Evidence on the economic impact or research and development

A great many studies have been performed to assess the economic impact of research and development. The statistical model usually involves the regression of output, or output growth, on a set of explanatory variables which includes the stock of R&D, or expenditure on R&D. The unit of observation varies from the firm to the industry to the national economy. Most studies have been conducted in the USA and Europe, or in the case of cross-country studies across the OECD – countries for which reliable R&D data have been compiled. Some studies examine only the private rate of return on a firm's own R&D expenditures whilst other studies estimate social rates of return which incorporate the benefits that spill over to other firms and industries. Further complications in analysing the literature result from the fact that whilst many studies report rates of return on R&D investment either net of capital depreciation or gross, other studies report the elasticity of output with respect to the stock of R&D capital.[1]

a) Private sector R&D

One of the earliest large-scale econometric studies was conducted by Lichtenberg and Siegel[2]. They studied productivity growth for over two thousand US firms over the period 1972 to 1985, finding that the gross rate of return on company-funded R&D is around 35 percent. They report a high premium on the benefits of research classified as 'basic' rather than 'applied'. Bernstein and Nadiri[3] examined similar data and estimated that whilst private rates of return (net of depreciation) were just over 20 percent, the spillover benefits accruing to firms in other industries exhibited a rate of return varying from zero to over 60 percent.

A study by Griffith, Redding and Van Reenen[4] models the inter-industry and international spillovers amongst 13 industries across 12 OECD countries over 23 years (1970-92). They find that the gross rate of return on own industry R&D is over 40 *percent* (see their Table 2, p.889). This estimate is based on data aggregated at industry level, so it internalises own-country within-industry spillovers. This is a carefully controlled study, taking account of unobserved country and industry specific effects as well as adjustments to the measurement of Total Factor Productivity for problems of measurement with respect to skill levels and hours of work. Their study takes account of most of the problems cited by Atella and Quintieri[5] in relation to microeconomic studies.

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[1] Rates of return (RoR) are related to elasticities (E) by the formula: RoR = E x Output / Stock of Capital.

[2] Lichtenberg, F. R and Siegel, D., *The Impact of R&D Investment on Productivity - New Evidence Using Linked R&D-LRD Data*, Economic Inquiry 29: 203-228 (April 1991)

[3] Bernstein, J. I. and Nadiri, M. I., *Product Demand, Cost of Production, Spillovers, and the Social Rate of Return to R&D*, NBER Working Paper.1991.

[4] Griffith, R. Redding, S. and Van Reenen, J., *Mapping the Two Faces of R&D: Productivity Growth in a Panel of OECD Industries*, Review of Economics and Statistics 8: 883-895. (4 Nov 2004)

[5] Atella, V. and Quintieri, B., *Do R&D Expenditures Really Matter for TFP?* Applied Economics 33: 1385-1389. (11 Sept 2001)

A recent survey by Wieser[6] assesses the international evidence. He reports considerable variation in the estimated social rates of return on R&D, averaging 28 percent but ranging from 7 percent to 69 percent. Taking account of spillover effects, the average social rate of return to R&D is around 90 percent, with spillovers between industries more important than within industries. There are wide variations in rates of return across industries. Significantly, there is no consensus as to which industries yield the highest returns, i.e., there is no evidential basis for 'picking winners' in terms of R&D support. Evidence is found that the contribution of R&D to productivity growth has been declining over time. However, this is likely to be due to the ongoing problem of measuring innovation in ever growing service sectors. It is also found that the differences in returns to R&D across different countries are not large although the USA is an outlier with relatively high returns.

This evidence is backed up in the Australian context by Productivity Commission[7] who report that the marginal rate of return to "R&D elicited through public support" lies between 35 percent and 100 percent.

b) Public sector R&D

Adams[8] investigates the relationship between the rate of productivity growth in 18 US manufacturing industries over the period 1953-83 to the rate of publication of scientific papers across nine scientific fields. Productivity growth is found to depend on the accumulated stock of field-specific scientific research, operating with a twenty-year lag, and on the employment by industry of scientists in the appropriate fields.

In a subsequent paper, Adams[9] examines the relationship between the volume of R&D activity and the scientific base for a panel of fourteen R&D-performing industries in the USA over the period 1961-86. He seeks to explain R&D activity as a function of the lagged stocks of scientific research in particular fields (proxied by the number of papers published worldwide) interacted with the proportion of employed scientists specialised in the field. He reports that the size of the scientific base does have a significant positive impact on the level of R&D activity. The implication is that basic scientific research provides fertile ground for applied commercial development.

This conclusion is supported by Mansfield[10], who analyses surveys of US businesses. Firms reported an average lag of seven years between the publication of academic research on which they have relied and the timing of their subsequent commercial innovation. Using estimates of the commercial value of the recorded innovations,

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[6] Wieser, R., *Research and development productivity and spillovers: empirical evidence at the firm level*, Journal of Economic Surveys, 19:587-621. 2005.
[7] Productivity Commission Research Report, *Public Support for Science and Innovation*, p. 628. March 2007.
[8] Adams, J. D., *Fundamental Stocks of Knowledge and Productivity Growth*, Journal of Political Economy 9(4): 673-703. 1990.
[9] Adams, J. D., *Science, R&D, and Invention Potential Recharge: U.S. Evidence*, American Economic Review, American Economic Association, 83(2): 458-62. May 1993.
[10] Mansfield, E., *Academic Research and Industrial Innovation*, Research Policy 20: 1-12. (1 Feb 1991)

Mansfield calculated the average rate of return on academic research to be of the order of magnitude of 28 percent.

Some studies of the productivity effects of public R&D have suggested that returns were lower than those estimated on business R&D - for instance Lichtenberg and Siegel[11], Nadiri[12] and OECD[13]. Subsequent research suggests that the results of these studies may be misleading for two sets of reasons. First, they failed to distinguish between different types of publicly funded research. Second, they failed to account for the time delay between productivity outcomes and the performance of public R&D, which tends to be focused more on the research than on the development side. Studies which incorporate lagged effects and distinguish types of public R&D do, in fact, find significant positive productivity effects. For example, Mamuneas and Nadiri[14] distinguish publicly funded R&D in the USA according to whether it is carried out in the business sector or in the public sector. Examining the cost-reducing benefits of R&D stocks in fifteen industries over the period 1956-1988, they find that both forms of public financed R&D generate statistically significant benefits, albeit with the stronger reduction in marginal costs coming from R&D performed within the business sector.

Guellec, and van Pottelsberghe de la Potterie[15] directly address the economy-wide returns to public R&D in their cross-country study and estimate that the long-run elasticity of productivity with respect to public R&D capital averages 0.17 over their sample of sixteen OECD countries. Furthermore, the elasticity is higher for countries with a relatively large share of university-performed research compared to government lab research and in countries where the business R&D intensity is relatively high, indicating that the spillover benefits of public research are complementary with corporate research activities.

It is possible that public sector research crowds out private sector research. A survey by David, Hall and Toole[16] found that studies conducted at firm level were more likely to report net substitution or crowding-out than were studies carried out at a higher level of aggregation. Moreover, crowding out was a common finding in US studies whereas a large majority of studies conducted in other countries found complementarity between public and private R&D. Guellec and van Pottelsberghe de la Potterie[17]examine the effect of government funding on business R&D across 17 OECD countries from 1981-96. They report that government funding stimulates business R&D expenditure (BERD) if the government research is contracted to the

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[11] Lichtenberg, F. R and Siegel, D., *The Impact of R&D Investment on Productivity - New Evidence Using Linked R&D-LRD Data*, Economic Inquiry 29: 203-228 (April 1991)
[12] Nadiri, M. I., *Innovations and Technological Spillovers*, NBER Working Paper No. 4423. 1993.
[13] OECD, *The Sources of Economic Growth in OECD Countries*, Paris: OECD Publication Services. 2001.
[14] Mamuneas, T. P. and Nadiri M I., *Public R&D Policies and Cost Behavior of the Us Manufacturing Industries*, Journal of Public Economics 63: 57-81. (1 Dec. 1996)
[15] Guellec, D. and van Pottelsberghe de la Potterie, B., *R&D and Productivity Growth: Panel Data Analysis of 16 OECD Countries*, OECD Economic Studies 33: 103-126. 2001.
[16] David, P. A., Hall, B. H. and Toole, A. A., *Is Public R&D a Complement or Substitute for Private R&D? A Review of the Econometric Evidence*, Research Policy 29: 497-529. (4-5 April 2000).
[17] Guellec, D. and van Pottelsberghe de la Potterie, B., *R&D and Productivity Growth: Panel Data Analysis of 16 OECD Countries*, OECD Economic Studies 33: 103-126. 2001.

business sector, but tends to partially crowd out BERD when performed in government laboratories. BERD is not affected by university research. They also find that tax incentives are effective in stimulating BERD, whilst recognising that some of this effect may work through an increase in R&D costs.

Of course, publicly funded R&D may result in benefits that are not captured in productivity measures. Salter and Martin[18] cite a number of surveys of firms which suggest that the private sector gains substantially from publicly funded research in a variety of ways:

1. Increasing the stock of useful knowledge;
2. Training skilled graduates;
3. Creating new scientific instrumentation and methodologies;
4. Forming networks and stimulating social interaction;
5. Increasing the capacity for scientific and technological problem-solving; and
6. Creating new firms.

c) The geographical location of research

There is a body of work investigating the links between scientific research, sometimes defined as university-based research, and measures of innovation. Some of these studies investigate the extent to which the benefits of research are concentrated within the geographic region where the research is carried out.

For example, Acs, Audretsch and Feldman[19], following Jaffe[20], analyse survey data on the rate at which firms register both patents and significant product innovations across US states and fields of technology in 1982. The authors conclude that own R&D activity is particularly important for large firms, which have sufficient scale to run their own labs, whilst smaller firms tend to benefit from the knowledge created in publicly funded research. The effectiveness of public research is enhanced by geographical proximity to private sector research labs. Similar results are found by Audretsch and Vivarelli[21] in their study of the determinants of annual regional patenting activity across fifteen regions of Italy over the period 1978-86. These studies deal with the contemporaneous relationship between innovation, private sector R&D activity and publicly funded research. As such, it is not clear that the strong correlations that have been identified are necessarily evidence of causation. It is plausible to suppose, for instance, that universities might respond to patterns of industrial activity and innovation by concentrating their research activities in those areas where the private sector is locally active.

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[18] Salter, A. J. and Martin, B. R., *The Economic Benefits of Publicly Funded Basic Research: A Critical Review*, Research Policy 30: 509-532. (3 March 2001)
[19] Acs, Z. J. Audretsch, D. B. and Feldman, M. P., *R&D Spillovers and Innovative Activity*, Managerial and Decision Economics 15: 131-138. (2 March (1994)
[20] Jaffe, A. B., *Real Effects of Academic Research*, American Economic Review 79: 957-970. (5 Dec. 1989)
[21] Audretsch, D. B. and Vivarelli, M., *Firms Size and R&D Spillovers: Evidence from Italy*, Small Business Economics 8: 249-258. (3 June 1996)

d) International technology spillovers

There is widespread evidence that the rate of technology transfer between countries depends on the policies and activities of the recipient country. Coe and Helpman[22] inspired a series of studies which report evidence that international technology spillovers amongst OECD countries are enhanced by trading with high R&D-intensive countries.

A second school of thought on international technology transfer is based on the models of Nelson and Phelps[23] and Abramovitz[24]. There are two forces in operation. The size of the technology gap relative to the world frontier represents the scale of opportunity to acquire productivity-enhancing technology. The opportunity to acquire foreign productivity is not sufficient, however, to generate rapid economic growth. A country must also possess the capacity to identify, capture, implement and adapt the technology. This 'absorptive capacity' is often modelled as a function of the level of human capital of the technology-acquiring country. Without a highly skilled scientific workforce to identify the appropriate technologies, or without a technologically capable management and production workforce, a country will be unable to make use of the foreign technologies.

A series of studies confirms that domestic investment in education enhances absorptive capacity.[25]

Further evidence on the determinants of absorptive capacity comes from a study of industry-level productivity growth covering 12 industries in 13 OECD countries since 1970[26]. It found that the role of trade is relatively weak whilst investment in both R&D and education increase the capacity of industries to absorb technology from the overseas leaders. The dual role of domestic R&D in promoting not only domestic innovation but also technology transfer from overseas is particularly interesting. The importance of own R&D for the acquisition and implementation of foreign technology is confirmed by the macroeconomic study of Guellec and van Pottelsberghe de la Potterie[27]. They suggest that the most important criterion for effective absorption of particular technologies is active domestic research in the cognate field.

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[22] Coe, D. T. and Helpman, E., *International R&D Spillovers*, European Economic Review 39(5): 859-887. 1995.

[23] Nelson, R. R. and Phelps, E. S., *Investment in Humans, Technological Diffusion, and Economic Growth*, American Economic Review 56: 69-75 (1-2 March 1966)

[24] Abramovitz, M., *Catching up, Forging Ahead, and Falling Behind*, Journal of Economic History 46: 385-406. 1986.

[25] Benhabib, J. and Spiegel, M., *The Role of Human Capital in Economic Development: Evidence from Aggregate Cross-Country Data*, Journal of Monetary Economics 34(2):143-173. 1994.; Frantzen, D., *R&D, Human Capital and International Technology Spillovers: A Cross-Country Analysis*, Scandinavian Journal of Economics 102(1):57-75. 2000.; Dowrick, S. and Rogers, M., *Classical and Technological Convergence: Beyond the Solow-Swan Growth Model*, Oxford Economic Papers 54: 369-385. 2002.

[26] See Griffith, R. Redding, S. and Van Reenen, J., *Mapping the Two Faces of R&D: Productivity Growth in a Panel of OECD Industries*, Review of Economics and Statistics 8: 883-895. (4 Nov. 2004)

[27] Guellec, D. and van Pottelsberghe de la Potterie, B., *R&D and Productivity Growth: Panel Data Analysis of 16 OECD Countries*, OECD Economic Studies 33: 103-126. 2001.

2. Design Principles and Criteria[1]

It is useful to consider and apply certain basic policy and program design principles, applying some of the lessons of the experience in Australia and other countries. Adherence to clear design principles is the best way to avoid flawed programs and unintended consequences. Good policy design should reduce inefficiencies in the innovation system and the extent of 'innovation regulatory red tape' around support programs. Approaches to design will frequently be influenced by the political mindset as to whether public innovation outlays represent 'expenditure' and costs to the community, or 'investments' for future benefit. Too often the former prevails over the latter.

Designing good policy essentially revolves around identifying the best solution to a problem. Gary Banks, the Chairman of the Productivity Commission, recently provided a succinct overview of the key steps in good policy development[2].

Key steps in best practice policy development

Developing the best policy approach to a particular social, environmental or economic issue requires systematic processes to ensure that the ultimate decision is as well informed as possible and therefore unlikely to have adverse or unintended consequences. The key steps are:

- *Understand the nature of the problem or issue and its causes.*
- *Determine why some form of policy intervention is called for and thus specify the policy objective.*
- *Outline the range of possible policy options (including non-regulatory approaches).*
- *Assess their relative efficacy in addressing the problem, and their impacts (costs and benefits) across different parts of the economy and sections of the community.*
- *Choose the option that maximises net social benefits, taking all impacts into account.*
- *Develop an effective implementation strategy to avoid undue transitional costs, and monitor the outcome.*

In 1998 Australia's Productivity Commission undertook a comprehensive survey of design principles for business programs[3], the so-called Lattimore review. This provides an excellent reference point and resource, and continues to be a reference model in Productivity Commission reviews. The following checklist is adapted from this framework, and its further elaboration in the recent Commission report on public support for science and innovation

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[1] Cutler, T. *Alliances for innovation and economic development: the Australian experience* A study prepared for the United Nations Economic Commission for Latin America and the Caribbean (ECLAC). 2008.
[2] Gary Banks, Public inquiries in policy formulation: Australia's Productivity Commission, Address at China-Australia Governance Program, Beijing, 3 September 2007.
[3] Lattimore R, Martin, B. Madge, A. and Mills, J., *Design Principles for Small Business Programs and Regulations*, Productivity Commission Staff Research Paper, Canberra, August 1998.

support for science and innovation[4].

Policy Design Criteria

Clarity about the problem to be solved.

Is there a clear and unambiguous statement of objectives and rationale? Does the policy or program target the problem effectively?

Inducement effect (additionality or behavioural change)

Is it clear how policy or program incentives will affect behaviour? Will it induce new or different activity? Is it likely to have acceptable take-up? Is the scale of the program consistent with the desired outcomes?

Contestability and transparency

Should there be contestable funding arrangements? Deliberate choices should be involved in deciding between contestable or noncontestable arrangements. The Productivity Commission notes[5] that such choices should be informed by:

- *the ability to define appropriate objectives in terms of community benefits;*
- *the ability to evaluate the merits of competing proposals against those objectives;*
- *the administrative and compliance costs involved in the application and evaluation of funding proposals; and*
- *the potential for strategic behaviour by stakeholders to obtain preferential treatment.*

A different insight might come from the tests for 'policy market' contestability. Are there low entry and exit barriers? This directs our attention to the appropriateness of any hurdles to accessing a program, or to potential problems with 'lock-in', both for participants or programme providers.

In the case of non-contested funding arrangements (as in block funding or bi-lateral arrangements) how might monopsony market pricing disciplines be applied to public policy?

Consistency

What are the possible interactions with other policies? Where does this policy fit within the overall policy portfolio?

Duration

How long would the programme need to be in place to produce the desired outcomes, or to produce sustainable results? This also draws attention to the desirability of aligning carefully the cycles for funding, milestones, and evaluation. It is also worth considering whether there is scope or benefit in program 'tranches', as in a venture

[4] Productivity Commission, *Public Support for Science and Innovation, Research Report*, Canberra, March 2007, See Chapter 10.1
[5] Ibid., p. 374.

capital model of migration through a development cycle. Finally, there is the question of planned program exits, discussed further below.

In addition to program duration, there is an ancillary question about the presumed lifecycles for participation by individual entities (this refers to expected or desired churn or turnover in participation).

Calculated risk

Lattimore et al tend to express risk criteria in terms of 'the avoidance of risk' and this can lead to a policy or industry culture of risk aversion. The more basic aspect to risk criteria is *the understanding of the nature of risk*. Research and entrepreneurship entail risk by definition. In science, for example, progress is made by the fallibility of the current state of knowledge, with as much learning arising from null hypotheses as from proofs. There is inevitably waste within a robust innovation system, but the key issue is how to capture the lessons from apparent failure. Most things involve risk. The appropriate test revolves around assumptions about the profile of risk and the potential return. 'Is this worth the risk?' Good public policy formulation will explore the appetite for risk and proceed on the basis of 'calculated' risk. Some assessments of high risk and high return might, for example, lead to policy models built around experimentation, or pilots. These are standard processes in leading edge industrial innovation, which often proceeds through a cycle from proof of concept (does it work in test conditions?) to pilot plants (can this be scaled to industrial strength?). Public policy discussions sometimes conflate these notions of experimentation and piloting, to the detriment of appropriate outcomes. Nonetheless, there are special categories of risk which are usefully addressed by design principles.

Risk management: (i) Adverse interactions with other programmes

This calls for attention to the possibility of conflicting signals arising from different programs or policies. Pertinent examples might include:

- conflict between objectives about research excellence and productivity (i.e., output by quality versus volume, as in the value of patents versus the number); or
- the conflict in building knowledge capability between knowledge diffusion and commercialisation (or public knowledge *versus* privatised knowledge).

A different kind of negative interaction might involve the scope for 'double dipping' and 'programme shopping'.

The flipside is to look for ways in which different programmes might be rendered more complementary and mutually reinforcing. This is particularly important where programme interventions occur at specific points in a value chain (such as R&D incentives). Both the potential positive and negative impacts on upstream or downstream activity or behaviours needs to examined. The risk of isolated interventions at a single point of the innovation system is that outcomes may become stranded or 'orphaned', with no path to impact.

Risk management: (ii) Unforeseen liabilities for government and 'moral hazard'.

The most basic example here is excessive risk to government revenue from uncapped or open-ended incentive programmes, especially those delivered through the tax

system. The Australian experience has shown that the impact of variations to the R&D Tax Concession has proved notoriously difficult to predict.

The biggest pitfalls arise from inadequate attention to possible 'contingent liabilities' for government, or the 'moral hazard' of policies which might leave government captive to the claims of sectional interests. Moral hazard often surfaces when the termination of a programme is contemplated. This frequently results in inefficient or sub-optimal programmes being continued because the expenditure of political capital in closing them down is just too high[6]. As with venture capital, there is merit in building 'exit' options into programme design. A very useful mechanism is to have explicit sunset terms, linked to an appropriate funding cycle, and explicit, *ex ante* criteria for the renewal of a programme.

Risk management: (iii) Strategic behaviour by firms

This is code language for the risk that firms and beneficiaries may be able to 'game' the system. Poor programme design may leave the way open for unexpected behaviours, some of which might undermine the integrity of a policy. A good example of this in Australia was the financial engineering around R&D Tax Concession Syndication. Another example is the way the new ventures backed by private equity might use the R&D grant schemes to leverage the value of their equity stake and to free up working capital for other purposes. No judgement is being made here as to whether or not this is inimical to the public interest. The real risk in public private interfaces around programmes arises from the often mutual incomprehension of the operating context and culture of the other. Where one party sees an opportunity to take advantage of 'blind spots' on the part the other, the risk is that this undermines the intended alignment of interests in certain outcomes. It can also breed suspicion and lack of trust.

The test in policy design is to keep asking how a self-interested, commercially savvy party would seek to optimise the private benefit from a public programme. There are several ways in which this can be done. The first design strategy is the 'hacker challenge' in computer software, where developers co-opt hackers to fireproof a system design. Where the stakes are high, this strategy can be used in public programme design. Retain the smartest commercial operators to tell you all the ways they could find to 'rort the system'. More generally, one of the sources of value from private sector participation in public sector governance or evaluation processes is the ability for these participants to provide a critique of how programmes might operate in the 'real world'. For example, anyone with a business background would quickly provide feedback that a small incremental tax benefit with high compliance costs is likely to have little industry impact. Another example is in the area of making judgements about the points at which 'additionality' might kick in as the threshold below which a firm or entity would be likely to undertake an activity anyway.

Administrative and compliance efficiency

While this is an obvious design principle, it is frequently ignored in practice. Problems arise when there is a mismatch between the inventive instrument or funding mechanism and the administrative framework. An example would be where a small grant programme involves complex application and assessment procedures. A

[6] This approach is exemplified in the EFIC case study.

proportionality principle should apply. Another source of inefficiency is where compliance regimes require special-purpose reporting which is different from related reports a firm may be required to produce for normal business compliance[7]. This practice commonly creates significant additional overhead costs for an entity. Compliance and evaluation can be over-engineered. Often very simple mechanisms can substitute for massive red tape.

Accountability and transparency

The strongest mechanism to promote accountability and transparency is the timely and open reporting of activity. The default position should be full public disclosure unless there are sound reasons for the introduction of limitations (such as the privacy implications of fully disaggregated data). Where commercial sensitivities limit disclosure there should be robust independent audit processes to provide assurance about the integrity of programmes.

Cost effectiveness

The cost effectiveness of programmes is best secured by establishing a business case model as part of the design process. This has the benefit of:

- enabling a proposal to be evaluated against alternative programme solutions for a given objective; and
- articulating the *ex ante* assumptions for review in evaluation processes.

Thinking about costs should not preclude attention to non-price factors and externalities. Externalities include examining whether an initiative might impose some significant costs on a particular group. Positive externalities should not be ignored.

Compliance with international obligations

There has been increased focus on compliance with international treaty obligations in policy design. Unfortunately, there is often little expert knowledge brought to bear on such compliance, leading to unnecessarily barren policy frameworks. On occasion international trade rules will be used an alibi for inaction.

As with all compliance regimes, there is often a great difference between the actual ‘black letter’ obligations and the purported intent or ‘spirit’ of an undertaking. It is arguable, for example, that obsessive concern with keeping to an expansive interpretation of an undertaking will penalise a country relative to others that operate on the basis of minimum compliance. Germany and Japan are good examples of the latter in the area of the application of WIPO rules to patent law.

Evaluation, monitoring and reporting.

The key principles here are:

- the development of the evaluation criteria and reporting requirements *ex ante*;
- a requirement for *ex ante* and *ex post* performance data;
- the independence of the review function as an ‘audit’ process; and
- proportionality.

[7] The CRC programme, for example, requires detailed financial reports as a different chart of accounts to those which a CRC needs to prepare as its statutory corporate returns.

Annex 4

In monitoring frameworks, there is scope for greater attention to be given to ‘lead’ as well as ‘lag’ indicators. The distinction between group or portfolio evaluation versus individual programme evaluation should be considered carefully.

Annex 6

I. Funding or research and research training in the higher education sector

A. Current funding schemes

The Australian Government operates a dual support system for funding of research and research training. The system consists of competitive grant programs, where funding is distributed to research teams through merit-based, peer-determined processes, and performance-related block grants, which are allocated to institutions.

The principal competitive grant awarding bodies, the Australian Research Council and the National Health and Medical Research Council, collectively distributed approximately $1.1 billion in 2008. Approximately $1.21 billion was provided in 2008 to eligible higher education institutions as block grants for research and research training, through a number of performance-based schemes. Institutions have considerable autonomy in deciding what research projects, personnel, equipment and infrastructure this funding should support.

The principal research block grants administered by the Department of Innovation, Industry, Science and Research are:

- Institutional Grants Scheme (IGS) - $308 million in 2008.
- Research Infrastructure Block Grants (RIBG) – $208 million in 2008.
- Research Training Scheme (RTS) - $585 million in 2008.
- Australian Postgraduate Awards (APAs) - $98 million in 2008.
- International Postgraduate Research Scholarships (IPRS) - $19 million in 2008.

Block grants are principally allocated to institutions using program-specific formulae that reward the performance of institutions in attracting research income, disseminating research results in mainly peer-reviewed publications, through the successful completion of research degrees by students, and by higher degree by research student load.

Institutional Grants Scheme (IGS)

The stated aim of the IGS is to maintain and strengthen Australia's knowledge base and research capabilities by developing an effective research and research training system in the higher education sector. Under this scheme, block grants are provided ($308 million in 2008) to support research and research training activities. Institutions have discretion in the way they spend their IGS grant provided it is used to fund any activity related to research.

The IGS allocation is based on an index of institutional performance comprising research income (60 percent), HDR student load (30 percent) and publications (10 percent). There is a safety net which prevents poorly performing institutions from losing more than 5 percent from year to year.

Research Infrastructure Block Grant Scheme (RIDG)

The RIBG scheme provides block grants to enhance the development and maintenance of research infrastructure and to meet project-related infrastructure costs associated with competitive grants awarded by bodies including the Australian Research Council and the National Health and Medical Research Council. Indirect research costs supported through RIBG include the non-capital aspects of facilities such as libraries, laboratories, computing centres and the salaries of support staff. The allocation is formula-driven with grant amounts reflecting the relative success of each institution in attracting Category 1 competitive research funds, as calculated from the Australian Competitive Grants Register (ACGR). The current level of funding provides a 'top-up' of approximately 20 percent to competitive grants.

Research Training Scheme (RTS)

The RTS is the largest of the block grants in support of research and research training. The RTS mechanism returns 75 percent of higher education providers' previous year's allocations and allocates the remaining 25 percent according to providers' relative success in a performance index comprising:

- higher degree by research completions (50 percent),
- research income (40 percent), and
- research publications (10 percent).

A 'safety net' provision reduces the potential loss to a poorly performing institution to a maximum of 5 percent from year to year.

Australian Postgraduate Awards

The APA scheme provides block grants to higher education institutions in support of training for a higher degree by research students. Awards are available for a period of two years for a Masters by research degree or three years, with a possible extension of six months, for a Doctorate by research degree. Award holders receive an annual stipend ($20,007 as of 2008) and may be eligible for other allowances. New scholarships are allocated to institutions on the basis of the RTS performance index described above.

