TAFE Directors AUSTRALIA

LH Martin Institute
For Tertiary Education Leadership and Management

Innovation and Applied Research Roundtable

Dinner Address

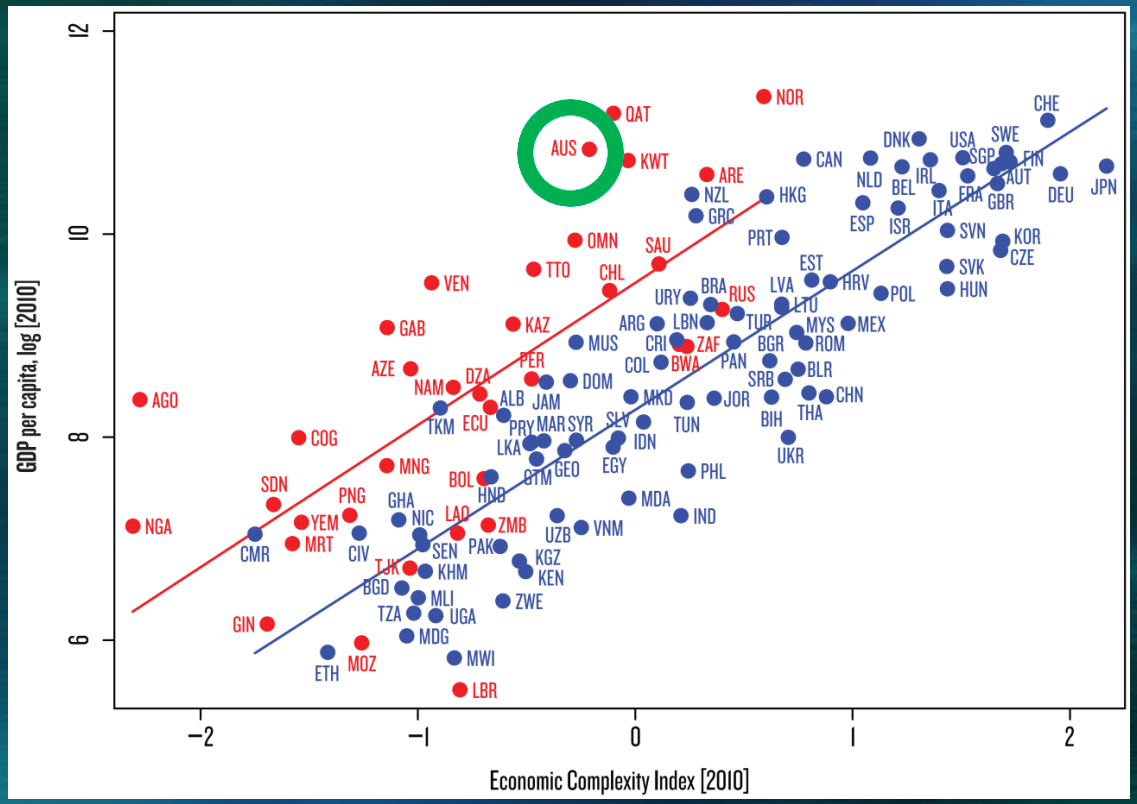
Professor Göran Roos

Economic Development Board of South Australia

The Role of Innovation and Applied Research in Increasing National Prosperity through Manufacturing

Prof. Göran Roos

National Prosperity is driven by the level of National Economic Complexity



A complex economy is one that

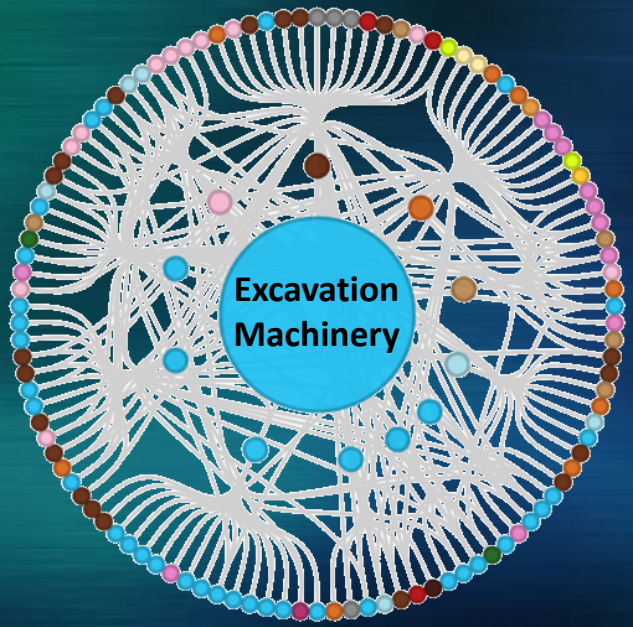
- Have a portfolio of activities – a very large share of which are exported and that cannot be offered by anyone else
- Where each of these activities require a large and diverse set of inputs, and
- Where many of these inputs are sourced in country
  - Production of complex systems is more complex than production of any of the constituent components
  - Production of advanced production tools is more complex than the products produced using these tools
  - Production of products is normally more complex than the production of the input services needed for these products
- Succeeds on non-price based competition allowing for high operating margins along the domestic part of supply value chain

