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Measuring Innovation: Towards Developing a Scorecard

Tasmania

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PREFACE

This paper is the result of a joint project by the Tasmanian office of the Australian Bureau of Statistics (ABS) and the Tasmanian Department of Economic Development and Tourism. The purpose of the project was to evaluate possible measures of innovation that could be included in a Tasmanian Innovation Index or Innovation Scorecard. Drawing from the research for the project, this paper provides a brief overview of the subject of innovation and how innovation can be developed and utilised. It also provides examples of how innovation is currently being measured in Australia and around the world and presents a proposed Tasmanian Innovation Scorecard.

Particular thanks and appreciation are extended to Ms Jo Crisp of the Tasmanian Department of Economic Development and Tourism, Prof. Keith Smith from the Australian Innovation Research Centre (AIRC) and Glyn Prichard and Damian O'Rourke from the ABS Innovation and Technology National Statistics Centre, who worked closely with the Tasmanian office of the ABS on this collaborative project and kindly supplied material for inclusion.

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ABBREVIATIONS

ABS	Australian Bureau of Statistics
AIRC	Australian Innovation Research Centre
ANZSIC	Australian and New Zealand Standard Industrial Classification
BCA	Business Council of Australia
BCS	Business Characteristics Survey
BERD	business expenditure on R&D
BLD	Business Longitudinal Database
CDM model	Crépon-Duguet-Mairesse model
CIS	Community Innovation Survey
DEST	Australian Government Department of Education, Science and Training
DITR	Australian Government Department of Industry, Tourism and Resources
EIS	European Innovation Scoreboard
EU	European Union
GDP	gross domestic product
GSP	gross state product
ICT	information and communication technology
IPRIA	Intellectual Property Research Institute of Australia
ISIG	Innovation Summit Implementation Group
KBE	knowledge-based economy
NSI	national system of innovation
OECD	Organisation for Economic Co-operation and Development
R&D	research and development
SISCA	Standard Institutional Sector Classification of Australia
SME	small and medium enterprise
STI	science, technology and innovation
TIAB	Tasmanian Innovations Advisory Board
US	United States (of America)

INTRODUCTION

BACKGROUND

Innovation and the uptake of new ideas and technologies are considered to be important drivers of economic growth and significant contributors to productivity and employment (Organisation for Economic Co-operation and Development – OECD, 2001). Innovation remains a key policy issue with the former government's overarching policy *Backing Australia's Ability – Building our Future through Science and Innovation* (Commonwealth of Australia, 2004) and the new Federal Government's recent announcement of the 'Review of National Innovation Systems'. As the importance of innovation is becoming more widely recognised, policies and programs are being implemented to promote innovation and jurisdictions are investigating the factors that lead to innovative capacity.

As a result, there is an increasing need to measure and assess the impact of investments in research, technology development and innovation, and to understand the socio-economic consequences of innovation. The evaluation of innovation performance and statistical comparisons between the States and Territories can improve our understanding of innovation in Australia and help measure the impact of policies and programs promoting innovation. It can also assist with targeting areas of need and helping Governments ensure that their investment in innovation is productive.

The ABS has conducted three national Innovation Surveys for the 2003, 2005 and 2007 reference periods and based the development of the surveys on the Oslo Manual (OECD, 1992, 2005) and the European Union (EU) Community Innovation Survey (CIS). The ABS publishes detailed innovation statistics every two years based on data collected from the innovation module contained in the Business Characteristics Survey (BCS) - see release in February 2008 (ABS 2008). The BCS aims to collect key measures on business characteristics to develop more relevant and effective government industry policies, supporting Australian businesses, particularly small and medium businesses. The data will be used to build a database for public and private sector analysts, the Business Longitudinal Database (BLD). It aims to provide users with business characteristics data augmented with financial data from administrative sources and other existing ABS surveys. Core innovation statistics are published in alternate years, with the most recent data being released in November 2007 (ABS, 2007a).

The Tasmanian Innovation Scorecard project involved extensive research and consultation. The paper draws from this research. It considers various concepts associated with innovation and its measurement and explores some different types of indicators of innovation. It concludes by presenting a case study, describing the development of the Tasmanian Innovation Scorecard.

