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South Australia
The State of Science

Powering Innovation & Translation Districts & Neighbourhoods

A Global Focus on Relationships Between R&D, Innovation and Productivity 2013-2014

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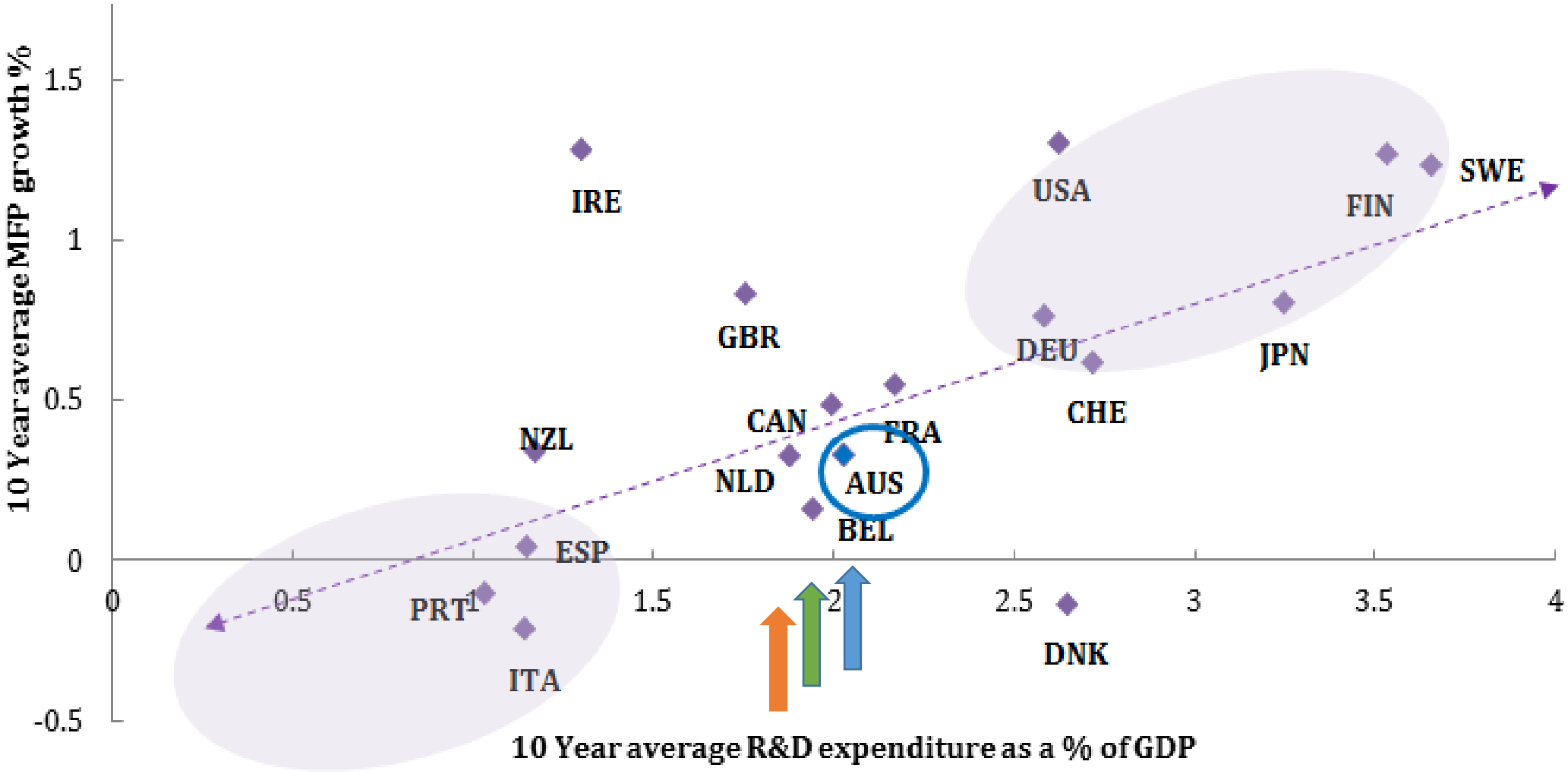

Source: World Development Indicators 2015

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Innovation and Economic Outcomes

- **Innovation is estimated to account for around half of total OECD GDP growth over the long-term *(OECD Innovation Strategy 2015: An Agenda for Policy Action)***

- **Innovation is the most important driver of long-term productivity and material living standards. The commercial application and diffusion of ideas underwrites long-term competitiveness and growth (*Australian Innovation System Report Office of the Chief Economist DIIS 2017)***

- **Innovation-active firms consistently outperform firms that don't innovate on a range of measures – including productivity and profitability *(Australian Innovation Systems Report)***

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Diffusion of New Technology and Productivity

- **Cross-country firm-level data show declining global productivity can be a result of a slower pace of technology diffusion across firms.**
- **Productivity growth in firms at the global frontier of technological change has remained robust and the productivity gap between frontier and non-frontier firms has widened.**
- **Firms below the technology frontier only receive the benefits of new technologies after they have been diffused to national frontier firms, and tested and adapted to country specific circumstances.**
- **The vast majority of Australian businesses adopt technologies, products or processes already introduced by other businesses and few introduce new-to-market technologies or innovations**

Andrews D, Criscuolo C, and Gal PN (2015), Frontier Firms, Technology diffusion and Public Policy: Micro Evidence from OECD Countries, OECD Productivity Working Papers No. 22, OECD Publishing, Paris

Building the STEMM Research & Innovation Value Chain

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Underpinning Economic Growth, Better Health and Environmental Sustainability

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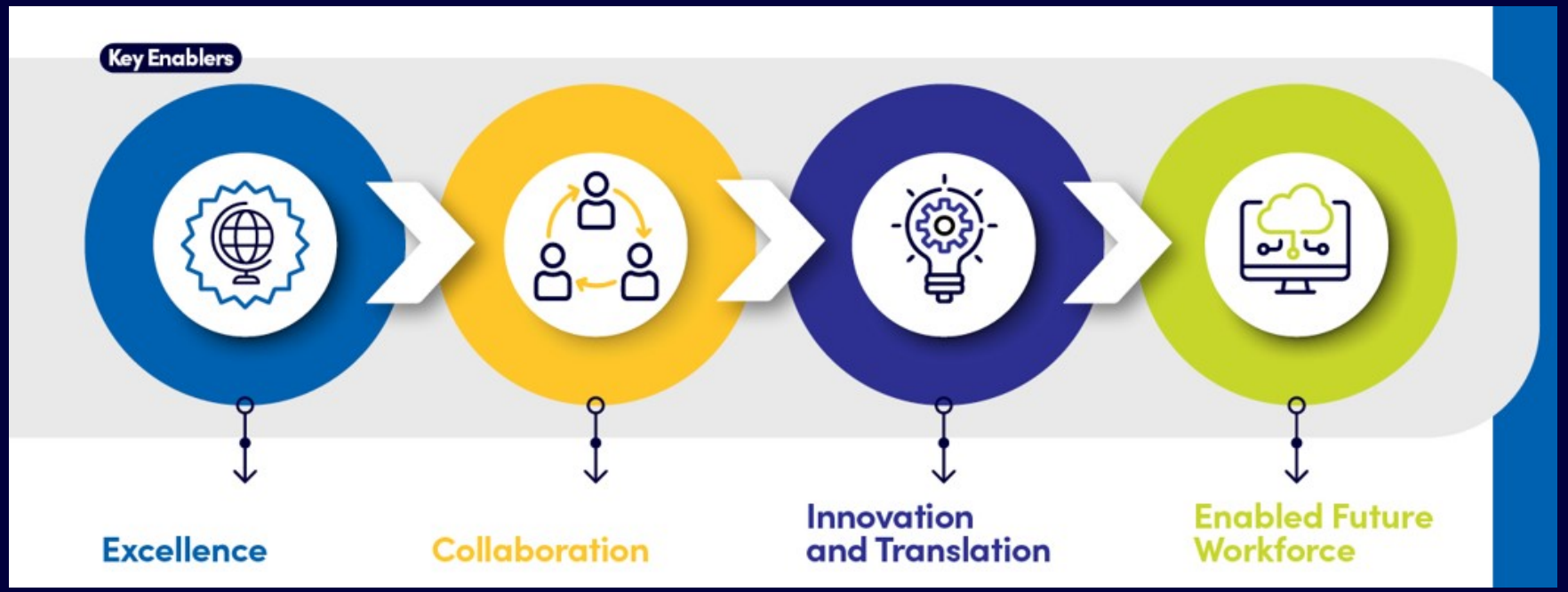