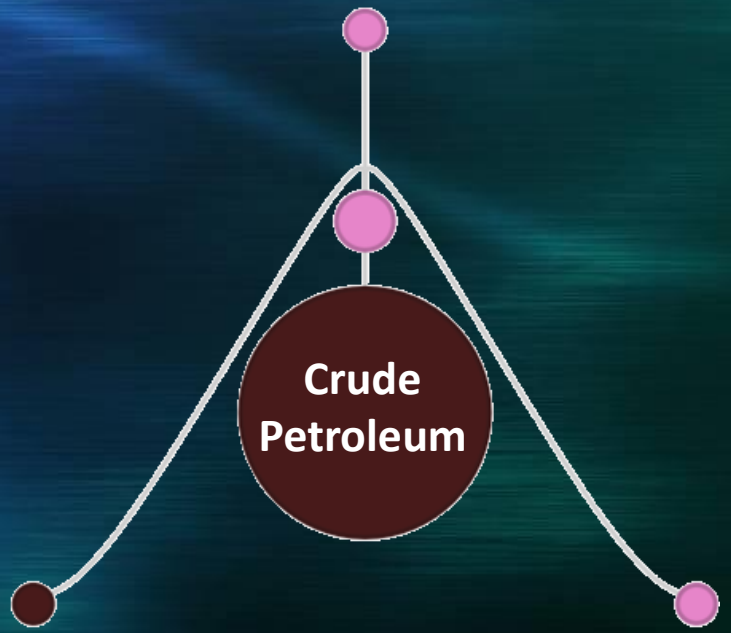
Hence prosperous economies are grounded in advanced manufacturing which in turns drive sophisticated service industries

Relative Complexity



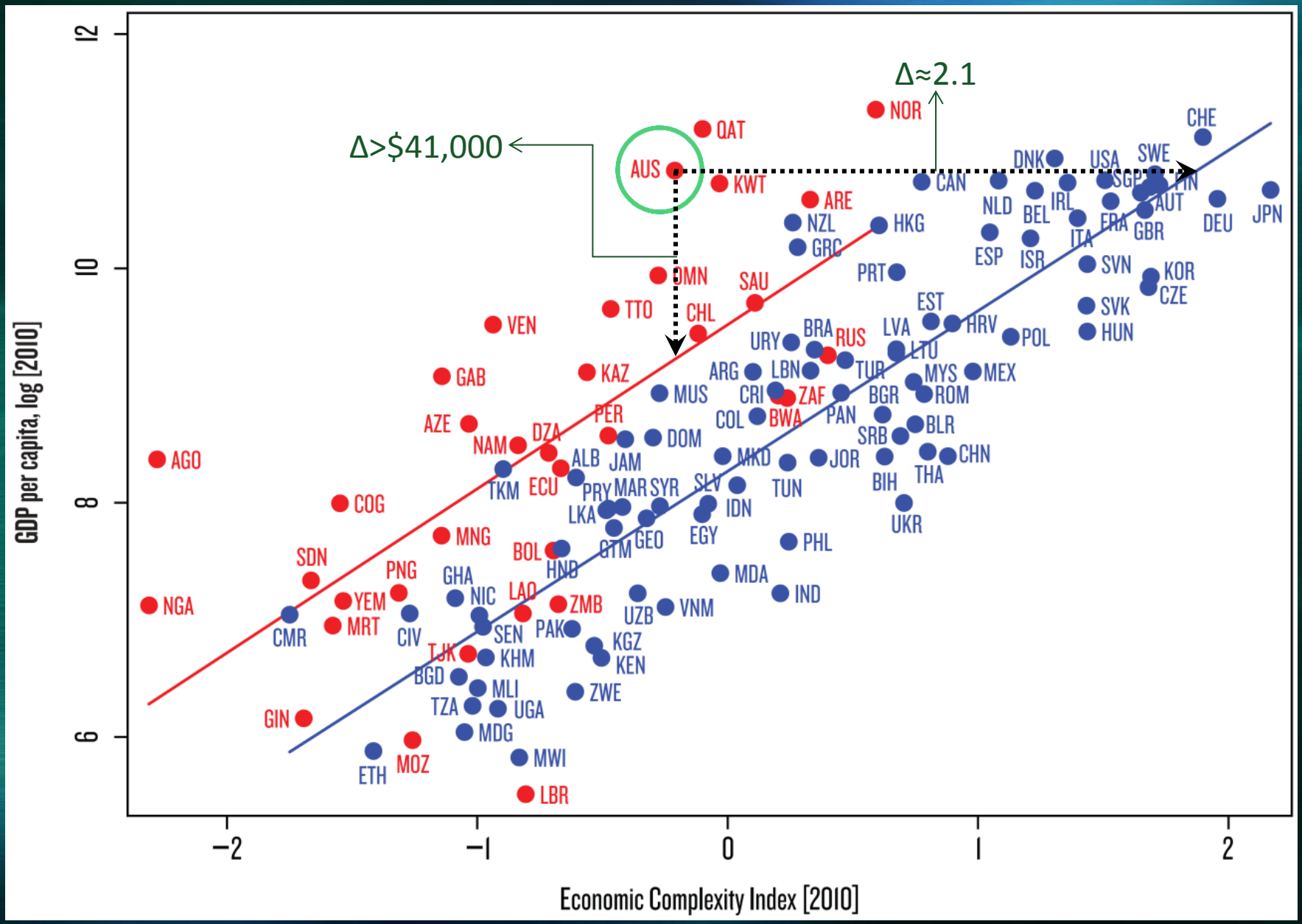

	Battle Tank	Passenger Aircraft	Frigate	Conventional submarine
Number of Suppliers	600	550	600	1600