DEFINING INNOVATION

There are several ways of defining innovation and these have evolved over time. The Oslo Manual indicates that early research was conducted by Schumpeter in 1934, in which he argued that:

> '… economic development is driven by innovation through a dynamic process in which new technologies replace the old, a process he labelled "creative destruction". In Schumpeter's view "radical" innovations create major disruptive changes, whereas "incremental" innovations continuously advance the process of change.'
>
> (OECD 2005, pg. 29)

Schumpeter proposed a list of five types of innovations:

1. Introduction of new products.
2. Introduction of new methods of production.
3. Opening of new markets.
4. Development of new sources of supply for raw materials or other inputs.
5. Creation of new market structures in an industry.

The OECD Oslo Manual (3rd Edition) gives an outline of the concepts involved in innovation and provides recommendations to run innovation surveys. The design of the 2003, 2005 and 2007 ABS Innovation Surveys (ABS 2006b) was based on the Oslo Manual.

Koberg (Koberg et al 2003) also describes innovation as being either radical or incremental. Radical innovation is 'major in scope or breadth, involving strategic innovations or the creation of new products, services or markets' (ibid, pg. 23). It is sometimes also referred to as disruptive innovation, as it causes major changes in the industry or field in which it occurs (Thornburn & Langdale 2003). Incremental innovation is low in its breadth of impact, but far more common than radical innovation and includes activities such as significant improvement of existing processes, products and services (ibid).

Koberg also defines four broad categories of incremental innovation. These are:

> '...procedural (management-determined innovations in rules and procedures); personnel-related (innovations in selection and training policies, and in human resource management practices); process (new methods of production or manufacturing); and structural (modifications to equipment and facilities and new ways in which work units are structured)'.

Some sources define innovation very broadly. For instance, the *Australian Innovation Scorecard* (Commonwealth of Australia, 2002), the OECD (OECD, 2005) and the Business Council of Australia (BCA, 2006) put emphasis on the process of converting ideas into economic outcomes; that is, the implementation of ideas and inventions is central to successful innovation.

The Oslo Manual (3rd Edition) provides guidelines for collecting and interpreting innovation data. The manual defines innovation as:

> '… 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' (OECD 2005, pg. 46).

INPUT-BASED MEASURES

Input-based measures of innovation are concerned with activity and resource usage which are believed to lead to innovation. The level of research and development activity (R&D) is often used as an indicator of innovative activity. R&D is defined in the *Frascati Manual 2002, Proposed Standard Practice for Surveys of Research and Experimental Development* (OECD, 2002) as comprising:

> '...creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications'.

Before the introduction of innovation surveys, R&D was frequently used as a proxy for all innovation inputs. While R&D is a very important part of the innovation process, other measures of innovation activities also need to be considered, as R&D constitutes only a part of innovative activity. According to the ABS publication *Innovation in Australian Business, 2005* (ABS, 2006b), only 27% of innovating businesses reported that they spent money on R&D in the survey period. It should also be noted that R&D does not always lead to product commercialisation or to new products and processes.

There are many non-R&D activities that can be part of innovation.

> 'These activities can strengthen capabilities that enable the development of innovations or the ability to successfully adopt innovations developed by other firms or institutions' .
>
> (OECD 2005, pg. 36)

The Oslo Manual 3rd Edition suggests that innovation activities include:

1. Identifying new products, processes, marketing methods or organisational changes;
2. Buying technical information, paying fees or royalties for patented inventions or buying know-how and skills through engineering, design or other consultancy services;
3. Developing human skills through training or hiring;
4. Investing in innovative equipment, software or intermediate inputs;
5. Reorganising management systems and business activities; and
6. Developing new marketing methods.

(OECD 2005, pg. 36)

OUTPUT-BASED MEASURES

Output-based measures of innovation are concerned with the new products, processes and services which are introduced as a result of innovation activity. There has been some discussion of the relative merits of input or output measures of innovation. The EU CISs and the Australian Innovation Surveys rely on an output approach, that is whether a business has attempted or is attempting to introduce a new or significantly modified product or process. Innovation surveys also inform on input activities that have led to, or were intended to lead to, implemented innovations. They are therefore very much targeted to the innovation process. Furman and Hayes (2004) have recognised that outputs are more important as measures of innovation than inputs and that improvements in the level of innovation do not arise from one or two factors but through increased investment in, and commitment to, a number of drivers.