International Postgraduate Research Scholarships

The IPRS scheme provides block grants to higher education institutions to maintain and develop international research linkages and specifically aims to attract top quality international postgraduate students to areas of research strength in the Australian higher education sector and support Australia's research effort. The program provides 330 new scholarships each year. New scholarships are allocated to institutions on the basis of the RTS performance index described above.

B. Analysis of the allocation criteria for the current funding schemes

The schemes allocate together over $500 million annually, predominantly on the basis of research income earned from national competitive grants and other sources. In part this is in recognition of the fact that competitive grants are not designed to meet the full costs of

research, an issue to which we will return.

An important implication of the allocation criteria is that universities are faced with only weak incentives to recruit high quality researchers who work outside of grant-winning areas, such as researchers working in theoretical areas where the need for expensive equipment and support staff are low. The primary output of such researchers is in internationally recognised publications, but publication output is given only a ten percent weight in the IGS allocation formula and zero weight in the RIBG scheme. Moreover, the current method of assessing publications gives the same weight to an in-house journal or book publisher (as long as it passes a minimum standard for refereeing) as it does to one of the world's leading international journals or academic publishing houses.

The high weight afforded to research income, rather than research output, under the IGS and RIBG formulae also imply a long lag in rewarding high quality performance. For example, if a university appointed a new researcher in 2000, that researcher would not be likely to submit a major ARC application until the beginning of 2001. If awarded, the grant would not commence until 2002. The financial return to the university on their initial investment in 2000 would not come through IGS and RIBG funding until 2004 – a four year lag. Moreover, the success of the grant application is likely to have reflected the researcher's publication performance in the mid to late 1990s, so the return to performance is likely to be between lagged between five and ten years.

The Excellence in Research for Australia (ERA) initiative was announced in February 2006. This initiative, to be developed by the Australian Research Council (ARC), will assess research quality using a combination of metrics and expert review. It will provide a sound basis for ranking the quality of research output across Australia.

FINDING 1. The allocation criteria for performance based block funding under the IGS and RIBG schemes give inadequate weight to the quality of research. In future, more substantial weight should be given to research quality using rankings derived from the ERA assessments.

The Research Training Scheme (RTS) and the domestic and international scholarship schemes (APA and IPRS) currently distribute over $700 million annually. The allocation criteria for these funds are dominated by historical funding rather than by any measure of the quality of training. Three quarters of the RTS funding, i.e. over $400 million of the total, is based on the previous year's allocation, and the safety net provision prevents any substantial re-allocations from taking place year to year. The rest of the funding is allocated according to a 'performance' index. Half of the weight in the performance index is allocated to research degree completions, and these completions are heavily influenced by past awards of scholarship funding.
Placing so much of the weight on historical funding implies that current funding of research training does not reflect the quality of the training. Rather than providing the best research teams in the country with funds and scholarships to attract the best research students, the current funding schemes consign a substantial proportion of research students to sub-optimal research environments.

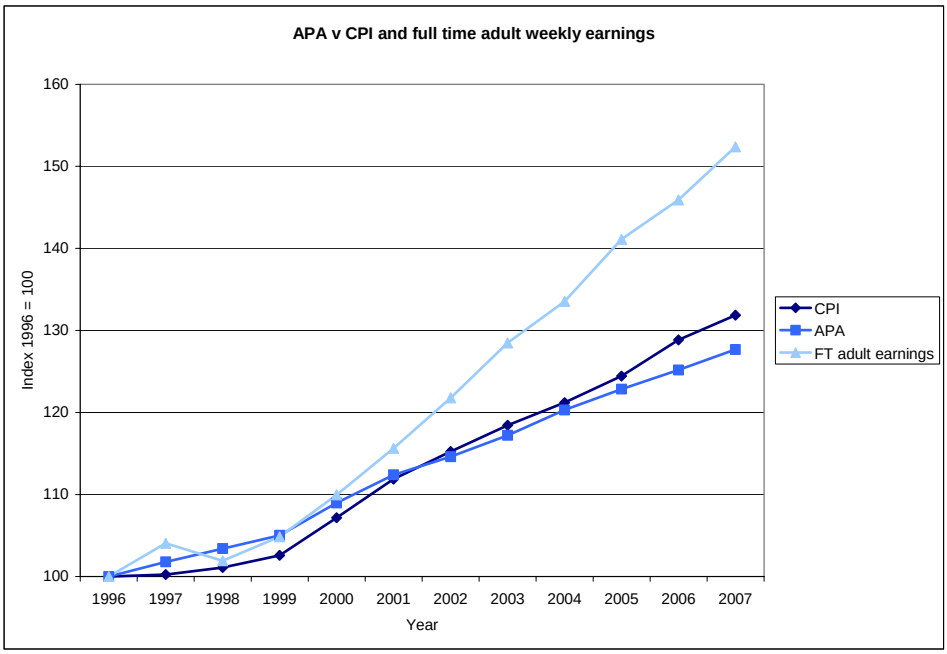
FINDING 2. The allocation criteria for the funding of research training and scholarships give inadequate weight to the quality of the research teams who supervise and train the students. In future, less weight should be given to historical funding patterns and more weight should be given to the quality of the supervising research teams based on rankings derived from the ERA assessments.

C. Analysis of the level of funding

Research Student Stipends

An array of evidence suggests that the level of stipends awarded to research students is inadequate. Research students are currently awarded an annual stipend under the APA of $20,007 for three years, extendable for 6 months under special circumstances. The real value of this stipend has been eroded over recent years. Figure 1 plots an index of the APA stipend rate from 1996 to 2007 compared with the Consumer Price Index (CPI) and an index of full time adult weekly earnings.

Figure 1: APA versus CPI and full time adult weekly earnings



Source: Department of Innovation, Industry, Science and Research submission to the House of Representatives Committee on Industry, Science and Innovation Inquiry into Research Training and Research Workforce Issues in Australian Universities

The figure indicates that growth in the stipend rate in recent years has failed to keep pace with that of either prices or wages. The comparison with wage levels is the most appropriate since this represents the opportunity cost of research training for a graduate. On this comparison, the value of the stipend has fallen by 17 percent sine 1996.

The Review Panel has noted that under the Australian Postgraduate Award (Industry) scheme research students are currently paid an annual stipend of $26,140. This level of stipend is judged to be sufficient to recruit and adequately support students undertaking

full-time research training.

At its current rate in 2008 (approximately $385 per week), the full-time APA stipend is only marginally above the Henderson poverty line[1] for the March quarter of 2008, which for a single person working is $378.08 per week (equivalent to $19,660.16 per annum).[2] The Council for Australian Postgraduate Associations (CAPA) has reported that the stipend rate will slip below the poverty line by the end of 2008.[3]

Further evidence of the inadequacy of the student stipend comes from a recent study by Universities Australia.[4] This study reports that, amongst full-time higher degree research students in 2006, 38 percent used up savings in order to study in 2006, 46 percent believed that supporting their studies put a great deal of financial pressure on their parents or partner. Three-quarters of part-time research higher degree students indicated they would prefer to study full-time if their financial circumstances permitted.

A further issue with the APA scheme warranting urgent attention is that support provided (up to 3.5 years) is not consistent with research training place allocations under the Research Training Scheme (4 years) and does not reflect the mean completion time for a full-time PhD of 5.4 years.[5] A key implication of this anomaly is that there is a gap of up to 12 months where students are unable to access income support under the APA scheme, at one of the most critical points in their research training – the write-up of the PhD thesis. Coupled with the low value of the APA stipend, this gap negatively impacts on the quality of the research training experience.

FINDING 3: Both the level and the length of support currently provided under the APA scheme are inadequate to encourage and support the participation of the best students in research training.

The full cost of university research

Funding of research and research training under the performance related block grants and the competitive grants program covers only a fraction of the full costs of research. Lacking full funding, research and research training are typically subsidised from other revenue streams – notably full fee income from overseas students. This cross-subsidisation is not sustainable in the longer term. If the fees paid by foreign students are

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[1] The Henderson Poverty Line as defined in the 1973 Commonwealth Commission of Inquiry into Poverty—Commission of Inquiry into Poverty, 1975, First Main Report, Poverty in Australia, AGPS, Canberra.

[2] Published by Melbourne Institute of Applied Economic and Social Research, University of Melbourne. http://www.melbourneinstitute.com/labour/inequality/poverty/default.html

[3] CAPA Media Release: APAs to Break Poverty Line. April 30 2008 http://www.capa.edu.au/files/APAs-to-break-poverty-line.pdf

[4] Universities Australia, Australian University Student Finances 2006: A summary of findings from a national survey of students in public universities, cited in the Department of Innovation, Industry, Science and Research submission to the House of Representatives Committee on Industry, Science and Innovation Inquiry into Research Training and Research Workforce Issues in Australian Universities, 2008

[5] Graduate Careers Australia *Post Graduate Destinations 2006: The Report of the Graduate Destination Survey*. 2007.

not reinvested by universities in providing high quality teaching and specialised support for students with linguistic and cultural challenges, then Australian universities will become uncompetitive in the global markets for undergraduate and postgraduate studies. Competitive pressure is likely to be particularly intense for the foreseeable future given the high exchange rate for the Australian dollar which results from the global commodity boom. A decline in overseas student income would, under the current funding system, play havoc with universities' research activities.

Innovative Research Universities Australia (IRUA), for example, have expressed concern in their submission to the Review at the over-reliance of Australian universities on international student revenues as a source for cross-subsidisation of research. They state that:

> *In our view, a continuation of this over-reliance to the extent currently demanded by higher education and research funding policy will significantly weaken Australia's innovation system*.[6]

IRUA furthermore pointed to the adverse effects of such cross-subsidisation on the quality of course delivery and related services, noting that:

> *A continued transfer of student fee income from learning and teaching budgets to research budgets could over time erode the quality of course delivery and student services. It is far preferable for surpluses generated from international student revenue to be re-invested in enhancing the quality of the student experience*.[7]

Other universities pointed to the distorting effect of partial funding. The University of Western Australia, for example, commented that:

> *While the initial intention of partial funding may have been to encourage universities to seek additional funds from industry and other sources, the result has been sub-optimal performance across the board and a distortion of priorities and effort. Commonwealth research agencies need to be funded in ways that allow them to fund the full cost of research and reward universities in an appropriate way for success*.[8]

Similarly, the NSW Department of State and Regional Development noted:

> *the current model leads to inefficiencies and sub-optimal allocation in universities and State governments, and increases the administrative burden associated with research programs*.[9]

Research Agencies have also expressed concern. CSIRO, for example, commented in its submission that:

> *the Australian NIS would be greatly simplified if funding bodies invested in the full cost of the research they are supporting…it is not uncommon for*

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[6] Innovation Research Universities Australia – Submission no. 332, p25
[7] Ibid, p26
[8] University of Western Australia - Submission no. 313
[9] NSW Department of State and Regional Development - Submission no. 632

> *research funders or agencies to leverage their funds two or three times (and occasionally higher) with the result that there is really very little new money to sustain the system. It is concerning that this has become the dominant mode of investment because it is producing serious distortions in the strategic roles of R&D providers and undermining their sustainability. This model of research funding results in marginal costing by the research providers and the subsidisation of research through other means; and it distorts the core purpose and roles of research organisations as they jettison their strategic research strategies in favour of shorter-term, near market research.*[10]

Available evidence suggests that the ARC and other key research funding agencies do not fully fund the cost of the research they sponsor. In particular, ARC competitive grants are designed to cover only incremental costs of research programs – typically covering the extra costs of new research and laboratory assistants and additional materials but contributing nothing to chief investigator salaries and overhead costs. Unless the application is specifically for a fellowship, the salaries of the researchers are met by the university, which also bears all of the overhead costs. Overhead costs can be very substantial covering administrative support, recruitment costs, IT facilities, internet access, libraries, etc. Infrastructure costs are supposed to be met by the retrospective allocation of block grant funding (for example, IGS and RIBG), but the relatively small pool of funding is clearly not sufficient to cover the shortfall on full costs.

The ARC currently estimates that it funds approximately 60 percent of the total direct cost for the research it sponsors through its Discovery Project scheme and reports a lack of capacity to support the indirect costs within its current budget.[11] The Australian Technology Network of Universities (ATN) suggests in material provided to the review that the contribution of universities to full cost recovery range from 30 percent to 50 percent. It is not clear whether these estimates include capital costs.

While precise estimates of the full costs of university research and research training are not currently available, the Review Panel understands that government is currently investigating the full costs of both teaching and research in Australian universities. The Review Panel considers that this work, along with an examination of the relative merits of approaches developed in other countries, could form an initial basis for determining the details of a suitable full costing and funding framework for Australia.

Lessons from other countries

For some time now, in recognition of these issues, countries have been progressively moving to towards systems which accurately account for the full economic costs of research activities and introducing funding mechanisms that recognise those costs.

For example, the Transparent Approach to Costing (TRAC)[12] is the standard, activity-based method used for costing in higher education in the United Kingdom (UK).

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[10] CSIRO - Submission no. 217
[11] Australian Research Council - Submission no. 576
[12] See http://www.jcpsg.ac.uk/downloads/guidance/Overview.pdf

Developed in 1999 as part of the UK Government's Transparency Review, since 2000, TRAC has been the methodology used by the 165 Higher Education Institutions in the UK for costing their main activities (Teaching, Research, and Other core activity).

The principle objectives of TRAC are:

- to provide consistent and robust information about the cost of activities to assist institutional planning and management;
- to provide a basis for the pricing of activities, particularly those that are publicly funded;
- to meet the requirement for accountability, particularly for the use of public funds, when the institutional portfolio includes a complex mix of activities; and
- to provide at both institutional and national level an appropriate and comprehensive cost model to guide investment for the future.

From 2005, the United Kingdom Government provided significant additional funding (120 million pounds a year from 2005-06 and additional 80 million pounds per year from 2007-08) to enable the UK Research Councils to fund projects at 80 percent of the TRAC full economic costs while maintaining the current volume of Research Council supported research in higher education institutions.[13]

FINDING 4. The current failure to identify the full costs of research and to fund university research accordingly is contributing to a lack of sustainability in both research activities and in the teaching export activities that provide the financial cross-subsidies. Current investigations by the Australian Government and information from the experience of other countries, in particular the UK, offer a relatively low-cost solution to the information problem.

Implications for funding levels and mechanisms

Once the full costs of research have been established, a transition to full-funding will become feasible. If the recommendations of the Review for increases in the level of research funding are accepted, it will be possible to move towards full-funding without jeopardizing the number of research projects which receive competitive grants and the amount of research funded by universities from performance based block grants. It is beyond the remit and resources of this Review to provide a full assessment of the optimal balance between competitive grant, performance related block funding and infrastructure funding from the new Education Investment Fund. These important assessments should be dealt with in the forthcoming process of negotiating mission-based compacts between government and universities.

To the extent that funding is increased and the allocative criteria for the block grants and funding for research training are aligned to the ERA rankings of research quality, we can expect more high quality research to emerge. Competition amongst universities for research-quality based funding can be expected, following the UK example, to encourage academic entrepreneurship which will improve the quality of research through

[13] Research Councils UK, http://www.rcuk.ac.uk/aboutrcs/funding/dual/fec.htm

specialisation and concentration of resources.[14]

Rather than debating whether Australia can support two or three 'world-class' universities, the focus should switch to establishing a hundred or more world-class research facilities and research groups across the whole university system. Domestic and international networking should be promoted to ensure that the benefits of specialisation and concentration of research activity spread across the whole of the system.

[14]A 2003 UK Department for Education and Skills report, *The Future of Higher Education*, pointed out that: "*Concentration brings real benefits, including better infrastructure (funding excellent equipment and good libraries), better opportunities for interdisciplinary research, and the benefits for both staff and students which flow from discussing their research and collaborating in projects."* The OECD has also picked up on this trend in a number of member and non-member countries. The Organisation's 2005 report, *Innovation Policy and Performance: A Cross-Country Comparison*, offers several examples of both the benefits arising from concentration of research and the problems arising from lack of concentration, noting particularly that fragmentation can lead to limited resources being spread to thinly, leading to an overall decline in research performance.

2. National Priority Research Centres

The Review recommends further consideration of the proposal that National Priority Research Centres be established in areas of key importance to Australia's innovative future. The Centres will build research collaboration among our best researchers, provide careers for our top young scientists and attract the best mid career researchers from across the world. The Centres would build research capacity at the highest level, providing knowledge and discoveries essential for a future competitive Australia.

These Centres will not duplicate the ARC Centres of Excellence. They will be set up in research areas which the Government regards as of high priority for innovation. They will support the best researchers in the country in the priority areas, irrespective of whether those researchers are in Universities, CSIRO or other Government funded research agencies, or medical research institutes. All categories of these researchers receive direct support and they will not be differentiated as to their Institution. The proposed duration of the Centres is ten years, not the shorter period which applies to the ARC Centres of Excellence and this is important because it not only provides the best young researchers of Australia new avenues for a career, but it is critical as a feature in attracting the best early to mid career scientists from around the world to make the decision to locate their research career in Australia.

These Centres will also be multidisciplinary and although focusing on fundamental research, they will need to present detailed plans as to how their discoveries will be delivered to end users. It is anticipated that highly regarded industry representatives will be on the Steering and Advisory Committees from the very beginning of these Centres.

The recommendation is to strengthen basic research and build capacity in areas of critical national importance by:

- Supporting the best scientists in Australia in chosen research areas
- Providing the means for these top scientists from different research institutions to collaborate closely towards agreed objectives
- Attracting high performing early to mid-career scientists from around the world to work in Australia, building our R&D capacity
- Linking each basic research centre with a series of satellite application research laboratories in both the public and private sectors

Australia is slipping behind its international colleagues and competitors in key areas of fundamental research in virtually every scientific discipline. We have developed an imbalance in the past few years between investment in basic and applications research. In the last decade, gross expenditure on all forms of R&D has grown, but the proportion spent on basic research has declined. Between 1994/95 and 2004/05, the share of expenditure on basic research declined from 27 percent to 23 percent, whereas applied research and experimental development grew from 73 percent to 77 percent. Increased investment in applications research has been justified but must be matched with increased

investment in the acquisition of new knowledge and intellectual property from basic research.

We have an ageing population of top researchers and these elite scientists are concerned with the deficiency of high performing, mid career researchers progressing through the ranks.

Australian academics (and researchers) aged in their 40s and 50s outnumber those in their 20s and 30s by 31 percent; a whole generation of potential academics appears to have been lost to other occupations, industries and countries.

In our country of only 21 million people, we lack critical mass and skills across many of the disciplines needed to generate new discoveries in topics of national importance. These issues are of particular concern to Australia's future growth – they include climate change, reduced fresh water supplies, degraded environments. Emerging paradigms of science, nanotechnology, biotechnology and epigenetics must be vigorously pursued if we are to be respected at the highest international forums of exchange of new scientific information.

The productivity commission’s 2007 report on public support for science and innovation noted that positive spill-over from basic research would only be realised if support were provided for mechanisms for efficient knowledge diffusion. The Centres and their road maps to applications provide for this need.

- We need to establish virtual National Priority Research Centres primarily focussed on basic research but with roadmaps for development and uptake of new knowledge and Intellectual Property into innovative industries.
- We must support our most distinguished researchers in a collaborative program approved by international peer review. Elite teams will be drawn from Universities, CSIRO, other PFRAs and Medical Research Institutes and would involve International Collaborations.
- The critical investments are for human resources and elite capability building, not for capital expenditure or additional administration load.
- The Centres if supported for a period of at least ten years would provide careers for our best young scientists as well as attracting high performing young scientists from around the world.

The proposed National Priority Research Centres will build on the current strengths of Australian science while addressing its shortcomings. The National Priority Research Centres will be based on collaboration. In a sense they will be similar to the Cooperative Research Centres, but will focus on strategic basic research.

The Centres will address the key problems and opportunities of our country. Global science systems are struggling to keep pace with the evolution of scientific endeavour. Many of the most urgent problems we face require novel approaches which facilitate collaboration across the traditional boundaries of disciplines, including those between the

"hard sciences" and the humanities and social sciences. The Centres will be interdisciplinary.

Human Resource Capability Building

The National Priority Research Centres will strengthen our human capital. They will build for the future by ensuring attractive arrangements and environments for world class researchers. In many cases these researchers will introduce new capabilities to Australian research, capabilities we need to enable us to be competitive in the first rank.

The centres will not uproot our best researchers from their present Institutions but instead, engage them for an agreed percentage of their time, 50 percent or more, in involvement in the Centres' collaborative programs.

The Centres will provide career opportunities for our best young scientists and will attract and develop leading, early to mid-career researchers from around the world. This approach has been successfully employed in CSIRO's Science Leader program which has attracted leading researchers from the United States, Europe, United Kingdom and China. These Science Leaders with the additional support provided to them have already proven to be catalytic centres of excellence in their respective fields. They are building powerful research groups.

The Centres will complement, not compete with the existing research funding fabric providing for Universities, publicly funded research agencies such as CSIRO, and medical research institutes. With their additional resources the Centres will strengthen the research fabric in Australia. The focus on applied research in the CRC Program, ARC linkage programs and CSIRO's Flagship programs has been warranted, but they have generated an unintended outcome - a reduction in the capacity for major research agencies to support the basic and strategic research necessary for the discovery of new knowledge so critical for future, powerful innovation.

Competitor Countries

Many of our major competitors have made substantial commitments to basic research capability recently and see this as being fundamental to their prosperity in the 21st Century. At the same time, they are developing novel ways to adapt to the changing circumstances of scientific endeavour including engaging in an unprecedented level of global competition for talent. The United States has employed a strategy of virtual multi-hub, multi-institution collaborations to support mega research projects through the National Science Foundation, National Institutes of Health and the Department of Energy. Japan has invested in 10 year support to a number of high priority research areas based around leading scientists. India and China have also made large investments to achieve rapid advances in the quality of their fundamental research capacity. China has moved within the last decade to transform many areas of science from a third world state to leading edge Institutes based around major investments in training and by attracting a cadre of top Chinese researchers from western countries. They have supplemented their efforts with the involvement of the Chinese scientific diaspora around the world.

If Australia does not maintain strength in basic research in key areas we will lose our international standing, we will not be a player in the emerging areas of science that are so important for innovation, and we will not be able to attract and train the top level of young scientists from around the world so adept at working across disciplines and in developing new technologies.

Our capacity to innovate depends upon a solid platform of enabling knowledge and technologies. A weakening of that platform over time will have serious consequences for our international standing and our national prosperity.

Governance

The government will nominate research areas of key importance to Australia. The Virtual Centres would be administered by the Department of Innovation, Industry, Science and Research (DIISR) along with other departments where appropriate. In the initial phase of the program it is envisaged that we should develop ten centres, each resourced at ten million dollars per annum for ten years (10 x 10 x 10). The $10 million figure is based on a structure comprising six groups of ten scientists. In addition there would be provision for specialised equipment.

International collaborations are likely to be an important part of the research in these Centres. A collaborative co-investment regime could be expected to provide an additional $5 million per year for each of the Centres.

The focus on quality, high profile issues of national significance is essential. The suggested level of funding and the timeframe are sufficient to ensure a continuity of commitment and thereby generate effective outcomes. These funds are not intended for capital investment – they are to support the involvement of lead scientists, to support postdoctoral fellows and early career scientists in the program, and importantly to provide for the attraction and employment of high performing mid-career science leaders from around the world.

The putative science leader and a number of other high achieving scientists from various Institutes, Universities, PFRAs or medical research initiatives in the designated area will be invited to produce a research proposal which would be peer reviewed by national and international experts. One research organisation (University or Government funded laboratory) will be invited to be responsible for the administration and financial management of each Centre. Reports to DIISR would include annual statements from external auditors and progress reports against agreed milestones and timelines. Scientific reviews by external experts would be conducted every two years. The science leader would be supported by an Advisory Committee with international experts and industry representation. As discoveries are made and intellectual property protection is put in place, the Advisory Committee will be responsible for initiating contact and arrangements ensuring delivery and use in applications to the advantage of Australia.

The National Priority Research Centres introduce a new and powerful investment for support of Australian R&D. The Panel has argued in this report for the increase of

Government investment for funding of research in Universities and Publicly Funded Research Agencies such as CSIRO. The Panel strongly believes that long-term basic research provides the new ideas and Intellectual Property that is needed to fuel the future Australian economy, providing the basis for successful participation in global enterprise, providing new opportunities in the evolving job markets, and supporting a quality of life desired by all Australians. The proposed National Priority Research Centres will enable direct research partnership between the most outstanding researchers in the University and Research Agency systems. The Panel recognises that in most scientific disciplines Australia has some elite, world ranking researchers but they are few by world standards. A strategy to bring these elite scientists into collaborative programs is sure to lead to synergies of discovery of new knowledge.

Many of the most urgent problems we have as a nation require novel approaches that facilitate collaboration across boundaries, including those between the 'hard sciences' and the humanities and social sciences. The proposed NPRCs will also strengthen our human capital by putting in place attractive arrangements for world-class researchers. These researchers will introduce new capabilities to Australian research, capabilities we will need to enable us to be competitive in the first rank. The NPRCs, with ten year contracts, will provide much needed additional career opportunities for our best young scientists, helping Australia to retain its high performing scientists.

The Centres will form a complementary parallel development to existing Government initiatives such as the National Collaborative Research Infrastructure Strategy.

NPRCs could be established in some of the recent breakthroughs in biotechnology (Box 1 – Epigenetics) and Nanotechnology (Box 2). These are areas where we do have some leading edge scientists in different but pertinent interactive disciplines – the Centres would optimise the probability of Australia maintaining a front line position in each of these areas, so crucial to future innovations in medicine and agriculture. We are uniquely placed to mount successful programs.

Other areas where a focus on strategic basic research is needed include Fossil Fuel Chemistry. The provision of clean, sustainable and cost competitive energy and chemical feedstocks is a key economic imperative for Australia. Australia is fortunate in having large reserves of coal and natural gas, which can provide both energy and an alternative feedstock source for chemicals. Environmental necessities require that new, more efficient and cleaner processes for the exploitation of these reserves be developed. There is limited research being conducted in Australia into the novel exploitation of the nation's fossil fuel endowment. There are isolated centres of research excellence, but there has been little incentive to focus, cooperate and integrate efforts needed to develop the basic science underlying future security and commercial exploitation. There is a world market for the new approaches successful research would provide.

It should be emphasised that the basis of the initiative is to study the fundamentals that can be expected to lead to future exploitation of novel intellectual property on a world

Box 1 - Epigenetics – the new frontier in biological research

Recently knowledge of the control of gene action has increased dramatically. With this has come a greater capacity to modify the genetics of plants and animals to increase food production and the nutritional quality of foods and animal feeds, and for the diagnosis and treatment of human disease. Epigenetic factors control the way that a cell uses encoded genetic information. Our understanding of epigenetics is in its infancy but recent technical developments now provide us with the tools required to further our understanding.

Epigenetic mechanisms are similar in all higher organisms. In Australia we have scientific leaders in plant, animal and human epigenetics. In a number of countries large investments are being made in projects aimed at understanding Epigenetic gene control (US NIH human epigenetics ($119m). If Australia is to maintain a frontline position, we need to invest to develop an interactive group of our best researchers in this area.

Basic knowledge of epigenetic gene regulation will be used to improve both medicine and agriculture. Epigenetics will help provide food security and food quality to protect animals and plants against disease and to better equip them to respond in a robust manner to environmental stress challenges.

Already epigenetic mechanisms are the target of drugs to control specific types of cancer. It is clear that epigenetic controls are involved in the interaction in the womb between the maternal and foetal genomes.

The proposed Priority Research Centre would develop capabilities in the genome wide analysis of changes in DNA methylation, chromatin proteins and small RNAs. Bioinformatic analyses of epigenetic regulation mechanisms will enable advances in plant and animal gene control which will also apply to the control the of human genes.

scale. This is the opportunity to invest in some of the best brains in Australia in the context of clean routes to energy, fuels and chemicals. Preliminary economic assessments will be made at an early stage in order to define achievable objectives, but the emphasis will be on building Australian capability and opportunity in the critical area of development. The immediate objective will be to develop fundamental understanding of the basic science and, where necessary, engineering of the creation of clean fuels and chemicals. In the longer term commercial exploitation of this understanding will be made.