Economic growth
↑Productivity
$ Investment/Exports
Better Health
Environmental sustainability

- Australian Innovation System Report 2017, Office of the Chief Economist
- Global Innovation Index 2020: Who will finance innovation?
- South Australian Productivity Commission report on R&D, 2021

South Australia: STEMM Research Excellence

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STEM Fields of Research	Australia OECD Quartile		South Australia OECD Quartile Equivalent Performance	
	Citation Impact	Industry Collab	Citation Impact	Industry Collab
ICT	Q1*	Q3	Q1**	Q4
Engineering	Q1*	Q4	Q1*	Q4
Technology	Q1*	Q3	Q1	Q3
Chemical Sciences	Q1*	Q4	Q1*	Q4
Mathematical Sciences	Q2	Q4	Q1**	Q4
Earth Sciences	Q2	Q2	Q2	Q1
Agriculture & Vet Sci	Q2	Q3	Q2	Q4
Physical Sciences	Q2	Q4	Q1**	Q4
Biological Sciences	Q2	Q3	Q2	Q4
Environmental Science	Q2	Q2	Q2	Q2

OECD ranking of Australia and SA in STEMM Fields of Research (2014-2018)

Q1 equivalent to the top OECD quartile.
Q1* equivalent to the top 3 performing OECD countries
Q1** higher than the top performing OECD country

Analysis by Office of the Chief Scientist for South Australia using Incites, Clarivate 2020

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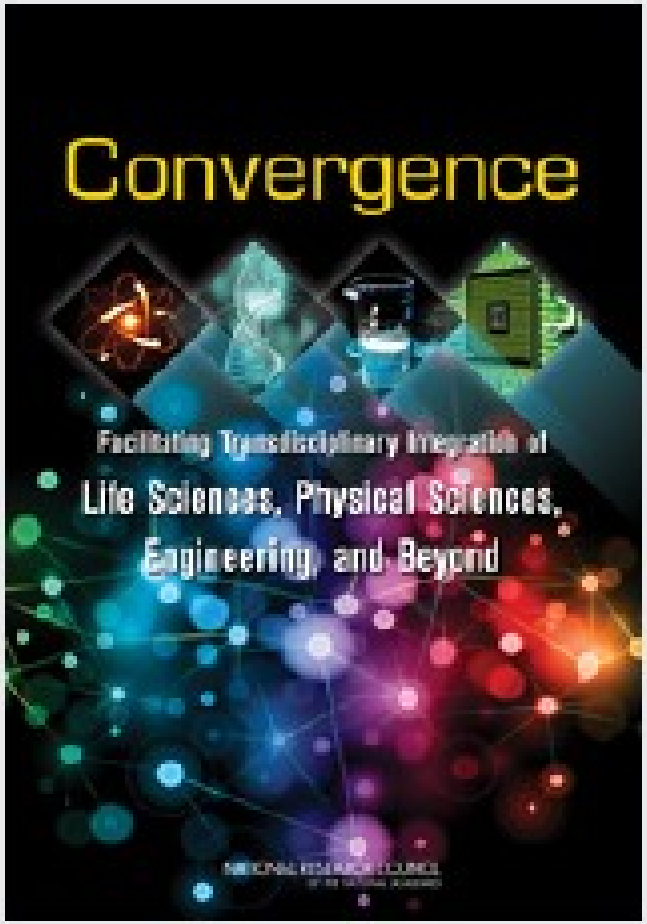
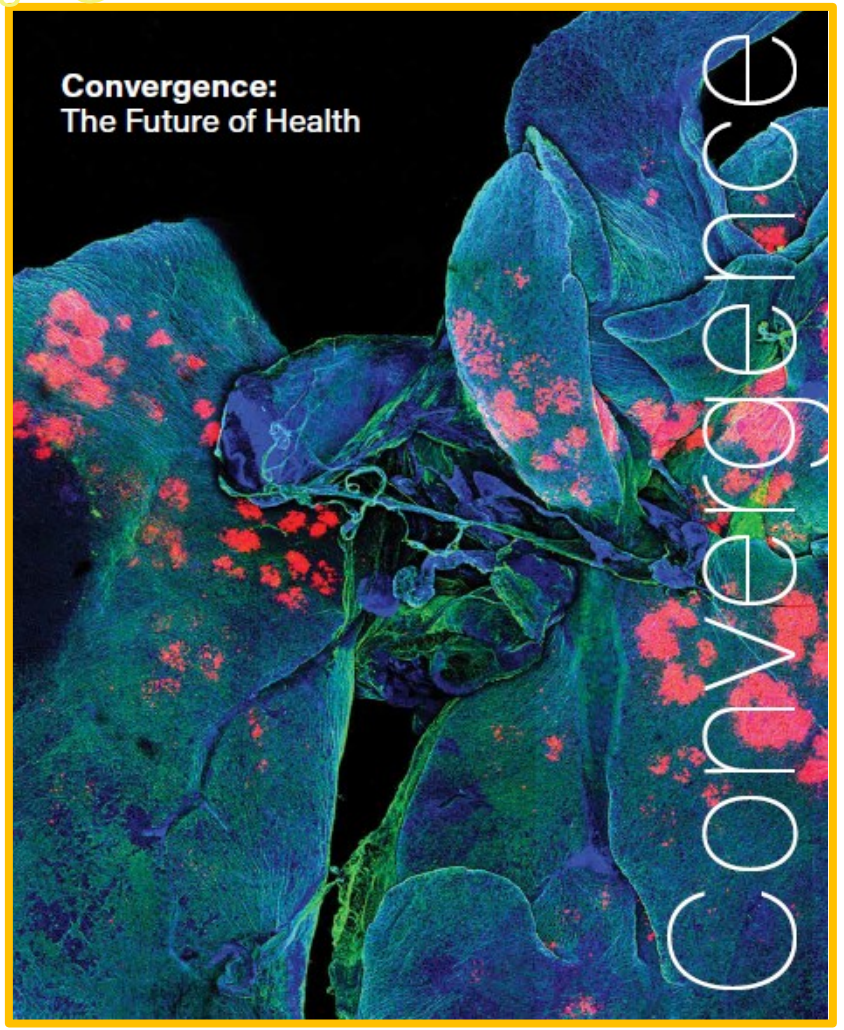


Convergence: Facilitating Transdisciplinary Integration of Life Sciences, Physical Sciences, Engineering, and Beyond
National Research Council 2014



Convergence: The Future of Health

National Institutes of Health 2016

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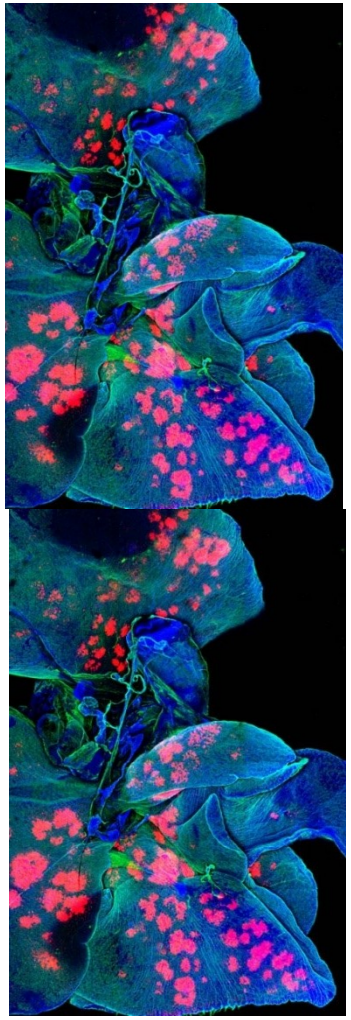
Understanding the Power of 'Convergence' of Disciplines

Convergence

- a result of the sharing of ideas and methods by chemists, physicists, computer scientists, engineers, mathematicians, and life scientists across multiple fields and industries.