OUTCOME-BASED MEASURES

Outcome-based measures of innovation are concerned with the impacts of innovation on economic performance and productivity and the social and environmental impacts of innovation. Such measures are still under development and several sources suggest that most current measurements of innovation are merely approximate proxy measures for innovation outcomes.

The Crépon-Duguet-Mairesse model (CDM, 1998) (which has been recently used by many organisations as part of an OECD working group) recognises these input-output-impact stages of the innovation process. In Australia, the Productivity Commission and the ABS released the results of a collaboration analysing innovation links to productivity (using the CDM approach) in an attempt to develop reliable outcome measures (ABS, 2007b). Further analytical work is expected to be undertaken in the future using information contained in the BLD developed by the ABS.

Several sources suggest it is important that the selected measures cover a broad range of innovation activity and should include a selection of input, output and outcome-based measures. It is also important to measure the capacity of industry, government and the community to foster and encourage innovation.

RADICAL VERSUS INCREMENTAL INNOVATION

As mentioned in chapter one, there are two levels of innovation – radical and incremental. There is considerable mention in the literature that the vast majority of innovation is incremental, and that it involves innovations in process, marketing, organisation and services. For example, *Innovation in Australian Business, 2005* (ABS, 2006b) suggested that in terms of new goods and services and new operational, organisational and managerial processes, the vast majority of innovations were 'new to Australia', 'new to the industry' or 'new to the business' only. Only 8% of innovating industries reported the introduction of goods or services that were 'new to the world' and less than 1% reported introducing 'new to the world' operational, managerial or organisational processes (ABS 2006b, p21). This indicates Australia is more a user of innovation introduced first elsewhere in the world than a source of innovation.

LINKAGES AND KNOWLEDGE DIFFUSION

Although radical innovation is potentially of much more value and has more far reaching effects than incremental innovation, 'new to the business' innovations can have powerful economic impacts over the long term. There is a considerable volume of literature about the importance of sharing and diffusing knowledge, supporting the view that measurement of diffusion would be important in the Australian context.

Rogers (2003) proposed that diffusion requires an innovation, a communication system, a social system and time. He further proposed that there are five stages in the diffusion of innovations. These are: knowledge of the innovation, persuasion, decision, implementation and confirmation.

Crucial to this process are 'early adopters'. These are the first to take up and promote new products, services and processes. Rogers found that these people tend to be younger, better educated and to have a higher socio-economic status than the general population. They also have better networks, work for larger organisations and are more innovation-minded in general.

LINKAGES AND KNOWLEDGE DIFFUSION *continued*

Roger's theory suggests a number of possible indicators of diffusion. These include the number and type of innovations, population characteristics, business characteristics, the number and type of networks and linkages.

Linkages between businesses are an important channel for diffusion and can be cluster-based, that is businesses in a locality or industry sharing a common interest. For example, the Australian wine industry, through collaboration and competition, has been innovative at a higher level than might otherwise have occurred (Gans & Stern 2003). In addition, the rate at which knowledge can be diffused can affect the rate of 'new to the firm' innovation and consequently the rate of productivity increases (Gans & Stern 2003).

CREATING AN INNOVATION CULTURE

Developing an 'innovative culture' is commonly mentioned in literature. This can apply at national, city or firm level. The idea is that if people are actively encouraged to think about innovation, more innovative ideas will be generated and diffused (Innovation Summit Implementation Group (ISIG) 2000). Knowledge and education measures could provide some indication of the capacity for the generation of innovative ideas.

Also central to this theme is the idea of creating a virtual circle of innovation in a city or country. Florida's 'Creative Class' suggests that by making a location attractive to innovative firms and creative individuals, they may be motivated to work and live there, and in turn make the location even more appealing to the types of people and businesses being sought (Florida, 2002).