The Antarctic and Southern Ocean Region plays a major role in the response of the whole Earth System to global warming. Changes in the Southern Ocean and Antarctic sea ice affect global ocean circulation, with impacts on Antarctic and Southern Ocean ecosystems, coastal ecosystems in the Pacific and Indian Oceans, and in the global climate. Australia needs the very best prognostic Antarctic and Southern Ocean science capabilities to support our climate change vulnerability and risk assessments. Without these capabilities, new management and adaptation policies for our nation will be hamstrung and the planning of our responses to the changes in the Antarctic and Southern Ocean region will be impossible.

Box 2 - Nanotechnology – potential for sustainable energy and healthcare
Nanoscience has emerged, in the past decade, as a critically important cross-disciplinary science, which constitutes a new and powerful toolbox for engineering materials and products at the molecular level. Nanoscale science deals with the theoretical and practical aspects of the synthesis, characterisation and application of nanoscale material building blocks. It has the potential to transform many Australian industries in areas such as clean energy, climate change mitigation and water management, treating disease and personalized medical care, and national security. Nanomaterials constructed by self-assembly or biomimetic processes frequently possess different, improved and sometimes revolutionary properties compared to their bulk counterparts. Nanostructured semiconductors and other electronic and photonic materials have exhibited extraordinary properties and performance promising for applications in solar cells, fuel cells and energy storage devices, energy-saving solid state lighting and water purification processes. Exciting new developments in creating novel electro- and photoactive materials by using self-assembly and bottom-up nanoprocessing offer the potential for groundbreaking innovations urgently needed in clean energy fuelling our carbon constrained world.

Applying the new found techniques of manipulating molecules affords the possibility for gene and drug delivery by directly moving molecules into cells, or devising new and powerful imaging and diagnostics all of which are essential in effective personalised medical care and treatment. With the extraordinary promises nanotechnology has shown, we propose this research centre of excellence to bring the best and brightest among nanotechnology researchers in Australia, to focus on transformative innovations in technologies for sustainable energy and health care.

The Centre will foster expanded opportunities for training Australia's Antarctic and Southern Ocean research 'stars' of the future. Major international partnerships with the world's best and brightest scientists will enable research at scales we could not tackle alone, as well as recruiting new talent from around the globe in areas where our local capability needs enhancement. While the focus of the Centre would be strategic and of the highest calibre, it also will build relationships with key Government agencies to ensure the research outputs have easy passage into policy.

Another Centre in the Humanities and Social Sciences would focus on 'Behavioural Changes associated with adaptation to Climate Change and Energy Efficiency'. Recent global conditions emphasise the need for Australia to increase our research capacity in 'Food Security, Nutrition and Human Health'.

The Panel foresees that the recommended Governance arrangements we have put forward, would be of seminal importance to the Government in advice as to the most critical R&D areas to be included in the portfolio of National Priority Research Centres.

Comparison of the existing R&D Tax Concession with proposed Tax Credits

The current R&D Tax Concession is a tax deduction which reduces the firm's taxable income by increasing (by 25 percent) the amount it can claim as a deduction for its R&D expenditure.[1] The proposed 40 percent and 50 percent Tax Credits will operate differently by providing firms with Credit to meet their tax liabilities. However they will not be able to claim their R&D expenses as a business deduction.

For a firm in tax profit, the benefit of the 40 percent Tax Credit can be considered as the sum of a 100 percent business deduction (based on a 30 percent corporate tax rate) plus an additional 10 per cent incentive. Similarly, the 50 percent Tax Credit is the equivalent of a 100 percent business deduction plus an additional 20 per cent incentive.

The examples in the accompanying table show the differing assistance effects of the existing tax incentives and the proposed Tax Credits for firms in tax profit and loss.

Where a firm is in tax loss, the 40 percent tax credit is not refundable. Accordingly, as in the case with the existing 125 percent tax concession, the concession is of no value unless and until the firm becomes profitable at which time the credit can reduce tax otherwise payable. For that reason the longer the firm takes to move into tax profit, the less value both the 40 percent tax credit and the 125 percent tax deduction concessions have. And where firms never move into profit, they gain nothing from these concessions. This is reflected in the accompanying table as a value of assistance varying between zero and 10 percent of R&D investment for the 40 percent tax credit, where the value of assistance to tax profit firms is 10 percent of R&D investment in tax saved.

Where this works to the *disadvantage* of tax loss firms for non-refundable concessions, the existing Tax Offset – which is refundable – turns this mechanism to the *advantage* of tax loss firms. Where firms receive the Tax Offset, they receive cash equivalent to the sum of two factors:

- The tax benefit in the credit/additional deduction – currently equal to 7.5 percent of eligible R&D investment which would become 20 percent under the proposed refundable tax credit – plus;
- The deduction they would have received on that R&D investment if they had been in tax profit. At current rates of tax that is 30 percent of R&D investment.[2]

This latter cashing out of the benefit of the deduction is effectively an interest free loan which is clawed back when the firm comes into tax profit. Accordingly the longer it takes for the firm to move into tax profit, the greater the benefit of this loan, and where the firm never moves into profit, the 'loan' is in perpetuity and is equivalent to a grant. Accordingly in the table below, the after tax value of assistance to tax loss firms varies from a minimum of 20 percent to a maximum of 50 percent which applies where they never move into profit.

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[1] In some cases some or all of the R&D may be depreciable, or treated as a capital item, and so would not normally be deductible. Where this is the case the concession will generally increase deductibility by more than 25 percent.

[2] Subject to the previous footnote - some or all of the R&D may be depreciable, or treated as a capital item, and so would not normally be deductible. In this case the scheme offers additional assistance over non-concessional tax arrangements.

ANNEX 8

Current R&D Tax Concession Support		Tax profit	Tax Loss
125% Deduction			Where firms are in tax loss, benefits vary according to whether and when a firm moves into profit
R&D Expenditure	*$1,000,000*		
Deduction @ 125%	$1,250,000		
Impact on Taxable Income	($1,250,000)		
Impact on Tax Liability	($375,000)		(*1)
Total Tax Deduction		$375,000	0 - $375,000
less: Normal business deduction		($300,000)	($0 - $300,000)
equals: Additional benefit		$75,000	$0 - $75,000
Value of assistance (*2)		**7.5% of R&D** (*3)	**0 - 7.5% of R&D** (*3)
Tax Offset			
R&D Expenditure	*$1,000,000*		
Deduction @ 125%	$1,250,000		
Impact on Taxable Income	($1,250,000)		
Impact on Tax Liability	($375,000)		(*1)
Total Tax Deduction			$375,000
less: Normal business deduction		**Profitable firms not eligible for tax offset, normal 125% concession applies**	($0 - $300,000)
equals: Additional concession deduction			$75,000
Value of assistance (*2)			**7.5% - 37.5%** (*3)
			Refund at 37.5% of R&D

Proposed Tax Credits		Tax profit	Tax Loss
40% Tax Credit (Firm Turnover in excess of $50m)			
R&D Expenditure	*$1,000,000*		
Deduction	$0		
Impact on Taxable Income	$0		
Impact on Tax Liability	($400,000)		(*1)
Tax Credit @ 40%		$400,000	$0 - $400,000
less: tax deduction forgone (at current 30% tax rate)		($300,000)	($0 - $300,000)
equals: net tax credit benefit		$100,000	$100,000
Value of assistance		**10% of R&D**	**0% - 10.0% of R&D**
50% Refundable Tax Credit (Firm Turnover under $50m)			
R&D Expenditure	*$1,000,000*		
Deduction	$0		
Impact on Taxable Income	$0		
Impact on Tax Liability	($500,000)		(*2)
Tax Credit @ 50%		$500,000	$500,000
less: tax deduction forgone (at current 30% tax rate)		($300,000)	($0 - $300,000)
equals: net tax credit benefit		$200,000	$200,000 - $500,000
Value of assistance		**20% of R&D**	**20% - 50.0% of R&D**
			Refund at 50% of R&D

[1] Where firms earn credits or deductions but are in tax loss these are of no value unless and until they can reduce tax when the company becomes profitable. For that reason tax benefits to a tax loss company decline in value over time. By the same token, where, as is the case with the Tax Offset, firms receive cash equivalent to the sum of the tax benefit in the credit/additional deduction *and* the original deduction they would receive on expensing the R&D this bringing forward of the benefit of the deduction is clawed back when the firm comes into tax profit. It has the status of an interest free loan. Accordingly the longer it takes for the firm to move into tax profit, the greater the benefit of this interest free loan, and in the case of the firm which does not move into profit, the 'loan' is in perpetuity and is equivalent to a grant. A firm that never reaches profit will get a zero value of assistance from a non-refundable credit/deduction as they are unable to utilise the credits/deductions carried forward. In contrast, firms that never reach tax profit receive the maximum level of assistance from the existing Tax Offset (37.5 percent) and from the proposed refundable tax credit. (50 percent)

[2] Value of Assistance based on entitlements under the current corporate tax rate of 30 percent.

[3] Firms can currently claim an additional 50% deduction for increased R&D expenditure over a 3 year average. With the Premium deduction the 'after tax value of assistance' can be as high as 22.5%. For firms eligible for the Tax Offset with the Premium deduction the 'after tax rate of assistance' can be as high as 52.5%. Note also that levels of assistance are greater than those quoted above, where some of the the R&D expenditure would, without the concession, be classified as depreciable or as of a capital nature.

Annex 9

Findings of the Intergovernmental Working Group

A coherent national innovation system

The 2008 Review of the National Innovation System has enabled a working group of representatives drawn from governments across Australia to assess and review the support they provide to stimulate innovative activities in the economy.

It has confirmed a changing view amongst governments in Australia about the nature of the national innovation system. Where previously the national system, to the extent that it was recognised as a system at all, was seen to be an amalgam of regional systems, it is now recognised as a coherent national system with regional differences.

The regional differences reflect both the differing natures of regional economies and the different stages of the innovation cycle that regions are focussed on.

It is also more clearly understood now that the Australian innovation system is part of a global innovation system and therefore needs to respond not only to the changes in the national environment but also to changes internationally.

This changed understanding has important implications for the way in which interventions are considered, designed and implemented. Innovation systems are dynamic, highly interconnected and evolve over time in response to global and national drivers. Therefore, there will need to be an awareness of these drivers and the types of interventions available to meet any challenges and opportunities that arise.

It is also clear that changing one part of the system is likely to have implications for other parts of it, and the impacts will need to be carefully considered in order to ensure the complementarity of policy approaches.

The role of governments

Governments at the national and state and territory level have important roles to play in leading and facilitating innovation. This extends beyond the well recognised and critical role of governments in addressing market failures and in better positioning the economy to take advantage of opportunities.

To support the development and effectiveness of the innovation system, governments must also be innovative in the services that they deliver and the way in which they operate. This is particularly important given that governments account for a significant share of the economy and are a key customer of the private sector.

Governments support and facilitate innovation through a range of interventions which vary in nature according to the aspect of the system they governments wish to target. It is important to note these interventions are part of a broader suite of initiatives aimed at business generally and as such, need to be integrated with them.

The key areas in which governments appropriately intervene in the innovation system can be categorised as follows:

- *Creating a supportive environment to encourage and facilitate innovation:* this includes creation and management of the regulatory and taxation environment, ensuring provision of

necessary infrastructure, ensuring the supply of educated and skilled people (through the education and training system and immigration), stable political and financial systems, recognition of geographical and global contexts, global competition and setting goals or targets.

- *Building innovative capacity to enhance innovation*: this includes focusing on people and organisations such a innovation readiness (research and development infrastructure, precincts and/or clusters, technology and knowledge diffusion, creativity and design, research-industry interaction and collaboration), facilitating business process improvements, greater levels of education, open access to information, improved efficiencies in capital and factor markets, and greater financial market sophistication.

- *Leveraging returns from innovation:* maximising improvement and outcomes from innovation and enhancing Australia's business sophistication. This includes research and development outputs, development of intellectual property regimes and related expertise, support for commercialisation of innovation outputs, business mentoring, leadership and coaching programs, access to finance and capital, and enhancing entrepreneurial and management skills.

These interventions occur through a variety of legislative, policy and practical instruments such as tax concessions/exemptions, financial incentives, target-setting, strategic investments, grants, funding models, programs and networks. They can be delivered by government in its own right or in partnership with others.

The roles of the Commonwealth and State and Territory Governments in developing the national innovation system are different but complementary. Division of responsibilities should, at the general level, reflect the approach to governance taken by COAG, thus ensuring that the governance of innovation is compatible with the broader approach across jurisdictions.

At the more specific level, the value of Commonwealth Government leadership on aspects of the innovation system that are common across jurisdictions is recognised, as is the strength of the States and Territories in being close to the point of service delivery and thus highly responsive to the needs of players in the innovation system. Both factors should be reflected in the roles and responsibilities accorded to the States, Territories and the Commonwealth.

Given how important change is in the innovation process, the governance of the national innovation system needs to be flexible and sufficiently robust to respond quickly to changes in the economic, social and political environment.

As well, maximising the effectiveness of the collective roles and responsibilities of the various governments requires the delivery of complementary, collaborative and integrated programs and services. It also needs to be recognised that governments have limited resources and priority setting is important to ensure maximum benefits are realised from government interventions. In practice, ongoing and regular dialogue between governments will be important for these issues to be addressed effectively.

The current situation

In announcing the Review, the Federal Minister for Innovation, Industry, Science and Research, Senator Carr, drew attention to the "bewildering array" of programs established by

governments across Australia and specifically requested advice on how to make it easier for firms to identify and access relevant programs.

The Review, through the collaborative work of the Commonwealth, State and Territory Governments, has identified 221 separate programs aimed at supporting innovation in firms with 135 of those claiming to have a direct impact on innovation and the remaining 86 supporting the foundation conditions of innovation. Another 101 programs were identified as either having an incidental impact on innovation or were more general business development programs.

A detailed analysis of the 221 innovation programs supporting innovation in firms has found that:

- 31 percent of the programs are provided by the Commonwealth, 69 percent by States/Territories;
- Commonwealth programs account for 90 percent of funding;
- There is no obvious systematic or significant duplication in programs although there is some overlap:
    - many programs are intended to leverage off other programs;
    - many of the State/Territory programs are sector specific reflecting local priorities; and
    - many of the programs are very small raising questions about impact;
- Only 36 percent of the programs have been reviewed;
- Many programs have unclear and unmeasurable KPIs;
- Few programs have on-line application processes –only 10 percent of Commonwealth, 28 percent of State/Territory; and
- Most programs are aimed at the early phases of the commercialisation chain (R&D and early commercialisation) or the initial two phases of the Cutler Innovation Cycle (knowledge generation and knowledge application).

A more detailed report on the analysis of the current suite of programs is at Attachment 1.

The Review has confirmed that for many if not most potential users the current suite of programs is 'bewildering' - that is, it is difficult to find and access the assistance firms need and should be able to get. There is therefore a compelling need to 'de-bewilder' the suite of innovation programs for firms.

Implications

Responsibility for the operation of the Australian national innovation system is shared between the Commonwealth and the State and Territory Governments. An agreed approach to the development and delivery of the appropriate suite of programs and other interventions is therefore essential.

There are overlapping responsibilities between governments so it is likely that there will be overlapping interventions. As long as any overlap is well considered and adds value to the overall suite of interventions this is not a bad thing. There is however a danger that the larger the number of interventions, the less clear they will be and the less easy it will be for target firms to access them. Effective coordination between governments in the way that interventions are designed and delivered will be essential to make them effective and efficient.

There is currently a lack of clarity in the suite of interventions that makes it more difficult for firms to access the assistance that they need than should be the case. This needs to be addressed by governments, both across jurisdictions and within them.

It is proposed that only those initiatives primarily aimed at improving the innovation capability and performance of firms be identified in the core suite of innovation programs. Other programs that have an indirect impact on the innovation performance of firms should be removed from this suite in the interest of clarity and ease of access. They are nonetheless valuable and important parts of what governments do to raise the innovation capability and capacity of the economy and should, where effective, be continued but in a way that does not make it more difficult for firms to identify and access the core suite of programs.

The proposed approach will require new disciplines to be adopted by all Governments in the way that interventions are designed and delivered.

It also suggests that a simpler access mechanism is required to make it easier for firms to find the assistance that they need. This is turn indicates that wherever possible the number of programs should be reduced, and the flexibility of the programs to adapt to changing circumstances and needs be increased.

Different parts of Australia have different needs depending on their local conditions. The suite of interventions needs to recognise this in a way that does not produce confusion for users of the interventions. For example, a small targeted program in a small state may be very effective while a similar sized program in a larger state may lack the critical mass needed to be effective.

In order to achieve an appropriate balance, common metrics and performance indicators need to be adopted to facilitate effective evaluation of both the individual interventions and the impact on the system as a whole. This will also require comprehensive data to be collected on the system as a whole, including at regional level, to enable informed assessments of its operation and performance.

Given the role of multiple governments in the national innovation system, an efficient mechanism is required to ensure on-going cohesion in approach to the development and delivery of innovation interventions.

Recommendations

The Intergovernmental Working Group proposes a number of recommendations in response to the issues outlined above and its terms of reference:

1. That Governments adopt a framework of principles for innovation interventions (at Attachment 2) to enhance consistency in approach across governments and improve the overall accessibility and efficiency of the suite of interventions.

   The intention of the principles is not to prevent governments continuing to develop and take appropriate action to support and improve innovation activity; rather, they are intended to guide how such interventions are developed. This approach is expected to ensure the competition between jurisdictions to improve their ‘innovation offer’ continues, but in a way that ensures the overall suite of interventions is not negatively impacted.

2. That Governments review the existing suite of programs and develop any new programs in the light of these principles with a view to:

- offering the least number of programs to achieve the desired effect;
- increasing program size and flexibility, where appropriate, in order to allow for more efficient response to changing circumstances and needs;
- harmonising the way in which programs are presented across the country; and
- assessing the suite of programs for coverage across the stages of the innovation cycle to ensure there is an appropriate level of attention being paid to all parts of the innovation system (noting that circumstances and priorities vary across the country).

Since the termination of Commercial Ready and Commercial Ready Plus there is no longer any generic national program supporting commercialisation activity. The Working Group regards this as a major gap in the range of assistance now available and this should be considered in the design of any future interventions.

3. That senior Government officials develop a collaborative mechanism to ensure that the agreed approach is adhered to by all Governments and that the approach can be varied quickly and easily when needed. The exact form of this mechanism will need to be determined in light of the overall governance decisions taken in White Paper. Any body should be authorised by and report periodically to relevant Commonwealth and State and Territory Ministers.

4. That common metrics, performance indicators and mechanisms for collecting and sharing data be developed and adopted by all jurisdictions.

5. That Governments together develop a simple and coordinated mechanism for providing information about and access to the full range of Commonwealth and State and Territory programs. This will need to be supported by an agreed approach to the provision of required information, the use of appropriate descriptors, and the development of streamlined/similar application processes. Such a mechanism should be linked to the data collection processes.

6. To facilitate the above, the data base of Commonwealth, State and Territory programs developed by the Working Group during the Review process be maintained and kept up to date.

Annex 9

ATTACHMENT 1

Intergovernmental Working Group Report on Programs/Initiatives Supporting Innovation in Firms

Executive Summary

The Intergovernmental Working Group (IWG) collected and analysed information on a suite of State/Territory and Commonwealth programs/initiatives supporting innovation in business. The analysis was aimed at examining the scope for simplifying innovation assistance programs and reducing duplication, making it easier for firms to identify and access relevant programs.

Data was collected from a survey of all jurisdictions. Due to differing interpretations of what constitutes an innovation program, and the influence of ongoing budget changes to jurisdictional programs, the database is not exhaustive. Rather, the following report provides an informed view of the suite of government programs operating in the national innovation landscape rather than a series of individual program assessments.

Findings

- Two hundred and twenty one programs supporting innovation in firms were identified, comprising 31% Commonwealth and 69% State/Territory. Commonwealth programs account for 90% of the total average expenditure for these programs, which is approximately $3.7b[1] per annum.
- There is some apparent intra- and inter-jurisdictional overlap in programs but this is neither systemic nor likely to have a significant impact.[2] Many programs are targeted to leverage off other programs.
- Most programs are at the early phases of the research commercialisation chain (R&D and early commercialisation) or the initial two phases of the Cutler innovation cycle (knowledge production and knowledge application).
- Only 36% of the programs have been reviewed. Many programs have unclear and/or unmeasurable KPIs.
- Only 10% of Commonwealth and 28% of State and Territory programs have on-line application processes.

In addition, an analysis of the more than 640 written submissions to the NIS Review was done in order to understand business and other groups' views on the NIS and innovation assistance programs.

The results supported the general agreement that there are a large number of government innovation programs, and that this may complicate the National Innovation System, particularly through having programs delivered by a range of government departments.

Most submissions commenting on programs agreed that there is some overlap and/or duplication, though there were no examples provided, and most thought there should be some reduction in program numbers. However, overlap was not necessarily seen as negative and many submissions argued the importance of maintaining the current assistance levels.

Many firms, especially SMEs, are not aware of eligible programs or where to go to find information on programs. Application processes were seen as too lengthy, cumbersome and/or expensive when weighed against potential gains.

There was strong support for an integrated, national innovation strategy and a governance platform to manage current issues with the program suite. A number of submissions advocated

[1] Annual expenditure figures are taken from reported Total Budgeted Expenditure divided by the number of years the program is reported as running. In aggregate these numbers provide an average approximation only.
[2] An exception may be export programs which are dealt with by the Mortimer Review and therefore not further discussed here.

a 'one-stop-shop' approach to providing information on government support, with communication and promotion seen to be an important part of the solution.

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Terms of Reference

In the context of the Review of the National Innovation System, the Working Group will act as a central point of liaison between the Commonwealth, State and Territory Governments, and representatives of local government, and respond to requests from the expert Panel conducting the Review.

The Working Group will also:

1. Identify and assess the complex mix of current and proposed State, Territory and Commonwealth innovation support and assistance programs against agreed national innovation priorities
2. Map these programs against the priorities and identify the extent to which these priorities are appropriately covered
3. Examine the scope for simplifying support for business innovation and reducing duplication, so that it is easier for business to identify and access relevant programs
4. Provide advice on a framework to ensure ongoing complementarities between State, Territory and Commonwealth programs; and
5. Identify metrics and means of improving data collection and the ongoing measurement, evaluation and optimisation of outcomes.

Annex 9

Introduction

The Intergovernmental Working Group (IWG) collected and analysed information on a suite of State/Territory and Commonwealth programs and initiatives supporting innovation in business. The analysis aimed to examine the scope for simplifying innovation assistance programs and reducing duplication, making it easier for firms to identify and access relevant programs. Data was collected from a survey of all jurisdictions.

Jurisdictions were asked to provide an exhaustive list of programs running in the last five years that support innovation in firms, using an electronic survey instrument agreed to by the IWG. The survey instrument was accompanied by explanatory notes. A further input to the analysis came from the public submissions to the review.

For the purposes of this report, an innovation program is any program that supports innovation or innovation-related activity in business. The definition of innovation and innovation-related activity is taken from the OECD Oslo Manual in order to have some consistency in deciding which programs are included in the analysis (See Appendix A). Using this process some 31% of programs submitted are not included in the analysis. This highlights the restrictive nature of the Oslo Manual definition of innovation (designed for measurement of innovation) and/or variation in understanding between jurisdictions and their agencies of what constitutes an innovation program. Given that a limited number of these programs have neither been evaluated nor have key performance indicators that explicitly target increased innovation, the decision to submit a program was a subjective one on the part of the survey respondents. Programs/initiatives that did not directly aim to supporting business innovation and only had an incidental impact on innovation were not included in the analysis.

The survey period overlapped with the budget process of many jurisdictions. Where possible, any program changes due to 2008-09 budgets have been incorporated. This has not been possible for all jurisdictions. In addition this database is not a proxy for science and innovation budget tables. Therefore projects that are still running but not accepting new applications are not considered in the following analysis.

For the above reasons, and the fact there is a large number of programs to be analysed, the following paper provides an informed view of the Australian innovation landscape rather than an individual program by program assessment.

The utility of this database in analysing the suite of Commonwealth, State and Territory innovation policies/programs operating in the National Innovation System should be recognised. This database offers a unique resource for policy development and benchmarking. The maintenance of the database into the future will also bring with it a new longitudinal dimension that will aid in the ongoing assessment of the national innovation system.

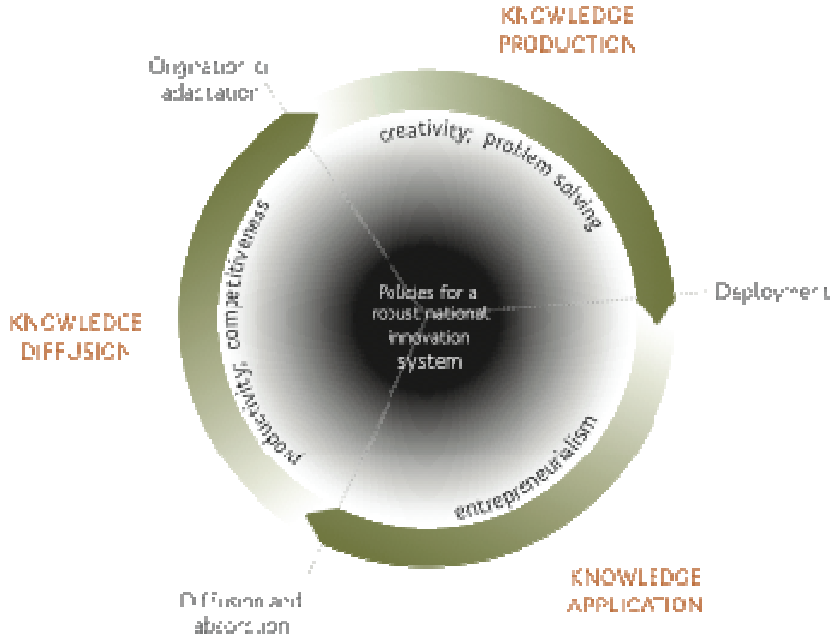
Program mapping to a model of innovation

All ongoing government innovation programs from the database were mapped to the model of innovation provided by Dr Terry Cutler (Figure 1). For each program/initiative, we relied on the rationale, objective, key performance indicators and in some cases whether or not it gave direct assistance or secondary support to firms to identify where every program would sit in the model. Verification/clarification was requested from State and Territory jurisdictions.

This particular exercise is limited in its scope: It was apparent that this simple diagram did not adequately match the model proposed by Dr Cutler in terms of stocks and flows. Given that the database gathered information only on programs that support innovation in firms subsequent modelling does not take into account underlying government investment in creativity and knowledge i.e. education, training and research and, due to the nature of the definition of

innovation, the mapping exercise has limited scope to take account of the many government programs that build basic business management skills.

Figure 1. Dr Terry Cutler's model of innovation



Source: Cutler. T, Submission to the Productivity Commission Inquiry into Public Support for Science and Innovation, 2006

Definitions for the mapping exercise

We were asked to start from scratch and to limit each program to one component of the cycle where possible. Inevitably some programs were classified against multiple components. Although every attempt was made to categorise each program/initiative some could not be clearly identified from the submitted information. Remaining black box programs are where the jurisdiction responsible has not responded to requests for clarification.

Knowledge Production (KP) Programs classified under KP aim in general terms to directly assist or indirectly support innovation in firms by increasing the amount of business-relevant knowledge e.g. R&D tax concession and Smart State Research Facilities Fund and Innovation Building Fund.

Knowledge Application (KA) KA refers to the knowledge base needed to identify ideas with commercial potential, transform these ideas into new products, processes, and organisation or marketing methods and appropriate their value in the marketplace. Programs classified under KA in general terms directly assist or indirectly support these activities, e.g. Market Ready Commercialisation Program and the Innovation and Commercialisation Grant.

