This chapter considers how Australian tertiary education may be optimised to contribute to national innovation. It argues that the concentration of Australia’s innovation policy on research, and particularly on research in universities, has skewed policy and effort away from its potential to increase productivity. Furthermore, concentrating research to maximise knowledge production has to be balanced by its dispersion to promote knowledge diffusion. Just as importantly, it is necessary to develop the interaction of research units and enterprises, suppliers, consultants, training institutions and associated bodies that comprise the innovation system or cluster in each field. While some clusters seem to develop serendipitously, although over a long time, the process may be strengthened and quickened by coordination, and the chapter closes by canvassing coordinating mechanisms.

Objectives for higher education and vocational education and training

There is no national policy for tertiary education: policy is set and normally considered separately for higher education and vocational education and training. Contributing to national innovation is only one of several purposes of Australian higher education. In its Higher education report for the 2003 to 2005 triennium the Australian Department of Education, Science and Training (2003: 1) says that the Government regards higher education as contributing to the fulfilment of human and social potential and to the advancement of knowledge and social and economic progress. Of the 5 purposes of higher education stated by the department, 3 are to develop individuals, 1 is to advance knowledge and understanding and 1 is to aid the application of knowledge and understanding to the benefit of the economy and society. The department states the Government’s objectives somewhat more precisely –

The overarching objectives of the Government’s policies for higher education are to:

• expand opportunity;
• assure quality;
• improve universities’ responsiveness to varying student needs and industry requirements;
• advance the knowledge base and university contributions to national innovation; and
• ensure public accountability for the cost-effective use of public resources.

(Department of Education, Science and Training 2003: 1)

These objectives are relatively recent, having been first stated in 1999 when the department first published its annual report on funding and other developments for the forthcoming triennium in its current form. They were somewhat restated in the Commonwealth’s Higher Education Support Act 2003 passed by Parliament late in the year. One of the 4 objects of the Act is ‘(c) to strengthen Australia’s knowledge base, and enhance the contribution of Australia’s research capabilities to national economic development, international
competitiveness and the attainment of social goals’. Contributing to national innovation is therefore not the dominant or even always explicit Government objective for higher education.


1. Industry will have a highly skilled workforce to support strong performance in the global economy.
2. Employers and individuals will be at the centre of vocational education and training.
3. Communities and regions will be strengthened economically and socially through learning and employment.
4. Indigenous Australians will have skills for viable jobs and their learning culture will be shared.

(ANTA, 2003a: 1)

Innovation appears in 1 of 12 strategies, contributing to the first goal of training industry’s workforce –

6. Enable training providers and brokers to partner with industry to drive innovation.
   - Research and development generates new knowledge and skills, and new ways to apply them.
   - Training drives innovation in the workplace.
   - Registered training organisations and brokers improve the performance of businesses through working with supply chains, skill eco-systems, industry clusters, research centres and global networks.

(ANTA, 2003a: 9)

ANTA (2003b: 2) complains that Australian innovation policy concentrates on ‘high-end’ r&d, leaving out vocational education and training. Ferrier, Trood & Whittingham (2003: 16) report that vocational education and training has been involved only marginally if at all in Australia’s cooperative research centres, which they say are a small but crucial element in the national innovation system in their strong commitment to applied research and to the implementation and/or commercialisation of research. However, ANTA (2003b: 6) acknowledges that vocational education and training is still at the early stages of engaging with the issues and the national innovation system. It is therefore worth considering how one might optimise Australian tertiary education to contribute to national innovation and assess the extent to which this may be compatible with other objectives for the sector.

Innovation is mainly about improving general productivity, not university research

Australian public policy has had an early if initially faltering interest in innovation. Interest was first stimulated by Barry Jones, a sometime Commonwealth minister for science, who first published his influential Sleepers, wake!: technology and the future of work in 1982. This book, which had its 4th edition in 1995, did much to promote thinking about the implications of the knowledge economy for Australia. By 1987 Australian public policy on innovation was still rudimentary, fragmented and ineffectual. This is illustrated by Australia’s mishandling of the proposal of the Japanese Ministry for International Trade and Industry to establish in Australia a multi-function polis. The mfp was to be a high-tech manufacturing and residential
development, but Australia failed to take advantage of the opportunity through a lack of vision (Baines, 2000) and ‘political incompetence, self-seeking and cupidity’ (Sorensen, 1998).