- it goes beyond collaboration to integrate historically distinct disciplines and technologies to create fundamentally new opportunities for life science and medical practice.

- forms comprehensive frameworks that merge areas of knowledge from multiple fields to address some of the world's grand challenges.



Convergence: The Future of Health Report MIT June 2016

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Texas A&M System Invests $500m in an Engineering Medicine Program

World Economic Forum: The Power of Prediction - Emerging Technologies 2018

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Augmented reality	AR will help surgeons visualize tissues beneath a patient's skin in 3D, contribute to assembly line processes and holographic-like guides. The total market for AR is projected to grow to $100 billion by 2020.
Personalised Medicine	Advanced diagnostic tools detect and quantify multiple signs of a disorder to determine the risk of disease and tailor therapeutics for the individual,
AI-led Molecular Design	Machine-learning algorithms analyse all known past tests to create new materials and drugs, discern patterns and predict what new molecules are most likely to work, identify and develop new drugs at a rapid pace and reduce chemical waste
AI that can Argue and Instruct	Technologies which allow the next generation of machine learning systems to absorb and organize unstructured data (raw text, video, pictures, audio, emails) and autonomously compose advice – or debate an opponent.
Implantable Drug-Making Cells	Implantable cells engineered synthetic biology can be programmed to control drug release within tissues to treat diabetes, cancer, heart failure, haemophilia, glaucoma and Parkinson's disease
Lab-Grown Meat	The development of lab-grown beef, pork, poultry and seafood from cultured stem cells.
Electroceuticals	Electroceuticals –delivering signals to the vagus nerve to regulate the immune system to treat migraines, obesity and rheumatoid arthritis.
Gene Drive	A new approach that can change the traits of a population or species has emerged using gene drives, genetic elements that pass from parents and spread through populations.
Plasmonic Materials	Creation of nano-antennas, solar cells and sensors for detecting chemical and biological agents including toxins. Nanoparticles can be infused and concentrate inside a tumour and light delivered results in the death of cancer cells only.
Algorithms for Quantum Computers	Once refined, quantum computers could simulate nature and help design materials. Algorithms could enhance the design of new materials in areas from energy to health science.

Changes in AI Researcher Focus 1998-2018

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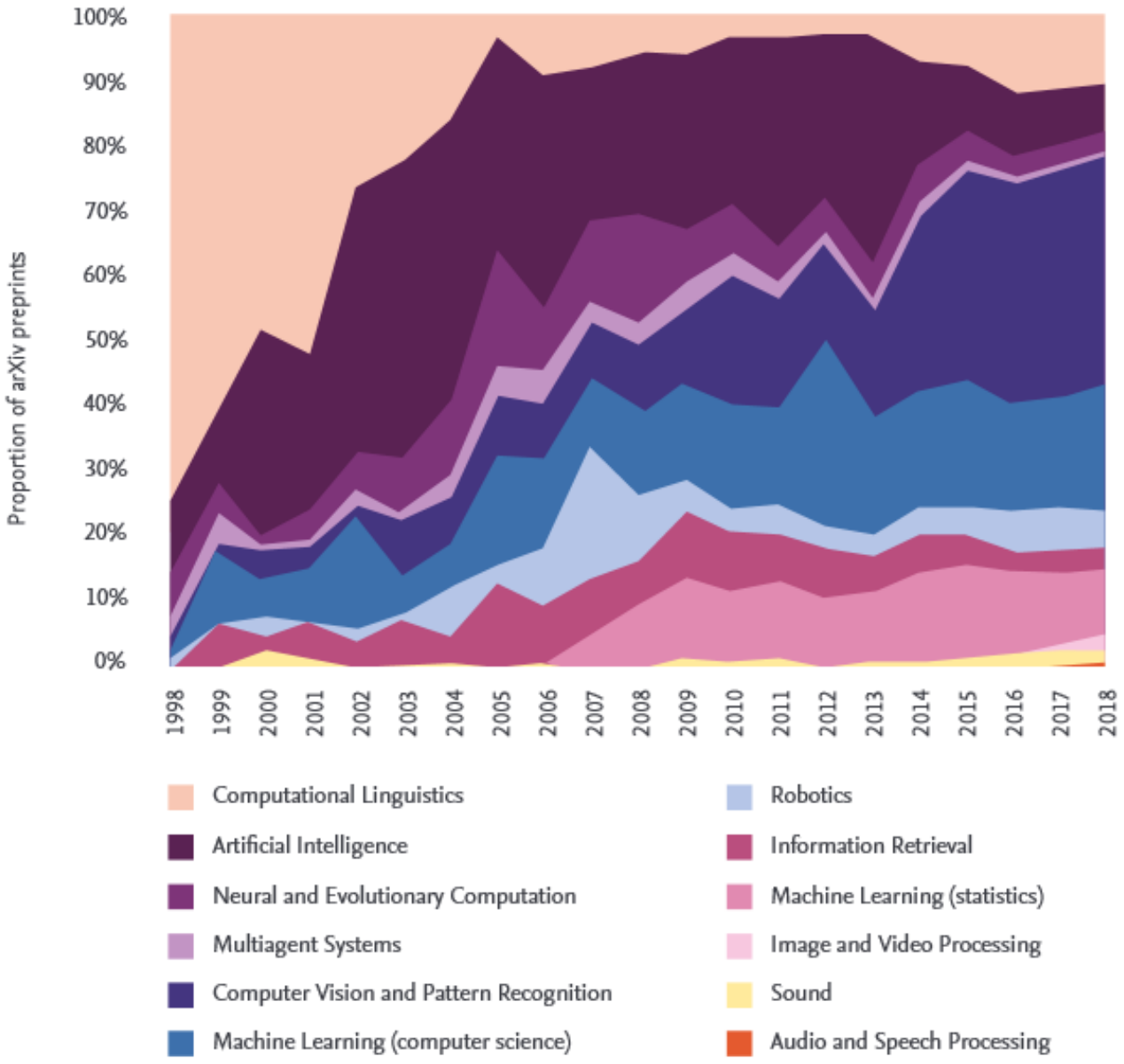

1998: computational linguistics & natural language processing research dominate.