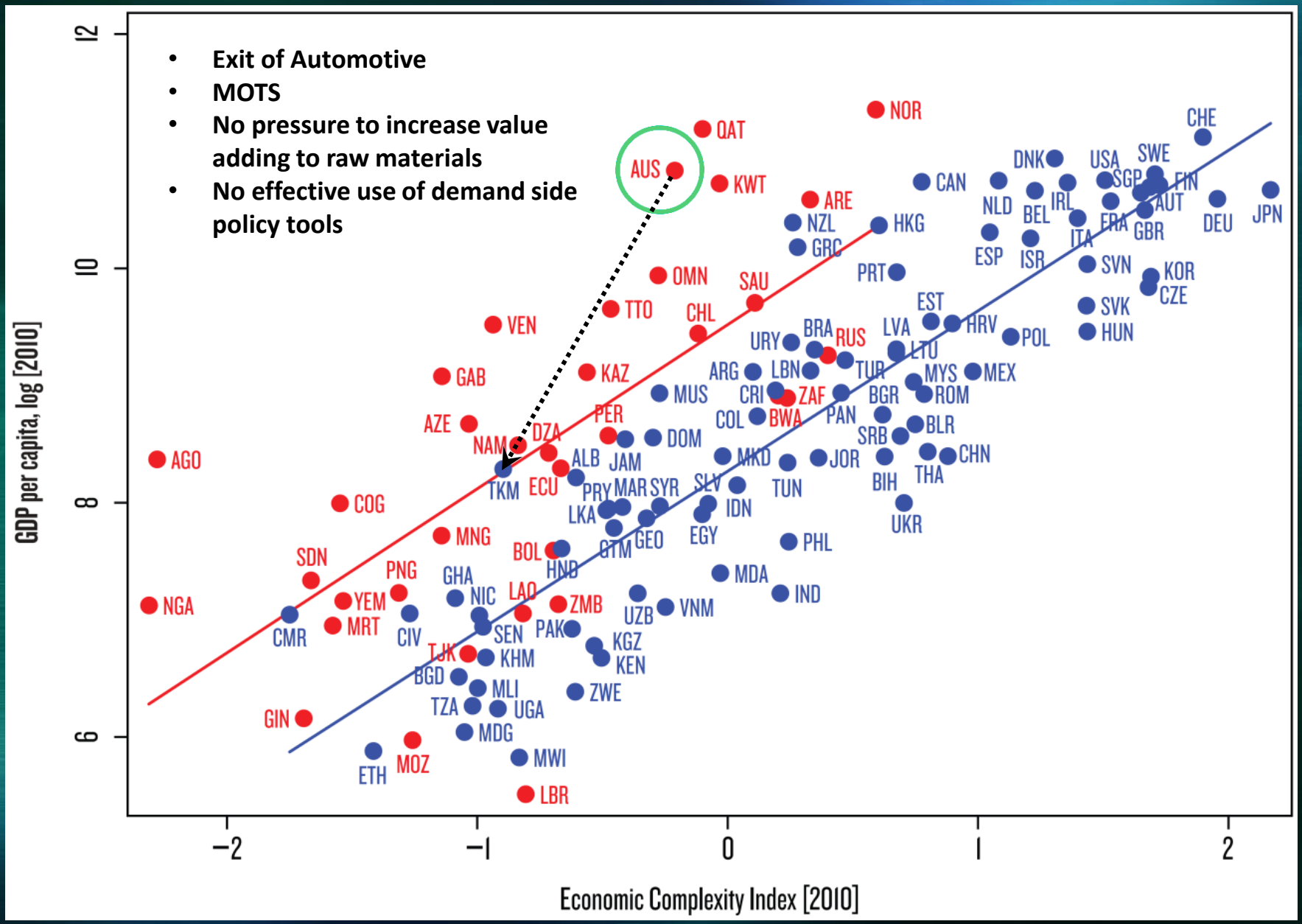
http://www.submarineinstitute.com/userfiles/File/ASC%20Hidden%20Assets.pdf

Australia's strategic choices



Graph extracted from : Hausmann, R., & Hidalgo, C. A. (2014). *The atlas of economic complexity: Mapping paths to prosperity*. MIT Press.

The Choice Australia is Currently Making



Graph extracted from : Hausmann, R., & Hidalgo, C. A. (2014). *The atlas of economic complexity: Mapping paths to prosperity*. MIT Press.

Manufacturing is changing fast when it comes to:

- Process and practices
- Locations
- Supply chains
- Goals and metrics
- Facilities
- Technology
- People
- Culture
- Resource footprint
- Good citizenship
- Collaborative position in the value chain
- The Role of people
- Etc.

The Tools that Government Have

Georghiou, L., 2008, Europe's Research System Must Change, Nature Vol. 452 24

It is not just about government and firms investing in research and innovation

Which is meaningless from a prosperity point unless national benefit realisation happens through the subsequent manufacturing of product or realisation of infrastructure in country.