By the early 1990s innovation had become a political slogan with the then prime minister Bob Hawke’s vision of establishing Australia as a ‘clever country’. However, by the end of the decade the Business Council of Australia, which is an association of the chief executives of most of Australia’s biggest companies, was concerned that Australia has allowed its commitment to innovation to slip. Its solution was to engage the Commonwealth Government in mounting an innovation summit in February 2000.

The background paper for the innovation summit prepared by the Department of Industry, Science and Resources (1999: 9) defined innovation as ‘the process that incorporates knowledge into economic activity’. It elaborated –

In common use innovation denotes both the process of transformation of an idea into a marketable product or service and the resultant new product, process or service. Historically, it encompasses evolutions in technology from the industrial revolution to the current ‘information age’. Practically it is about change within individual firms and organisations. From the perspective of government, it is about change in the way people live and work and build on the foundation of the country’s knowledge base and national prosperity.

In short, innovation is about putting ideas to work. It is a process by which firms, industry and governments add value through successful exploitation of a new idea for the benefit of a part or whole of business, industry or the nation. It spans a range of ideas-based improvement processes, including technological change, and improvements in organisational, financial and commercial activities.

Innovation covers ‘the million little things’ which improve the operation of firms or other institutions (Romer, 1992). It is a much broader concept than research and development (R&D), although the outcomes of R&D are among its most powerful expressions.

Innovation is also about the exploitation of knowhow - ideas acquired from a broad range of sources. Technology transfer and technology acquisition, its adoption and adaptation, frequently prove to be a faster way of acquiring know-how than through R&D. Know-how about organisational and other commercially relevant innovation activities is likely to be acquired, through experience rather than research.

(The Department of Industry, Science and Resources, 1999: 9)

The Department’s position is supported by Lundvall & Borrás (1997: 133) who observe that ‘Incremental technical innovation based on learning, diffusion of technology and organisational change are certainly more important for the performance of any single national or regional economy than major innovations’.

Notwithstanding the insistence in the innovation background paper that innovation is not just about research and development, the recommendations in the final report of the innovation summit implementation group concentrated heavily on research and development. Of the summit’s key recommendations costed by the group, 78% of additional expenditure was recommended on research and development – 60% on increased funding for research in higher education and 18% to support industry research and development through increased tax
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concessions. The Government’s response Backing Australia’s ability - an innovation action plan for the future concentrated even more heavily on research and development, almost all in higher education institutions. Of the $2.8 billion committed over 5 years, 91% was for higher education, 4% for r&d tax concessions and 5% to compensate somewhat for the transfer of Commonwealth funding from public to private schools (Commonwealth of Australia, 2001).

Higher education’s capture of innovation policy was complete in May 2003 when the Minister for Education, Science and Training Dr Brendan Nelson (2003) issued Our universities: backing Australia’s future announcing that ‘A comprehensive evaluation of the effectiveness of the Knowledge and Innovation reforms’ would consider only the operation of the main university research block grant schemes –

A comprehensive evaluation of the effectiveness of the Knowledge and Innovation reforms will be undertaken to ensure that the policy framework for Australia’s competitive research funding is effective. This evaluation will focus on the operation of the Institutional Grants Scheme, Research Infrastructure Block Grants and the Research Training Scheme. In particular, it will assess the validity of current research performance indicators, their weightings in the performance formula, their effect on particular disciplines, universities and student groups and the effectiveness and impact of the current transition arrangements.

(Nelson, 2003: 33)

Committing almost all of the Commonwealth’s innovation effort to higher education research fails to redress what seems to be a structural problem in Australia’s national innovation system. We note from the table below that while Australian governments provide 17% more of the country’s funding for research and development than the average for members of the Organisation for Economic Co-operation and Development, Australian business contributes 18% less than the OECD average. Australian higher education does 10% more of the country’s research and development than the OECD average but Australian business does 23% less than the OECD average. As a consequence Australia has an extraordinary 40.7 higher education researchers per 10,000 members of the labour force, 2.5 times the OECD average. Of the other OECD countries only Finland (41.9 higher education researchers per 10,000 workers) exceeds Australia and only Sweden (35.5) otherwise comes close. Australian business researchers are less than half the OECD average representation per 10,000 workers and are growing slower than the OECD average.