2018: computer vision and pattern recognition and machine learning dominate

Elsevier AI Report 2019

AI Training: Advancing Health Care

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AI : Understanding the Human Proteome Delivering Tools to Tackle Disease

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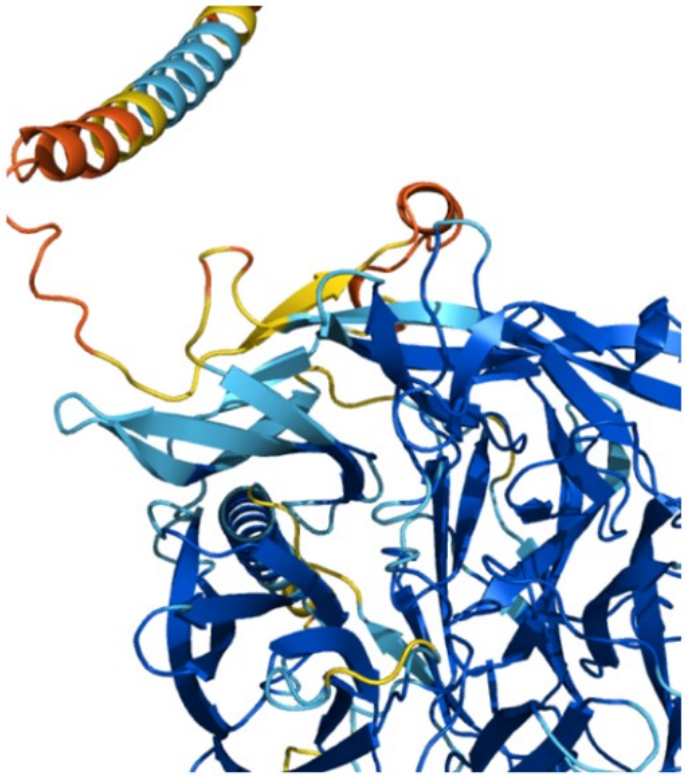
AlphaFold is an AI system developed by DeepMind that predicts a protein's 3D structure from its amino acid sequence. It regularly achieves accuracy competitive with experiment.

Structural coverage of the proteome using the state-of-the-art machine learning method, AlphaFold[2], at a scale that covers almost the entire human proteome -98.5% of human proteins.



Q8I3H7: May protect the malaria parasite against attack by the immune system.
Mean pLDDT 85.57.

Jumper J et al. Highly accurate protein structure prediction with Alpha-Fold (Nature 2021)
Tunyasuvunakool K et al, Highly accurate protein structure prediction for the human proteome (Nature 2021)

World Economic Forum: The Power of Prediction - Emerging Technologies 2018

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Quantum Communication and Data Game Changers

Quantum Technologies: One of 9 Initial Critical Technologies

- Secure networks using quantum key distribution (QKD) can transmit sensitive data e.g. financial transactions and provide encryption and security

- Harnessing 'a few qubits' can be used together with AI to drive faster solutions to complex logistics problems, new approaches to drug discovery, development of new materials etc. etc

Building the STEMM Research & Innovation Value Chain to drive the Supply Chain

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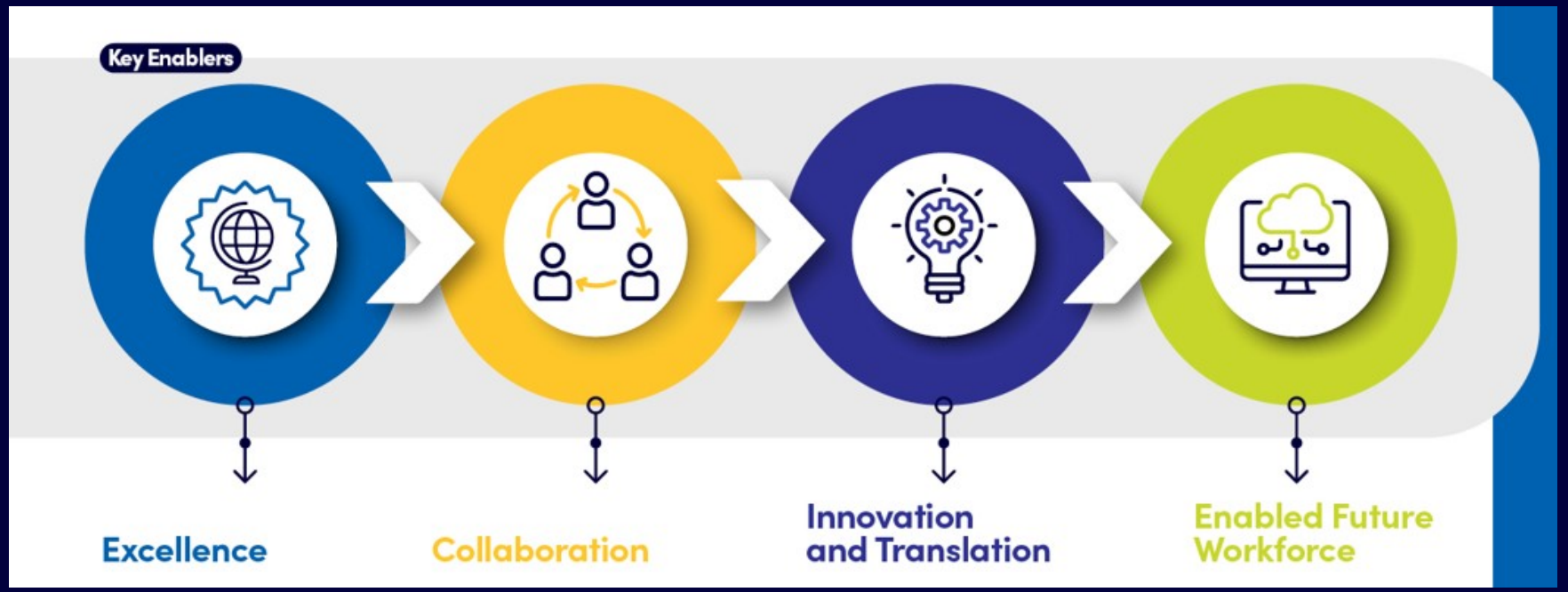

Supply Chain

Economic growth
↑Productivity
$ Investment
$Exports
↑ Skilled Jobs
Better Health
Environmental sustainability

Sources for role of STEMM Research & Innovation Value Chain driving the supply chain:

- Australian Innovation System Report 2017, Office of the Chief Economist
- Global Innovation Index 2020: Who will finance innovation?
- South Australian Productivity Commission report on R&D, 2021

"Strong Economies are Science Economies"

Source: EPSRC Delivery Plan 2016/17-2019/20

South Australia: Industry-Research Collaboration

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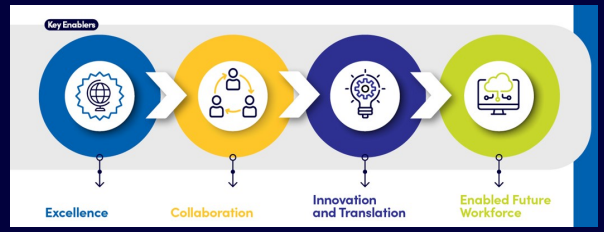

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Environmental Science	Q2	Q2	Q2	Q2

OECD ranking of Australia and SA in STEMM Fields of Research (2014-2018)

Industry Research Collaboration ranks in the bottom half of the OECD for Australia & South Australia

Exceptions: Earth and Environmental Sciences

Analysis by Office of the Chief Scientist for South Australia using Incites, Clarivate 2020

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Industry-Research Collaboration
Business Expenditure on R&D Relative to GSP

BERD/GSP %	NSW %	VIC.%	SA%	WA%	TAS%.	QLD%	ACT%	NT%
2017-18	1.13	1.06	0.74	0.61	0.57	0.55	0.55	0.12
2015-16	1.19	1.10	0.78	0.87	0.65	0.64	0.25	0.30
2013-14	1.34	1.33	1.03	1.02	0.59	0.90	0.42	1.00

Industry Research Collaboration Drives Innovation

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Access to research excellence drives high growth firms

Advanced Manufacturing: A New Definition for a New Era, 2017

Collaboration between research and 'end users' - industry, government, health builds 'innovation active' firms

Australian Innovation System Report 2017, Office of the Chief Economist

Australia and SA rank relatively low against OECD nations in terms of industry & research collaboration.