Given that Australia is a High Operating Cost Environment delivery of Value for Money requires Firms to simultaneously have a:

- Continuous focus on cost reduction and productivity improvement
- Continuous focus on integrated innovation and productivity improvement

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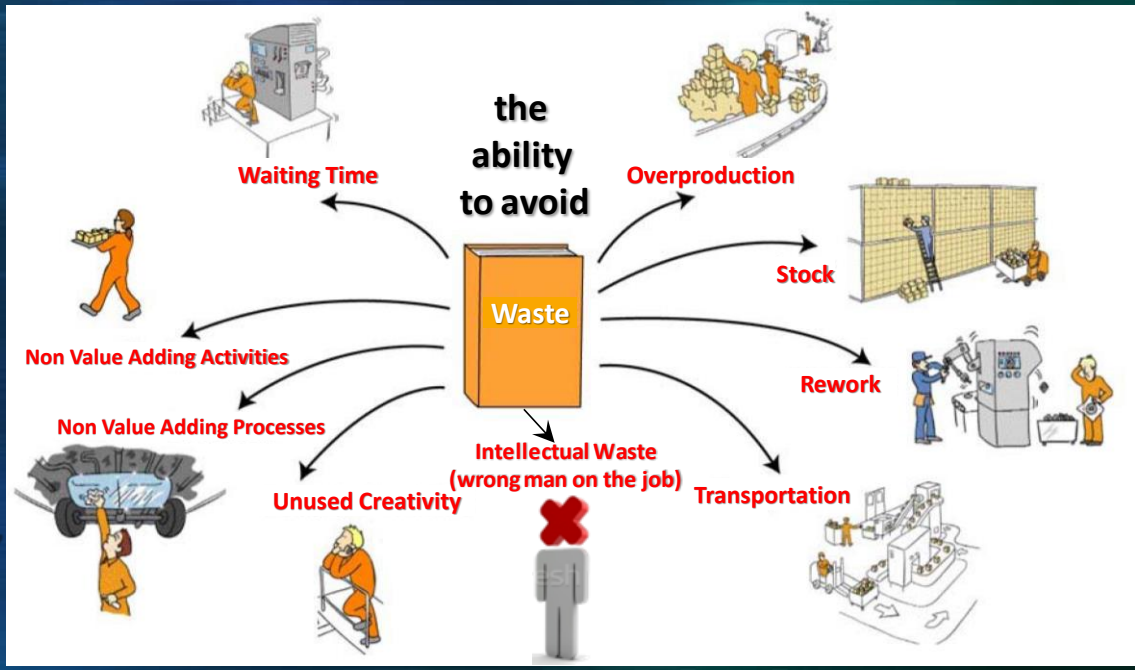
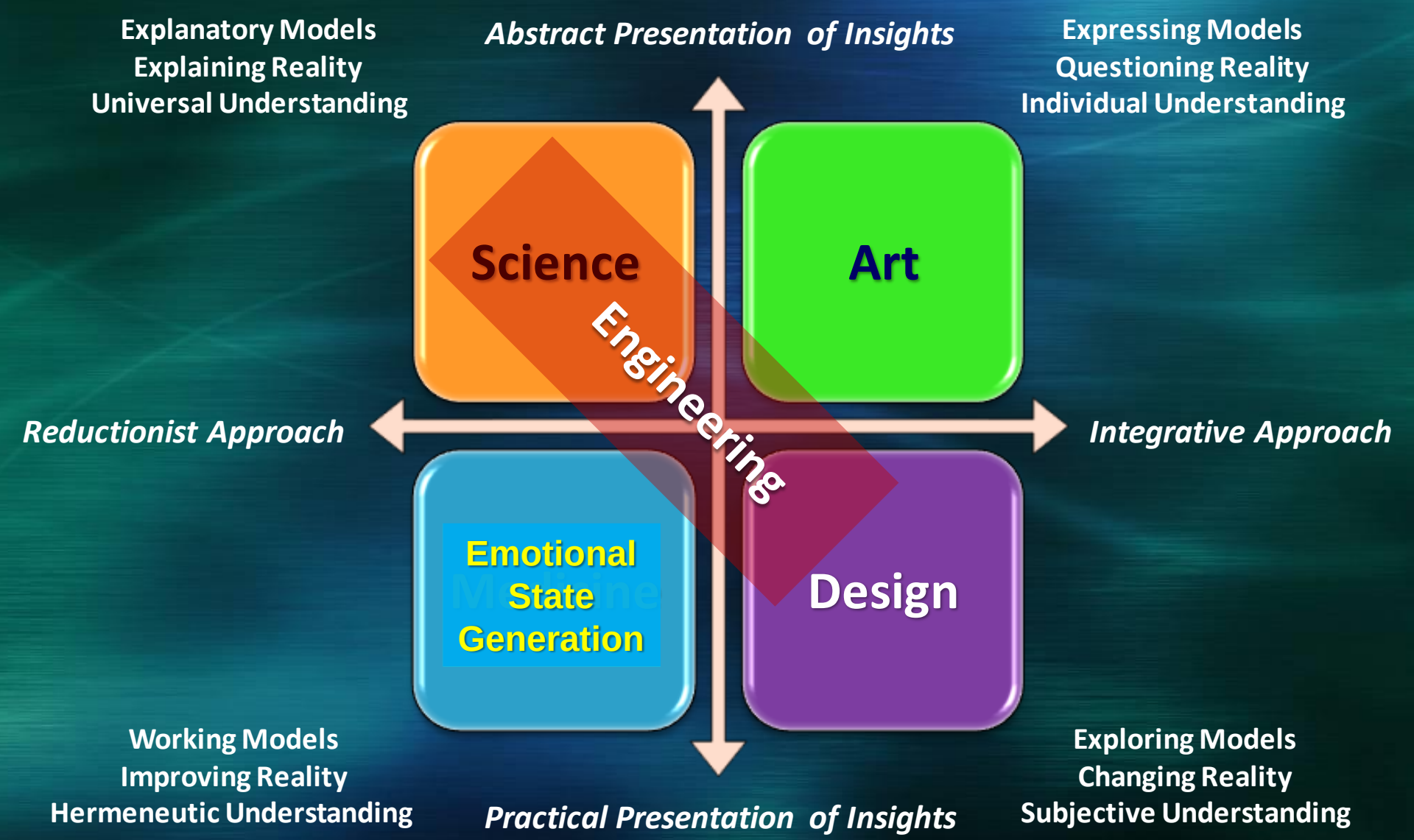
Continuous focus on cost reduction and productivity improvements through application of lean and agile manufacturing principles cont.