STRUCTURE OF THE ECONOMY

It is important to consider the structure of an economy when investigating indicators of innovation. This is because different indicators will be more relevant to measurement of innovation in smaller economies as opposed to larger, or global economies (Godin 2004).

Business demographics are also important. Small and medium sized enterprises face different problems to large enterprises in the innovation process. Smaller enterprises tend to be more specialised in focus, have more limited resources and have greater difficulty in obtaining funding for innovative activities (OECD 2005). This may impact upon the assessment of which indicators to use for a specific State or Territory.

SCORECARD OR INDEX

A common issue in the literature is the choice between a scorecard or an index for measuring innovation. A scorecard is made up of a number of elements that attempt to measure factors associated with innovation. In contrast, an innovation index is based on a weighted calculation of a number of measures of innovation (Jones et al, 2003).

An index produces a 'single' number, which is convenient for comparison over time and with other jurisdictions. However, determining meaningful weights to construct indexes is problematic and fairly subjective and therefore subject to criticism. Consistent standards across the innovation pipeline, from idea to commercialisation and diffusion, are also important.

Scorecards bring together indicative data from a range of sources and, now that many countries have innovation surveys, these should be an integral part of the suite of scorecard indicators. If they are broad in scope, scorecards should be seen as adding valuable context to core innovation measures provided by innovation surveys. Scorecards therefore complement innovation surveys, informing on broader innovation capability.

CONSTRUCTING AN INNOVATION SCORECARD

Godin (2004) proposed that consideration should be given to the model to be used when selecting indicators of innovations such as a National System of Innovation (NSI) model or a Knowledge-Based Economy (KBE) model. The NSI model emphasises the measurement of the performers in the system and the flows between them (e.g. flows of knowledge or personnel). The KBE model emphasises the measurement of the production, diffusion and use of knowledge. Godin favoured the NSI model as more readily measurable, but in practice many scorecards use elements of both approaches.

There are also different approaches to the number of indicators used. A smaller number is easier to manage and report on, but may require a long consultation process to ensure that consensus is obtained on the representativeness of the indicators chosen. A longer list may give a more comprehensive overall picture as no single measure of innovation taken in isolation is very meaningful (Godin 2004).

When selecting the actual indicators, it is important to capture a variety of elements in the process of innovation, that is measures of input, activities, output and outcome. In practice, it can be difficult to measure outcomes, but it is worth trying to incorporate some outcome measures as these contribute to the overall picture of innovation performance (Godin 2004).

Finally, Godin suggests that the following criteria should be considered when deciding which indicators to use: theoretical (or conceptual) validity, empirical reality, comparability, relevance, availability and cost of data collection. Data availability, or the cost to collect data that is not already available, is a primary concern when constructing an innovation scorecard (Godin 2004).

TYPES OF INDICATORS

There are a number of common types of indicators that appear regularly in innovation scorecards.

The Australian Government publications, *Backing Australia's Ability 2002–03* and *2004–05*, (Commonwealth of Australia, 2003 and 2005) suggest the following indicators for innovation scorecards:

Human resources

These indicators measure the potential of human capital to contribute to innovation and to transform ideas and technologies into tangible economic outcomes. They include measures of talent (percentage of workers in relevant sectors; numbers of scientists or researchers per capita; etc.); educational attainment (participation, number of graduates, etc.); and availability of education (enrolment in adult learning, etc.).

Knowledge creation

These are measures of the potential for generating new ideas and technologies. They include expenditure on R&D and other innovative activities; and the development of intellectual property such as number of patents or scientific papers.

Knowledge diffusion

This refers to the capacity to transfer new ideas and technologies throughout the economy. Usual measures include internet connection figures and investment in information and communication technology (ICT).

Technology

These measures are largely about improving the contribution to productivity of capital such as plant and equipment, through embodied technological innovation. There is some overlap with knowledge diffusion, as this includes the use of and investment in ICT; but it can also include the use of and investment in other new technology.

Linkages and collaboration

Collaboration, locally and internationally, is an effective means of achieving increased innovation. Possible measures include the number and value of R&D outcomes that have been commercialised, and the level of commercialisation of university and other research institute projects.