Knowledge diffusion (KD) Programs classified under KD aim in general terms to support the diffusion or transfer and subsequent take-up of successful/best practice innovation in the market. Any program where the main objective is to build absorptive capacity of firms is considered here, e.g. Capability and Technology Demonstrator Program and Eco-efficiency Toolkit.

System Integration (SI) Programs classified under SI systemically facilitate the entire innovation cycle (could be sector specific or innovation at a regional/national level). These might be government strategies to broadly enhance innovation or programs that promote a culture of innovation or entrepreneurship. In cases where the objective of a program/initiative targets KP, KA and KD, SI was the component chosen, e.g. Western Australian Inventor of the Year Award.

Findings and Discussion

Programs and initiatives that support innovation in firms

A number of submissions to the review supported the view that there were a large number of business programs available:

> *Since 1996, the volume and variety of Federal Government grants has ballooned. We are now familiar with over 290 different grant programs for business nationally, awarded by State and Federal Governments. Our researchers are finding new grant programs weekly and this list is not yet definitive.*[3]

> *Since the advent of government innovation initiatives in the 1980s, there have been a myriad of specific programs aimed at addressing key perceived shortcomings and impediments.*[4]

and while there was some agreement to reduce the number of programs:

> *Programs need to be reduced in number and access simplified.*[5]

> *This review should seek to....streamline available programs and eliminate unnecessary duplication between jurisdictions.*[6]

there was general agreement that the level of support currently provided should not be reduced:

> *The Government is looking to find significant budgetary savings. While it is very important for the Government to take action to contain inflation, this should not be done at the expense of programs that increase productivity and Australia's international standing and competitiveness.*[7]

> *Do not decrease funds for existing R&D support programs when implementing the priority process.*[8]

> *[We recommend] that the Government maintain all other existing innovation at their current level of funding in real terms, without seeking offsetting savings, so that Australia can enjoy a sustained period of comprehensive support for innovation.*[9]

This survey and analysis identified 221[10] Commonwealth, State and Territory programs and initiatives supporting innovation in firms (Table 1).[11]

The Commonwealth has a relatively small percentage of the total number of programs (31%) which accounts for some 90% of the $3.7b total averaged annual expenditure, compared with the large percentage (69%) of State and Territory programs that account for only 10% of the total annual averaged expenditure.[12]

The 221 programs supporting innovation in firms were further categorised according to whether the program is 'direct assistance' i.e. chiefly designed for business or the commercial

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[3] GrantReady – Submission no. 443
[4] Momentum Funds Management – Submission no. 358
[5] Engineers Australia – Submission no. 433
[6] Australian Coal Association – Submission no. 434
[7] CRC Committee – Submission no. 212
[8] Engineers Australia – Submission no. 433
[9] Momentum Funds Management – Submission no. 358
[10] This number will vary as program changes are introduced in the 2008-09 budget process for jurisdictions are introduced. The number is also dependent upon the definition of an innovation program.
[11] This number does not equate to the total number of industry development programs available nationally. Subsequent tables will not always add up to 221 programs since not all questions were completed by the survey respondents.
[12] Annualised expenditure was calculated by dividing the number of years reported in question 13 into the total budgeted expenditure reported in the same question.

sector and can be accessed by industry (e.g. Climate Ready) or 'indirect support' i.e. where the outcomes of the program benefits industry but industry does not receive direct assistance (e.g. Cooperative Research Centres) (Table 1).

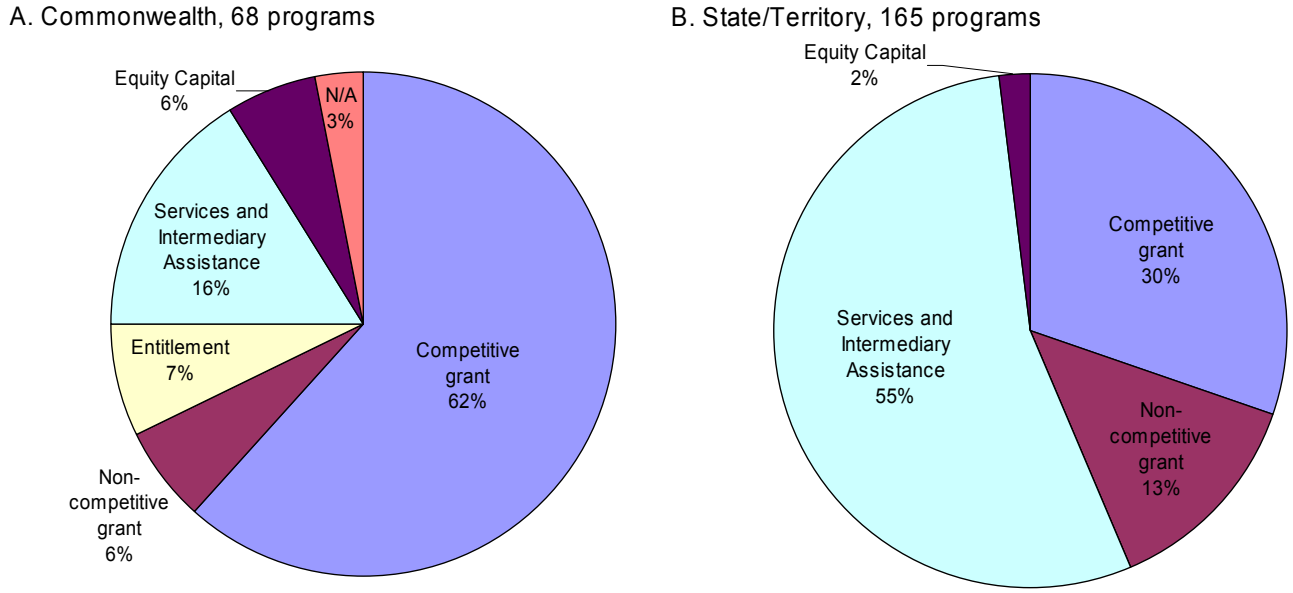
Table 1. Australian Government Programs Supporting Innovation in Firms

	Direct assistance to business e.g. grant		Indirect support for business e.g. infrastructure	
Commonwealth Government	**№**	**Averaged annual expenditure, $m**	**№**	**Averaged annual expenditure, $m**
ARC	-	-	10	727
Austrade[13]	3	145	-	-
CSIRO	3	58	2	220
DAFF	1	9	4	234
DBCDE	-	-	2	61
DEEWR	1	1	-	-
Defence	4	61	1	4
DEWHA	4	334	1	28
DIISR	14	941	8	253
DRET	7	228	-	-
IBA	1	32	-	-
Questacon	-	-	1	2
NHMRC	-	-	2	3
Sub-total	**38**	**1808.6**	**31**	**1531.5**
State/Territory Governments				
Australian Capital Territory	5	2.1	3	6.2
New South Wales	20	12.8	14	85.9
Northern Territory	3	1.0	3	0.4
Queensland	31	47.1	13	40.9
South Australia	16	29.2	1	2.8
Tasmania	11	3.1	-	-
Victoria	10	48.1	4	63.1
Western Australia	9	2.2	9	10.2
Sub-total	**105**	**145.5**	**47**	**209.4**
Sub-total all jurisdictions	**143**	**1954.1**	**78**	**1740.9**
All Australian Government Programs	**221**		**3695.0**	

In terms of program/initiative delivery mechanisms, 62% of Commonwealth programs were delivered in the form of competitive grants (Figure 2). Commonwealth expenditure on the five entitlements, particularly the R&D Tax concession and the Automotive Competitiveness and Investment Scheme, together provide the largest direct assistance to firms ($753.9m p.a.). Naturally, the States/Territories offer no tax-based entitlements. Direct Commonwealth assistance to firms heavily supported R&D (Tables 2 & 3). Some commercialisation activity was supported but this was generally sector-specific (most notably the Defence programs). Since the termination of Commercial Ready and Commercial Ready Plus there is no longer any

[13] Austrade has not yet reported budget information for the New Exporter Development Program or the Global Opportunities program.

Figure 2. The total number of programs for the Commonwealth (A) and the States and Territories (B) categorised by delivery mechanism.



generic national competitive grant supporting commercialisation activity.[14] There was general agreement on a lack of support for commercialisation activity from the submission analysis and many were submitted before the termination of Commercial Ready:

> *There is a real need for support for the "proof-of-concept" stage of the commercialisation chain to bridge the gap between good ideas, lodging provisional patents and the development of a more secure patent position, market assessment and a program which is a reasonable prospect for industry investment and commercialisation*[15].
>
> *There is a need for programs that support innovators early in the creative process, helping them experiment or further develop ideas, find potential partners or develop skills and knowledge before they establish business structures*[16].
>
> *While the Government spends billions of dollars supporting R&D, most sectors receive no support in commercialising a product into the market. As a result, much of the support and funds are wasted as companies become stranded and unable to further their project*[17].
>
> *Most innovation support programs in Australia actually support only one component of innovation – formal R&D.*[18]

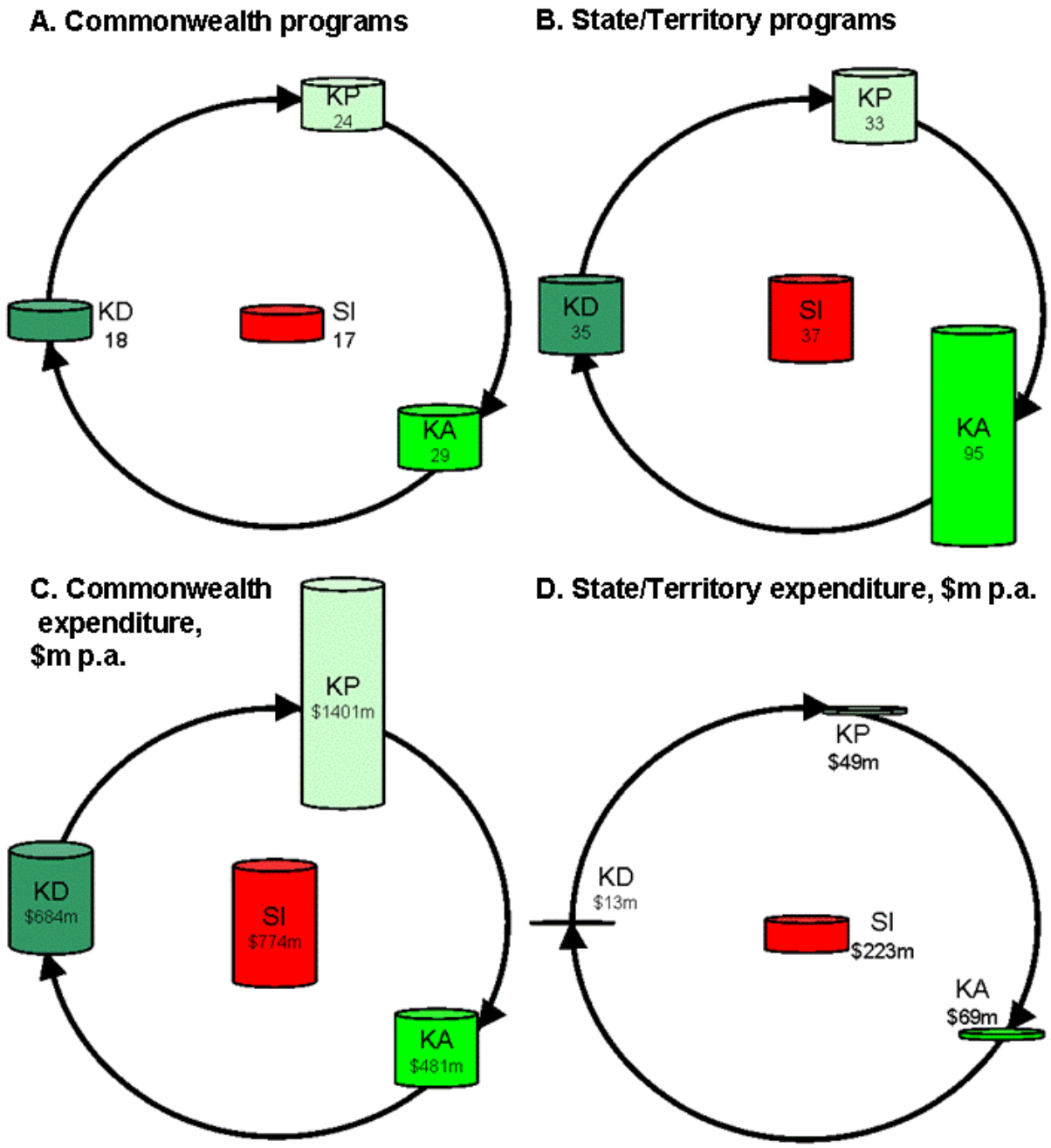
The results from the mapping exercise show that the program coverage is fairly even across all innovation components for the Commonwealth but that total annual expenditure is focussed towards Knowledge Production (Figure 3). The Commonwealth government has a higher proportion of programs providing indirect support to business (45%) compared to the States/Territories (31%). Emphasis was on provision of infrastructure (e.g. NCRIS), national priority research, and encouraging collaboration between publicly funded research

[14] Both the Renewable Energy Fund and the Climate Ready programs only support projects that address the climate change challenge.
[15] University of New South Wales – Submission no. 497
[16] National Association for the Visual Arts – Submission no. 628
[17] GrantReady – Submission no. 443
[18] Innovation Research Network – Submission no. 332

organisations and industry (e.g. National Research Flagships). This investment is represented by the high annual expenditure in the knowledge production component in Figure 3.

In contrast to the Commonwealth, 105 programs (69%) of the 152 State/Territory programs provide direct assistance to business. The majority of these programs (54%) of were delivered through services and intermediary assistance. Despite this high proportion of service and intermediary assistance programs they account for only 32% of the total average annual expenditure. Grants were the major expenditure for the States and Territories, taking up 68% of total annualised expenditure. Interestingly, non-competitive grants (grants provided on a discretionary basis) were a high percentage of total annualised expenditure (22%) for the States and Territories.

Figure 3. Mapping of innovation programs and their annualised expenditure to Terry Cutler's model of innovation. See Figure 1 for details.



Support to firms for commercialisation of research was a major theme for State and Territory governments and is clearly visualised in the knowledge application component of the innovation model (Tables 4 & 5, Figure 3). When ranked by expenditure, the top five direct assistance programs were dominated by competitive grants given to firms for research, development and commercialisation (Table 4). State/Territory governments focus expenditure on the System Integration component and to a lesser extent Knowledge Application (Figure 3).

For the States and Territories there was a proportionately low investment in knowledge diffusion (Figure 3). Although investment in knowledge diffusion is apparently high for the Commonwealth, this component is dominated by the sector-specific Water Smart Australia program (Table 2). Many submissions argued that current programs do not adequately serve the businesses which seek to operate and integrate into the international environment:

> *Businesses now operate in an international space, and many grant programs do not account for this.*[19]
>
> *Under the majority of existing programs, market visits are limited to export promotion. However, AI Group has identified a need amongst companies to travel overseas to gain insights into innovative practices for their industry.*[20]
>
> *There should be greater scope for programs, such as Commercial Ready and CRCs to allow a greater portion of eligible expenditure, not just on research, to occur overseas – schemes that exclusively generate benefit to Australia can lead to an insular mindset.*[21]

Given the poor rate of program evaluation (discussed later) it is difficult to determine if this small or highly sector-specific investment is a cause for concern. Innovation is about the application of ideas and that ideas have to be made or discovered only once and can then be used by many others without diminishing their usefulness. If most productivity growth stems from the diffusion of innovations and their subsequent adaptation and, Australia itself has a estimated 2% contribution to the world's generation of science and engineering knowledge, then this low investment in knowledge diffusion may be a significant under investment by all jurisdictions. Although the Commonwealth's new Enterprise Connect initiative aims to improve the absorptive capacity of approximately 10,000 Australian firms per annum it will be sometime yet before the impact of the program will be known.

Given the high percentage of State and Territory programs included in 'Services and Intermediary Assistance', this area was broken down further to show the range of delivery mechanisms it contained (Table 6). The highest proportion of Service & Intermediary programs were in the sub-categories of education, mentoring and awareness raising and also business information and advisory services. The information and advisory services typically provided general business information as well as innovation-specific information and advice. A high number Government regulations and strategies were reported by the States and Territories and the majority of these 'programs/initiatives' were of indirect support to firms. Interestingly one of the lowest reported sub-categories was Intermediary Assistance suggesting that the delivery mechanism 'Services and Intermediary Assistance' could be split into more than one category in the future.

It is important at this point to highlight the effect of the definition of innovation and what is an innovation program on the analysis of this report. All jurisdictions were asked to determine to what level value-adding innovation is a focus and outcome of the initiative (Table 7). Out of the 221 reported programs supporting innovation in firms only 135 programs/initiatives were claimed to have a direct impact on innovation within business. The remaining 86 programs

[19] GrantReady – Submission no. 443
[20] Australian Industry Group – Submission no. 265
[21] South Australian Government – Submission no. 566

supported the foundational conditions necessary for innovation but were not claimed as having a direct impact on innovation in business. There were an additional 101 programs that were submitted that are not included in the analysis. These additional programs:

- Did not meet the definition of innovation and/or innovation-related activity or,
- Were not directly aimed at supporting innovation (not its core rationale) but had an incidental impact on innovation.
- Were mostly basic business development and export programs.

This data highlights the importance of a consistent definition of innovation and the issue of whether business development or export programs should be included in any future analysis of programs supporting innovation in business in the context of a national innovation system.

Table 2. The top five Commonwealth direct assistance programs ranked by total averaged expenditure, $m per annum (annualised estimate)

Program/Initiative	Agency	Commercialisation Chain	Innovation cycle	Expenditure, $m p.a.
R&D Tax Concession	DIISR	Research & Development	Knowledge Production	550
Water Smart Australia program	DEWHA	Development	Knowledge Diffusion	320
Export Market Development Grants (EMDG)	Austrade	Export	Knowledge Diffusion	145
Automotive Competitiveness and Investment Scheme	DIISR	Research & Development	Knowledge Production	131
Renewable Energy Fund	DRET	R&D, Commercialisation	System Integration	71

Table 3. The top five State/Territory direct assistance programs ranked by total averaged expenditure, $m per annum (annualised estimate)

Program/Initiative	Jurisdiction	Commercialisation Chain	Innovation cycle	Expenditure, $m p.a.
Energy Technology Innovation Strategy	Victoria	R&D, Commercialisation	System Integration	38
Innovation and Investment Fund for South Australia	SA	Entire chain	System Integration	25
Clearing House (a business information service)	Queensland	R&D, Commercialisation	Knowledge Application	17
Innovation Projects Fund	Queensland	R&D, Commercialisation	System Integration	15
Centre for Energy and Greenhouse Technologies	Victoria	Development, Commercialisation	Knowledge Production/Application	5

Table 4. The top five Commonwealth indirect support programs ranked by total averaged expenditure, $m per annum (annualised estimate)

Program/Initiative*	Agency	Commercialisation Chain	Innovation cycle	Expenditure, $m p.a.
Discovery Projects	ARC	Research and Development	Knowledge Production	281
National Research Flagships	CSIRO	Research and Development	System Integration	217
Rural Research and Development Corporations	DAFF	Entire chain	System Integration	210
Future Fellowships	ARC	Research and Development	Knowledge Production	169
Cooperative Research Centres Program	DIISR	R&D, Commercialisation	Knowledge Production/Application	136

Table 5. The top five State/Territory indirect support programs ranked by total averaged expenditure, $m per annum (annualised estimate)

Program/Initiative	Jurisdiction	Commercialisation Chain	Innovation cycle	Expenditure, $m p.a.
Future Farming	Victoria	R&D, Commercialisation, Export	System Integration	51
Research and Extension Projects	NSW	R&D, Commercialisation	System Integration	50
Medical Research Support Program	NSW	Research, Commercialisation	Knowledge Production	20
Research and Development	Queensland	R&D, Commercialisation	System Integration	18
Queensland Renewable Energy Fund	Queensland	Development, Commercialisation	Knowledge Application/Diffusion	10

Table 6. Services and Intermediary analysis of Commonwealth and State/Territory programs	Direct assistance programs №	Indirect support programs №	Total №
Education, Public/Industry Awareness & Promotion	19	3	22
Government Strategy, Policy and Regulation	4	5	9
Information and Advisory service	27	2	29
Intermediary Assistance	7	-	7
Network/Cluster/Incubator Development	7	3	10
R&D Service	2	4	6
All of the above	1	-	1
Unclear	5	2	7
Total	**72**	**19**	**91**

Table 7. Program/initiative impact on innovation			
Jurisdiction	**Impact on Innovation**		
	Direct	**Direct and Indirect**	**Indirect**
Commonwealth	**11**	**25**	**33**
States/Territories	**12**	**51**	**20**
Subtotal State/Territory	**23**	**76**	**53**
Subtotal all jurisdictions	**34**	**101**	**86**

Program/initiative design elements

Evaluation should be an integral part of program design and management, and the review process must be based on clear, measurable and relevant KPIs, which are a function of good program design. It is also important that the review process itself be robust and consistent:

> *It is important to acknowledge that each program has a different objective and when being reviewed, needs to be measured against that objective. However, there is a case for a common set of methodologies, or at the very least, principles to govern the undertaking of reviews.*[22]

It is essential that programs be reviewed or assessed in order to find out what has worked and what hasn't, and so inform future policy development, and allow evidence based program rational and design to produce programs that are well targeted and deliver real assistance.

[22] CRC Committee – Submission no. 212

The Intergovernmental Working Group will recommend a set of framework principles that should contribute to a more standardised development of innovation interventions, including programs. These new principles would contribute to a more standardised development of innovation programs and interventions, and would allow for the better collation and coordination of information coming out of initiative reviews and feeding into future policy development and program design.

Submission analysis revealed there is strong support for an integrated, national innovation strategy and governance platform to manage issues with the current program suite:

> *To encourage novel programs and ideas and help reduce duplication, [Australia should] adopt an integrated approach to governance of the innovation system, which facilitates cross-portfolio cooperation at federal level and cooperation across jurisdictions.*[23]
>
> *The National Innovation System should…establish a collaborative environment for the different levels of Government to jointly pursue policy and program development and where appropriate the joint and seamless delivery of programs and services.*[24]
>
> *There is strong evidence that some programs within the NIS are not well integrated: the various programs should be synergistic, not competitive.*[25]
>
> *I think the shortage, or shortcoming, in our innovation system is due to a lack of a coherent strategy or framework for supporting innovation and entrepreneurship in both the profit and not-for-profit sectors, and the lack of good implementation.*[26]

Key features of this integrated system would be:

1. Its holistic approach to supporting innovation in firms:

Programs should support innovators at various stages of the development process, be designed from the perspective of the innovator and be able to accommodate all types of businesses from sole traders upwards.[27]

2. A harmonisation of program design and program evaluation processes:

Reporting and compliance requirements of all programs should be reviewed to ensure they are harmonised and appropriate for the level of funding provided, particularly those programs targeted at SMEs.[28]

It is the view of the CRC Committee that there would be a major improvement to governance in the National Innovation System if there were a commonly established, rigorously tested method of evaluation of outcomes from programs designed to foster innovation.[29]

Treasury or other central agency should be tasked to develop a framework for rigorous evaluation of Government funding programs in the innovation space and oversee, or at least review, all innovation program evaluations.[30]

It is important to acknowledge that each program has a different objective and when being reviewed, needs to be measured against that objective. However, there is a case

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[23] National Association for the Visual Arts – Submission no. 628
[24] Queensland Government – Submission no. 459
[25] Woffenden, Mark – Submission no. 379
[26] Balan, Peter – Submission no. 328
[27] National Association for the Visual Arts – Submission no. 628
[28] CRC Committee – Submission no. 212
[29] *Ibid*
[30] *Ibid*

for a common set of methodologies, or at the very least, principles to govern the undertaking of reviews.[31]

DIISR should, in conjunction with the Treasury Department, develop guidelines for the measurement of outcomes delivered by all programs within the National Innovation System.[32]

The Australian Government should consider…[supporting] the concept of integrated and/or seamless delivery in developing innovation programs.[33]

3. The evaluation of applications and programs should focus on the objective of the program, not the bureaucratic detail:

Program administrators should act according to the intent behind the program. Administrators in some programs have become too focused on applying red tape, ticking boxes, guaranteeing successful outcomes or applying pedantic interpretation of the wording with in program guidelines.[34]

The goal is to ensure that the different program objectives are aligned, programs are mutually beneficial, and finally programs would be able to share a repertoire of communal resource in terms of language, artefacts etc. This will help to maximise benefits of shared synergies within the different programs and eliminate inefficiencies.[35]

…the key measure for a successful grant program should be the effectiveness of the program in achieving its aim.[36]

The following results describe several elements of program/initiative design that are relevant to the above submission commentary.

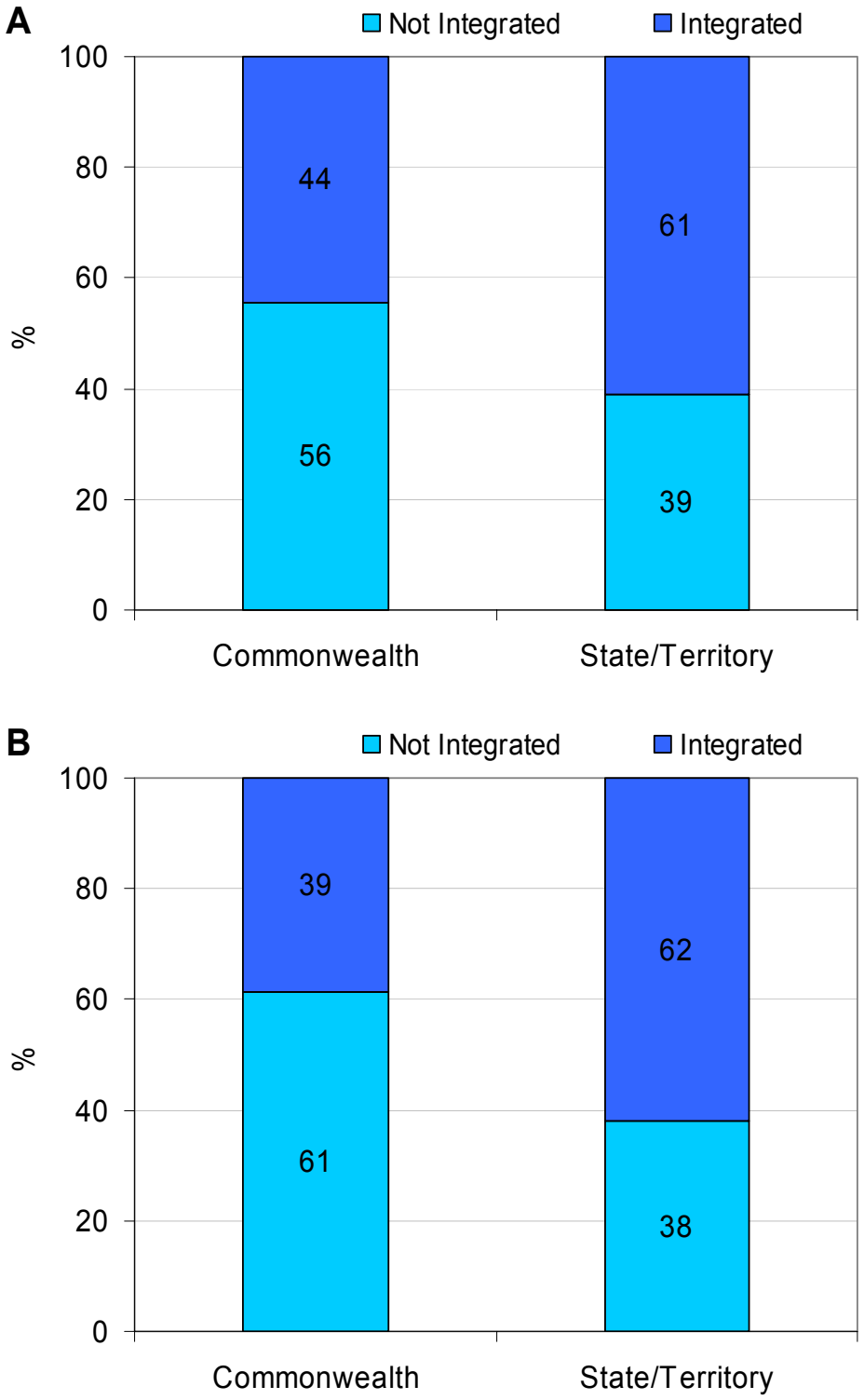
Integration with other programs

Sixty one percent of all programs are integrated in the sense that they were designed to operate in conjunction with other programs (e.g. by assisting applicants to access support from another program) (Figure 4). The percentage of direct assistance programs that are integrated is higher for State/Territory programs (61%) compared to the Commonwealth (44%). Of the Commonwealth programs that were integrated, these programs were integrated predominantly with other Commonwealth programs (75%). Few programs were designed to be integrated with State/territory programs (22%).