It seems that this is not entirely a failure of business. Australian governments’ direct investment in business research and development is 4.6 less than the OECD average, and its indirect investment (including tax expenditures) is almost 3 times less the OECD average.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Australia</th>
<th>Canada</th>
<th>EU</th>
<th>OECD</th>
<th>UK</th>
<th>US</th>
</tr>
</thead>
<tbody>
<tr>
<td>R &amp; D expenditure as % of GDP</td>
<td>1.53%</td>
<td>1.94%</td>
<td>1.93%</td>
<td>2.33%</td>
<td>1.90%</td>
<td>2.82%</td>
</tr>
<tr>
<td>% R&amp;D funds from government</td>
<td>46%</td>
<td>31%</td>
<td>35%</td>
<td>29%</td>
<td>30%</td>
<td>27%</td>
</tr>
<tr>
<td>% R &amp; D funding from business</td>
<td>46%</td>
<td>42%</td>
<td>56%</td>
<td>64%</td>
<td>46%</td>
<td>68%</td>
</tr>
<tr>
<td>% R&amp;D done by higher ed</td>
<td>27%</td>
<td>30%</td>
<td>21%</td>
<td>17%</td>
<td>21%</td>
<td>14%</td>
</tr>
<tr>
<td>% R &amp; D done by business</td>
<td>47%</td>
<td>57%</td>
<td>64%</td>
<td>70%</td>
<td>67%</td>
<td>74%</td>
</tr>
<tr>
<td>Higher ed researchers per 10,000 workers</td>
<td>40.7</td>
<td>21.1</td>
<td>18.3</td>
<td>16.5</td>
<td>17.0</td>
<td>13.2</td>
</tr>
</tbody>
</table>

TABLE 1: R & D BY BUSINESS AND HIGHER EDUCATION, AUSTRALIA AND SELECTED OECD COMPARATORS, 2001

Innovating Australia 4 Tertiary education
<table>
<thead>
<tr>
<th>Measure</th>
<th>Australia</th>
<th>Canada</th>
<th>EU</th>
<th>OECD</th>
<th>UK</th>
<th>US</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business researchers per 10,000 workers</td>
<td>1.7</td>
<td>3.3</td>
<td>2.9</td>
<td>4.1</td>
<td>3.2</td>
<td>6.9</td>
</tr>
<tr>
<td>Growth of business researchers 1991-2001</td>
<td>2.09</td>
<td>6.41</td>
<td>2.91</td>
<td>3.62</td>
<td>1.54</td>
<td>3.27</td>
</tr>
<tr>
<td>Direct govt funding of business R &amp; D as % of GDP</td>
<td>0.03%</td>
<td>0.04%</td>
<td>0.10%</td>
<td>0.14%</td>
<td>0.13%</td>
<td>0.25%</td>
</tr>
<tr>
<td>% of business R&amp;D financed by government</td>
<td>3%</td>
<td>4%</td>
<td>8%</td>
<td>8%</td>
<td>10%</td>
<td>11%</td>
</tr>
</tbody>
</table>


While there isn’t necessarily any virtue in being at or above the OECD average on every indicator, being so skewed from OECD averages as is Australian higher education and business research and development at least raise questions. And it suggests that if, possibly for very good reasons, Australia decides to continue concentrating its research and development so heavily in universities, that special measures may be desirable to ensure that at least some of this effort is devoted to business’ direct interests.

**Selectivity, scale, concentration and diffusion**

Research funding is allocated selectively when choices are made between priorities or between researchers, but this does not necessarily concentrate resources in larger groups. Research funding may be more selectively allocated to active or productive researchers, but they may still work alone or in very small groups, or be widely dispersed amongst departments or institutions. Selectivity is considered desirable in research funding because less benefit is obtained by allocating resources to research which is less productive, of lower quality or to areas which are less important. The extraordinarily high number of higher education researchers per 10,000 workers in Australia compared with almost every other OECD country may very well be an argument for greater selectivity in allocating research resources (presumably in this case mostly time) but it is not necessarily an argument for greater concentration of research.

The term ‘critical mass’ is used to argue for several quite different outcomes. Its original meaning is in physics: the minimum amount of fissile material needed to maintain a nuclear chain reaction. By analogy it may be extended to the organisation of research as the threshold value for size (Evidence Ltd, 2003a: 21) – the minimum size of a research unit to maintain a viable or good research program. Johnson (1994: 34) concludes that there is a threshold effect in many fields of the physical sciences below which the amount or quality of the research performance is reduced. He estimates the threshold at from 3 to 5 academic researchers plus postdoctoral fellows, postgraduate students and technical staff. Johnson (1994: 31) further reports evidence ‘that the optimal size of a research group is about 6 fully qualified scientists working in the same problem area with perhaps another dozen support staff, graduate students and postdoctoral fellows, . . . [and] as many foreign visitors as can be accommodated.

