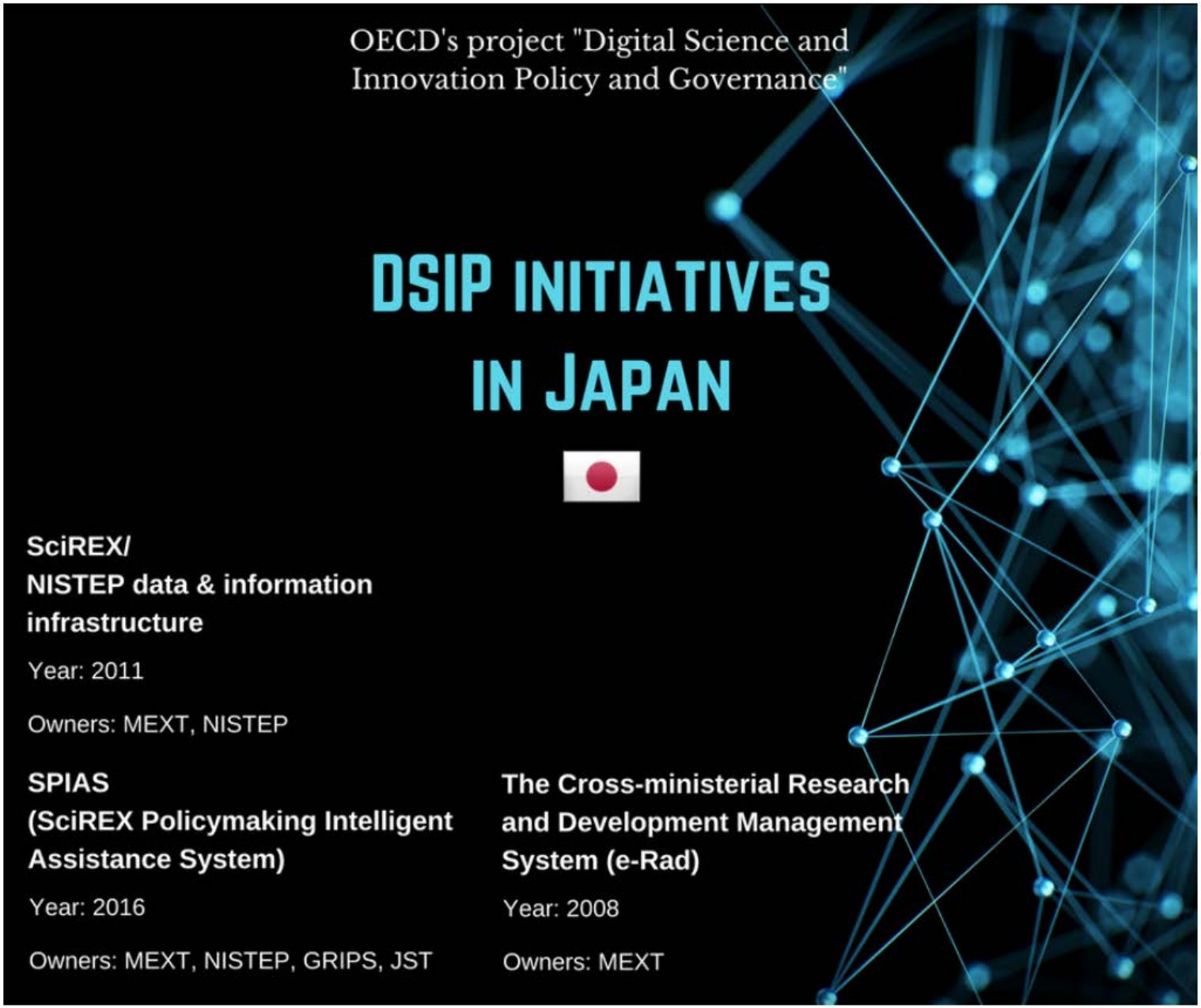
Case study of Norway's DSIP landscape

- The Norwegian Ministry of Education and Research commissioned OECD to conduct a case study of its DSIP landscape
- "First of a kind" project. Opportunity to develop and test a framework for analysis.
- The work on the case study included
  - an extensive literature review,
  - a one-week mission to Norway to conduct interviews,
  - a half-day workshop in Oslo to test initial findings and hypotheses,
  - a series of follow-up phone interviews with relevant stakeholders.
  - further analysis of official documents
- 70-page report submitted to NOR authorities in October, currently under review.



General reflections from the case study from an OECD-wide perspective

- DSIP role likely to be **incremental** rather than **fully transformative**;
- Possibilities depend on broader data infrastructures, hence the importance of coordination with
  - the **general digital governance system** and how it deals with **administrative data**
  - the country's **statistical system**.
- Data integrity requires **trust and incentives** among providers of information.
- Communication and demonstration of the impacts of DSIP should be integral of design. There may not be sufficient co-design with users and "outsiders".
- The national perspective in a global context
  - National systems operate in a **global contexts**. Domestic solutions are often insufficient.
  - There are strong **economies of scale** in developing DSIP systems. National systems may be in some cases be sub-optimally small.



Source: oe.cd/dsip

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THANK YOU!