- Eliminate Waste:
  - Overproduction
  - Transport, which adds no value to the product
  - Process, transactions that should not exist
  - Waiting time, intermediate stock which generates queue in the process
  - Stock, throughout the production process, supply chain and finished products
  - Activities, which adds no value to the product;
  - Defects, which burden the productive process generating rework, wasted of time, manpower, hours of equipment etc.
  - Unused Creativity
  - Wrong person doing the job



Moura, DA. & Botter, RC. 2012. "Can a shipyard work towards lean shipbuilding or agile manufacturing?" in Rizzuto & Guedes Soare eds. "Sustainable Maritime Transportation and Exploitation of Sea Resources" Taylor & Francis Group. London.

Summary of value creation approaches



Roos, G., *"Manufacturing into the Future"*, Adelaide Thinker in Residence 2010 - 2011, Adelaide Thinkers in Residence, Government of South Australia, Adelaide, Australia, 2012

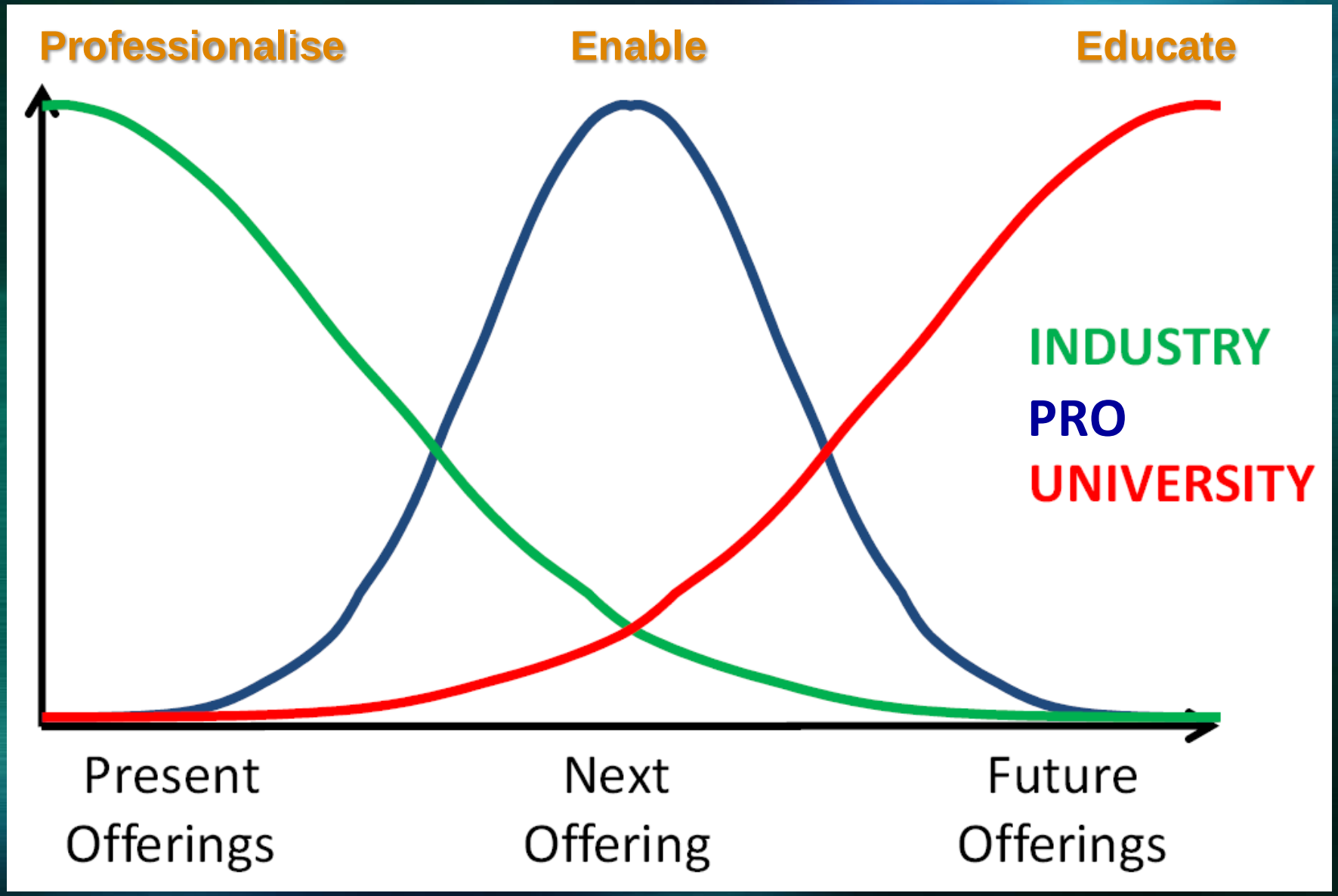
Summary of Value Appropriating Innovations