While the minimum size of a successful research group may be quite small and the optimal size not much bigger, there may nevertheless be a scale effect. Larger research groups may be more successful or productive per researcher than smaller research groups, and one might expect that this scale effect plateaus or even becomes negative for groups larger and much larger than the optimal size. Evidence Ltd (2003b) tested the existence of a scale effect by
examining data from the UK’s research assessment exercise for 2001. Evidence Ltd (2003a: 22) notes that the unit of analysis ‘is therefore not necessarily an academic department but is the group of staff submitted by a university to an RAE Unit of Assessment. These will usually be from one academic resource centre (department or school) but they may include cognate researchers from other schools and one school may be split into two or more units of assessment’.

Evidence Ltd (2003a: 23) found that big units on average perform more effectively in research than small units, but there is a great variation in the performance of small units. Many small units perform worse than large units but some perform at a standard comparable with the largest. This pattern produced a statistically significant correlation between unit size and research income per full time equivalent staff, PhD awards per fte staff, publication output per fte staff and research performance or impact measured by average citations per paper (Evidence Ltd, 2003a: 23). However, Evidence Ltd (2003b: 63) reports a very large amount of residual variance even where there is a strong correlation, indicating many exceptions to the otherwise strong pattern.

Evidence Ltd found this broad pattern across a wide range of disciplines not only in the sciences but also in the arts and humanities. Evidence Ltd (2003a: 23) concludes that ‘there are size factors associated with research performance and they evidently occur across many disciplines but causation, correlation or consequence cannot be determined at this stage.’ This is because ‘small units that become good at research acquire the resources to become large units. Conversely, large units that do badly at research lose resources and decline in size as well’ (Evidence Ltd, 2003a: 24).

Evidence Ltd cites several earlier studies which found no clear evidence that unit size contributes to research achievement –

Johnston notably comments that ‘the widespread introduction of policies of resource concentration around the world are found to have been based on little examined assumptions and in operation to be at times counter-productive’. Cohen argued that the size of groups and their productivity simply increased proportionally and that there was no reliable evidence for the existence of a size or a range of sizes for research group that maximized output per unit of size. Seglen found no correlation between group size and productivity for Norwegian microbiologists. Rey-Rocha similarly concluded that team size among Spanish geologists did not appear to be as important for scientific productivity as the status of team members.

(Evidence Ltd, 2003b: 50)

Evidence Ltd’s finding of a scale effect for research may reflect the particular dynamics of the UK’s research assessment exercise – its reward for a particular construction of research establishing path dependence (Geuna, 1999: 171) or its construction of data that generates a scale effect. Alternatively it may reflect the particular way the research assessment exercise constructs units of assessment, which don’t necessarily correspond with actual research teams. Evidence Ltd (2003a: 22) notes that ‘research units may be teams, laboratories, departments, schools or institutions. Because these different kinds of units may bring research together in different ways their scale relationship with research performance should be studied separately. For example, a team is made up of various numbers of individuals, a department consists of individuals in one or more teams and a university is home to many people in a smaller or larger number of departments. If we considered scale factors solely in relation to staff FTE
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across these different organisational layers then we would be obscuring essential structural information.’

If there were a general scale effect for research that would be an argument for concentrating research resources until each research unit were of the optimum size. But notwithstanding a common misapprehension, a scale effect for research would not be an argument for concentrating research by institution. There is little evidence of an economy of scope in research production – that a research team in one field benefits by being organisationally linked to teams in other fields, or even that research benefits from being produced jointly with teaching (Geuna, 1999: 27). Research units of appropriate size and great quality may be located within universities which do not have many other such units. Some 54 units with the highest ratings of 5 or 5* in the UK’s 2001 research assessment exercise were in institutions with 3 or fewer units rated so highly (HERO, 2001). Conversely, universities which have numerous research units of appropriate size and high quality also support research units of indifferent quality and sub optimal size.

Concentrating research resources in units of appropriate size and of the highest quality may maximise research productivity and quality on the criteria normally used to assess research performance, but it may reduce the community’s benefit from research. This is because research has to be incorporated in the productive process to generate economic benefits. Lundvall & Borrás (1997: 154) argue that knowledge production at universities needs to be integrated more closely with the innovation process, since much innovation depends on tacit knowledge which is socially embedded in organisational networks and as Lundvall (1992: 8-9) had earlier observed, innovation blurs the conceptually distinct but in practice continuous stages of invention, innovation and diffusion. Concentrating research expertise distant from their sites of potential use may inhibit the diffusion of research as quickly and as thoroughly as desirable. This is supported by Moussouris (1998: 93-4) who argues that there is too much concentration on research ‘breakthroughs’ and too little attention to the importance of research diffusion in generating economic development.