In contrast the State/Territory direct assistance programs were designed to integrate predominantly with other State/Territory programs (26%) or both Commonwealth and State/Territory programs (69%).

[31] *Ibid*
[32] CRC Association – Submission no. 320
[33] Queensland Government – Submission no. 459
[34] GrantReady – Submission no. 443
[35] Hyland, Paul – Submission no. 118
[36] GrantReady – Submission no. 443

Figure 4. The percentage of innovation programs/initiatives, providing direct (A) and indirect (B) assistance to firms, designed to operate in conjunction with another program ('integrated').



Key Performance Indicators (KPIs)

The survey data indicated that approximately 24% of all Commonwealth, State, and Territory programs that support innovation in firms did not have KPIs , and the suitability of those that were present was variable.

Table 8 . Presence/Absence of key performance indicators			
	No	*Yes*	
Direct assistance programs	**№**	**№**	**%**
Commonwealth	8	24	75
States/Territories	17	88	84
Sub-total all jurisdictions	**25**	**112**	**82**
Indirect support programs			
Commonwealth	16	13	45
States/Territories	10	35	77
Sub-total all jurisdictions	**26**	**48**	**65**
All Australian Government Programs	**51**	**160**	**76**

A analysis of 100 randomly selected programs was made to establish the strength of the KPIs associated with them (Table 9).

Table 9. Clarity and Measurability of KPIs	%
Programs with clear and measurable KPIs	11%
Programs with generally clear KPIs that may be measured but with some difficulty	26%
Programs with unclear or immeasurable KPIs	28%
Programs with no KPIs or none specified	35%

While the exercise was somewhat subjective, the objectives and KPIs of programs were often found to be unclear, making it difficult to assess what the program was meant to achieve (Table 9).

Even where clear KPIs were supplied, these were often difficult to measure, and where measurement was possible, they often did not provide meaningful information on the performance of the program. For example 'number accessing or assisted by the program' was a common indicator given; while this is easily measurable it does not give a true indication of whether the objectives were met.

Clear, measurable and relevant KPIs are important to the design of any program, without them, it is difficult to hold program implementation accountable against the policy objectives of the program. KPIs that provide robust information on the performance of the program are essential in providing an accurate assessment of the program effectiveness.

Further, clear objectives and KPIs will provide information on the intent of the program, making it easier for potential clients to pick a program appropriate to their needs.

Assessment/Review

The survey found that only 36% of all programs have been evaluated (Table 10). This low number of programs that have been reviewed or have received any type of assessment is a cause of concern. When taking into account the age of programs, the percentage of program evaluation increases from 23% to 62% for programs running 5 years or longer. However, this rate is still startlingly low. Only Commonwealth programs running 5 years or longer providing direct assistance to firms has a moderately high rate of evaluation (82%). However, the lowest rate of

evaluation was for Commonwealth indirect support programs (14% and 47% for programs <5 years old and ≥5 years, respectively).

Table 10 . Program evaluation frequency			
Direct assistance programs	**No**	**Yes**	**Underway**
Commonwealth			
<5 years	18	4	4
≥5 years	2	7	2
State/Territory			
<5 years	56	10	7
≥5 years	11	16	5
Sub-total	**86**	**40**	**19**
Indirect support programs	**No**	**Yes**	**Underway**
Commonwealth			
<5 years	12	1	1
≥5 years	9	7	1
State/Territory			
<5 years	28	5	3
≥5 years	5	6	0
Sub-total	**54**	**19**	**5**
Total	**141**	**56**	**23**

Online Application

Jurisdictions were asked if their programs could be applied for online (Table 11; Figure 5) in order to assess the ease of access to programs by business. Only 22% of all programs directly accessible by business have an online application process. This percentage is higher for State/Territory programs (28%) than for Commonwealth programs (10%).

Figure 5. The percentage of applications that can be submitted online.

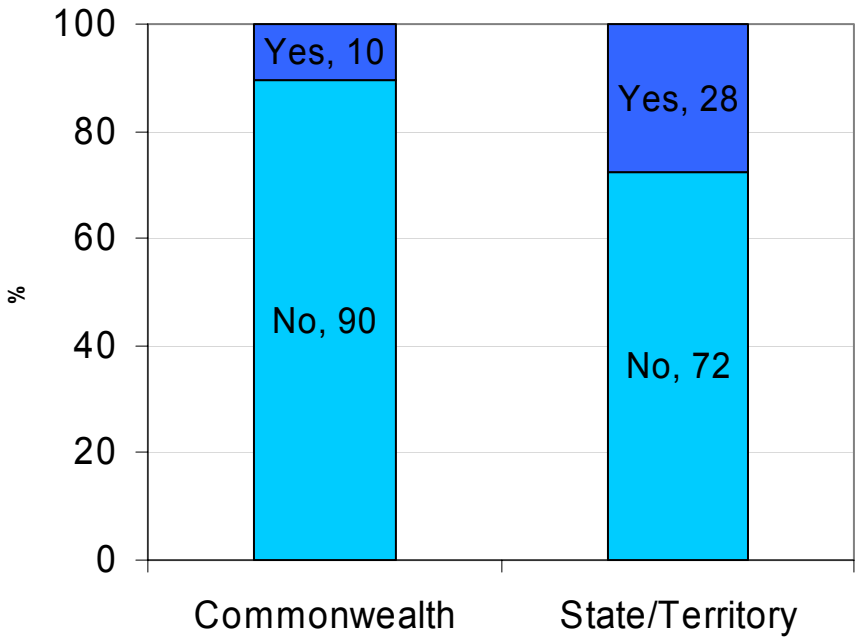


Table 11. Online application frequency

Direct assistance programs	No №	Yes №	Yes %
Commonwealth	26	3	10
States/Territories	42	16	28
Total	**68**	**19**	**22**

Overlap/Duplication

We looked at possible overlap and duplication among the 221 identified government programs supporting innovation. This large number of programs nationally might suggest that overlap and duplication is likely. However, one should consider this issue from the perspective of a firm. A firm based in NSW should in principle, be able to access NSW and Commonwealth government programs and would not have access to programs provided by other jurisdictions. Our main concern is therefore to address any unnecessary duplication of programs and resources between the Commonwealth and each States or Territory.

Assessment of overlap is based on the rationale and objectives of each program. Given the lack of clarity of objectives and key performance indicators the ultimate assessment of overlap rests with the jurisdictions concerned. It can be expected that given the national focus of the Commonwealth and the regional focus by the States and Territories that some similarity of programs or programs with overlapping objectives will exist among them. Many jurisdictions have programs that are designed to leverage Commonwealth programs and may therefore appear to overlap.

> *Queensland has many examples in which Commonwealth programs have been leveraged by the addition of State Government funded programs and vice versa.*[37]

Although a number of submissions to the Review made mention of overlap and duplication, none provided specific examples.

> *IRU Australia supports the government's view that there is a need to address the current uncoordinated and duplicated nature of innovation strategies and programs operating in various jurisdictions…* [38]

This was not a universal view.

> *In my view, at the Commonwealth level there is little or no duplication of science and innovation programs. Use of the term "vast" cannot be justified in relation to Commonwealth science and innovation programs, and most State and Territory Government programs are applicable only within a single jurisdiction. There is a lot of merit in having programs which are targeted at specific definable goals.*[39]

> *Innovation in the Australian mineral industry has not been notably affected by program duplication, except to the extent that inefficiencies resulting from duplication may have reduced the proportion of funding available to the industry.*[40]

> *ATSE is not aware of any significant overlap or duplication between Commonwealth and State/Territory Programs and notes that a 2003 study found good complementarity in this area. The 169 programs that are*

[37] Queensland Government – Submission no. 459
[38] Innovative Research Universities Australia – Submission no. 95
[39] Bell, John – Submission no. 37
[40] Minerals Council of Australia – Submission no. 445

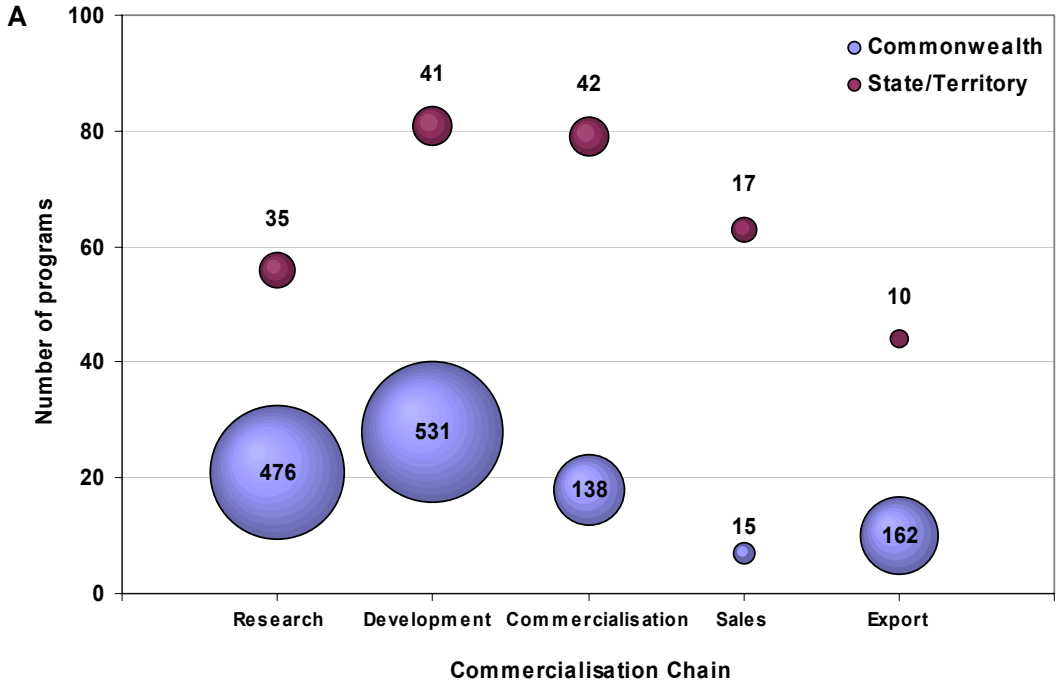
sometimes mentioned include programs offered by individual State/Territory governments to firms located within their jurisdictions which are therefore not available to firms located elsewhere.[41]

Mapping the programs against the commercialisation chain (Figure 6) for both direct and indirect programs highlights a similar coverage for both Commonwealth and State and Territory programs. The large number of programs, especially with their focus on the early parts of the commercialisation chain (Figure 6), suggests a large degree of duplication and overlap. However, this is not the case.

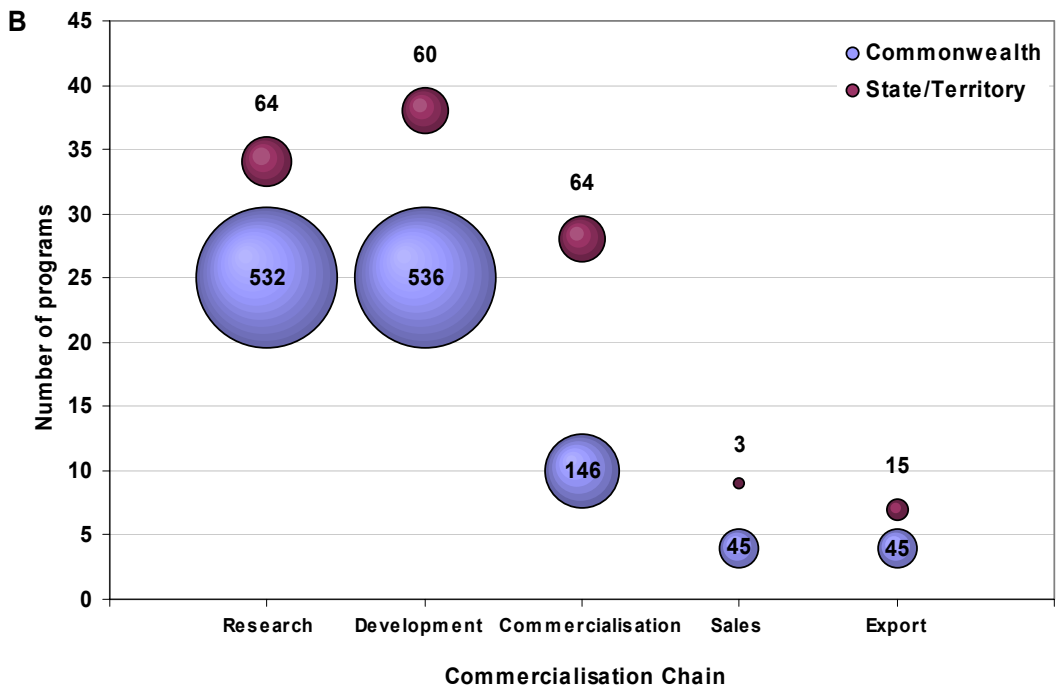
Where the States and Territories have programs that do essentially the same thing, this is duplication, but not overlap, as firms can only access the program in the jurisdiction they are based in, and not the program in another jurisdiction. Successful programs in a particular jurisdiction can serve as a model for other states and territories. This can even be seen as a healthy development.

Program duplication and overlap is not necessarily a problem if the programs' objectives and outcomes are complementary. A 2003 report on behalf of the then Department of Education, Science and Training (The Contribution of the States and Territories to Australia's Science and Innovation System) found good complementarity between State/Territory and Commonwealth programs.

Figure 6. A map of Commonwealth and State/Territory programs providing direct support (A) and indirect support (B) for firms across the commercialisation chain. The size of the bubble and the number annotation represents total averaged annual expenditure in $m.



[41] Australian Academy of Technological Sciences and Engineering – Submission no. 567



> *Innovation is also a risky business and Governments need to accept that impacts and outcomes from investment in any national innovation system must tolerate…some degree of national/local program overlaps (not bad per se if reinforcing each other).*[42]

There are two situations which can lead to true overlap of programs: *intra-jurisdictional*, where a jurisdiction has multiple programs that provide the same service; or *inter-jurisdictional*, where the States and Territories have similar programs to Commonwealth programs.

Intra-jurisdictional overlap - where a jurisdiction has multiple programs. Based on information provided by all jurisdictions, there are several cases where intra-jurisdictional overlap of program objectives is apparent (Table 12). Where this is identified sometimes the delivery mechanism or the sector differs. For example the South Australian governments' Growing Global ICT Companies and Market Access Program appear to overlap in objective, however, the former is a sector-specific service & intermediary assistance program and the latter is a generic competitive grant. Instances of intra-jurisdictional overlap are most frequent for information and advisory service programs. Of these programs:

- Half are aimed at small or small to medium sized businesses;
- Around 80% have an expenditure of $2M per year or less;
- Most are aimed at general business practice but several include or targeted commercialisation elements;
- Few target industry sectors but of those that do these are mostly for manufacturing. Also, several targeted export and several targeted rural/regional business; and
- Where multiple programs in this category are identified for a jurisdiction, these are almost all run out of the same department.

[42] South Australian Government – Submission no. 566

Table 12. A list of examples of programs within each jurisdiction that may overlap and could be combined (none for WA, NT, VIC).	
Commonwealth	Climate Ready & Renewable Energy Fund Emerging Indigenous Entrepreneurs Initiative & Business Development Assistance (Advisory service component)
ACT	PYKSIS Commercialisation Program & Canberra Business Point.
NSW	Stepping Up Program, Business Advisory Services, Innovation Advisory Services.
QLD	Advanced Manufacturing Advisory Service & QMI Solutions
SA	Innovation and Commercialisation grant & Innovation Development Grant
TAS	Springboard Accelerator program & Market Ready Commercialisation Program.

Table 12 highlights programs that were included in the analysis. Additional overlap was identified from the suite of general business development and export programs that were excluded from the analysis e.g. Small Business Mentoring Program (Vic) & Under New Management (Vic).

Inter-jurisdictional overlap - where the States and Territories have similar programs to Commonwealth programs. Given the mirroring of program focus between Commonwealth and State and Territory programs (Figure 6) overlap would be expected. However, even where there appears to be overlap, this may not actually be the case, as many State and Territory programs assist firms through the provision of services rather than the grants provided through Commonwealth programs (Figure 2).

All jurisdictions have programs to assist biotechnology companies within their jurisdictions (Table 13), which overlap with the Commonwealth programs, particularly for R&D. However, jurisdictions reserve the right to set up programs focussed on locally important economic sectors over and above what is available from the Commonwealth in order to stimulate the local economy and will continue to do so in any Commonwealth/State/Territory cooperative effort to streamline assistance programs. Even within the Biotechnology/ Pharmaceuticals/Life science/Medical industries sectoral programs), there appears to be little scope for overlap as these programs were from a range of States (with 2 from the Commonwealth), and had a range of objectives and delivery mechanisms. Several of these programs provided infrastructure but given the nature of and scope for infrastructure in this broad sector this is not unreasonable.

Such programs are also deliberately designed to leverage Commonwealth programs, rather than simply duplicating what the Commonwealth program does. Many actually provide a different service and have a different delivery system to the Commonwealth program.

Commonwealth and Victorian Research Programs

An analysis of Commonwealth and Victorian research programs was undertaken to determine the extent of overlap and duplication. Based on the program objectives, the following categories were developed and research programs classified accordingly to facilitate the analysis as *business assistance*, *collaboration*, *infrastructure*, *leverage* or combinations of them. For example, *business assistance*, some similarities were found in terms of sectoral targeting (renewable energy, resources, pharmaceuticals and health sciences). However, the delivery mechanisms are significantly different, with Commonwealth programs using competitive grants in 70% of the assistance programs while only 33% of Victorian programs use this delivery mechanism.

The differences are more dramatic when considering research programs where collaboration was the main objective. In Commonwealth programs only one out of 11 (9%) are sector specific, while 3 out of 4 Victorian programs are sector targeted. Delivery mechanisms are also very different. The Commonwealth uses competitive grants as delivery mechanism in 10 out of 11 programs, while Victorian programs use this delivery mechanisms in only in 1 out of 4 programs, services intermediary assistant and non-competitive grants are also used as program delivery mechanisms in Victoria.

In research programs which have as a main objective infrastructure support, Victorian programs are more industry-targeted than Commonwealth programs. Again Victoria uses non-competitive grants and services and intermediary assistance as delivery mechanisms while Commonwealth uses mainly competitive grants.

Specific examples of apparent inter-jurisdictional overlap are detailed below:

The Water for Industry (Vic) program appears to overlap with the Water Smart Australia program and/or the On-farm Irrigation Efficiency pilot program delivered by the Commonwealth (DEWHA).

The Research and Development (Qld) program appears to overlap with the Rural Research and Development Corporations program delivered by the Commonwealth (DAFF).

Some elements of the new Commonwealth (DIISR) Enterprise Connect program have similar delivery and objectives to many of the State/Territory business information and advisory service programs listed in Table 12. However, Enterprise Connect has a narrower target market in that it only assists business with greater than $2m a year turnover. Enterprise Connect will also work with local providers rather than duplicate services.

A number of State programs aiming to increase business expertise in export; particularly the Trade Fairs and Missions (Vic), the Trade Support Scheme (NT), the Business Boost Program and Practitioner Development-Travel (Tas) and the Market Access Program (SA) appear to overlap with the Export Market Development Grants (EMDG) delivered by the Commonwealth (Austrade). Several of these programs were excluded from the analysis of the database and are examined in detail by the Mortimer Review of Export Policies and Programs.

Additional overlap was identified from the suite of general business development and export programs that were excluded from the analysis e.g. The Aboriginal Business Development Program (NSW) appears to overlap with the Commonwealth's Emerging Indigenous Entrepreneurs Initiative (DEEWR).

In summary, there are some overlapping programs where the objective and delivery mechanism is apparently duplicated. This is the case within most jurisdictions and also between States and the Commonwealth. Further investigation of the impact of these

apparent overlaps may be warranted between the jurisdictions concerned. This overlap is not systemic, neither is it likely to have a high impact given the generally large difference in scale between Commonwealth and State/Territory expenditure.

The sectoral nature of innovation programs

Of the 143 innovation programs that provide direct assistance to firms, 85 (59%) are sector-specific (Table 13). There is significant inter-jurisdictional variation in the percentage of State/Territory direct assistance programs that are sector-specific (0-75%) however, the overall 58% is similar to the Commonwealth (63%) in terms of sectoral targeted innovation programs.

Biotechnology, pharmaceuticals and health sciences top the number of single sector-specific innovation programs (Table 13) with 16 programs (20% of all sector-targeted programs). Manufacturing follows with 14 programs (17% of all sector-targeted programs).

Table 13. Industry sector targeted programs	Total	Commonwealth	State/Territory
Biotechnology; Pharmaceuticals; Therapeutics; Life Science; Medical; Health	16	2	14
Manufacturing; Automotive; Aerospace; Tooling	14	3	11
Energy	9	6	3
ICT	6	1	5
Arts; Film; Creative industries	6	0	6
Agriculture; Food	6	3	3
Defence	4	4	0
Other	2	1	1
Science; Research; Technology	2	0	2
Regional; Rural; Remote	5	0	5
Education; Training	1	0	1
Several (cover a range of the above)	14	4	10
Total targeted programs	85	24	61
Total non-targeted or not clearly targeted programs	58	14	44

The higher proportion of sectoral programs identified raises the question whether the innovation system has enough generality built into it. The termination of Commercial Ready certainly highlights this generality/specificity issue. Does this high proportion of sectoral programs create any gaps in the innovation system? A number of submissions identified gaps in sectoral coverage.

> *The arts are frequently overlooked in innovation policy, the result being that few programs are accessible to the sector. Of the suite of available AusIndustry programs, for example, only one offers support that artists and small or micro businesses could access and that program is very targeted in its scope.*[43]
>
> *…in the areas of ICT and other sectors, most of the funding has now dried up and there is very little available at either the State or Federal level. There is also a distinct lack of direct support for: companies travelling and working in*

[43] National Association for the Visual Arts – Submission no. 628

> *certain countries, collaboration, development of online technology [and] start-up businesses.*[44]

In general, the variety of Commonwealth and State/Territory innovation support programs reflect some logical separation and are complementary rather than substitutes. The comparison between Commonwealth and Victorian research projects shows in most of the cases, the levels of sectoral targeting and delivery mechanisms are different. Overall this is in accord with the Department of Education, Science and Training 2003 report, *The Contribution of the States and Territories to Australia's Science and Innovation System,* which found:

> *. . a major focus for these governments has been to ensure that they are able to leverage Commonwealth funding programs for science and innovation.* (p. *x*)

These findings do not support a significant or systematic overlap/duplication of Commonwealth/State and Territory programs supporting innovation in firms leaving little scope for a significant reduction in the number of programs. There may be scope for streamlining future programs, either by having a single supplier, or with a single owner and jurisdiction-based delivery – especially if the programs are relatively generic and do not have significant local economic factors

There is certainly still scope for States and Territory to provide the on-the-ground basic business management assistance to smaller firms and this is arguably a suitable role for States and Territories.

Since the States and Territories have a large number of programs with limited budgets, it may be better to bring some of these programs together and provide an integrated suite of services from a smaller number of programs. This would produce a smaller number of more broadly based programs with larger budgets, and reduce the overall administration costs associated with a large number of small programs.

Mapping programs against the National Innovation Priorities

All programs/initiatives were mapped to a draft of the National Innovation Priorities provided by the NIS Review Panel on the 12th June 2008. To date there is no improved list of priorities. The draft priorities were provided as follows:

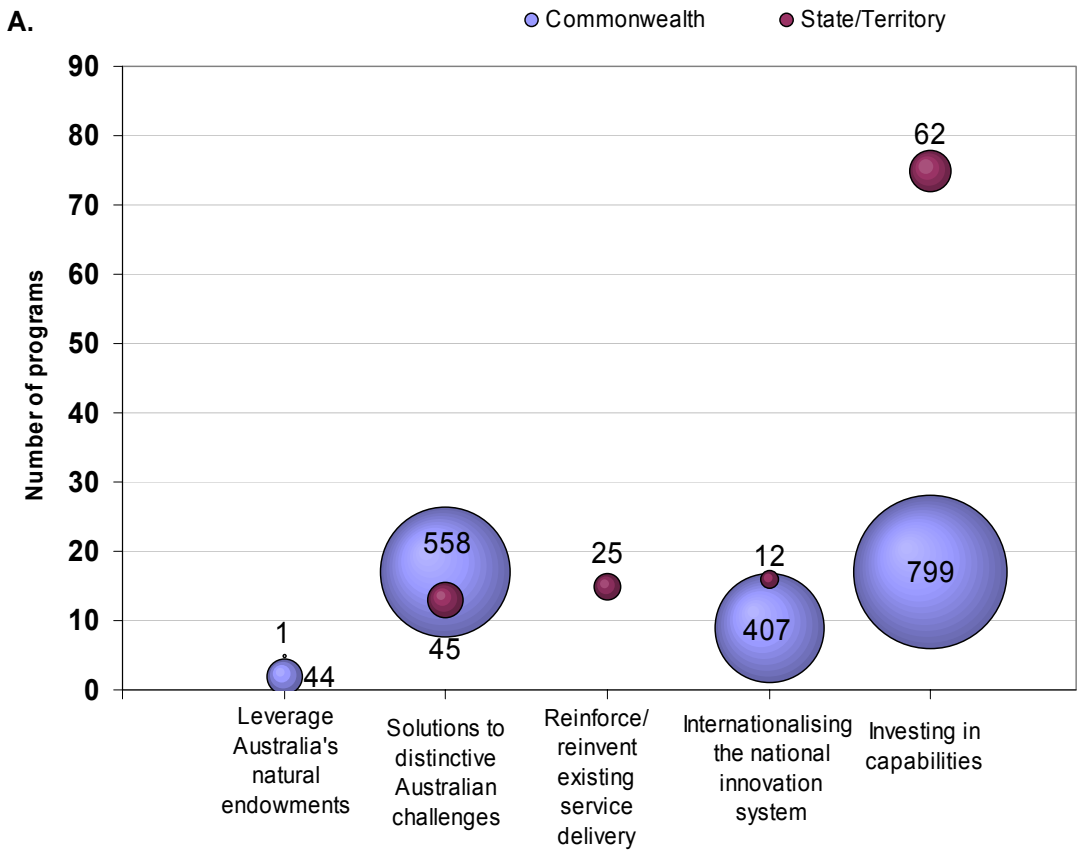
1. Leverage Australia's natural endowments/build strengths (minerals, agriculture/food, health, sport, resources, education)
2. Distinctive Australian situation/challenges (solutions to problems for Australia and the world) – multicultural, health, cities, marine, tropics, deserts, sparcity, sun, space, climate, water salinity
3. Scope to reinforce/reinvent existing service delivery (competitively)
4. Internationalising the NIS (absorptive) – inwards innovation investment, hubs, Diaspora, trade intensity
5. Investing in capabilities – education, reinstate social accord

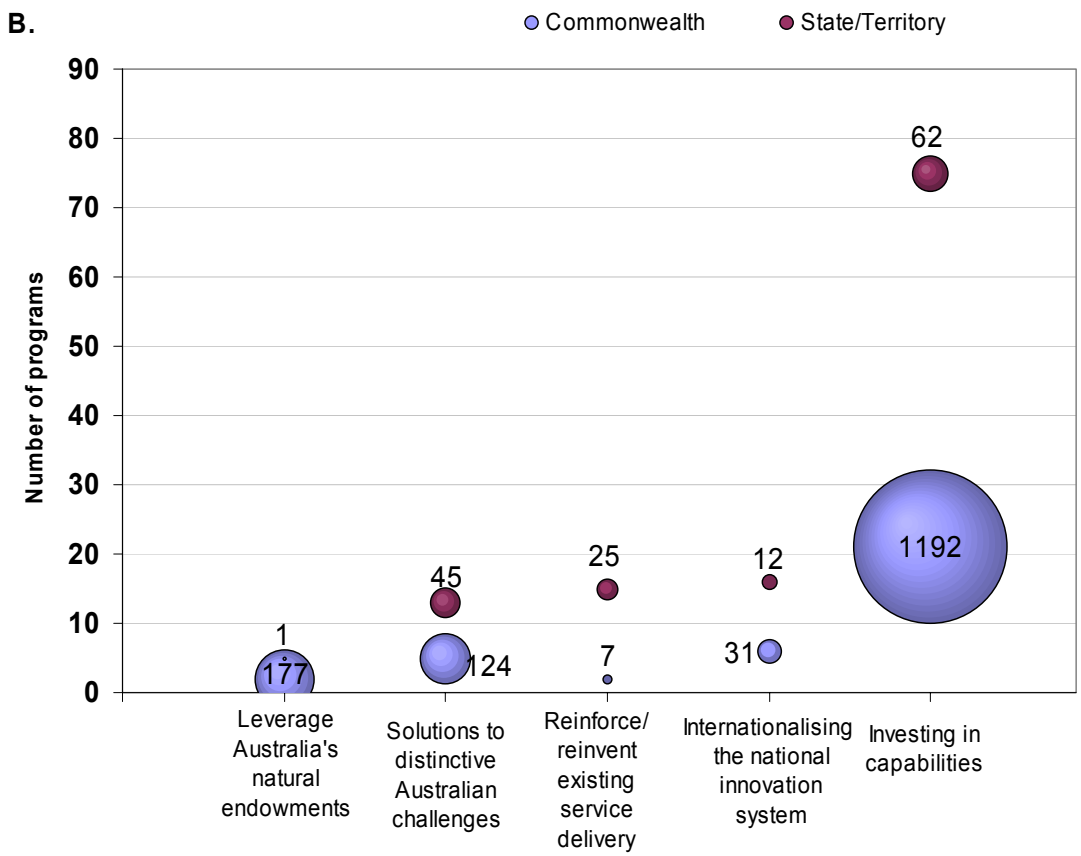
Given that we do not have explicit descriptions of each priority the mapping exercise can be described as completely subjective. As with the model of innovation, the mapping of each program/initiative relied on the rationale, objective and key performance indicators to identify whether it would map against any of the national innovation priorities.