Finance

An important indicator is the pool of funds available to commercialise ideas and technologies. The Australian Innovation Scorecard uses investment in venture capital as a percentage of Gross Domestic Product (GDP) as a measure (Commonwealth of Australia 2005, pg. 14–15).

Market outcomes

Market outcomes are the economic returns on the investment in innovation. In addition to the commercialisation measures noted previously, common measures include growth in Gross State Product (GSP), value of exports, the level of value added by manufacturing industries per head and sales generated from new or improved products. Care needs to be taken when using these indicators as other factors, such as changes in exchange rates or commodity prices, could also be a significant factor at times. Another common indicator used is sales generated from new or improved products.

Tolerance

Some researchers have argued that creative people want to work in a welcoming, inclusive society and that intolerant societies are less innovative and less attractive to creative people (Florida 2002; Hendry & Brown 2005). There is limited evidence as to which are the most appropriate indicators of a tolerant society.

Innovation culture

This refers to both the perceived desirability of a place to work and live in the eyes of 'creative class workers' and the perceived value in the community of pursuing innovative and entrepreneurial activities (Florida 2002). As with tolerance, there is limited evidence as to the most appropriate indicators of an innovation culture and further research is required before it can be measured with any certainty (ISIG 2000).

AUSTRALIAN APPROACHES

All Australian governments have policies and programs designed to stimulate innovation. The main drivers for these programs are the generation of jobs and growth from technology-based industries; moving up the value chain in traditional industries such as agriculture, as well as diversifying industry; and ensuring involvement in major enabling technologies, such as ICT and biotechnology. In addition, state and territory programs are frequently designed to encourage clusters of innovation in particular industries and to take advantage of Australian government programs to obtain funding. Substantial details of the state and territory programs are provided in the Allen Consulting Group's report (2003) *Contribution of the States and Territories to Australia's Science and Innovation System*.

THE ABS INNOVATION SURVEYS

The ABS conducted the 2003, 2005 and 2007 Innovation Surveys following strong support from government agencies and other stakeholders interested in measuring innovation. All surveys used the framework contained in the Oslo Manual to develop the survey questionnaires and ensure broad comparability of innovation statistics with those collected internationally. In recent times, the ABS has moved away from the collection of innovation data using a 'stand-alone' survey, to the collection of detailed innovation data on a biennial basis using the Business Characteristics Survey (BCS) which combines a range of business characteristics data. As outlined in the Introduction, the BCS is an important source of data for the Business Longitudinal Database (BLD) and the development of the BLD will ensure that users are able to conduct longitudinal analysis of business innovation along with other business characteristics. Broad innovation statistics collected from the 2005–06 BCS were released in November 2007 (ABS, 2007a). Detailed innovation statistics collected from the 2006–07 BCS will be released in August 2008 (ABS 2008).

The scope of the 2003 and 2005 Innovation Surveys was all businesses in Australia with employment recorded on the ABS Business Register of five or more employees, except those classified to the following institutional sectors or industry divisions:

1. Standard Institutional Sector Classification of Australia (SISCA) 3000 General Government
2. SISCA 6000 Rest of the World
3. Australian and New Zealand Standard Industrial Classification (ANZSIC) Division A Agriculture, Forestry and Fishing
4. ANZSIC Division M Government Administration and Defence
5. ANZSIC Division N Education
6. ANZSIC Division O Health and Community Services
7. ANZSIC Division Q Personal and Other Services

These institutional sectors and divisions were excluded from the innovation surveys because of statistical and cost constraints.

The 2005 Innovation Survey was conducted by mail and was based on a random sample of approximately 6,800 businesses, stratified by industry, state/territory and number of employees and with weighting factors used to construct the whole-population estimates. The response rate of the survey was 93%. Based on the framework of the Oslo Manual, the survey was extended to include any innovative activity that was abandoned during the reference period or was incomplete at the end of the reference period.