"…SA has an opportunity to lead the change…South Australian Productivity Commission 2021

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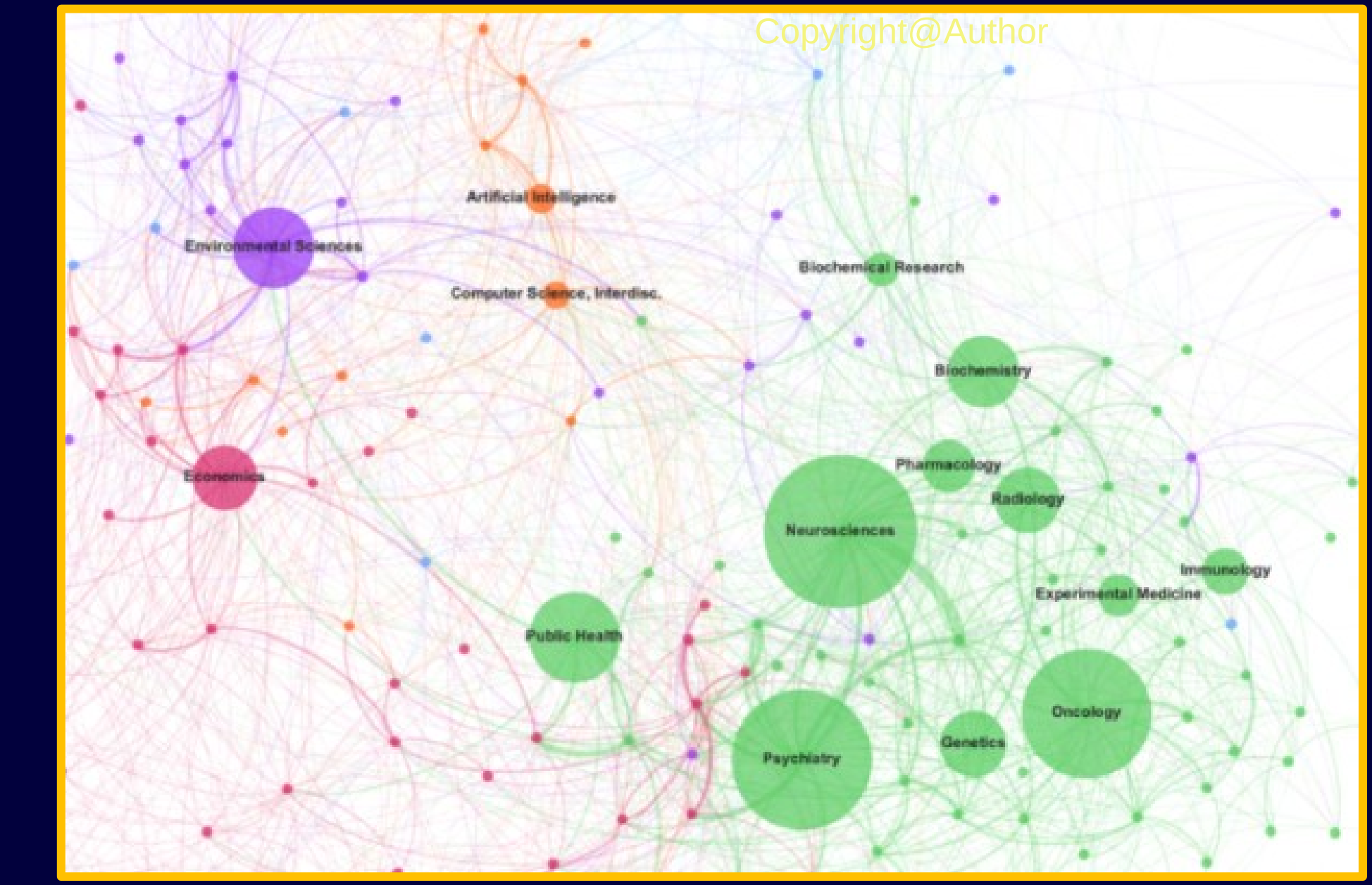

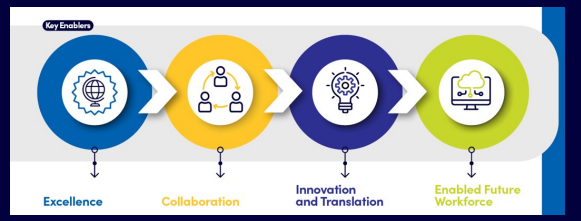

Convergence of Disciplines
Knowledge Quarter Zuidas Amsterdam

Global Institute of Innovation Districts
Web of Science and Lens.org Analysis

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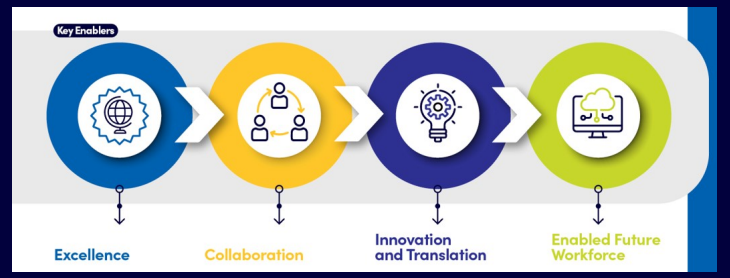

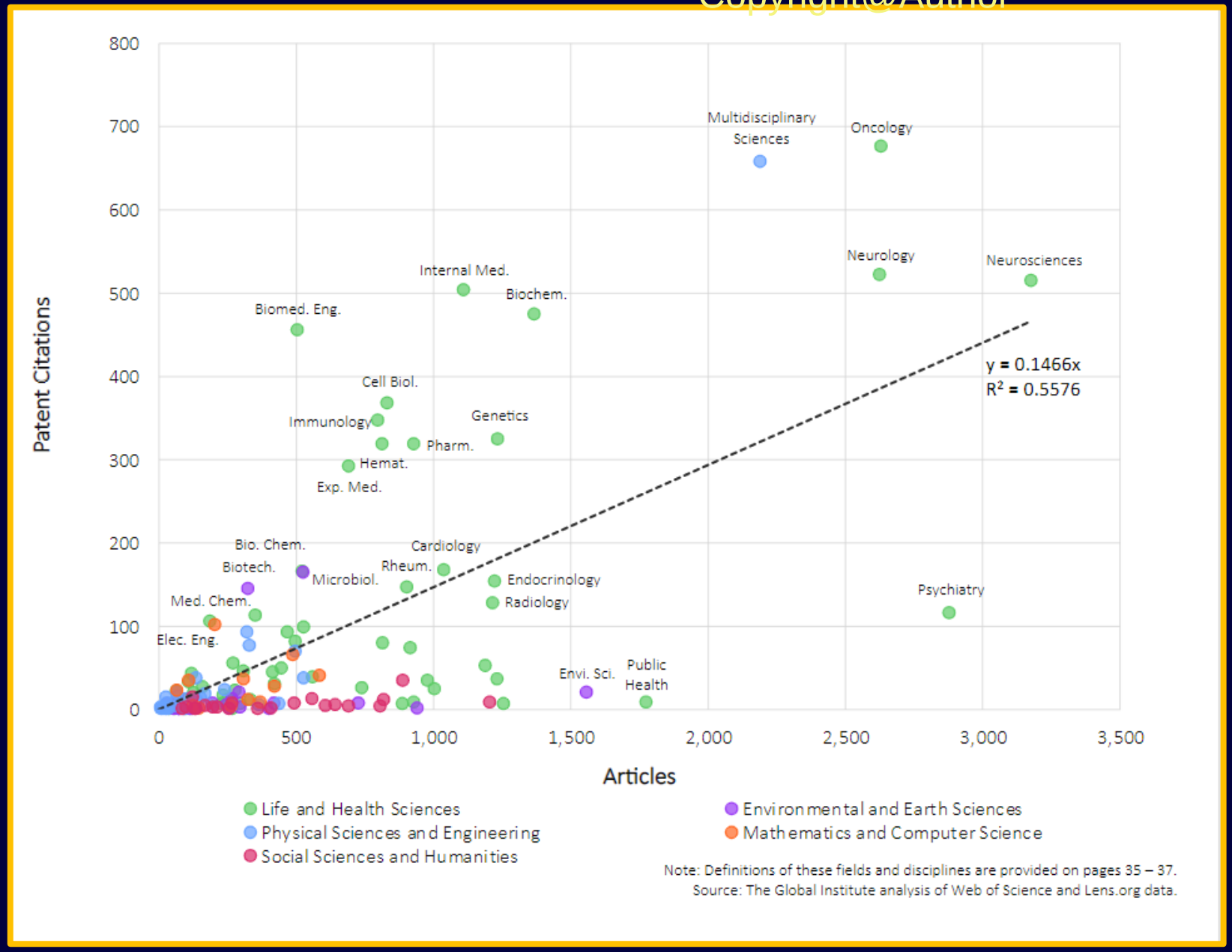

Collaboration driving innovation..