- **Effectiveness Improving Innovations**

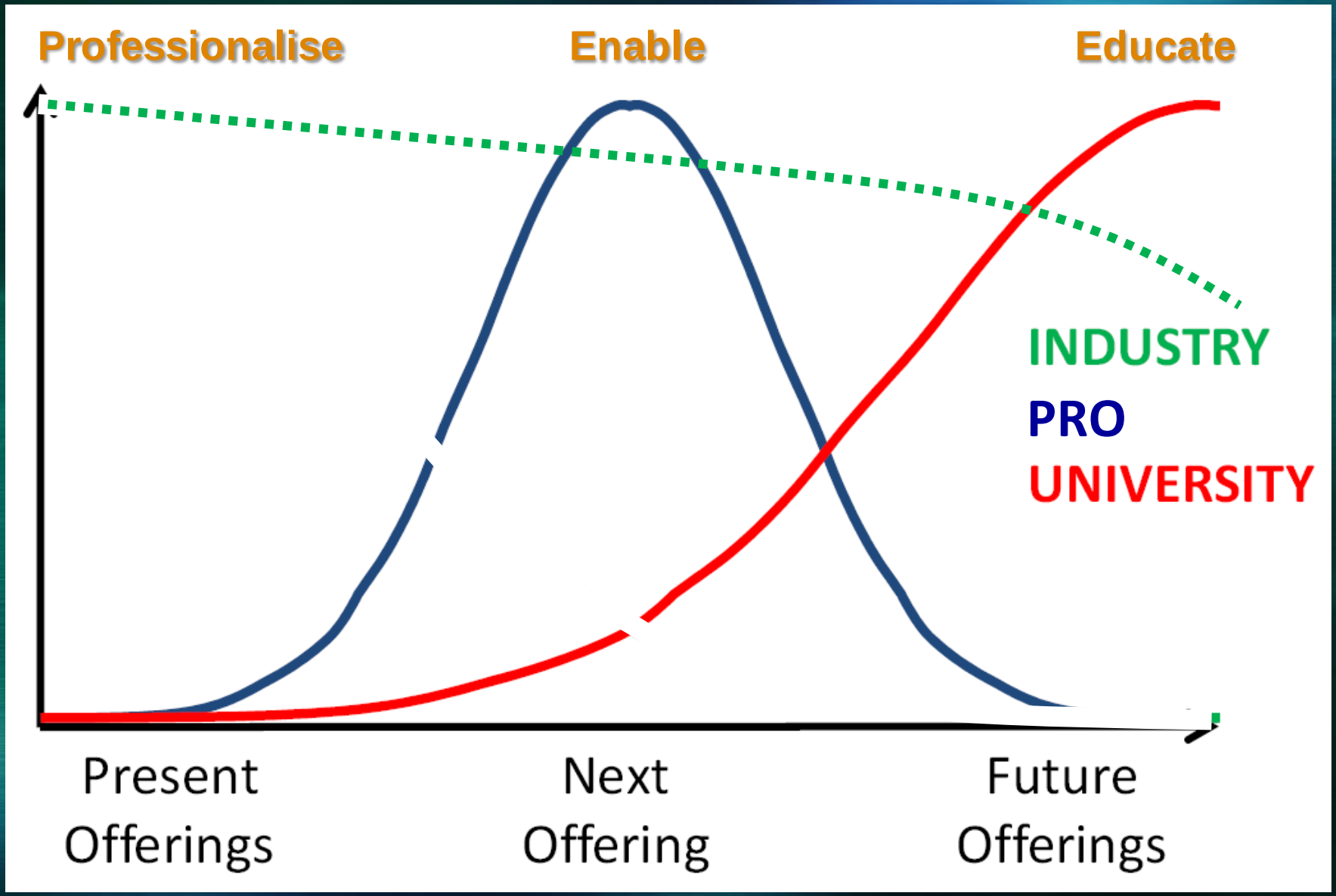
- **Business Model Based Innovations**

Roos, G., *"Integrated Innovation – The necessary route to profitability"*, in B+I Strategy (ed.), Estrategia, Bilbao, Spain, December, 2011, pp. 51-58

The world from a SME's point of view



The world from a MNE's point of view



The role of TAFE

- Skilled production, trade and technician occupations are essential in the generation, design, installation, adaptation and maintenance of new technologies.

- Firms in countries with a comparatively large proportion of their production workforce with higher-level VET qualifications reveal the following characteristics:
  - lower defect and re-work rates
  - lower ratios of indirect labour such as forepersons, supervisors, quality checkers and clerical support to direct labour
  - higher plant capacity use as a result of much lower rates of machinery breakdown due to preventative maintenance undertaken by machinery operators and staff skilled in this area
  - greater capacity to introduce and efficiently operate computer-controlled machinery that facilitates product customisation and product innovation.

- The supply of VET skills is influential in determining not only what goods and services are produced in a national economy, but how they are produced.
- Firms' product market choices are constrained by the availability of necessary skills and hence so is the ability to succeed in achieving a strategy based on non-price based competition since firms producing high quality, specialised goods and services require a well-qualified workforce capable of rapid adjustment in the work process and continual product innovation.
- By comparison with universities, TAFE have certain features which make them particularly suited to the role of technology deployer or innovation intermediary:
  - a more explicit economic development role than universities. In general, technical colleges are concerned with technology deployment because they want to teach theoretical and practical skills which will be immediately applied. Universities are more concerned with enabling students to acquire and apply a body of theory, and with making advances in this body of theory.
  - a greater focus on meeting the particular needs of industry and students in the region in which the colleges are located. This is due, in part, to the fact that in many regions colleges are the leading source of technical expertise and the core of regions knowledge infrastructure. This applies especially in their relationship with SMEs
  - a direct link to the investment activities of firms. Acquisition of new plant and/or the introduction of new products invariably involve training. In most instances this training needs to be customised and is typically supplied by TAFE or equipment suppliers
  - a greater flexibility and adaptability than universities
  - an under-rated and undervalued contribution in their role as 'intermediary institutions, putting companies and services in touch with one another and encouraging technology transfer and information exchange.