While participants in the new ‘competitiveness debate’ generally acknowledged the contribution of elite models of higher education to sustain the R&D that underlays technological innovation – eg the MIT or Stanford exemplars of a ‘world class’ research university fueling the rise of whole new industries and high-tech districts – a new research stream emerging at this time also pointed out that this elite model appears incomplete from an economic development perspective.

Indeed, a major problem associated with the concentrated human capital investments that characterise this ‘R&D-intensive’ model is that overall it fails to acknowledge the import of diffusing skills broadly throughout the workforce in order to generate the incremental improvements in technologies, products, and processes which generally occur ‘downstream’ of the initial breakthrough-stage of an industry’s development. As cross-national research went on to explore to what extent the broad-based, diffusion-oriented education/training policies of Europe and Japan support the flexible, ‘high performance’ production methods that facilitate continuous adaptation to both economic and technical change, concomitant efforts to pinpoint US workforce skills ‘deficits’ focussed not on at the top end of the occupational pyramid but at various points along the middle to bottom end.

(Moussouris, 1998: 93-4. Emphases in the original; references omitted.)
As Salter & Martin (2001: 512) observe paraphrasing the OECD, ‘knowledge and information abound, it is the capacity to use them in meaningful ways that is in scarce supply. Often this capacity is expensive to acquire and maintain’ (emphasis in the original). Rosenfeld (1998: 4) argues that in the US ‘community colleges are particularly helpful to small and midsized enterprises, since they are better positioned to reach them than universities, consultants, and service agencies, many of which prefer not to bother with “know-how” needs that may not be technologically challenging or of a scale that can be sufficiently profitable’. Part of the explanation for the high productivity of much of Australian agriculture may be the broad diffusion of research and innovation through the applied research laboratories, demonstration farms and extension and outreach activities of State departments of agriculture. In contrast there is no comparable applied research laboratories and diffusion, demonstration and outreach for secondary industries in which Australia’s performance has generally been much weaker.

Clusters

An important institution for diffusing research and innovation is clusters of ‘interconnected companies, suppliers, service providers and associated institutions in a particular field’ (Porter & Ketels, 2003: 19). According to Porter & Ketels (2003: 19) –

Increasing productivity through more sophisticated ways of competing depends on parallel changes in the microeconomic business environment. The business environment can be understood in terms of four interrelated areas: the quality of factor (input) conditions, the context for firm strategy and rivalry, the quality of local demand conditions, and the presence of related and supporting industries. Because of their graphical representation the four areas have collectively been referred to as the ‘diamond’.

* * *

Clusters constitute one facet of the diamond, but they are best seen as a manifestation of the interaction of all the diamond’s elements. Clusters are geographically proximate groups of interconnected companies, suppliers, service providers, and associated institutions in a particular field, linked by commonalities and complementarities. Clusters such as IT in Silicon Valley or high performance cars in Southern Germany can be concentrated in a particular region within a larger nation, and sometimes in a single town. Other clusters are national and sometimes stretch across borders into adjacent countries, such as Southern Germany and German-speaking Switzerland. Proximity must be sufficient to allow efficient interaction and flow of goods, services, ideas, and skills across the cluster.

(Porter & Ketels, 2003: 19, 27)

Porter (1998) and Porter & Ketels (2003: 27) argue that ‘clusters affect competitiveness in three broad ways: First, clusters increase the level of productivity at which constituent firms can operate. . . Second, clusters increase the capacity for innovation and productivity growth. . . Third, clusters stimulate and enable new business formation that further supports innovation and expands the cluster’ (emphasis in the original). However, –

Only a small number of clusters tend to be true innovation centers. Others may tend to specialise in producing products aimed at particular market segments, or be manufacturing centers. Still other clusters can be regional assembly and service centers. Firms based in the most advanced clusters often seed or enhance clusters
Clusters are normally located within a relatively small geographic area, at least in the early stages of innovation. Salter & Martin (2001: 518) cite studies showing that ‘research collaboration within a country is strongly influenced by geographic[al] proximity; as distance increases, collaboration decreases, suggesting that research collaboration often demands face-to-face interaction.’ This is because innovation relies on tacit knowledge picked up in the informal sharing of knowledge and ideas in ‘dense’ networks of firms and other relevant institutions such as universities (Salter & Martin, 2001: 524). Rosenfeld (1998: 1-2) argues that the close proximity and spatial interdependence of clusters create ‘collective externalities’ that allow participants to transact business more cheaply and easily, achieve a scale that attracts specialised services and resources, resolve problems more quickly and efficiently, and learn sooner and more directly about new technologies and practices.