Innovation Precincts, Districts, Neighbourhoods

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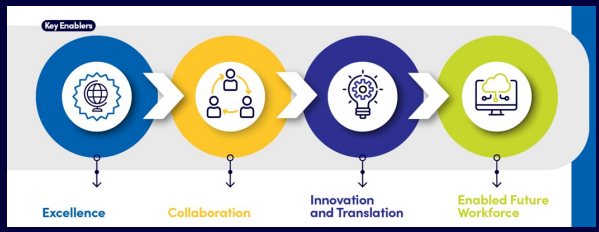

Manchester" Oxford Road Corridor and CityLabs
World-class hub for health innovation in the heart of the largest clinical academic campus in Europe.
Access to

- **clinical and academic facilities located along the Oxford Road Corridor Manchester University NHS Foundation Trust**
- **Business support**
- **over 20,000 STEM graduates a year**

ID Manchester
World-leading science and technology innovation hub dedicated to the growth of the science and technology sector- building a £1.5 bn Innovation District

CATAPULT
Medicines Discovery

United Kingdom

Key Criteria for a Globally Significant Innovation & Translation District

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- Leading-edge Anchor Institution
- Leadership, Culture & Collaboration
- Amenity & Infrastructure
- Competitive Advantage & Market Drivers

Magnet Cities: The Role of Innovation Districts
'Decline, Fight Back, Victory'

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- **A global KPMG study of 160 cities determined the characteristics of a magnet city using measures of annual jobs growth, GDP, R&D spend and population growth including the proportion of 'young wealth creators' measured using the number of patents/10,000 people as a proxy.**

- **The KPMG Report concluded that a *"relentless' focus on attracting young wealth creators, contributed directly to a city's economic growth"* and that there was;**

- ***"a specific relationship between cities and the young wealth creators who chose to move there. These cities provided the physical cityscapes, social networks, peer groups, restaurants, houses, investors, transport links, restaurants and bars they needed to set up their companies.***

- ***'Simply throwing up a start-up space and a couple of new apartment blocks will not draw new young people into a city that doesn't offer anything else….".***

https://assets.kpmg/content/dam/kpmg/pdf/2015/03/magnet-cities.pdf

Innovation and Translation Districts
Magnets for Talent

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'geographic areas where leading-edge anchor institutions and companies cluster and connect with start-ups, business incubators and accelerators' (Brookings Institution)

'the clustering of industries and workers that occurs, usually in knowledge-intensive roles, attracts additional entrepreneurs and innovative industries. This in turn drives up average incomes, gross value-add (GVA) and exports' (Arup Report)

- **knowledge & economic assets - research intensive institutions, firms and organisations with a focus on knowledge creation; and**
- **physical assets- the buildings, spaces and infrastructure which support collaboration and innovation with a focus on knowledge transfer;**
- **networking assets- the key relationships between different organisations and people that generate, develop and commercialise ideas i.e. a focus on knowledge application**

EXCITE STRATEGY: Realising the Value in the Value Chain: Enablers

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Excellence

- Scalable Excellence
- Global Standing
- 2030 SA Horizon Research Infrastructure and Technology Plan

Collaboration

- Talent: Global Innovators
- Powering Innovation Districts
  - Innovation and Translation Intermediaries
  - Frontier Technology Capability Centres
  - Industry Doctoral Training Centres
  - Business and SMEs co working spaces

Innovation & Translation

- Innovation and Translation Intermediaries
- Knowledge Transfer Networks
- Innovation Challenges
- Impatient capital

Enabling The Future Workforce

- STEMM Skills: Capacity, Diversity & Capability
- 'Young Wealth Creators': Attraction and Retention

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Powering Innovation & Translation Districts & Neighbourhoods

Strategic priorities

- External Innovation & Translation Intermediaries
- Frontier Technology Capability Centres
- Industry Doctoral Training Centres
- Collaboration and Convergence

Intermediaries: Leveraging National Investment in Industry-Research Collaboration

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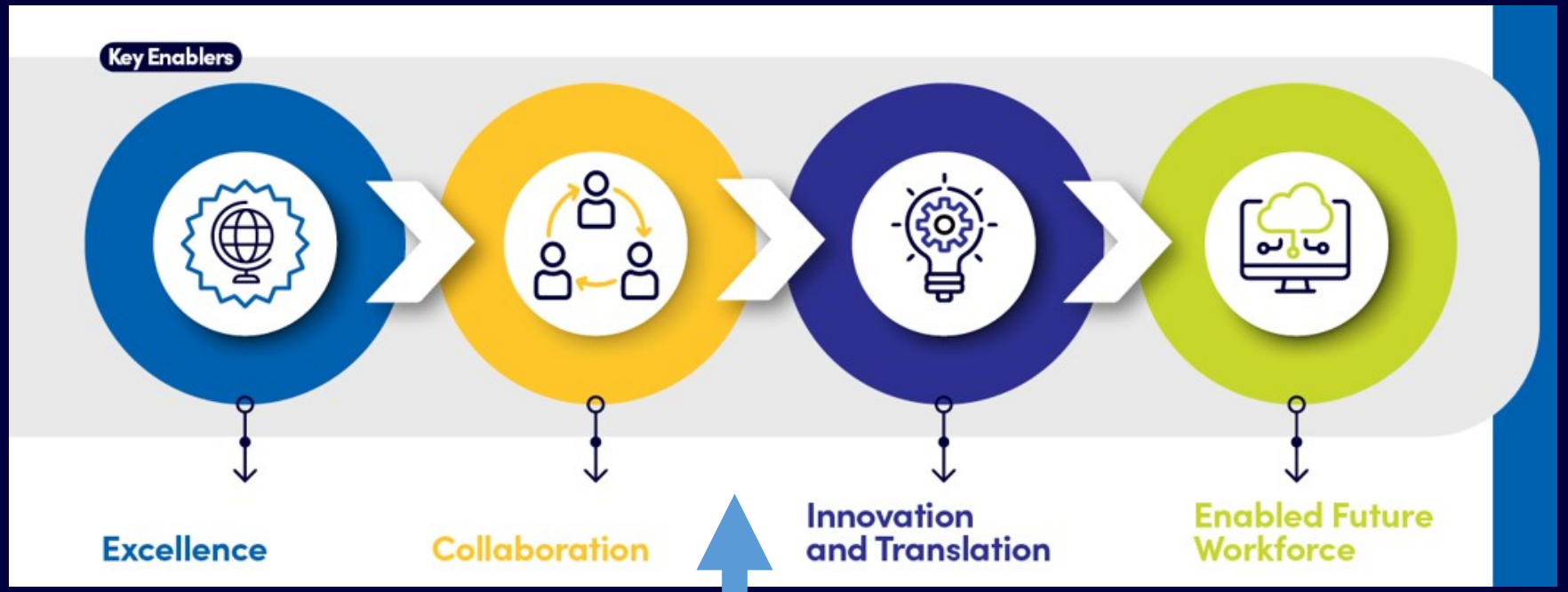