THE AUSTRALIAN INNOVATION SCORECARD

The Australian Innovation Scorecard, developed in 2002 and updated in 2004, was first produced as part of a whole-of-government Innovation Statement, led by the then Department of Education, Science and Training (DEST), with assistance from the then Department of Communication, Information Technology and the Arts (DCITA) and the then Department of Industry, Tourism and Resources (DITR). Indicators were chosen to reflect the innovation process and to allow benchmarking against other OECD countries. The fifteen indicators shown in the report were grouped into six categories (Commonwealth of Australia, 2003):

1. Knowledge creation – the ability to generate new ideas and technologies:
   - R&D expenditure in government and higher education sectors as a % of GDP
   - Scientific and technical articles per million population
   - Number of United States (US) Patents per million population
   - Business sector R&D expenditure (BERD) as a % of GDP

2. Human resources – the capacity of the labour force to transform these ideas and technologies into tangible economic outcomes:
   - Percentage of workforce with tertiary education
   - Number of Science Graduates per 10,000 persons in labour force
   - Researchers per 10,000 persons in the labour force

3. Finance – the pool of funds available to commercialise ideas and technologies:
   - Investment in Venture Capital as a % of GDP

4. Knowledge diffusion – the capacity to transfer new ideas and technologies throughout the economy:
   - Investment in ICT as a % of business sector gross capital formation
   - Internet users per 1,000 population
   - Investment in new equipment – investment in machinery and equipment as a % of GDP

5. International collaboration – the international linkages of Australia's innovation system:
   - Share of foreign affiliates in manufacturing R&D
   - Breadth of international science and engineering collaboration

6. Market outcomes – economic return on the investment in innovation:
   - Average annual growth in multi-factor productivity between 1997 and 2001
   - Expenditure on innovation as a share of total sales in manufacturing (Commonwealth of Australia 2002, pg.15)

When using this scorecard, it should be kept in mind that an increase in any one of the various indicators may not necessarily be a better outcome for the economy. This is true especially for input type indicators such as those in the knowledge creation and human resources categories, as it is difficult to prove a direct relationship between increased expenditure and subsequent increases in innovation output.

THE AUSTRALIAN INNOVATION SCORECARD *continued*

The scorecard was not designed to be prescriptive, but to provide an overview of Australian trends in key innovation indicators and to compare these to trends in OECD countries (Commonwealth of Australia 2005, pg. 5). The innovation report *Backing Australia's Ability (2004-05)* indicated that the then Government's investment focused on three key elements in the innovation process:

1. Strengthening Australia's ability to generate ideas and to undertake research;
2. Accelerating the commercial application of ideas; and
3. Developing and retaining Australian skills (Commonwealth of Australia 2005, pg1).

In January 2008, the Federal Government announced the establishment of a review of the National Innovation System, to be headed by Dr Terry Cutler.

Most states and territories have developed their own set of innovation indicators, usually incorporating some aspect of the Australian Innovation Scorecard. In 2003, the ABS developed the South Australian Innovation Scorecard for the Office of Innovation in South Australia. This scorecard uses a subset of the Australian Innovation Scorecard (2002) for which state level data can be obtained.

Queensland is an example of a state that has chosen to use a far more extensive list of indicators. In 2004, the Queensland Government produced *Smart Queensland: Smart State Strategy 2005–2015* (Queensland Government, 2005). This strategy includes 25 indicators, grouped under five headings. These are:

1. Strong economic foundations for a Smart State:
   - Economic growth (% annual change)
   - GSP per person
   - Employment growth (% annual change)
   - Unemployment rate
   - Labour productivity growth
   - Public infrastructure spending
   - Per person net worth
   - Population growth
   - Growth in exports
   - Business investment in machinery, equipment and intangible assets
   - Tax burden

2. Sustainable development for future prosperity:
   - Urban water consumption in South-East Queensland
   - River conditions
   - Air quality (days per year)

3. Education and skills for a knowledge economy:
   - Year 7 students achieving the national benchmark in reading, writing and numeracy
   - Apparent retention rates Years 7/8 to 12 for full-time secondary school students
   - Post-school qualifications, employed persons aged 25–34
   - Vocational education and training qualifications
   - Household access to computer and Internet at home

THE AUSTRALIAN INNOVATION SCORECARD *continued*

4. Research to create tomorrow's ideas:
   - Government per person expenditure on R&D
   - Higher education expenditure on R&D by type of activity