Geographic proximity may become less important as an industry matures. Salter & Martin (2001: 527, 519, 528) postulate that ‘the value of geographic spillovers and untraded interdependencies varies over time’. They may be particularly important when the direction of technological development is uncertain, increasing the importance of tacit knowledge and of direct interactions in interpreting and applying new information. Gesling (1992: 122-3) distinguishes between phase 1A innovation – ‘swarming’, when proximity is important; from phase 1 B innovation – ‘strategic networking’ when proximity is less important and partners are sought from throughout the nation and world.

While there have been several studies of the significance of the size of research teams in maximising research quality and productivity, there has been little work on the minimum and optimal size of clusters for fostering innovation. The prominent clusters are very large indeed and even the smallest of the existing US biotech clusters is bigger than the whole of Australia’s biotechnology industry (Commonwealth of Australia, Ernst & Young and Freehills, 2001). The logical conclusion to establish one big cluster is unlikely in Australia, and in any case it may also be undesirable since it would compromise tertiary education’s other objectives. In the next section we consider what structures have been proposed for Australian tertiary education and what may be possible and desirable to contribute to innovation.

**Structuring tertiary education**

Most discussion of the form of tertiary education in Australia is of supra-institutional forms, known in Australia as sectors and in the US as segments. International comparisons are confused by differences in the denotation of ‘higher education’. In the US ‘higher education’ includes the non baccalaureate granting 2-year or community colleges, the closest Australian analogue of which are now known as vocational education and training providers, formerly institutes of technical and further education. In the UK ‘higher education’ includes the ‘franchise’ programs of the non baccalaureate-granting colleges of further education that contribute to baccalaureates awarded by universities. The UK also includes in ‘higher education’ the recently established foundation degrees which are similar to the US’ associate
degrees in being at least 1 year’s duration less than standard baccalaureates and in generally having less theoretical orientation than standard baccalaureates.

Research-intensive university sector

One of the most long standing, sophisticated, largest and influential structures of tertiary education is California’s segmentation into the research intensive University of California, the comprehensive California State University and the open access California Community College System. There has been no formal distinction between research intensive and comprehensive higher education institutions in Australia since 1988 and in the UK since 1992, but the universities with the biggest research incomes have formed self-selected informal groups – the group of 8 in Australia and the Russell group in the UK. These groups argue for increased concentration of research funding in their institutions, which on some arguments amounts to a reintroduction of a formal distinction or ‘binary divide’ between a research intensive and a comprehensive higher education sector. These claims are marked by a dotted line in figure 1, which probably reflects the big research universities’ aspirations more than reality but nonetheless does not concede them the formal distinction they seek.

**Figure 1: Formal (——) and Informal (- - - -) Designation of Tertiary Education Sectors in California, The UK and Australia**

<table>
<thead>
<tr>
<th>Distinctive feature</th>
<th>California</th>
<th>UK</th>
<th>Australia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research intensive</td>
<td>University of California</td>
<td>Russell group</td>
<td>Group of 8</td>
</tr>
<tr>
<td>Comprehensive baccalaureate-granting</td>
<td>California State University</td>
<td>Other universities</td>
<td>Other universities</td>
</tr>
<tr>
<td>Open access</td>
<td>California Community College System</td>
<td>Further education colleges</td>
<td>Vocational education and training providers</td>
</tr>
</tbody>
</table>

One big centre

A common progression from promoting the formal designation of a research intensive sector of higher education is to advocate the concentration of research funding in an even more select group of high performing research universities. This seems to be the natural outcome of competition, including competition for a significant proportion of research funding (Geuna, 1999). However, it is now being proposed as explicit government policy. The recommendations of the UK’s Roberts review (2003) of the future for research assessment would lead to the further concentration of research funding in the ‘research intensive’ institutions. The then UK minister for higher education, Margaret Hodge, suggested that research might be limited to a group of elite universities, perhaps not going much beyond the ‘golden triangle’ of Oxford, Cambridge, and the London institutions (MacLeod, 2003a) although the new minister Alan Johnson may be rethinking this policy (MacLeod, 2003b).

In Australia the attention of big business and other elite opinion has been attracted by the observation of the vice chancellor of the university with the biggest research funding, the University of Melbourne, that Australia probably does not currently have a university that ranks in the top 100 in the world (Gilbert, 2001). However, the aspiration for Australia to have 1 or 2 universities in the world top 100 seems unrealistic when one notes that to fund just
the University of Melbourne at the same rate as Harvard University would require the Commonwealth to almost double its current allocation to higher education (Griffith University, 2002: 3).