[44] GrantReady – Submission no. 443

The innovation priorities are not meant to be a complete model of the innovation system therefore we should not expect that all programs/initiatives will neatly fit into one priority or another. In practice, however, all but three programs could be mapped to one or more of the draft national priorities. The results suggest that the majority of the programs target the fifth priority, investing in capabilities, which we interpreted as more than just investment in education and social inclusion (Figure 7). This result is expected since this exercise is not exhaustive representing a map of only one form of government investment/regulation i.e. programs/initiatives supporting innovation in firms. There were fewer programs that aimed to leverage Australia's natural endowments/build strengths. Both Commonwealth and State/Territory governments have invested significantly in solutions to Australian challenges. These direct assistance programs are targeted at managing water resources, tackling climate change and encouraging innovation in indigenous firms. State/Territory governments have an additional focus on regional issues.

Figure 7. A map of Commonwealth and State/Territory programs providing direct support (A) and indirect support (B) for firms across the draft National Innovation Priorities. The size of the bubble and the number annotation represents total averaged annual expenditure in $m.





Ways of Improving Access for the Business Community to Programs supporting innovation in firms

A single portal for information on government programs

There appears to be little opportunity to significantly reduce the number of innovation programs without also significantly reducing the amount of assistance provided. However, there is no doubt that firms have difficulty in finding out information on such an array of programs.

> *There are many programs to provide support for SMEs. Unfortunately, many SMEs are not even aware of the programs that are available to them and don't have the time to navigate the Government labyrinth to identify the scheme relevant to them. Even when they can find the right program they are often too busy running their business to work through the various requirements to access the support.*[45]

> *Among small business, a general lack of understanding and awareness about how and where to access capital for new and growing business ventures may impede innovative companies to realise opportunities.*[46]

> *Research conducted by the CRCSI suggests that a substantial 64 percent of companies in the Australian spatial information industry felt that the time and effort taken to find out about government support programs for R&D is an impediment to innovation in their company.*[47]

[45] CRC Committee – Submission no. 212
[46] WA Department of Industry and Resources – Submission no. 603
[47] CRC-Spatial Information – Submission no. 303

> *Companies are not aware of grant programs for which they are eligible, including rebates they are entitled to receive.*[48]
>
> *The process of finding grant information and confirming eligibility through Government channels is complicated and confusing. Most companies abandon the system.*[49]
>
> *Currently, the schemes available in both state and federal government are not widely understood or accessible.*[50]
>
> *The sheer complexity of the current programs at state and federal level makes it difficult to discern what is available for industry to pursue.*[51]

The number of programs need not necessarily lead to a "bewildering array". What is important is not the number of programs, but the ease of access to information on programs relevant to the particular circumstances of the firm seeking assistance.

> *IRU Australia…sees a need to significantly enhance the coordination of access to information about the different initiatives and programs in place across the country.*[52]

According to a submission by GrantReady (a firm providing a service to assist businesses identify suitable Commonwealth, State or Territory grants),

> *The current array of grant programs we have found are represented on over 115 different websites. Federally, there are over 55 websites detailing grant programs; which is extraordinary since there are about 19 Federal Government departments, of which approximately half are business related. They are presented in different formats, with different information and different terminology.*[53]

Other submissions to the NIS review also point out the need for a single portal providing grants and incentives for innovation.

> *Successful International models and commercialisation programs are loosely based around a pipeline or one stop shop model and incorporate a critical pathway of programs and services.*[54]
>
> *Consolidation of [innovation] support into a single interface would enable responsiveness to the rapidly evolving needs of SMEs throughout their life cycle of innovation, and needs to be supported by a suite of programs structured under broader definitions of innovation than currently apply to programs such as R&D Tax concession and Commercial Ready.*[55]

A single point of access with a searchable database on all State, Territory and Commonwealth programs that provide direct assistance to firms, and a search engine that

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[48] GrantReady – Submission no. 443
[49] *Ibid*
[50] AMITL – Submission no. 505
[51] Boeing Australia – Submission no. 259
[52] Innovative Research Universities Australia – Submission no. 95
[53] GrantReady – Submission no. 443
[54] Hyland, Paul – Submission no. 118
[55] AMITL – Submission no. 505

will allow a search to quickly identify relevant programs, would go a long way to easing the current difficulty faced by firms in seeking assistance.

This would also obviate the need for radically re-organising the current suite of assistance programs, which would lead to significant disruption to the provision of assistance to firms.

> *The recommended solution is to establish a common governmental portal for innovation support, including standardised reporting for common features. Where possible include State/Territory innovation support programs in the same portal. This shared process could be trialled in a small jurisdiction like that of the NT.*[56]

Firms generally do not differentiate between innovation programs and other industry development programs. Such a database should, therefore, also contain similar information on all other direct assistance industry development programs. This would offer a one-stop shop for advice on all programs, but also would offer firms a complete suite of programs covering the majority of the commercialisation path – a continuous coverage over the entire journey of companies, from start up to export success.

> *An 'end-to-end' suite of program support is needed, simple in design and of low transactional cost that spans R&D, business processes and support for global export.*[57]

An example of a web site that offers relevant information about a range of businesses support, and is a comprehensive gateway to government information and services for both the Commonwealth and the States is www.business.gov.au.

Communication

An essential component of any portal to program information for business is a communications strategy to raise awareness of the portal. A portal would be of little use if the firms that are meant to benefit from it are not aware of its existence. A number of submissions emphasised that such a strategy is needed.

> *It [is] also important that innovation programs be publicised widely.*[58]
>
> *We need to look at how we can better coordinate and communicate government support programs for SMEs and minimise the administrivia [or trivial administration] in all the relevant funding programs.*[59]
>
> *For the Government to be more effective [at promoting programs], a more targeted campaign may be required. This could involve broad advertising around general grant concepts, rather than promoting a single grant. A simple message that can be pushed out through multiple channels could be more effective in reaching a wider audience with better awareness.*[60]

Such a strategy would need to be developed in consultation with those who would benefit from the portal to ensure that how firms search for information is captured, understood and incorporated into any communications strategy

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[56] NT Research and Innovation Board – Submission no. 242
[57] South Australian Government – Submission no. 566
[58] National Association for the Visual Arts – Submission no. 628
[59] CRC Committee – Submission no. 212
[60] GrantReady – Submission no. 443

> *…there appears to be a clear disconnect with the grant promoters understanding of how companies become aware of grant programs.*[61]

On-line access for completing and submitting application forms.

Analysis from the database of Commonwealth, State and Territory innovation programs indicates that, of the 88 programs that have application processes, only 22% have on-line access for completing and submitting application forms (10% Commonwealth and 28% States and Territories).

Recognising that some grants programs required detailed information, full online application should be a priority.

Having an online application process would speed up the application process, providing a faster turnaround of assessment. This is important as many businesses have to devote valuable resources to applications and so require a rapid response from government.

> *GKNAES has regularly looked at government grants to complement its R&D expenditure. However, the preparation time versus possible funds on offer makes the effort difficult to justify. Grant money is supposed to minimise risk, however, the risk of not getting the grant after the lengthy application process is in itself risky due to the large amounts of resources required (often including costly consultants). Further to this, long lead times associated with many of the grants can inhibit the solution to urgent problems.*[62]

> *The time it takes from submission of a grant application to receiving a response is a key indicator of the worth of a program to an applicant. If that timeframe takes longer than one month, most companies are not interested.*[63]

Having an online application process also supplies jurisdictions with electronic and easily searchable applications that provide easy access for data extraction and review/assessment.

Commonality across application forms.

There is very little commonality in the application processes of government innovation programs. The present system for program application is far from standardised. Firms need to deal with a myriad of formats for obtaining program information and for the application process.

> *The sophistication of grant programs, detailed in large and unyielding documents is a deterrent to potential applicants.*[64]

This is especially onerous on small businesses

> *…small businesses are disadvantaged by the cost involved with the paperwork in making an application under [the R&D Start] program. As this is a competitive program, bigger businesses have the advantage of being able to hire outside expertise to do the paperwork.*[65]

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[61] *Ibid*
[62] GKN Aerospace Engineering Services – Submission no. 408
[63] GrantReady – Submission no. 443
[64] *Ibid*
[65] WA Department of Industry and Resources – Submission no. 603

Having a certain degree of commonality for application forms (recognising that different programs may require differing information) would reduce the significant array of forms currently required, and provides a degree of familiarity to firms that subsequently apply for different programs

A move to online applications provides an opportunity to produce a more similar suite of application forms. And potentially provides an option to "auto fill" a number sections of an application with information from previously applications.

Appendix A

Definitions of Innovation and Innovation-related Activities [66]

An ***Innovation*** is the implementation of a new or significantly improved product (good or service) or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations.

- A ***Product Innovation*** is the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses. This includes significant improvements in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics. Product innovations can utilise new knowledge or technologies, or can be based on new uses of combinations of existing knowledge or technologies.
- A ***Process Innovation*** is the implementation of a new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software. Process innovations can be intended to decrease unit costs of production or delivery, to increase quality, or to produce or deliver new or significantly improved products.
- An ***Organisational Innovation*** is the implementation of a new organisational method in the firm's business practices, workplace organisational or external relations. Organisational innovations can be intended to increase a firm's performance by reducing administrative costs or transaction costs, improving workplace satisfaction (and thus labour productivity), gaining access to non-tradable assets (such as non-codified external knowledge) or reducing costs of supplies.
- A ***Marketing Innovation*** is the implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing. Marketing innovations are aimed at better addressing customer needs, opening up new markets, or newly positioning a firm's product on the market, with the objective of increasing the firm's sales.

Innovation-related Activities are all scientific, technological, organisational, financial and commercial steps which actually, or are intended to, lead to the implementation of innovations. Examples of innovation-related activities are:

- All forms of R&D (intra- & extra-mural R&D and R&D that is not directly related to the development of a specific innovation);
- Acquisition of disembodied technology and know-how;
- Acquisition of embodied technology;
- Tooling up and industrial engineering;
- Industrial design;
- Other capital acquisition;
- Production start-up; and
- Marketing for new or improved products.

Important Notes

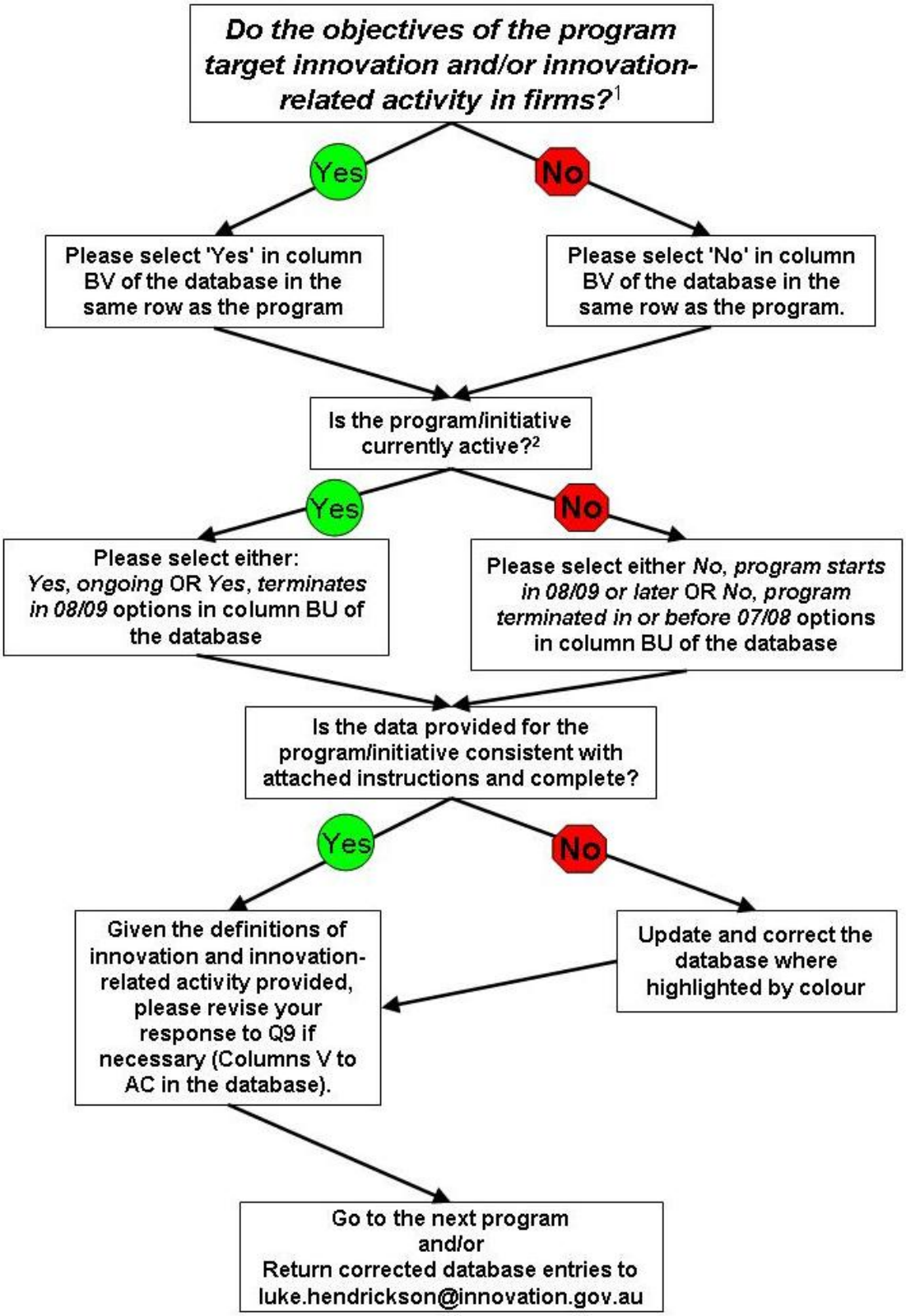
- An innovation must have been *implemented*: (i) a new or improved product is implemented when it is introduced on the market; (ii) new operational processes, organisational methods or marketing methods are implemented when they are brought to actual use in the firm's operations.

[66] See Chapter 3, Oslo Manual, OECD, 2005

- The minimum requirement for an innovation is that it must be *new (or significantly improved) to the firm*.
- Innovations can be either *radical* or *incremental.*

Annex 9

For every program under your jurisdiction please follow this flow chart:



Notes: 1) In the database provided to you missing data is highlighted in blue, data that is inconsistent with earlier questions is highlighted in red and data identified as requiring confirmation or clarification is highlighted in green. 2) An active program is defined as a program with a budget allocation.

Annex 9

ATTACHMENT 2

Innovation Interventions – Framework of Principles

Preamble

To ensure that the National Innovation System reflects and responds effectively to changing demands, a coordinated and flexible innovation system is of vital importance. As noted in the *Findings of the Intergovernmental Working Group* all Governments have a role to play in supporting the development of Australia's National Innovation System.

A *Framework of Principles for Innovation Interventions* is therefore proposed to enhance consistency in approach and support the overall accessibility and efficiency of the suite of interventions.
The underlying intent of the Framework is to maximise the effectiveness of individual and collective actions by Governments in support of the development of the National Innovation System; with a particular focus on ensuring the suite of interventions reflect and respond to changes in demand side needs and priorities and improving coordination and consistency (where possible) across jurisdictions. The Framework does not seek to prevent governments continuing to develop and take appropriate action to support and improve innovation activity.

The Framework covers only those initiatives primarily aimed at improving the innovation capability and performance of firms. Focusing on this core suite of innovation initiatives will help to minimise confusion with initiatives aimed at other aspects of the innovation system or business capabilities more generally (e.g. in areas such as skills and small business support).

New disciplines and behaviours will need to be adopted by all Governments to support the implementation and ongoing operation of the Framework. In particular, an efficient mechanism will need to be established (potentially building on existing Inter-Governmental forums) to ensure ongoing commitment to and management of the Framework and related actions.

DRAFT Framework Principles for Innovation Interventions

Principle	Guiding Considerations
1. Supports the development and effectiveness of the National Innovation System.	• Does the initiative seek to enhance the capacity, capability and/or cohesion of the National Innovation System? • Does the initiative address an identified national innovation priority? • Does the initiative add value to the existing suite of National Innovation System interventions (consider gaps, opportunities to leverage from existing initiatives, regional needs, potential confusion, etc)? • Has interplay with other policy levers impacting on innovation (e.g. tax, regulation, education and training) been considered and accounted for? • Is there a capacity to replicate the initiative across the National Innovation System? • Has initiative design incorporated any commonly agreed language, descriptors, and evaluation/risk management methodologies etc? • Does the initiative consider the impact of the targeted priority with other elements of the innovation system? • Has collaboration with other jurisdictions been considered or undertaken with a view to: - Maximising opportunities for shared learning and efficiencies across the system? - Identifying opportunities for streamlining of initiatives and delivery mechanisms?
2. Reflects and responds to demand side needs and priorities.	• Has the market or demand for the initiative been tested? • Does the design of the initiative facilitate flexibility to respond to changing and emerging demand side needs and priorities? • Does initiative design facilitate ease of understanding and access by target users (consider design, delivery, compliance burden, and marketing and communication elements)? • Does the initiative facilitate ease of understanding and access by target users? • Are marketing and communications coordinated with existing mechanisms (where possible)?

Principle	Guiding Considerations
3. Rationale for intervention and role of government is clearly identified.	• Does the initiative address a national innovation priority or an identified element of the National Innovation System? • Is the innovation system issue or opportunity to be addressed clearly identified (i.e. in terms of market or system failure, or on economic/social development grounds)? • Has the initiative considered the least cost intervention for maximum benefit (i.e. what alternatives have been considered; including government doing nothing)? • Is the rationale for intervention and identified approach supported by a sound evidence base?
4. The best placed jurisdiction(s) is/are responsible for design and delivery.	• Has an assessment been made regarding the best placed jurisdiction(s) to design and deliver the initiative? – Does the initiative trigger any constitutional or other considerations of responsibility? – Is the initiative related or similar to other initiatives already being delivered or developed by government(s)? – Is there a strong national dimension to the initiative? (suggests the C'wlth) – Does the initiative target a specific local or regional objective? (suggests State/Territory) – Is there a service delivery element to the initiative? – Are there any economies of scale in the provision of the initiative? – Is there a strong international component to the initiative? – Has collaboration with other jurisdictions been considered or undertaken with a view to supporting the identification and allocation of responsibility?
5. Innovation risk is assessed, accepted and incorporated into initiative design.	• Does the initiative recognise and account for elevated risk associated with innovative activity? • Is the assessed risk level accounted for in risk management strategies, key performance indicators, application process, and evaluation methodologies? • Does initiative design provide for fast failure recognition and a subsequent ability to change or terminate the initiative quickly?

Principle	Guiding Considerations
	• Does the initiative assist the delivery agent to incorporate risk in delivery? • Has the initiative considered pilot programs/prototyping as a risk management strategy?
6. Initiatives are well designed with clarity about: • Purpose; • Expected outcome; • Key performance indicators; • Evaluation processes; • Return on investment (financial, economic, or social); and • User/target.	• Has the market or demand for the initiative been tested? • Are the intent and expected outcomes from the initiative clear? • Are the key performance indicators for the initiative clear and measurable? • Do reporting and data collection requirements facilitate initiative evaluation? • Have review processes been established to support ongoing evaluation of the initiative? • Does the design of the initiative facilitate flexibility to respond to changing and emerging needs (i.e. linked to evaluation)? • Are the eligibility criteria clear, transparent, and aligned with the rationale for intervention? • Does the initiative design seek to minimise the compliance/administrative burden for end-users and delivery agent(s)? • Has the initiative identified the most effective delivery mechanism for the initiative (any jurisdiction or private sector agent); having regard for ease and efficiency of delivery? • Does the design of the initiative assess, accept and incorporate risk into initiative design and evaluation mechanisms?
7. Initiatives evaluated for impact on regional/national innovation system.	• Have appropriate data items/measurement/benchmark tools been identified and incorporated into program evaluation? • Do evaluation mechanisms account for issues/difficulties in measuring innovation system outcomes? • Has the need for external input/expertise been considered? • Have or will evaluation results been shared across jurisdictions? • Does evaluation inform future scale and scope of program?

Rural Research and Development

Innovation is a vital part of maintaining the ongoing growth, profitability and sustainability of Australia's rural industries, especially in the face of increases in competition in domestic and international markets. Investors and providers of rural R&D vary across a wide range of Commonwealth and state/territory agencies, including the 16 rural research and development corporations and companies (RDCs), the CRCs, universities funded through the ARC, and CSIRO.[1]

Improved overall understanding of the rural innovation system is needed to better align respective efforts and collaboration. The Review consultation process raised a strong consensus need for greater national strategic leadership, a broader framework around prioritisation, and coordination across jurisdictions and institutions.

The Panel sees as a priority that the Australian Government should develop a national rural innovation strategy to:

- Ensure optimal outcomes are gained from public investment in rural R&D including improved delivery of research and development directed at issues of national public concern
- Determine where public investment is needed to achieve greater effectiveness and efficiency in agriculture and food supply chains, taking into account the work being done by the Primary Industries Ministerial Council
- Reduce the duplication of research activity through institutional consolidation to promote administrative efficiency and critical mass
- Review existing rural research and development levy arrangements and contribution levels, including contributions made by both industry and government, to ensure the effective delivery of research and development to meet the demands of both public and private interests.

Tropical Innovation

As one of the few developed nations with a substantial tropical footprint and a strong R&D base in tropical science, Australia is well placed to take a leadership role in developing and marketing products and services in the areas of tropical health, food, environment and urban design.

The tropics comprise approximately 50% of world’s population on 33% of world’s landmass and with 50-80% of the world's biodiversity. Projections based on current growth rates suggest that the gross Tropical World Product will reach $US40 trillion by 2025, with knowledge-intensive industries accounting for 20 per cent, or $US8 trillion, of this economy.[2]

The extent to which Australia is able to capture a significant portion of this economy will be determined in some part by the extent of its pre-eminence in tropical R&D. It is already a leader in some areas such as coral reef ecology. However, exploiting other opportunities in fields such as health and agriculture will require a conscious decision

[1] The Department of Agriculture, Fisheries and Forestry – Submission No. 661
[2] Calculations based on data available from: The World Factbook, Central Intelligence Agency (http://www.cia.gov/cia/publications/factbook/), accessed July 2007

to build world research and development leadership and to develop Australia's capacity to commercialise and market the resulting products and services.

A coordinated and strategic approach will be necessary to properly overcome the challenges faced by tropical populations both within Australia and throughout the world and to take advantage of Australia's tropical expertise. The cross-jurisdictional nature of opportunities and challenges for the tropics and the large number of existing policy and institutional research initiatives suggest the need for a high level overarching coordination mechanism.

Building pre-eminence in tropical innovation will require not only substantial critical mass on the ground in Australia but also strong linkages to key areas of tropical research domestically and internationally. This could best be achieved by establishing an iconic tropical research and innovation precinct that provided a shared research environment for Australian and international researchers, and where industry and other end-users could interact and partner. A Tropical Innovation precinct would build capacity, expertise, critical mass and connectivity in tropical research and raise its profile both nationally and internationally.

