



New South Wales Government
Independent Planning Commission

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**Best research organisation structures for solving
hard and intractable (national) problems**

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Chair, Independent Planning Commission
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Focus of speech – I've got a problem needing R&D; what help is available?

...if you are:

- a government
- a community or public sector agency (e.g. CFS)
- an industry sector (e.g. grains industry)
- a group of companies with pre-competitive problems
- a business (established or start up)
- a research lab

Where can you get support to get your problem solved?



Let's consider some features that drive the shape of the national R&D and innovation landscape

- Farsighted concentration on **new knowledge for major industries**
- We are **poor at manufacturing**
- Many believe that our firms are **not exploiting new knowledge enough**
- **Medical research is a vote winner**
- Major research funding opportunities are good for **attracting top staff to Australian universities**. Top staff & their research drive **international university rankings** which helps with **attracting foreign students**
- We believe we are **poor at commercialising R&D findings**
- We've often puzzled that we have a **lot of expertise (universities, CSIRO, ANSTO, etc.) – and wonder how can we tap into it?**
- Many believe that **'skin in the game' will drive commitment**. This can lead to the **'burden of matched funding'**.



Let's consider some features that drive the shape of the national R&D and innovation landscape

- Farsighted concentration on new knowledge for major industries (**CSIRO, Agriculture R&D Corporations**)
- We are **poor at manufacturing (numerous attempts at manufacturing CRCs)**
- Many believe that our firms are **not exploiting new knowledge enough (R&D Tax Incentive)**
- **Medical research is a vote winner (funding levels for medical research compared to other areas)**
- Major research funding opportunities are good for **attracting top staff to Australian universities. Top staff & their research drive international university rankings** which helps with **attracting foreign students (ARC Centres of Excellence, Federation Fellows)**
- We believe we are **poor at commercialising R&D findings (CRC Program, Linkage grants)**
- We've often puzzled that we have a **lot of expertise (universities, CSIRO, ANSTO, etc.) – and wonder how can we tap into it? (CRC Program, Linkage grants, ARC Centres of Excellence)**
- Many believe that 'skin in the game' will drive commitment (**almost all government schemes involving universities & firms; the 62 (or so) ACGR Category A grants**). This can lead to the 'burden of matched funding'.