Both proposals are not for a new form of tertiary education, but for the establishment of an even more selective group of super research intensive universities within the existing organisational form. The limit to these proposals is the concentration of research in one big centre or ‘flagship’ institution as it is commonly expressed in the US. As the Australian National University (2002: 6) pointed out in its submission to the recent Commonwealth review of higher education, this was the initial rationale for the establishment of the ANU in 1957 (Foster & Varghese, 1996). In those days the existing Australian universities conducted little or no research and did not award the PhD, then regarded as a dangerous German innovation all the more suspicious since it had been adopted in the US.

As we have seen, there is no evidence of an economy of scale or scope for research at the institutional level, and concentrating research in one or perhaps a select few institutions would limit research diffusion to the immediate locale of the centre and it would relegate the rest of Australia to provincial status, which is unlikely to be acceptable in a federation. What may be acceptable is concentrating research in each broadly defined field in a national centre but dispersing centres geographically. This would gain the benefits of scale in each field but would locate each centre throughout the country so that each jurisdiction can be the centre of something. Two possibilities for combining concentration and dispersal are considered: matrix and hub-and-spoke.

Matrix

Davis (Griffith University, 2002: 36-7) proposes that institutions be encouraged to develop new institutional types through multiple contestable funding. This would be achieved by establishing an institutional teaching performance fund of $271 million and an institutional community service and equity performance fund of $271 million to complement the institutional grants scheme of $271 million, which would be renamed the institutional research performance fund.

In Davis’ scheme institutions would be allowed to compete for 2 but not 3 performance funds, thereby requiring them to choose 1 of 3 options to maximise their institutional performance: research and teaching, research and community service, or teaching and community service (Griffith University, 2002: 37). Davis’ scheme, which has universities concentrating on 2 of their 3 broad roles, may be generalised as a matrix where the selection may be made by field of research, innovation cluster or indeed any other salient characteristic. This is illustrated in figure 2.

![Figure 2: Matrix organisation of tertiary education](image)

The matrix form is more sophisticated than most other proposals to structure Australian tertiary education, but is probably still too crude to optimise the sector’s contribution to
innovation. This is because it would require a dichotomous decision whether an institution should participate seriously or not in an activity such as a research field or cluster. While its implementation would probably be more nuanced, at least diagrammatically the matrix doesn’t allow for institutions to be moderately involved in an activity, or involved in only part of an activity.

**Hub and spoke**

A more sophisticated elaboration of the matrix is the hub and spoke. In this form one institution would be designated the hub of an activity such as research in a specified field but other institutions and their staff and students would be able to apply for support to access the hub’s facilities and other fixed resources. While the hub of each activity would be unambiguously located at just one institution, the extent of other institutions’ participation may range from partnership to perfunctory, and that may change over time. It would also be possible to make the hub of each activity a different size depending on its importance, and to vary that from time to time.

With these flexibilities it would be possible to construct the allocation of hubs (whether by competition or otherwise) so that each university had a reasonable prospect of hosting at least one hub, while one would expect that the institutions with considerable accumulations of academic capital would host a disproportionate number of hubs. It would also allow institutions to be spokes to as many hubs as they could attract funding or fund from their internal resources. The current organisational form in Australian higher education closest to the hub and spoke is cooperative research centres. However, these centres coordinate research programs, whereas research hubs in this model would be mainly concerned with developing facilities and coordinating access to them.

It would also be possible to give hubs a broader role than just supporting research to support research diffusion and innovation generally. This would open the possibility for businesses, trade associations, vocational education and training institutions and others to participate either as hubs or spokes.

**Coordination**

Karmel (2001) argues for the re-establishment of ‘an independent statutory body standing between the universities and the government along the lines of the commissions which operated successfully from 1959 to 1987’. Karmel argues that such a body is needed to protect intellectual freedom by insulating universities from direct government control or influence and to inform public policy on higher education by undertaking ‘objective analysis’ unaffected by political/electoral considerations. Such a body would also at least be highly desirable to coordinate any more sophisticated organisation of higher education such as the matrix and hub and spoke forms described above.