The Panel sees merit in the Australian Government establishing a Tropical Innovation Council with responsibility for setting overall research and innovation priorities and strategies and allocating funding sourced from both State and Federal governments. A Tropical Innovation Precinct could also be created to build capacity, expertise, critical mass and connectivity in tropical research and raise its profile both nationally and internationally

Annex 12

1. Preliminary Innovation Indicators

A OVERALL ECONOMIC IMPACTS

A1 GDP per capita
A2 Productivity growth
A3 Trade intensity
A4 Increased welfare
A5 Environment
A6 R&D by priority SEOs

B INNOVATION OUTCOMES AND OUTPUTS

B1 New or improved products, processes, services
New to firm
New to market
New to world
No of firms innovating
B2 New businesses employing staff
B3 Exporting firms
B4 Global firms
No firms in global top 100
No of firms in top 500 innovators
Firms with > 50% trade intensity
Industries with > 10% global market share
B5 Generation of Intellectual property
Patents
Trademarks
Registered designs
Royalty streams
Terms of IP trade

C KNOWLEDGE GENERATION

C1 Share of world publications
C2 Share of world citations
C3 Number of scholarly journals
C4 Innovation diffusion (gap in metrics)
C5 Firm absorptive capacity (gap in metrics)

D HUMAN CAPITAL

D1 Education as % of GDP
D2 As per cent of OECD average
D3 Firm expenditure on training
D4 Higher degree enrolments
D5 STEM as % of HEI enrolments
D6 PhDs in workforce

E INVESTMENT IN THE RESEARCH BASE AND INOVATION

E1 R&D expenditure as % of R&D
GERD
BERD
Philanthropic investment
Extramural as % of total
E2 Investment by SEOs
E3 R&D intensity by Industry cf Rest of World
E4 Investment in research infrastructure

E5 Investment in major national facilities

F GLOBAL INTEGRATION

F1 People Flows

F2 Firm integration

F3 Institutional integration

G FRAMEWORK CONDITIONS

G1 FDI attractiveness

G2 Venture Capital availability

G3 Public engagement with innovation

G4 Standards

H KNOWLEDGE EXCHANGE EFFICIENCY

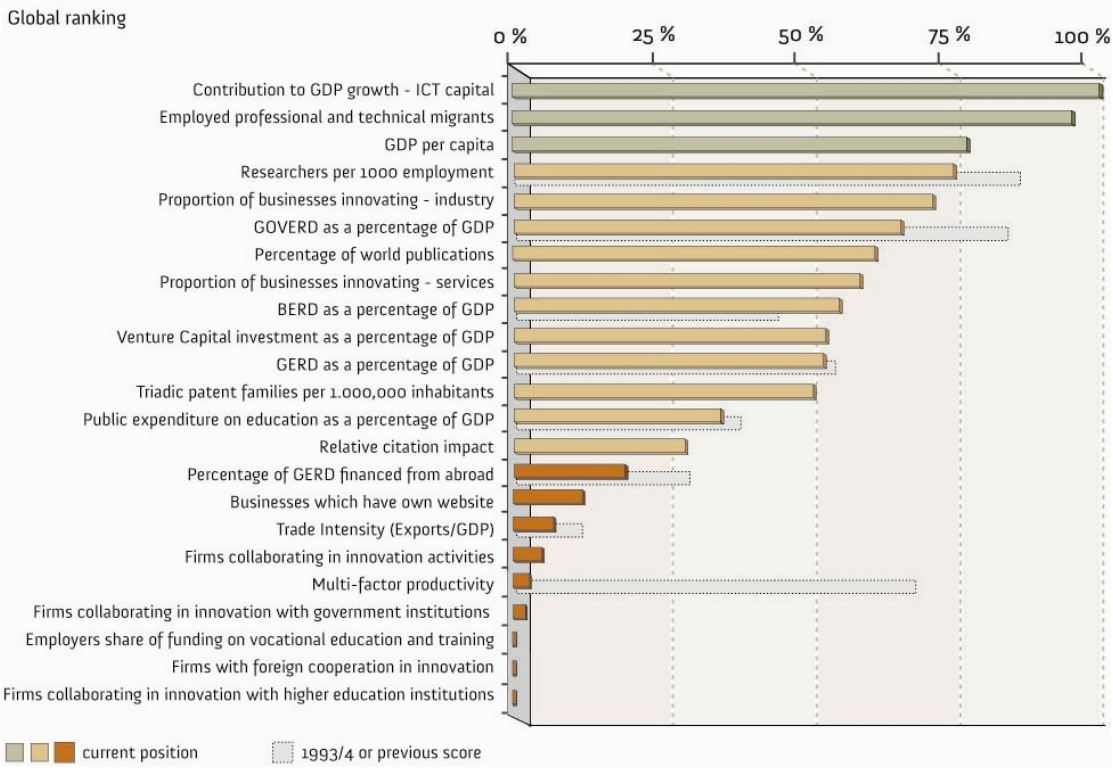
H1 Ease of Collaboration

2. Global Ranking Dashboard

The global ranking dashboard provides a snapshot view of Australia's rank compared to OECD countries in a number of statistical measures.

The graph ranks Australia's position and indicates the quartile of its ranking.

In some cases ranks are also provided for previous years, indicating the change in Australia's performance overtime on these measures compared to other countries. See explanatory notes and caveats below.



Caveats

- The global ranking dashboard is not intended to detail Australia's position at one point in time (one particular year).
- Data and ranks in the global ranking dashboard has been gathered from different years and compared to different sets of countries, i.e. individual indicators may use data from different sets of countries.
- Data from countries against which Australia has been ranked may not be from the same year or time period.
- Definitions used in data collection from other countries may vary from the definitions used in the Australian data set (for example the definition of SMEs)

Explanatory notes

Contribution to GDP growth – ICT capital
The proportion of growth to GDP accounted for by ICT.

Employed professional and technical migrants
A measure of the number of employed professionals and technical migrants (who were born overseas) as a percentage of total employed professionals and technicians in Australia.

GDP per capita (an index of per capita income)
A measure of the appropriation of the value of goods produced per person in Australia, equal to Gross Domestic Product (GDP) divided by population (total number of people).

Researchers per 1000 employment
The number of researchers per 1000 people in employment.

Proportion of businesses innovating – industry and services
The percentage of all businesses that introduced or implemented any type of innovation during the reference period.

GOVERD as a percentage of GDP
Expenditure by government organisations on R&D (GOVERD) as a percentage of Gross Domestic Product (GDP).

Percentage of world publications
Australia's rank in terms of our contribution to total world publications.

BERD as a percentage of GDP
Business Expenditure on R&D (BERD) as a percentage of Gross Domestic Product (GDP).

Venture capital investment as a percentage of GDP
Venture capital investment as a percentage of GDP. This measure only captures formal venture capital investments.

GERD as a percentage of GDP
Gross Expenditure on R&D (GERD) as a percentage of Gross Domestic Product (GDP).

Triadic patent families per 1 000 000 inhabitants
Triadic patent families are defined by the OECD as a set of patents taken at the European Patent Office (EPO), the Japan Patent Office (JPO) and the US Patent and Trademark Office (USPTO) that protect the same invention.

Public expenditure on education as a percentage of GDP
Direct public expenditure on educational institutions plus public subsidies to households (which include subsidies for living costs) and other private entities, as a

percentage of GDP and as a percentage of total public expenditure, by level of education and year.

Relative citation impact
The impact factor indicates the number of citations of publications in relation to the number of publications. It gives an index of the impact of a country's publications.

Percentage of GERD financed from abroad
The volume of funds from abroad invested in Australian R&D, reflecting the continuing globalisation of R&D.

Businesses which have own website
A measure of the percentage of businesses with ten or more employees that have their own website. For Australia, businesses in agriculture, forestry and fishing, education and religious organisations are excluded.

Trade intensity
A measure of exports as a percentage of GDP.

Firms collaborating in innovative activities
Collaboration is an important part of the innovation activities of many firms. It involves "active participation in joint innovation projects with other organisations", but excludes pure contracting out of work.

Multi factor productivity
GDP can be broken down into the weighed sum of growth rates of the main factor inputs, labour and capital, with the respective weights being the shares of labour remuneration and capital income in total income or costs. The part of GDP growth that can not be explained by the rate of growth of capital and labour, the so-called Solow residual, is assumed to be the growth in multi factor productivity.

Firms collaborating with government institutions - total
This is a measure of the rank of the percentage of firms collaborating in innovation with government institutions.

Employers share of funding on vocational education and training
A measure of the share of funding of continual vocational education and training provided by employers compared to other funding sources.

Firms with foreign cooperation in innovation
This is a rank of the percentage of all firms with foreign cooperation on innovation.

Firms collaborating with higher education institutions – total
This is a rank of the percentage of firms collaborating in innovation with higher education institutions.

Sources:

Contribution to GDP growth – ICT capital:	OECD STI: Scoreboard 2007
Employed professional and technical migrants:	OECD STI: Scoreboard 2007
GDP per capita:	Total Economy Database, January 2008, http://www.conference-board.org/economics/
Researchers per 1000 employment:	OECD STI: Scoreboard 2007 OECD, MSTI, April 2008
Proportion of businesses innovating – industry:	Community Innovation Statistics, Statistics in Focus, 2004 ABS, Innovation in Australian Business, 2005
GOVERD as a percentage of GDP:	OECD, MSTI, April 2008
Percentage of world publications:	Thomson-ISI, 2006
Proportion of businesses innovating – services:	Community Innovation Statistics, Statistics in Focus, 2004 ABS, Innovation in Australian Business, 2005
BERD as a percentage of GDP:	OECD, MSTI, April 2008
Venture Capital investment as a percentage of GDP:	OECD, Venture Capital Trends and Policies, 2003
GERD as a percentage of GDP:	OECD, MSTI, April 2008
Triadic patent families per 1,000,000 inhabitants:	OECD Factbook 2008: Economic, Environmental and Social Statistics
Public expenditure on education as a percentage of GDP:	EarthTrends, The World Bank – World Development Indicators Online, 2007
Relative citation impact:	Thomson-ISI 2006
Percentage of GERD financed from abroad:	OECD, MSTI, April 2008
Businesses which have own website:	OECD STI: Scoreboard 2007
Trade Intensity (Exports/GDP):	EarthTrends, The World Bank – World Development Indicators Online, 2007
Firms collaborating in innovation activities:	OECD STI: Scoreboard 2007
Multi-factor productivity:	OECD STI: Scoreboard 2007
Firms collaborating in innovation with government institutions:	OECD STI: Scoreboard 2007
Firms with foreign cooperation in innovation:	OECD STI: Scoreboard 2007
Firms collaborating in innovation with higher education institutions:	OECD STI: Scoreboard 2007

Annex 12

Submissions to the Review of the National Innovation System Overall data and analysis

General

Submissions closed on 30 April 2008 with 633 received by that date.

After the Federal Budget of 13 May 2008 it was decided to open the process up for Post-Budget submissions to give the opportunity for comment on announcements made in the Budget. Sixty Post-Budget submissions were received.

As at 29 August 2008, a total of 739 submissions were received, this included the 62 Post-Budget submissions and 46 late submissions. Of this 739, 18 were confidential submissions.

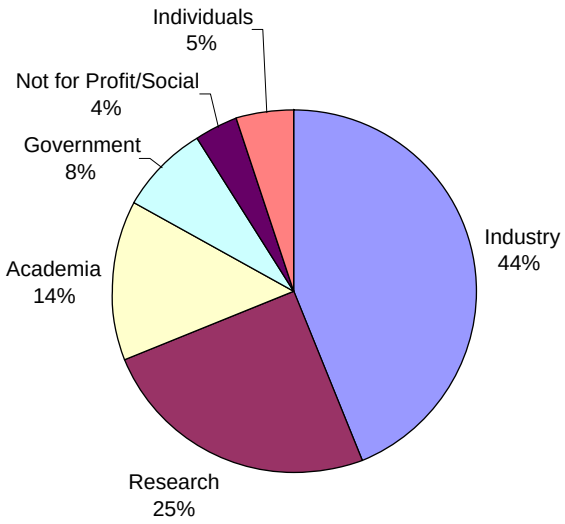
Submissions were posted on the website as soon as declarations of interest were obtained (excluding confidential and Post-Budget submissions). As at 29 August 2008, 11 submissions still did not have declarations of interest and so do not appear on the website. However, they were included in the analysis process.

Breakdown of submissions by sector of author

Submissions were categorised into sector of author by reading submissions and taking into account the author's overall background and perspective. The breakdown is shown in Figure 1. Note that this analysis excludes confidential submissions. These categories were defined as follows:

Categorisation	Definition
Industry	Businesses & Individuals with strong industry links
Research	Private, Public Sector, CRCs, Museums & Collections, Individuals with strong research links
Academia	Universities, TAFEs & their groups/networks, Individuals with strong University links
Government	Commonwealth, State, other countries
Not for profit/social	
Individuals	Individuals with no strong sectoral affiliation

Figure 1: Breakdown of submissions by sector of author



Database

A custom-designed database was developed into which all non-confidential submissions, including those without declarations, were entered. The only submissions not entered in this way were the confidential ones which were read only by the panel members.

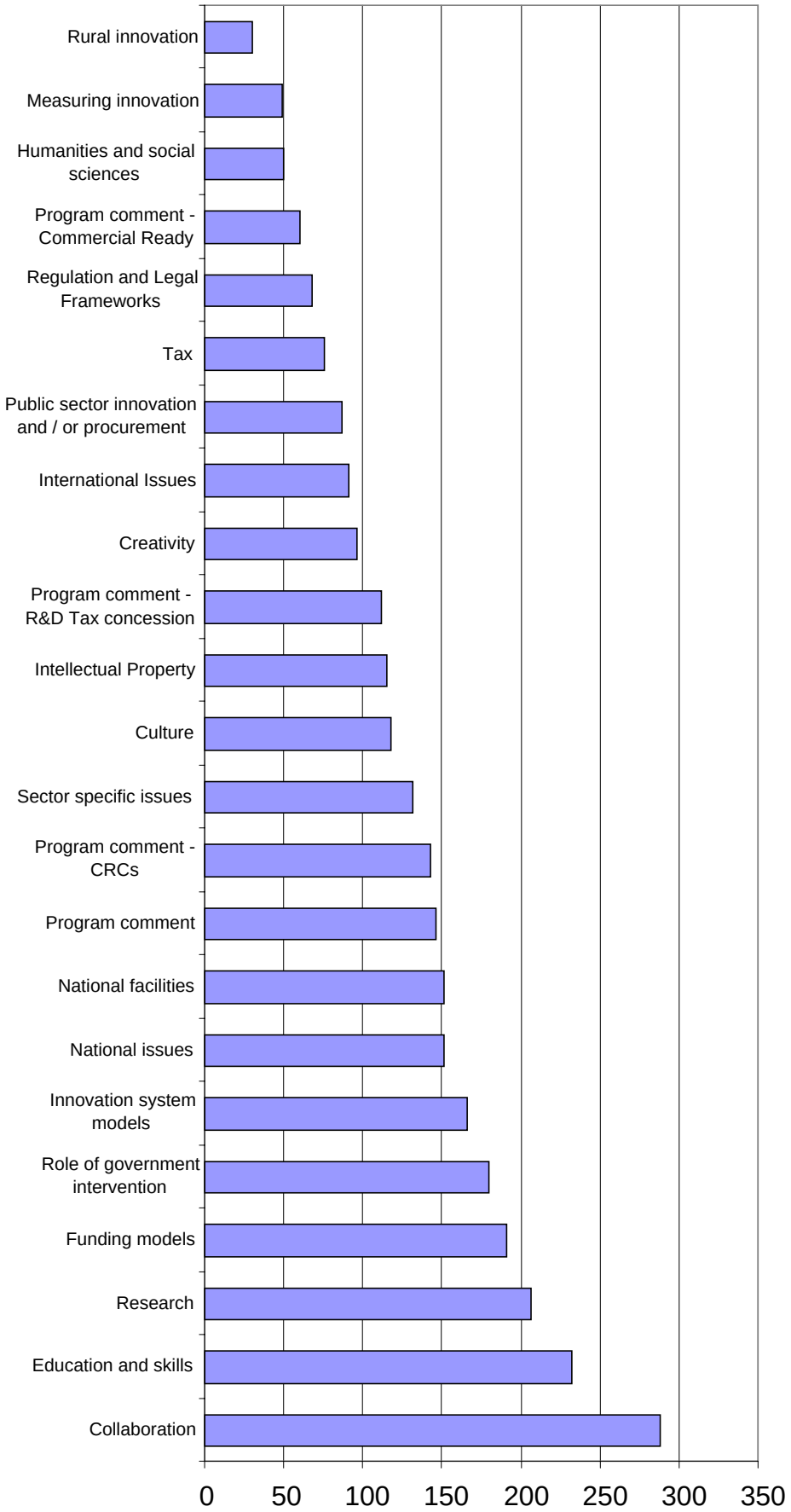
Specific recommendations or comments were captured in the database under the following subject headings, submissions were entered under as many subject headings as they covered.

1. Collaboration
   (eg. Linkages, International linkages, Knowledge diffusion/transfer, Business to business, Business to academia, Business to government, Academia to academia, Academia to government, Government to government, Barriers to collaboration)
2. Creativity
   (eg. Creative problem solving)
3. Culture
   (eg. Organisational, National, Diversity and social inclusion, Risks of innovation)
4. Education and/or skills
   (eg. Training, Job specific skills, Skills retention, Bringing into firm, Primary education, Secondary education, Tertiary education, TAFE/VET)
5. Funding models
   (eg. Industry models, Research models, Program models, International investment, Venture Capital)
6. Humanities and social sciences
7. Innovation System Models
   (eg. Framework, Principles, Governance)
8. International issues
   (eg. Challenges, Opportunities)
9. Intellectual Property
   (eg. Patents, Trademarks, Design)

10. Measuring innovation
    (eg. Benchmarking, Setting goals, Innovation indicators)
11. National facilities, collections and infrastructure
12. National issues, national challenges and opportunities
    (eg. National Innovation Priorities, Climate change, Water, Aging population)
13. Program comment
    (eg. Australian Government programs, State programs, Gaps, Compliance, Application processes)
14. Program comment – specific to Cooperative Research Centre's (CRC's)
15. Program comment – specific to Research & Development (R&D) Tax Concession
16. Public sector innovation and/or procurement
    (eg. Procurement, Culture, Leadership, Service delivery, Innovation in government, Government role in encouraging innovation)
17. Regulation and legal frameworks
    (eg. Bureaucracy, State/territory regulatory issues, Compliance costs, Business regulation, Standards)
18. Research
    (eg. Benefits, Value, Cost, Role)
19. Role for government intervention
20. Rural innovation
21. Sector specific issues
    (eg. Enabling technologies, nanotechnology, biotechnology, Information Communications Technology (ICT), Services, Manufacturing, Agricultural, Mining, Pharmaceuticals)
22. Tax issues
23. Other/Specified

Submissions covered a wide variety of subjects as shown in Figure 2. Subjects most covered by submissions were collaboration, education/skills, research, funding models, and the role of government intervention. Although this ranking varied somewhat across the stakeholder groups, both collaboration and education/skills ranked highly across most stakeholders.

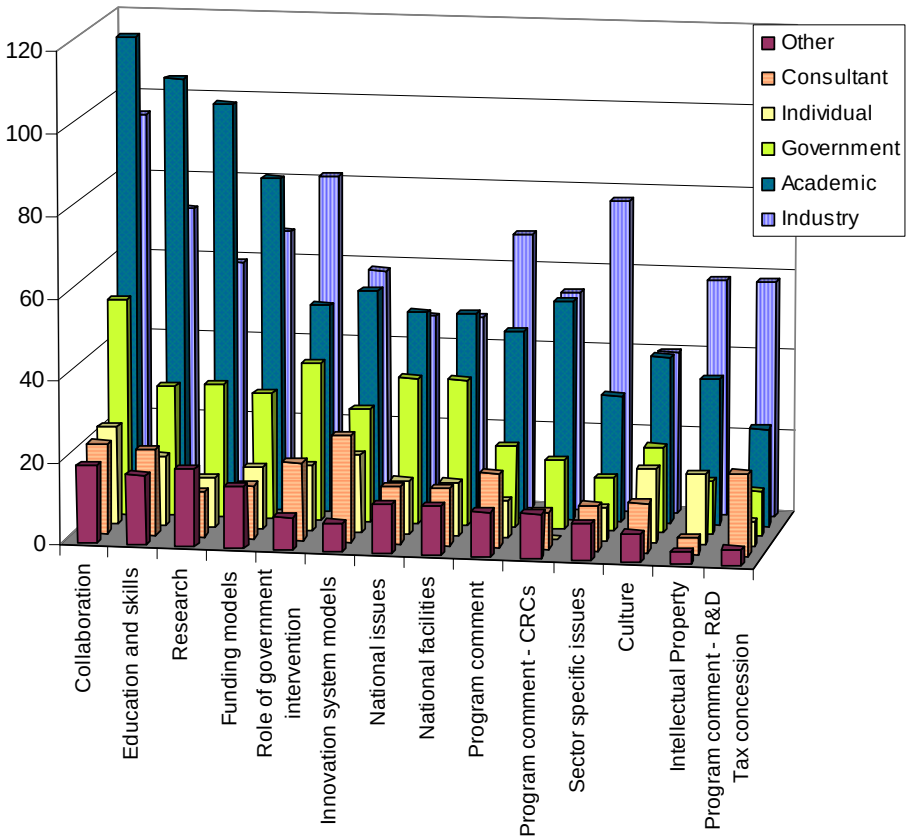
Figure 2: Subject areas covered in submissions as captured in database



Note: that submissions may cover more than one subject.

Not surprisingly, particular subject areas were of greater interest to some stakeholder groups[1] than others. For example, industry submissions were more likely to discuss sector specific issues while government groups were more likely to cover national issues. Figure 3 shows stakeholder interest in the fourteen most common subject areas (subject areas are in order of highest number of submissions covering a subject area to lowest, from left to right).

Figure 3: Number of submissions discussing the fourteen most prevalent subject areas by stakeholder group.



Note: that submissions may cover more than one subject and be identified as coming from more than one stakeholder group. Also stakeholder group categories differ from those in Figure 1 so data will not be comparable)

Analysis Papers

Analysis was carried out to identify key points coming out of the submissions. This consisted of extracting specific recommendations, significant commentary or evidence and categorising under topic. Some topics also lent themselves readily to keyword searches and so these were used to supplement database analysis.

List of (secondary) analysis papers:

- Angel Investors
- Biotechnology and Nanotechnology
- Business angels
- Collaboration (excluding CRCs)
- COMET (Commercialising Emerging Technology) Program

[1] Submissions were assigned sectors as they were analysed into the database. In some cases more than one sector was identified, and these categories differ to breakdowns shown in Figure 1.

- Commercial Ready (pre and post budget)
- CRC - CRCs Comments on CRCs
- CRC - Industry Comments
- CRC - Research Organisations (RO) Comments
- CRC - Universities Comments
- Creativity
- Culture
- Education and Skills
- Enterprise Connect
- Funding Models - Others Comments
- Funding Models - Research Organisations (RO) Comments
- Funding Models - Universities Comments
- Grand Challenges and Prizes
- HASS (Humanities, Arts and Social Sciences)
- Immigration
- Industry Cooperative Innovation Program (ICIP)
- Innovation for Aboriginal & Torres Strait Islanders
- Innovation programs
- Innovation System Models and National Issues
- Innovation Vouchers
- International Issues
- IP
- Management Education
- Marine Sciences
- Measuring Innovation
- National Facilities, Collections and Infrastructure
- NCRIS
- NICTA (National ICT Australia)
- Pharmaceuticals Partnership Program (P^3)
- Pharmaceuticals Sector
- Post Budget Commercial Ready
- Precincts
- Procurement
- Public Sector Innovation
- R&D Tax Concession
- Regulation
- Renewable Energy Development Initiative (REDI)
- Research
- Role of Government
- Rural Innovation
- Rural R&D Corporations
- Sector Specific
- Services Sector
- Small Business Innovation Research Program (SBIR)
- State Government Submissions
- Tax
- Trade Gravity
- Tropical - Environment Science & Management Issues
- Tropical - General Issues
- Tropical - Health Issues
- Tropical - Primary Industries
- University Submissions
- Venture Capital

- VET (Vocational Education and Training) Sector

Collaborating to a purpose

1. Executive summary

Introduction

The Cooperative Research Centres Program was established by the fourth Hawke Government in 1990, having been designed by Professor Ralph Slatyer, the then Chief Scientist, primarily to encourage collaboration in research and development between the private sector and the public sector research bodies but also to address research concentration for world-class teams and preparing PhD graduates for non-academic careers.

To date there have been 10 selection rounds resulting in 168 CRCs over the life of the Program (102 if renewals and new-from-existing are not counted separately). In 2007-08 there were 58 CRCs. Of these, 25 were in their 1st term, 16 in their 2nd term and 17 in their 3rd term. Nine CRCs reached the end of their funding term in June 2008, hence there are 49 CRCs receiving funding in 2008-09. The first selection round resulted in 20 CRCs; the last round in 2006 resulted in 3 new CRCs, 7 new-from-existing CRCs and 4 extensions.

The total investment by the Commonwealth is of the order of $3 billion, with almost $9 billion (in kind and in cash – tied and untied) leveraged from participants - including approximately $2.9 billion from universities; $2.3 billion from industry; $1.6 billion from government endusers; and $1.1 billion from CSIRO.

Since its inception, the Program has delivered significant, identifiable economic and social benefits, particularly through end-user application of research.

As a discrete part of the broader review of the National Innovation System (NIS), the Minister for Innovation, Industry, Science and Research, Senator the Hon Kim Carr, announced a Review of the Cooperative Research Centres Program on 22 January 2008. The Chair of the Review was Professor Mary O'Kane; she was supported by the Collaboration Working Group (CWG) of the National Innovation System (NIS) Review.

The Review looked at the general issue of collaboration and its place within the NIS; and at how the CRC Program fits with other programs in the NIS in contributing to national productivity and social good through collaboration. The Review took note of some consistent themes coming through the consultations and submissions and sought to understand these in the light of the CRC Program's evolution, as reflected in data on the Program and changes to the selection criteria. It also considered how changes in funding and incentive systems for CRC participants, especially the public-sector research providers, have affected the way these participants have interacted with the Program. In line with its terms of reference, the CWG also drew on the Productivity Commission's Research Report of 9 March 2007, *Public Support for Science and Innovation*.

Why collaborate?

There are many benefits to be had from bringing groups of researchers and end-users together. These include the achievement of critical mass; overcoming fragmentation

caused by distance and a smaller resource base; bringing together different perspectives, experience, skills and knowledge; breaking down specialist silos and restrictive organisational boundaries and fostering cross-disciplinary interactions; encouraging skills and knowledge transfer; promoting mutual understandings; and managing risks.

These benefits of collaboration underpin the CRC Program. However, the Review emphasises that collaboration should not be an end in itself but a means to generate productive and innovative outcomes for both the collaborators and the taxpayers whose funds are invested in the Program.

Governments at all levels have been active in encouraging collaboration in the NIS. From the 1980s onwards there has been an increasing understanding of the need for Commonwealth Government support for collaboration to tackle high-risk projects, and a variety of programs has been introduced, including CSIRO National Research Flagships, ARC Centres of Excellence, ARC Linkage Grants, and, very recently, NHMRC Partnership for Better Health Grants. These have been complemented by a range of State government programs.

A recent ABS study found that innovative firms show a strong tendency to collaborate – but with other firms. Of those firms which collaborate, only about 3% do so with government organisations and about 2% with higher education research organisations[1]. Australia still needs programs such as the CRC Program to bridge the gap between our strong public-sector research capacity and its potential use by innovative Australian firms.

While about 570 Australian firms have participated in CRCs, funding even in a large program such as this is limited, and consequently the firms participating represent only a small fraction of all Australian firms. However the CRC Program has had a whole-industry impact in CRCs where there is strong drive from a strong industry intermediary. For example, large numbers of agricultural businesses have benefited from rural Research and Development Corporations' involvement in CRCs; and mining businesses have benefited from the broker role AMIRA International has played in mining CRCs. The Review suggests that in future the Program encourage more CRCs with impact across broad groupings of end-users.

The CRC Program has changed focus over time

Analysis of the Program's objectives, selection criteria and guidelines reveals that the CRC Program has changed considerably since its inception. While cooperative research is still the underlying raison d'être for the Program, the early ideals of enhancing and expanding the nation's overall scientific and technological research capability to support broadly stated national objectives have been replaced by a heavy emphasis on supporting end-user driven research and research capable of producing commercial return. While the early guidelines looked for a balance between strategic pre-competitive research and shorter-term research leading directly to application or commercialisation, the later guidelines placed an absolute focus on commercialisation/utilisation of outcomes. This has been emphasised by more

[1] ABS 8158.0 Innovation in Australian Business 2005

stringent requirements to demonstrate their IP management and commercialisation 'vehicles', with clear milestones and 'paths to adoption'.

The early rounds required that the research itself be of high quality, but this has been less prominent in later rounds. While graduate education and training was a specified objective for the first years, specific reference to this was dropped from the objectives and the selection criteria in 2004 (though CRCs were still required to have a PhD program). The early rounds recognised the cooperative aspect of CRCs, but the later rounds emphasised end-users over research providers, to the point of requiring that research providers not be in the majority on governing boards. Early CRCs were permitted considerable flexibility about their management and governance arrangements, so long as there were clear lines of responsibility and accountability linking the participants, but there has been a steadily increasing specification of requirements, and CRCs in the last two rounds have been required to be incorporated with independent chairs and the full governance strictures of corporate entities.