Toner, P. (2005). *Keeping Up with Technology: A Pilot Study of TAFE and The Manufacturing Sector*. National Centre for Vocational Education Research Ltd. PO Box 8288, Stational Arcade, Adelaide, SA 5000, Australia.

Prais, S. J. (1995). *Productivity, education and training: facts and policies in international perspective* (Vol. 48). Cambridge University Press.

Mason, G., Van Ark, B., & Wagner, K. (1996). Workforce skills, product quality and economic performance. *Acquiring skills: market failures, their symptoms and policy responses*, 175-97.

Estevez-Abe, M., Iversen, T., & Soskice, D. (2001). Social protection and the formation of skills: a reinterpretation of the welfare state. *Varieties of capitalism. The institutional foundations of comparative advantage, Oxford*, 145.

Finegold, D. (1999). Creating self-sustaining, high-skill ecosystems. *Oxford review of economic policy*, *15*(1), 60-81.

Rosenfeld, S. (1998). Technical Colleges, Technology Deployment, and Regional Development. OECD, Modena, Italy

Challenges for TAFE

- Concern over status, which stimulates technical colleges 'to become polytechnics and polytechnics … to offer post-graduate degrees'.
- Reduced student numbers and falling quality of students is occurring in 'many OECD countries'. This is 'attributed to parents encouraging their children into academic tracks … manufacturing employment is considered blue collar and has lower status among youth, even if wages are much better'. This is occurring despite the problem of skill shortages for college trained technicians. This is a major problem if funding for teaching staff and equipment is linked to student intake
- Resistance to change by teaching staff 'because it requires considerable effort on their part to restructure the content, learn how to use an unfamiliar technology, or rethink the teaching process'. Industry is sometimes critical of the TAFE teachers 'resistance' to training packages and competency-based training
- Maintaining the currency of equipment, which is difficult for most colleges. However, on the other hand, sometimes technology acquisitions are 'not demand driven by industry but inspired by educators' with the result that such 'centers have not met expectations and are … underutilised by SMEs [small and medium-sized enterprises] … because the equipment is more advanced and expensive than they need'. Financial constraints adversely affecting the ability to maintain the currency of equipment is an issue
- Fragmentation and competition among education and training providers can lead to wasteful duplication of equipment and curricula development and a 'sub-optimal' size of training provider. This means that the training provider does not have a large enough budget to employ specialist teachers, invest in equipment, or undertake staff and curriculum development. Competition between colleges needs to be finely balanced so that it provides a stimulus to innovation and improved service delivery, rather than promoting waste and reduced standards of teaching.

Toner, P. (2010). Innovation and vocational education. *The Economic and Labour Relations Review*, *21*(2), 75-98.
Toner, P. (2005). *Keeping Up with Technology: A Pilot Study of TAFE and The Manufacturing Sector*. National Centre for Vocational Education Research Ltd. PO Box 8288, Stational Arcade, Adelaide, SA 5000, Australia.
Rosenfeld, S. (1998). Technical Colleges, Technology Deployment, and Regional Development. OECD, Modena, Italy

TAFE should increase the focus on

- Increasing mutual absorptive capacity by personnel exchange between TAFE and Industry [on all levels]
- Increasing cooperation with CRC's to:
  - improve the timely flow of new knowledge into the VET sector;
  - enable CRC's to utilize VET's strong links with industry
  - promote teacher currency through professional development opportunities for VET personnel within the cooperative research centers.
- Ensuring that Success factors for industry/TAFE cooperation are in place:
  - TAFE must meet the needs of the client and respond quickly;
  - industry must clearly define the training issues, if necessary, with TAFE's assistance;
  - both parties must develop a mutually beneficial working relationship;
  - TAFE staff need to be pragmatic, practical, and prepared to take calculated risks;
  - TAFE managers must develop an appropriate organizational culture which fosters innovation and quality in the products or services delivered;
  - TAFE must make the necessary investment in human resources;
  - the skills and capability of the college must be actively promoted to industry.

Ferrier, F., Trood, C., & Whittingham, K. (2003). *Going Boldly Into the Future: A VET Journey Into the National Innovation System*. National Centre for Vocational Education Research, 252 Kensington Road, Leabrook, South Australia 5068, Australia (Cat. no. 940; $39.60 Australian).
Anderson, T. (1992). *Case Studies in Industry/TAFE Liaison: Success Factors*. TAFE National Centre for Research and Development, Ltd., 252 Kensington Road, Leabrook, South Australia 5068, Australia..

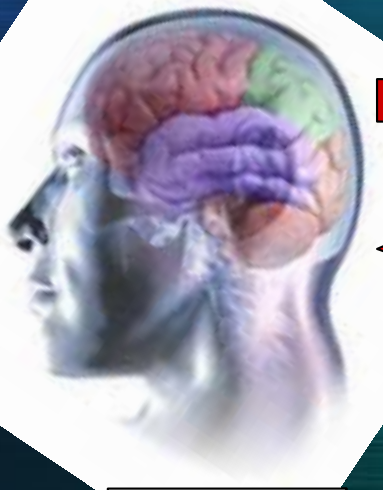
Successful TAFE students describe new learning in terms of processes,

whereas less successful students describe new learning through details of specific tasks.