Supply Chain

$Exports

$ Investment

Jobs

Modern Manufacturing Initiative
$1.3bn fund

CRC Program ($20-70m /year)

CRC Projects (~$3m /project)

AMGC (~$1m/project)

Medical Research Future Fund
$20bn fund

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South Australia
The State of Science

Industry Doctoral Training Centres

"Centres for Doctoral Training have already proven to be successful in attracting the world's brightest minds and industry support to address the scientific and engineering challenges we face." **Professor Lynn Gladden, Executive Chair, Engineering and Physical Sciences Research Council (EPSRC), part of UK Research and Innovation (UKRI), Feb 2019**

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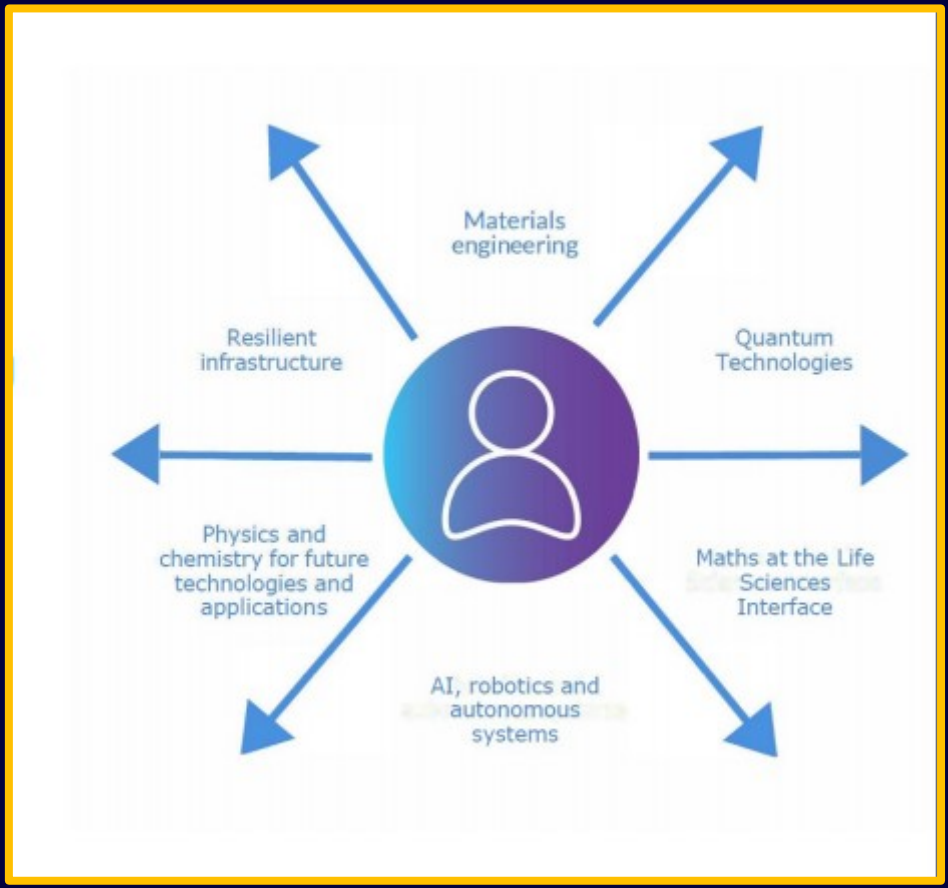
Industry Doctoral training Centres: Engineering and Physical Sciences Research Council (EPSRC)

- EPSRC Model launched in 2009
- Cohort approach to training
- Research element plus technical and transferrable skills training
- Address emerging and multidisciplinary challenges
- Facilitate work across disciplinary boundaries, bringing together different viewpoints and expertise



Source: UKRI CDT Directors Meeting, June 2019

Case study: Biopharmaceutical Bioprocessing Technology Centre (BBTC)

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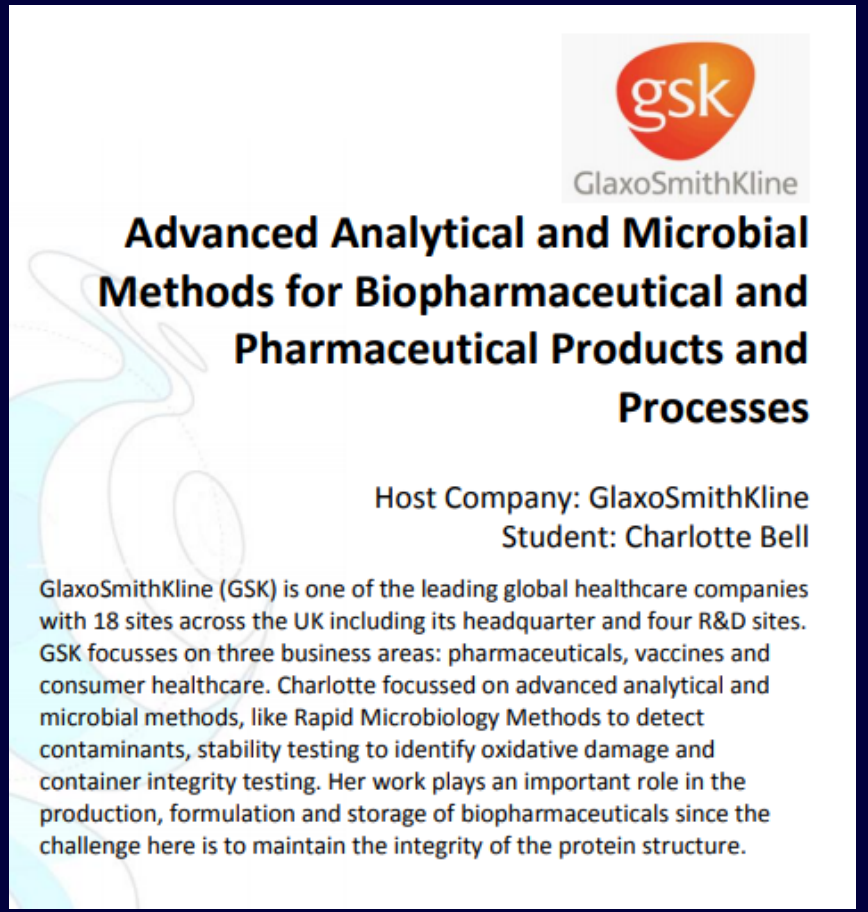
- Founded in 2008
- Interface between Biology, Chemistry and Engineering to develop better decisions and design tools for more efficient, cost effective (bio)processes
- Over 10 years, worked with 32 companies on almost 50 research projects/students
- Almost all alumni in fulltime employment, majority work in a relevant sector as engineer, scientist or manager