But the need for national coordination extends well beyond higher education. We have noted that vocational education has not been included in the national innovation policy nor in cooperative research centres, one of the Commonwealth government’s only mechanisms to engage higher education research with its end users. This is but one manifestation of the divide between higher education and vocational education and training (Wheelahan, 2000) which is unusually deep in Australia (Moodie, 2003: 55). Balaguer and colleagues (2003) argue that Australia’s innovation systems are highly dispersed geographically, sectorally and
organisationally. They argue that this limits potential economies of scale in innovation and production and risks fragmentation – the sub-critical concentration of knowledge production resources. They add that ‘the demand for new knowledge is also dispersed, which may impede the development of effective link[s] between potential suppliers and users of knowledge’ (Balaguèr et al, 2003:17).

There are a number of ways this could be done. Innovation could be coordinated nationally by sector. Separate bodies could be established to coordinate higher education, tertiary education (higher education and vocational education and training) and a mechanism could be established to foster the agglomeration and coordination of elements of the national innovation system, say by industry sector or cluster. Alternatively the basic unit of coordination could be geographic. The Victorian and UK governments propose to coordinate tertiary education and industry development through local learning and employment networks (State of Victoria, 2002) and regional development agencies (Secretary of State for Education and Skills, 2003a, 2003b). In Australia this would build on an earlier attempt to coordinate national development through regional development councils. Some still exist and are useful for regional consultation, but they have never been given a coordinating role.

Like much of northern continental Europe, Germany has a coordinated market economy in contrast to the liberal market economies of wealthy Anglo countries (Hall & Soskice, 2001). Nonetheless, its trade associations may be a useful model. These comprise business, employees and government and are organised as national bodies with regional chapters. They share information and coordinate investment in and the provision of research, training and other pre-competitive and shared infrastructure (Culpepper, 2001). This close coordination produces a generally high alignment of higher education, training and employment, but it makes changing any part of the system difficult, slow and uncertain. As a consequence Germany’s higher education and training is considered inflexible and resistant to change (Huisman & Kaiser, 2001:63). This would fail to meet Whitley’s (2003: 1017) preference for a system that can focus research but flexibly change its focus: ‘Systems that are able to mobilise large numbers of specialists to deal with new intellectual goals and problems, and to train researchers in new techniques and ideas at relatively short notice, seem likely to produce a wide variety of knowledge and skills that could be useful to firms dealing with high levels of technical uncertainty.’

Conclusion

We have seen that Australia’s national innovation policy has become preoccupied almost exclusively with research, and particularly with research in universities. This is part of a long and general practice of Australian governments to concentrate research policy on universities and major publicly funded research agencies (the Australian Institute of Marine Science, the Australian Nuclear Science and Technology Organisation, the Commonwealth Scientific and Industrial Research Organisation and the Defence Science and Technology Organisation) to the relative neglect of research in industry. When Australian governments have considered industrial research its has been at the prompting of public research figures to increase the tax concession for expenditure on research, much of which is spent in universities and other public research agencies.

This distortion in public policy has concentrated Australia’s research funding and activity heavily in the public sector in comparison with the US and OECD and European Union averages. There may be good reasons for maintaining the heavy concentration of Australian
research in universities, but if Australia is to have a strong national innovation system special measures will be needed to direct at least some of this effort to business’ direct interests. In its background for the innovation summit the Department of Industry, Science and Resources (1999: 7) argued that Australia’s history, geography and its federal government structure have resulted in a national innovation system that is highly fragmented and frequently operates at a sub-optimal scale. The department argued that the innovation system exhibits too few links and/or active coordination across all the players, despite the best intentions of the recent past. The department’s (1999: 8) first recommendation to the summit therefore was to encourage greater interaction among the players in the system.

Of the ways of organising tertiary education considered in this chapter, only the matrix and the hubs and spokes forms are likely to provide the scale and interaction that the Department of Industry, Science and Resources believes is desirable to contribute to the national innovation system. The matrix is more readily implementable but would make a lesser contribution to national innovation. The hubs and spokes would make a greater contribution but would be correspondingly harder to implement. A cautious approach would be implement a matrix initially with a view to evolving it to the greater sophistication of hubs and spokes.

Whatever form is chosen it seems likely that some coordinating mechanism would be needed to manage the transition to the new form and to coordinate the several participants in a national innovation system. As Karmel has argued, an independent statutory body is needed in higher education to implement government policy but filter out party and electoral interests. A higher education statutory body could be part of a larger coordinating mechanism as the Higher Education Council was part of the National Board of Employment, Education and Training (Dawkins, 1988: 12). Alternatively higher education statutory body could be organisationally separate from the mechanism that coordinates the national innovation system, although of course one would expect them to pursue complementary and mutually reinforcing policies.

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