These trends are consistent with the drive over the last 20 years to derive financial returns from commercialisation of intellectual property arising from publicly supported research – the current program objective and guidelines provide a framework for commercialisation of research from CRCs. However the Review notes the findings of two economic-impact studies[2] of the CRC Program which have argued that the while the economic impact of the Program has been considerable, it has been primarily through end-user application of research rather than direct commercialisation.

The Productivity Commission argued that the emphasis on commercial outcomes was less defensible from an economic efficiency perspective and more likely to result in research collaborations of a type that a firm or industry collective would undertake anyway. In any event, CRCs typically appear not to have the know-how and resources to be particularly good at commercialisation (with singular exceptions).

The Productivity Commission recommended, and this Review agrees, that a greater emphasis be placed on translating research outputs into not just economic, but also social and environmental, benefits. The latter two objectives can be achieved by re-instating public good as a CRC objective, a commitment made in the current Government's election promises and which the Review supports.

Concerns about the CRC Program

Through most of its life the CRC Program has been popular with participants. However the consultations and submissions to this Review and submissions to the 2007 Productivity Commission Report indicated that the Program is less attractive than formerly to some important participant groups, most notably CSIRO and the research-intensive universities, but also some significant end-users. The concept of end-users and research providers working together on research to produce productive outcomes still draws strong support – the problems seem to centre on the

[2] Allen Consulting Group, *The Economic Impact of Cooperative Research Centres in Australia — Delivering Benefits for Australia,* A report for the Cooperative Research Centres Association Inc, December 2005; and Insight Economics 2006, *Economic Impact Study of the CRC Programme*, Prepared for the Department of Education, Science and Training, Insight Economics, Melbourne.

collaboration vehicle itself, and what is allowed and encouraged explicitly and implicitly in the Program.

The need for a more flexible Program, and the complexity and cost of CRC governance arrangements, were frequently raised in submissions and consultations about the CRC Program by end-users and research providers alike. Indeed, it was consistently raised as one of the 'dark matters' of the current innovation system during the consultations. The high costs of bidding for CRCs, the transaction costs of involvement with them, the lack of flexibility in suiting governance and management to the needs of the partners, and the lack of an adequate return on investment for partners, especially when the CRC is incorporated, also drew comment.

Intellectual property (IP) arrangements drew a lot of comment. Despite detailed coverage of this matter in the legal agreements for CRCs, early clarity seems to be lacking. Continuing unrealistic expectations by universities and government research bodies that the IP within a CRC will generate a major financial flow to their institutions underlies many of the cited difficulties in reaching agreement on IP arrangements. This is exacerbated by the belief – encouraged by the application process – that the CRC itself will be the commercialiser of the IP resident in the CRC. Agreements would be easier to negotiate if it were accepted that the industrial/end-user partners are the logical developers of the IP, with the question of fair and reasonable returns from the industrial partner to the research providers and their institutions a matter to be negotiated, in general terms, at the commencement of the CRC.

The Review agrees that

> *collaborative innovation and the transfer of ideas are often impeded and curtailed by problems and delays arising out of the negotiation and formalisation of agreements for collaborative research.*[3]

Comments against evaluation principles

The Review was specifically asked to evaluate the CRC Program against principles used for new policy proposals and reviews. The first goes to *Appropriateness*. The Review finds the Program primarily addresses a gap left by the market directly, and also indirectly, through the influence it has had on the design of other programs. In the past, when public good was one of the Program's objectives, it has also sponsored some innovative collaborations addressing social inequity. The Review also finds that the CRC Program is appropriate as a national program, pulling together research expertise from across the country often with active assistance from State Governments.

On the *effectiveness* of the Program – whether it represents value for taxpayer funds, and whether it has achieved its stated objectives – the Review has taken note of two recent studies[4] and also the Productivity Commission's report. While the Review is

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[3] Fitzgerald and Austin, law academics who work with the Open Access to Knowledge (OAK) Law Project at Queensland University of Technology, in submission to NIS Review, 428A-Fitzgerald & Austin, p.13.

[4] Allen Consulting Group, *The Economic Impact of Cooperative Research Centres in Australia —*

cautious about placing too much credence on the precise figures produced by the economic models used, these studies give confidence that the CRC Program does provide a positive return on taxpayers' funds invested.

The current CRC Program objective is:

> *to enhance Australia's industrial, commercial and economic growth through the development of sustained, user-driven, cooperative public-private research centres that achieve high levels of outcomes in adoption and commercialisation.*

It is hard to produce a precise quantitative estimate of how much the CRCs have enhanced Australia's growth, especially net economic growth. High levels of *commercialisation* have not occurred but there is evidence that benefits have come from industry *application* of CRC research. Like the Productivity Commission, but for additional reasons, this Review does not consider the current Program objective to be appropriate. This issue is addressed at Recommendation 2.

In looking at the *efficiency* of delivery of the CRC Program, the Review was cognisant of the oftstated complaints about the high costs associated with planning, bidding for and establishing new CRCs, and the ongoing governance and transaction costs. The Program requires more flexibility; and improved efficiency in the selection and review process (see Recommendations 3 and 7).

On *integration* – whether government agencies are working together to deliver on measure objectives within clearly defined lines of responsibility – greater integration with agencies offering related programs would benefit the Program, in both program-design quality and operating efficiencies, and would provide better articulation between programs that form a 'spectrum' in the NIS.

The CRC Program has a formidable *performance assessment* system of reporting and reviewing including annual reports; a major third-year review; and a requirement to lodge a Commercialisation and Utilisation Plan. The Review suggests that the system might be excessive rather than robust, and that its selection procedures are inappropriately risk averse. This issue is addressed in Recommendation 7.

The Review finds that the CRC Program does *strategically align* with the government's long-term policy priorities for innovation driving economic growth.

The future

The CRC Program needs to work for all those funding it and participating in it. It needs to be an appropriate, efficient and effective investment of government funds. It needs to produce research for end-users that allows rapid breakthrough business transformation. For research providers, it needs to attract and stimulate their very best researchers. For all parties the organisational and funding arrangements need to work smoothly while consistent with prudential requirements.

Delivering Benefits for Australia, A report for the Cooperative Research Centres Association Inc, December 2005; and Insight Economics 2006, *Economic Impact Study of the CRC Programme*, Prepared for the Department of Education, Science and Training, Insight Economics, Melbourne.

The feedback from consultations, workshops and submissions was overall remarkably consistent about current concerns with the CRC Program. No one suggested that the Commonwealth should stop providing incentives for research collaborations between researchers from the universities and publicly funded research agencies on the one hand and industry and public and community sector users on the other. The biggest issue was on the degree of change required.

Continue the CRC Program with additional funding

The Review finds there is still a need for a program supporting big, end-user-inspired and driven, risk-addressing research projects directed at significant national issues (and outcomes) across Australia's innovation system. The benefits of the CRC Program warrant continued investment in it, provided its objectives are re-focused, the problematic aspects raised in submissions and consultations addressed, and its success in meeting the new objectives regularly reviewed.

Unless some extra funding is injected into the Program, the next round will be able to fund only a small number of centres. This could exacerbate the unease with aspects of the Program. In particular the next round could see a 'spike' in applications as many existing CRCs are likely to apply to be new CRCs.

If CRC funding is to be linked directly and specifically to solving major problems of market failure/creation and public good, more frequent opportunities to submit applications for CRCs are desirable, and an annual round is proposed.

Recommendation 1

1.1: That

i. a re-focused and modified CRC Program continue, and
ii. the next evaluation recommend whether the Program continue in light of the modifications and the impact of changes arising from the Innovation White Paper.

1.2: That

i. funding be injected into the Program to allow for annual rounds to take place over the next five years;
ii. there be a selection round at least once a year so that emerging market failure/creation and urgent public good issues can be addressed quickly; and
iii. the Program encourage CRCs of varying lifespan (typically 4-7 years but up to a maximum of 10 years where appropriate), with funding up to a maximum of $45M over the life of the Centre.

Change the Program objectives - collaborating to a purpose; end-user take up of CRC research

The emphasis of CRC research must be directed to end-user uptake rather than commercialisation by the CRC itself. This requires changing the objectives to focus very specifically on research collaborations aimed at ameliorating a clearly-identified risk, such as

- a significant challenge in creation of a new industry area; or
- a significant challenge in an existing industry sector where the risk involved in solving the challenge is too great for a single firm to tackle alone; or
- a significant challenge in the provision of public goods and services; or

- a significant challenge in an area of community or social benefit (and not restricted to an area represented by government portfolios).

The solution to the challenge would provide a significant advantage – not necessarily commercial – for CRC end-users, preferably with significant spillovers. Without an exact challenge to be met, it is difficult to decide whether the research is potentially valuable: either to end-users, or to the national benefit.

CRCs would be put together to carry out research to address the CRC's core challenge, pass the findings on to end-users as efficiently as possible (including through provision of PhD graduates who have been trained through the CRC), then wind up (either winding up the research program for which funding was received or wind up altogether). The focus of the research should be at the pre-competitive or, in the case of public-good CRCs, pre-applicative stage.

This emphasis on a single purpose will also help avoid the tendency by CRCs to become an end in themselves.

Recommendation 2: That

i. the prime objective of the CRC Program be to provide support for pre-competitive or pre-applicative research ventures between end-users and researchers which tackle a clearly-articulated, major challenge for the end users addressing identified risk gaps such as:
   - a significant challenge in creation of a new industry area; or
   - a significant challenge in an existing industry sector where the risk involved in solving the challenge is too great for a single firm to tackle alone; or
   - a significant challenge in the provision of public goods and services; or
   - a significant challenge in an area of community or social benefit (and not restricted to an area represented by government portfolios).

   The solution to the challenge should be innovative and of high impact and capable of being deployed rapidly by the end-users to good effect. Each CRC should be of high national benefit with significant spillovers.

ii. a secondary aim of the Program be to encourage closer working ties between Australia's public-sector research organisations (universities and PFRAs) and end-user groups and to encourage end-user-focused education, especially at the PhD level.

CRC organisational arrangements need to be fit for purpose

Solving big challenges requires organisational arrangements fit for purpose. The joint venturers in a CRC need to be very clear on what they are attempting to do; how they intend to go about doing it, and what governance, management, reporting and end-user take up arrangements for CRC outputs are most likely to work for them. And to attract funding, they need to be able to justify their proposals. The Program needs to be flexible enough to accommodate this.

CRCs do not need to be incorporated to be successful. Of course, issues of leadership and management, accountability and responsibility, must be addressed early in the collaboration; but there are many different models for what are fundamentally joint ventures, and the collaborators should be free to choose a model which is most likely to ensure the aims and purpose of the collaboration are achieved. This extends to

representation on the Board (if there is one), which should be linked to the input of resources into the CRC and the participants' wishes, rather than the present arbitrary requirement that end-users and/or independents hold a majority of Board positions.

Flexibility of lifespan and membership arrangements were frequently raised as problems even though they are technically allowed under the guidelines. The general period should be 4-7 years, with occasional opportunities for shorter and longer terms if the situation warrants; and membership arrangements should permit partners to join late and exit early.

Allowing more flexible arrangements means that the initial case has to be well made. Applicants must demonstrate how the proposed research and education program will address the identified challenge and then how the end-user partners will deploy the research findings and gain advantage from the Commonwealth investment with spillovers.

The Legal Agreement between the Commonwealth and the CRC needs to be as simple as possible, with one party (the CRC itself or an agreed agent) signing on behalf of the CRC. The Agreement also needs to formally require compliance with both research ethics and research integrity codes and guidelines.

Recommendation 3

3.1: That the CRC Program guidelines be modified:

i. to permit much greater flexibility than at present including in organisational structures, governance models, lifespan (typically 4-7 years but up to a maximum of 10 years where appropriate), membership arrangements, intellectual property arrangements and size of Commonwealth grant (up to a maximum of $45M over the life of the Centre) but
ii. that there be even higher requirements than at present on applicants to demonstrate why their proposed structure, membership arrangements, research plan, end-user absorptive capacity, leadership, key research people, outputs, likely impacts, performance metrics, governance, management, intellectual property arrangements, Centre lifespan and funding are appropriate to deliver a solution to the identified challenge and the fast and effective uptake of results by end-users.

3.2: That the legal agreement between the Commonwealth and the CRC be as simple as possible, with the recent practice continued of one party (the CRC itself or an agreed agent) signing on behalf of the CRC.

3.3: That the legal agreement include provisions requiring the CRC to be fully compliant with all relevant Commonwealth and State research integrity and ethics codes and guidelines and with all international treaties dealing with these matters. Records of all ethics applications and their current status must be kept up to date and be available at all times for inspection.

Helping potential participants work out what they need to do - an auxiliary program

Public-sector partners are experienced at submitting big grant applications but industry (especially service industries and those sectors populated by SMEs) and

community groups often find it harder. And they find it hard to locate the most appropriate research partners.

The introduction of an auxiliary program to assist such groups to explore shared problems, formulate shared approaches to solving them and establish the details of collaborations – collaborations that might in time be the basis for a CRC bid – would address this issue. Under the program, potential applicant groups would:

- have an opportunity to explore, frame and experiment with ideas, challenges, problems and opportunities affecting their sectors
- get the definition of their problems right and work how to go about solving them
- identify appropriate research partners and end-users work out the formal arrangements for working together including IP, management and governance arrangements
- find out who is doing similar work around the world and decide whether to seek them out as international partners, or direct their own focus into other areas
- work out the skilled labour force requirements.

The auxiliary program would complement the proposed Industry Innovation Councils which are to be introduced by the Commonwealth Government later in 2008 and will operate in 'key sectors' to support the Enterprise Connect network.[5]

Recommendation 4

That a new program be established to assist industry and other end-user groups to undertake strategic analysis or innovation mapping projects and to establish collaborative ventures between end-users and researchers, including publicly funded research institutions. The priority is to support new collaborations in areas with little history of collaborative activity or a low research and development base, particularly service industries and those sectors populated by SMEs.

Promote to the right participants

A wider diversity of participants needs to be encouraged into CRCs. This includes SMEs, which have long been identified as a vital part of the Australian economy; services industries, which underpin Australia's domestic economy; and the humanities and social sciences, which are particularly important to the services industries, but also have an increasing role in the multidisciplinary approach which is required to solve most pressing real-world problems.

Because education – especially research training – is essential to developing Australia's innovation capacity, and because universities are significant research providers, it is important that every CRC application continue to secure a commitment in the bid from at least one Australian university. The university must guarantee to provide supervision for PhD students associated with the Centre, in return for CRC funding of the supervision if needed; and be continually vigilant in ensuring the research training experience for students is comprehensive and in line with industry and educational needs.

Involvement on the international stage is also vital if Australia's innovation system is to develop to its full capacity. Strong engagement with international research groups

[5] http://www.ato.gov.au/budget/2008-09/content/bp2/html/expense-20.htm

working on similar challenges to those of an Australian CRC must be encouraged including, where appropriate, joint projects.

Recommendation 5

That participation in the CRC Program be encouraged, allowed or required as follows:

i. SME and service industry involvement in CRCs be specifically encouraged;
ii. CRCs addressing challenges across several service industries be encouraged
iii. strong engagement with international research groups working on similar challenges be encouraged including, where appropriate, joint projects; and that funding of research undertaken overseas be allowed;
iv. CRC applications in Humanities and Social Sciences fields be allowed and encouraged; and
v. CRCs continue to be required to have at least one Australian university as a partner.

Re-design the funding arrangements

The funding arrangements for CRCs need to work in a way that ensures that the Commonwealth's investment in a CRC is appropriate, and that the funding rules encourage participation in the Program by both end-users (especially from SMEs and the services sector) and research providers.

Contributions to CRCs can be made in different ways, but in the past the balance between the Commonwealth, research-providers and end-users has not been the most effective. Requiring end-users to provide substantially higher cash funding to maximise the value of the Commonwealth's contribution would be in line with international best practice for major centres. However, for SMEs, which are typically less cashed up to support the quality of research required, a continued ability to commit through in-kind contributions is warranted.

Universities (and, to a lesser extent, other research providers) face a continual challenge in finding the funding required to undertake their research activities. This, plus the changes to CRC governance which restricted their representation on CRC boards, has led to a perverse situation. Some research providers have resorted to side deals with potential CRCs, making their contributions conditional on being guaranteed a return in research funding several times greater than their contributions. In other words, for many research providers CRCs have ceased being eagerly sought-after collaborations and become rather circumscribed research granting bodies. The complexities and ill-will surrounding these deals are, in turn, resulting in leading researchers abandoning the CRC Program. The Review recommends that the CRC Program not insist on research provider contributions but encourage such contributions and, in line with this, adopt the system currently used in the ARC Linkage Grants for universities (and other research providers) to specify what they are contributing to each CRC.

For public good CRCs, it is important that applications provide evidence that relevant Government agencies and portfolios, whether State or Commonwealth, strongly support the CRC application.

Recommendation 6

That the approach to funding of CRCs be redesigned in accord with the following:

i. the share of public funding of any CRC be aligned to the level of likely induced social benefits;
ii. CRC end-user applicants normally be expected to provide more than half the cash contribution towards the CRC;
iii. in-kind contributions not be rated the same as cash during the selection and reporting processes, but treated as an important secondary factor. In turn, tied in-kind contributions (which should be declared at the time of application and in annual reporting) should not rate as highly as untied in-kind contributions;
iv. there be scope to modify the application of recommendations ii and iii to the advantage of end-user applicants where they are predominantly SMEs or from the community sector;
v. universities and PFRAs be encouraged but not explicitly required to make cash or inkind commitments to a CRC bid – but that, where they do make contributions, they be described in the same way as for other university/end-user collaborations (e.g. ARC
Linkage Grants) and that they include details of program leaders and key researchers and their time commitments;
vi. predominantly public good applications be scrutinised to see that they do indeed have the funding support of the 'home' Commonwealth and State portfolios or authorities; or, where this is not the case, that the reasons why are addressed as part of the application; and
vii. there be no upper limit on postgraduate stipends offered within CRCs.

Encouraging fleet and flexible CRCs requires top quality program design and management

The Review recommendations are aimed at ensuring a much greater diversity of CRCs with organisational arrangements designed to maximise the chances for each particular CRC to be as effective as possible. Encouraging this diversity and instituting the increased flexibility needed will require program managers who are experienced in end-use-focused research, research management, and program design and management. The Review recommends such expertise be co-opted into the Program from across the NIS.

Rigorous assessment against criteria aligned to the Program objectives is essential. Under the modified CRC Program proposed, changes to the current selection criteria are required and selection should be fundamentally based, in line with best practice for grants as large as this, on layered peer review.

Successful review mechanisms are one of the keys to running a successful research funding program. They help maintain rigour and focus, and ensure accountability. Hard-nosed review using a core of common measures across all CRCs (and across other collaboration programs) should be encouraged. However, review mechanisms are not useful if they have no consequences. A level of failure should be expected and accepted as the CRC Program will cover areas where there are risk gaps. There should be an expectation that a proportion of CRCs will lose funding at each review round.

Recommendation 7

7.1: That

i. the CRC Program be administered at senior levels by secondees from across the NIS who have experience with similar programs as successful research end-users, researchers and research administrators.
ii. CRC Committee members be chosen to ensure the committee has expertise in program design, delivery and review, and significant experience in successful joint ventures deploying research results.

7.2: That the selection process involve layered peer review against detailed selection criteria which include the following:

- the risk being addressed (how significant is the problem? What is the current state-of-the-art worldwide in addressing this problem?)
- the quality of the research approach and plan and how it will address the identified risk
- the capabilities of the participants (how well do the proposed end-users connect with the identified problem, and how highly regarded in their field are the proposed researchers?)
- the quality of the leadership and the research and management teams
- the quality of the education program
- the proposed success/progress metrics
- how the end-user partners will deploy the research findings and gain advantage from the Commonwealth investment
- the expected wider spillover benefits and how these will be taken up by parties outside the collaboration
- the genuineness of the joint venture and alignment of interests (i.e. checking that it is not 'hollow collaboration'), and
- the suitability of the proposed accountability and governance arrangements including the management of the joint venture.

7.3: That

i. CRC applications be submitted using a two-stage process. Applicants would initially make the case in a written application(s) and, if shortlisted, following peer review, would be given the chance to augment this at interview;
ii. the CRC Committee establish disciplinary-based standing committees drawing on expertise in the ARC and NHMRC to manage the peer-review processes associated with the first-stage culling, and second-stage ranking. These committees should use a common formal process which should include giving the applicant CRC the chance to comment on assessors' comments in writing;
iii. the CRC Committee consult with the ARC and NHMRC to develop a joint database of assessors to do the rigorous assessing of CRC applications for consideration by the standing committees;
iv. the standing committees rank proposals assigned to them on all criteria after obtaining sufficient peer assessments, and then overall, and make recommendations to the CRC Committee; and
v. the CRC Committee consider all the input and recommend a final list to the Minister.

7.4: That a common core of evaluation metrics be developed that would apply across all CRCs and would allow for cross-comparison between them. These should include, at minimum, metrics on research quality, end-user uptake, international connections

for national benefit, and researcher education. As well as reporting on the core evaluation metrics, it is recommended that CRCs, in their annual report, report on measures specific to their CRC and agreed at the time the CRC is awarded.

7.5: That annual reports be examined closely for early warning signs of difficulty.

7.6: That a major hard-nosed review of each CRC using a common evaluation framework take place at the end of each 3 years – or more frequently if there are early warning signs of failure – of the life of a CRC, with a final review as it is finishing; and that it be an explicit condition of funding that termination be an option if the review's findings are adverse.

7.7: That the CRC Committee establish a Review Sub-committee to

i. oversee the review process;
ii. propose the composition of the initial and subsequent review panels to the CRC Committee for approval. The same review panel should be used for all CRCs in a field of application in order to ensure cross comparison. Each review panel to be chaired by a Sub-committee member;
iii. consider feedback from the review panels;
iv. prepare a report for the CRC Committee on each review round including a list of CRCs reviewed, ranked by success to date; and
v. propose which CRCs continue to receive Commonwealth funding under the Program and which should no longer be funded.

Improve articulation with other programs in the NIS

The Review recommends ongoing and effective articulation and cooperation between the CRC Program and other funding programs in the NIS, especially with CSIRO Flagships, ARC Linkage Grants and NHMRC Partnership for Better Health Grants.

Recommendation 8

8.1: That the CRC Program build close policy and operational links with other collaborative research programs in the National Innovation System and that it articulate well with the CSIRO National Research Flagships Program, ARC Linkage Program and the NHMRC Partnerships for Better Health Program. While the CRC Program should focus more on funding large end-userdriven collaborative pre-competitive research, the Linkage Program should continue to fund simpler end-user/university partnerships. In line with the move to larger Linkage grants, these programs should complement the CRC Program by supporting long term-basic/strategic research with smaller, shorter and more flexible arrangements between groups of firms either independently or in conjunction with universities and public sector research agencies. The administrators of these programs (and related State programs) should meet regularly to discuss applications that might be eligible to either scheme.

8.2: That

i. a common core of broad evaluation measures be developed that would apply across all

Government innovation funding programs (especially programs involving collaboration) and their projects;

ii. common application and review forms/processes be used as far as possible across all innovation funding schemes, especially schemes involving collaboration (including Federal & State schemes); and
iii. a much improved capacity to review innovation funding programs (especially schemes involving collaboration) be developed along with a robust capacity to cease funding weaker projects. Sometimes international review mechanisms are needed.

8.3: That the ARC Centre of Excellence Program be enlarged and become annual and that it encourage applications from innovative research concentrations that have proved themselves producers of high quality and high impact research through programs such as the CRC Program (but also through multi-partner, collaborative ARC Discovery and Linkage grants).

Conclusion

The Review expects implementation of its recommendations to result in many more end-user industries and service providers being involved in CRCs. End-users will come from a wider range of industries and services than have so far participated in CRCs. More of them will be SMEs. Universities and PFRAs will be excited about the opportunities for quality research with potential national and international impact and will be enthusiastic participants. They will partner with end-users as joint venturers in CRCs to tackle big problems that affect a whole industry or sector or community. The solutions will be rapidly deployed by end-users to the benefit of end-users and, through spillovers, the wider community.

CRCs will be diverse in structure, size and longevity. Some will be quite small; others large. Some will be short term; others for a longer term of up to 10 years. Some will incorporate; others will choose different management and governance structures that suit their purpose. Most will have international connections so that Australia can be informed by, and inform, the rest of the world. Employers will compete for researchers and PhD graduates from CRCs. There will be growth in related programs, including ARC Linkages, to develop and nurture collaborative activity. When the problem is solved, participants will move on to other forms of collaboration to solve other problems. Success on all these fronts will be a measure of the relevance and importance of the CRC Program to Australia’s innovation system. Success will also guarantee a sound return on the Commonwealth’s investment. And success will contribute to a sustainable, community-oriented, productive, creative and prosperous Australia.

2. Recommendations

Recommendation 1

1.1: That

i. a re-focused and modified CRC Program continue, and

ii. the next evaluation recommend whether the Program continue in light of the
modifications and the impact of changes arising from the Innovation White Paper.

1.2: That

i. funding be injected into the Program to allow for annual rounds to take place over the next five years;

ii. there be a selection round at least once a year so that emerging market failure/creation and urgent public good issues can be addressed quickly; and

iii. the Program encourage CRCs of varying lifespan (typically 4-7 years but up to a maximum of 10 years where appropriate), with funding up to a maximum of $45M over the life of the Centre.

Recommendation 2

That:

i. the prime objective of the CRC Program be to provide support for pre-competitive or pre-applicative research ventures between end-users and researchers which tackle a clearly-articulated, major challenge for the end users addressing identified risk gaps such as:

- a significant challenge in creation of a new industry area; or
- a significant challenge in an existing industry sector where the risk involved in
- solving the challenge is too great for a single firm to tackle alone; or
- a significant challenge in the provision of public goods and services; or
- a significant challenge in an area of community or social benefit (and not
- restricted to an area represented by government portfolios).

The solution to the challenge should be innovative and of high impact and capable of being deployed rapidly by the end-users to good effect. Each CRC should be of high national benefit with significant spillovers.

ii. a secondary aim of the Program be to encourage closer working ties between Australia's public-sector research organisations (universities and PFRAs) and end-user groups and to encourage end-user-focused education, especially at the PhD level.

Recommendation 3

3.1: That the CRC Program guidelines be modified:

i. to permit much greater flexibility than at present including in organisational structures, governance models, lifespan (typically 4-7 years but up to a maximum of 10 years where appropriate), membership arrangements, intellectual property arrangements and size

of Commonwealth grant (up to a maximum of $45M over the life of the Centre)

but

ii. that there be even higher requirements than at present on applicants to demonstrate why their proposed structure, membership arrangements, research plan, end-user absorptive capacity, leadership, key research people, outputs, likely impacts, performance metrics, governance, management, intellectual property arrangements, Centre lifespan and funding are appropriate to deliver a solution to the identified challenge and the fast and effective uptake of results by end-users.

3.2: That the legal agreement between the Commonwealth and the CRC be as simple as possible, with the recent practice continued of one party (the CRC itself or an agreed agent) signing on behalf of the CRC.

3.3: That the legal agreement include provisions requiring the CRC to be fully compliant with all relevant Commonwealth and State research integrity and ethics codes and guidelines and with all international treaties dealing with these matters. Records of all ethics applications and their current status must be kept up to date and be available at all times for inspection.

Recommendation 4

That a new program be established to assist industry and other end-user groups to undertake strategic analysis or innovation mapping projects and to establish collaborative ventures between end-users and researchers, including publicly funded research institutions. The priority is to support new collaborations in areas with little history of collaborative activity or a low research and development base, particularly service industries and those sectors populated by SMEs.

Recommendation 5

That participation in the CRC Program be encouraged, allowed or required as follows:

i. SME and service industry involvement in CRCs be specifically encouraged;

ii. CRCs addressing challenges across several service industries be encouraged

iii. strong engagement with international research groups working on similar challenges be encouraged including, where appropriate, joint projects; and that funding of research undertaken overseas be allowed;

iii. CRC applications in Humanities and Social Sciences fields be allowed and encouraged; and

iv. CRCs continue to be required to have at least one Australian university as a partner.

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