Metso, S. (2014). A multimethod examination of contributors to successful on-the-job learning for vocational students. Ph.D.-Thesis. *Acta Universitatis Lappeenrantaensis*.

Universities are good at research and comparatively bad at innovation

Research



Creativity

Innovation

Firms are good at innovation and comparatively bad at research

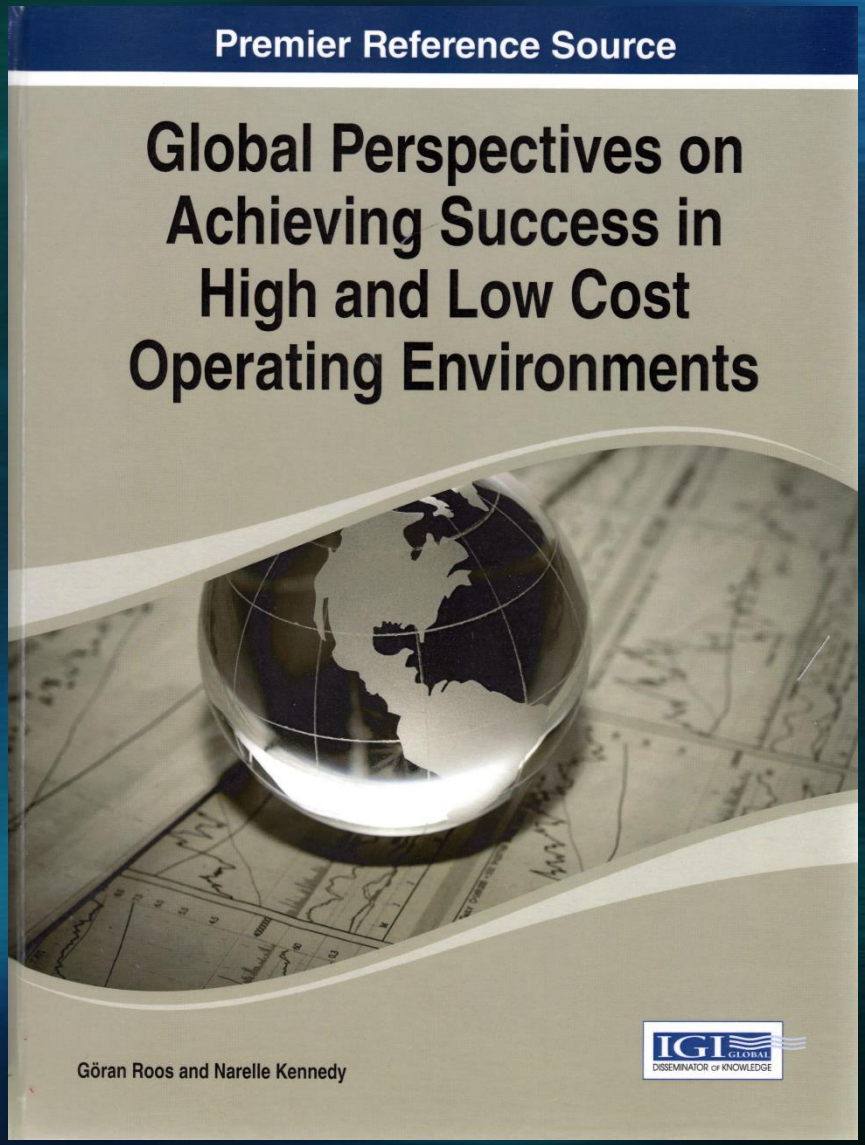
Some Requirements on Suppliers of Effective Applied Research

- **Higher emphasis on Manufacturing Readiness Level than on Technology Readiness Level**

Manufacturing Readiness	Activity		Technology assessment and proving				Pre-Production		Production implementation			Production optimisation
	Manufacturing Readiness Level (MRL)		1	2	3	4	5	6	7	8	9	10
	MRL Description		Concept proposed with scientific validation	Application and validity of concept validated or demonstrated	Experimental proof of concept completed	Product validation in laboratory environment	Basic capability demonstrated	Process optimised for production rate on production equipment	Capability and rate confirmed	Full production process qualified for full range of parts	Full production process qualified for full range of parts and full metrics achieved	Continuous improvement through LEAN approaches
System Acquisition Milestones		Pre-Concept Refinement				Concept Refinement	Technology Development		System Development and Demonstration		Production and Deployment	
Technology Readiness Level	Activity	Discovery & Research		Innovation							Commercialisation	
	Technology Readiness Level (TRL)	1	2	3		4	5	6	7		8	9
	TRL Description	Basic Principles Observed and Reported	Concept or Application Formulated	Experimental proof of concept		Concept or process validation in laboratory	System or component validation in relevant environment	System model or demonstrator validation in relevant environment	System prototyping demonstrator in an operational environment		Actual system completed with qualified test and demonstration in operational environment	Actual system mission-proven in successful mission/operations

- **Payer owns [IP]**
- **Have researchers/project managers with industrial experience**
- **Deliver on agreed time and within agreed budget**
- **Easy to work with**
- **Know when someone else is better than you are and refer to/use them**

More of what needs to be done by government and firms in:



Q&A