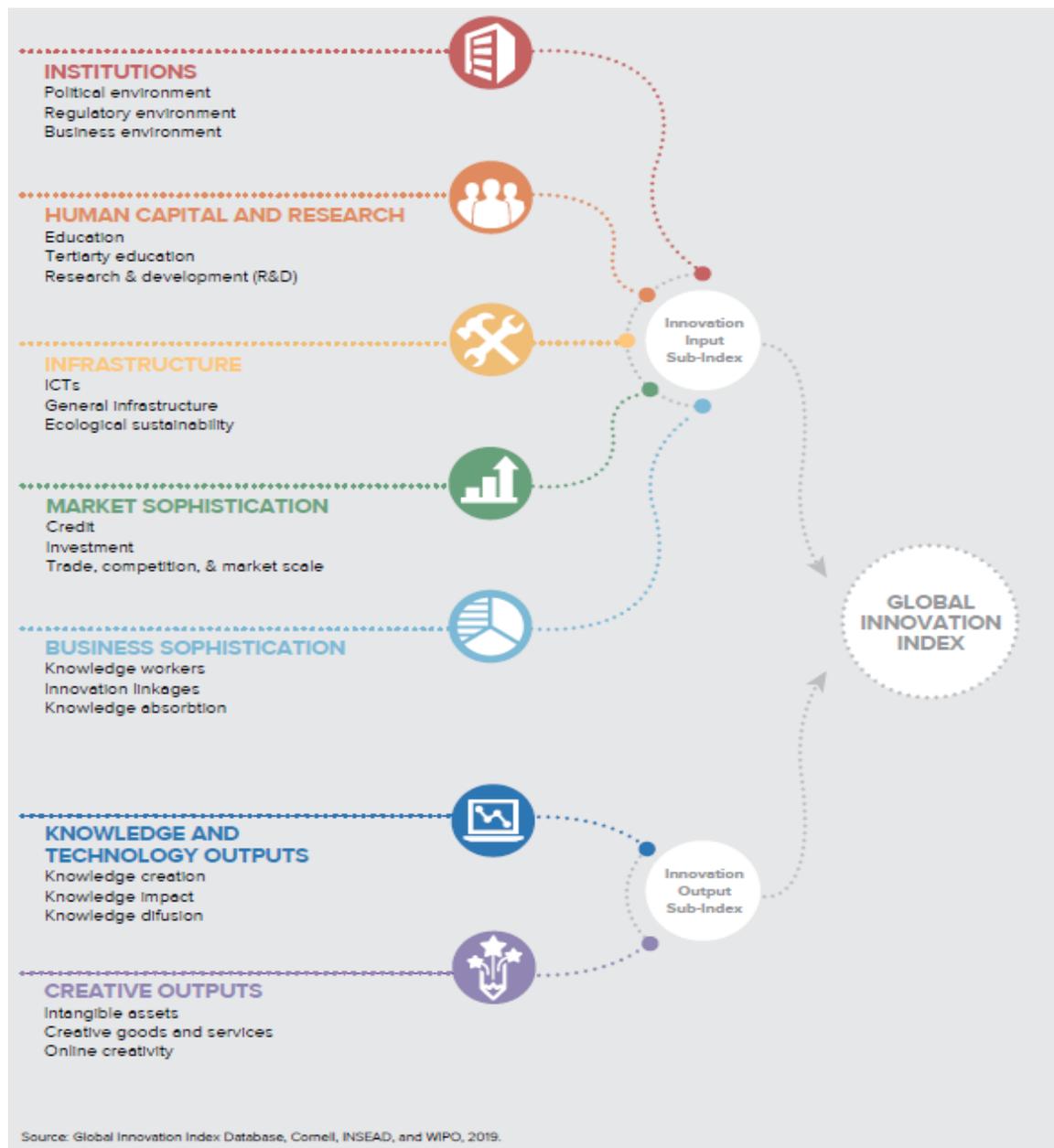


Is our R&D landscape delivering for us?

- We are not that great at getting from (our good) innovation inputs to innovation outputs compared to other top OECD countries.
- See various innovation indices – story pretty consistent.
- In the Global Innovation Index 2019, Australia came 22nd. But its innovation input ranking was much better at 15. Though its innovation output ranking was 31.



Framework of the Global Innovation Index



Top performers on Global Innovation Index

TABLE 1.1

10 best-ranked economies by income group (rank)

Rank	Global Innovation Index	Innovation Input Sub-index	Innovation Output Sub-index
High-income economies (50 in total)			
1	Switzerland (1)	Singapore (1)	Switzerland (1)
2	Sweden (2)	Switzerland (2)	Netherlands (2)
3	United States of America (3)	United States of America (3)	Sweden (3)
4	Netherlands (4)	Sweden (4)	United Kingdom (4)
5	United Kingdom (5)	Denmark (5)	United States of America (6)
6	Finland (6)	United Kingdom (6)	Finland (7)
7	Denmark (7)	Finland (7)	Israel (8)
8	Singapore (8)	Hong Kong, China (8)	Germany (9)
9	Germany (9)	Canada (9)	Ireland (10)
10	Israel (10)	Republic of Korea (10)	Luxembourg (11)

Australia ranked 22nd



So *is* our R&D landscape delivering for us?

- Probably not as efficiently as we'd like
- But there are **many great organisations and schemes out there that provide lots of opportunity for expert help, analysis and funding support**
- Yes it's a complex scene ...



Why is the problem definition/specification step important?

Remember **DARPA**'s innovation successes. One of its major techniques involved:

- specifying a version of the problem that was difficult but not open ended. Developing tight performance metrics
- choosing several teams to start working on the solution in parallel & measuring and publishing their performance against the metrics frequently
- whittling down to top-performing teams for end run
- doing the whole thing again with better problem specification some time later if it didn't work



Australian organisations emphasising problem definition

- Agriculture R&D Corporations
- AMIRA Ltd
- NSW Government through the Office of the Chief Scientist & Engineer (PFAS, koalas, mining in the catchment)
- Research-intensive companies e.g. CSL & EOS
- Companies with mega projects e.g. Rio Tinto & BHP



Universities can be super-problem-solvers *AFR 6/12/15*

“Why should we **turn to universities to solve major problems**? Well, universities, because of their research expertise, are **good at posing and refining problems and working together to ask and articulate what the issue is**. And **universities are great connectors with a strong international reach**. Ask an academic to solve a hard problem and if they don't know how, they know who will.”

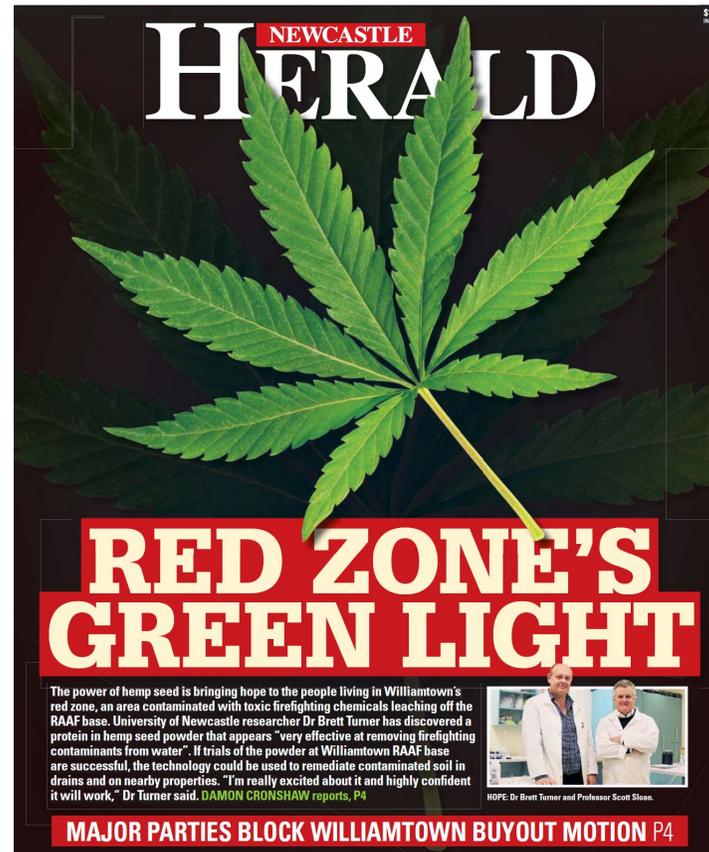


Problem definition can be done by:

- consulting an expert or several experts in parallel (e.g. CSG Review)
- a problem definition workshop maybe with funding body (e.g. geothermal 3D map at NICTA)
- getting nearest neighbour experts to say who o/s might be consulted
- joining a group with similar issues & together find a group to work with in public sector and define problems when applying for grant
- a group of firms settling on most important precompetitive problems to be solved for their group (e.g. Norway's SFI scheme)
- talking to intermediary groups like AMIRA or GRDC
- choosing a problem solving group (e.g. Innocentive) & use their input structure
- using a specialist firm in your field (e.g. EOS)
- just putting the problem out there – PFAS & University of Newcastle; Flame Security International



Lateral solution to PFAS cleanup



NEWCASTLE
HERALD

**RED ZONE'S
GREEN LIGHT**

The power of hemp seed is bringing hope to the people living in Williamstown's red zone, an area contaminated with toxic firefighting chemicals leaching off the RAAF base. University of Newcastle researcher Dr Brett Turner has discovered a protein in hemp seed powder that appears "very effective at removing firefighting contaminants from water". If trials of the powder at Williamstown RAAF base are successful, the technology could be used to remediate contaminated soil in drains and on nearby properties. "I'm really excited about it and highly confident it will work," Dr Turner said. [DAMON CRONSHAW reports, P4](#)



HOPE: Dr Brett Turner and Professor Scott Sloan.

MAJOR PARTIES BLOCK WILLIAMTOWN BUYOUT MOTION P4

Sometimes it's important to tackle the easier version first. Think DARPA having many tries at hard problems

- Rio Tinto with ARC Centre of Excellence in Autonomous Systems built Mine of the Future
- Somewhat literal automation of existing processes
- Now looking at more revolutionary way of solving the problem



Moving to problem solving – potential partners

- Publicly-funded research agencies (e.g. CSIRO, ANSTO, AIMS)
- Universities especially major research groups, often reached through DVCR Office
- Cooperative Research Centres and former CRCs
- ARC Centres of Excellence (e.g. Mine of the Future, PFAS)
- Medical Research Institutes
- Intermediaries a group of companies/organisations with pre-competitive problems (e.g. AMIRA, GRDC, etc.)
- Specialist research-oriented companies – often used in Defence (e.g. EOS) & Pharma
- Competition-style intermediaries
- Overseas institutes e.g. Crown Research Institutes in NZ, Fraunhofer in Germany, SFI Centres in Norway, overseas universities
- Several of the above



Competition-style & crowd-sourcing intermediaries (DARPA inspired, getting worldwide expertise working on your problem)

- The Goldcorp Challenge
- X Prizes & Hero X, the Kickstarter of X prizes
- Innocentive <https://www.innocentive.com/>
- Data-competition companies (Kaggle) - <https://www.kaggle.com/>
- Plenty more specialist competitions at <https://www.ideaconnection.com/outourcing/>



It's important to discuss

- Why can I be sure this group can deliver for me? Who precisely will be involved?
- Who else should be involved?
- What happens if key researchers are unavailable?
- Capacity to do the work or precisely what piece are they are doing
- Deliverables & progress performance indicators
- Fail-fast mechanisms. What do we do if things aren't going well?
- Nature of arrangement. JV? Contract? Partnership?
- Timeframes including if we go faster or slower than expected
- Cost & payment structures
- What funding support schemes might we use? Advantages & disadvantages?
- Intellectual property arrangements – who will own & have access to what
- Will students be working on this? Are there any special arrangements needed?
- System integration - arrangements for bringing different pieces of the puzzle together



What's your partner's motivation?

- Possibly not discussed but important to understand.
- Can be an issue when partners are applying to various funding schemes which don't 'fully fund' the public sector partner. This is what we refer to as 'the burden of matched funding'.
- What should we do if it'll create a problem?



What goes with what ...

Type of organisation	Good at
PFRAs (CSIRO etc)	Big national problems (e.g. best diet for Australians) & big system problems (e.g. Murray-Darlin Basin)
Universities & CoEs	Problem definition. Tackling intractable problems in specialist areas
CRCs	Precompetitive research for a specialist industry sectors
Specialist firm	Specialist advice with strong commercial understanding
Intermediaries	Problem definition. Putting those with a problem in touch with solvers and providing contractual arrangements
Competition systems	Problems where publicity is not an issue

Bonuses

- Graduates (including PhD) have worked on your problem. Possible employees.
- The relationship ... good for solving the next problem or knowing what to avoid
- Possibly special-purpose software or equipment