Source: BBTC Impact event 2019 Project Booklet

EXCITE IDTCs – Model

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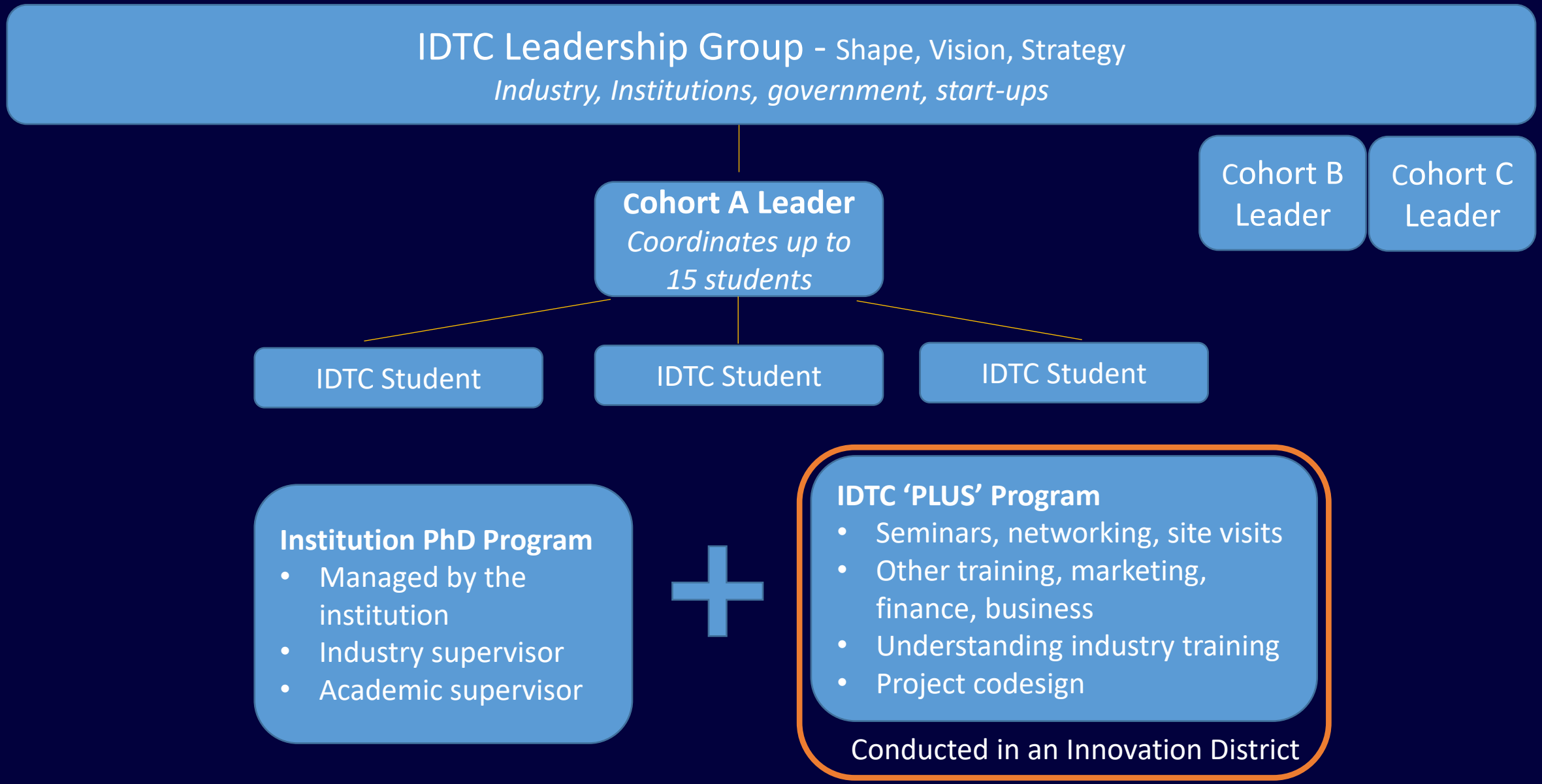

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LOT FOURTEEN

- Australia's first innovation neighbourhood
- Bringing together researchers, entrepreneurs and high-tech industries:
  - defence and space
  - artificial intelligence
  - cyber security
  - robotics and big data
- Collaborative environment

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LOT 14

- Australia Space Agency Hub;
- International Centre for Tourism, Hospitality and Food Studies;
- Aboriginal Art and Cultures Gallery
- Entrepreneurship
- Start-Ups

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To the South
The Tonsley Industry 4.0 Translation and Innovation Neighbourhood

Building Collaborations Delivering Innovation

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How to build the Value Chain?

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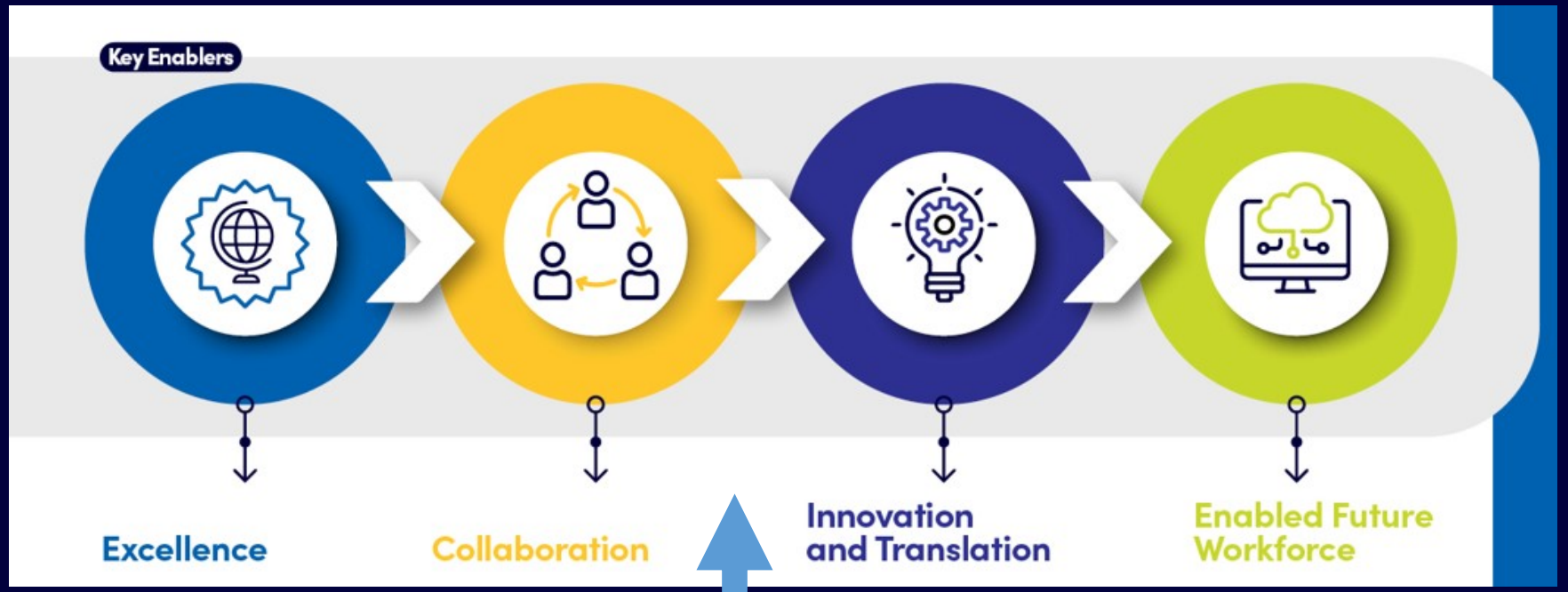

Supply Chain

$Exports

$ Investment

Jobs

Modern Manufacturing Initiative $1.3 Billion fund

CRC Program ($20-70 M /year)

CRC Projects (up to $3M /project)

AMGC (up to $1M/project)

Medical Research Future Fund - $20 Billion Fund

Powering Innovation & Translation Districts & Neighbourhoods

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- Priority area for EXCITE
- Harnessing returns on sunk capital costs

The SA STEMM R&I Value Chain: Delivering the Metrics of Success
Innovation and Translation Neighbourhoods

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Excellence
- Scalable Excellence
- Global Collaboration
- World Class Research Infrastructure
- Talent

Collaboration
- Global Innovators
- Industry Doctoral Training Centres
- Frontier Technology Capability Centres
- Business and SME co-working spaces

Innovation and Translation
- Intermediaries
- Knowledge Transfer Networks
- Innovation Challenges
- Impatient capital

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South Australia
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Industry & Research Collaboration Driving Innovation & Translation