5. Innovation to convert ideas into value:
   - Queensland business expenditure on R&D (BERD)
   - Per cent of BERD by industry
   - Total growth in Queensland knowledge-intensive exports
   - Number of spin-off firms created with headquarters in Australia
   - Number of patents granted per million residents
   - Business usage of computers and Internet (including web presence)

The Victorian Government, in contrast, has opted for a more restricted list and currently reports on five major indicators (*Victorians. Bright Ideas. Brilliant Future. Victorian Government Innovation Statement, October 2002*) These are:

1. GSP per worker
2. Proportion of population that has completed at least upper secondary education
3. Gross expenditure on R&D
4. Exports as a percentage of GSP
5. Proportion of GSP invested in productive capital

EVIDENCE OF INNOVATION IN AUSTRALIA

Patterns of Innovation in Australian Businesses, 2005 (ABS, 2007d) provides a detailed examination of innovation in Australia. The main characteristics described in the publication are:

1. During the two calendar years ended December 2005, innovating businesses in Australia represented 33.5% of all businesses.

2. Innovation in goods or services was lower than operational process innovation and organisational/managerial innovation in most industries.

3. Across all states and territories, introduction of new organisational/managerial processes was the predominant type of innovation.

4. The proportion of innovating businesses increased with business size.

5. Most states and territories reported proportions of innovating businesses between 30% and 35%. The exceptions were South Australia (40.1%), Western Australia (37.1%) and the Australian Capital Territory (28.4%).

6. Innovating businesses reported that approximately 4.5% (or just over $40 billion) of their total income from sales of goods or services during 2004–05 could be attributed to new goods or services introduced or implemented in the reference period.

7. Total expenditure on innovative activity (including Research and Experimental Development) by all business was $38.7 billion.

8. Innovating businesses introducing new goods or services spent 1.8% of their total business expenditure on this activity.

9. Expenditure on implementing new operational processes or organisational managerial processes was 1.4% and 0.6% of total business expenditure respectively, for innovating businesses.

EVIDENCE OF INNOVATION IN AUSTRALIA *continued*

10. Businesses operating under current ownership for under 9 years had a higher propensity to innovate than businesses under current ownership for 9 years or more.

11. Foreign ownership appears to be associated with higher levels of innovation.

12. The most commonly reported barrier to innovation, for both innovating and non-innovating businesses, related to costs.

13. Profit-related drivers were the most frequently cited reasons driving innovation, reported by 94.2% of innovating businesses.

14. The proportion of innovating businesses involved in collaboration was 26.0%, compared with 6.4% of non-innovating businesses.

15. The likelihood of an innovating business undertaking any collaboration increased with employment size.

16. The most reported source of ideas or information for innovative activity was internal sources (75.8%).

17. Institutional sources (7.7%) were least used by innovating businesses as a source of ideas or information. Institutional sources included universities or other higher education institutions, government agencies, private non-profit research institutions and commercial laboratories.

THE OECD SCIENCE TECHNOLOGY AND INNOVATION SCOREBOARD

The OECD's Science, Technology and Innovation (STI) Scoreboard (OECD 2007) breaks measures into nine categories:

1. R&D and investment in knowledge, which includes 9 measures, mainly related to R&D.
2. Human resources in science and technology, which includes 12 measures of university graduates, researchers, employment and earnings.
3. Innovation policy, which includes 7 measures of government funding, university patents, tax treatment and collaboration.
4. Innovation performance, which includes 8 measures of patents, scientific articles and innovation by companies.
5. ICT, which includes 15 measures of ICT investment and trade and internet usage.
6. Particular technologies, which includes 10 measures of innovation in biotechnology, bioscience, nanotechnology and nanoscience.
7. Internationalisation of science and technology, which includes 7 measures of international investment, ownership and collaboration.
8. Global economic flows, which includes 11 measures of international commerce and other information transfer related factors.
9. Productivity and trade, which includes 8 measures of income, productivity and economy structure.

THE EUROPEAN INNOVATION SCOREBOARD

The European Innovation Scoreboard (EIS) (OECD 2006) consists of 25 measures grouped into five themes and includes measures similar to the Australian Innovation Scorecard. The measures are:

1. INPUT – Innovation drivers:
   - Science and engineering graduates per 1,000 population aged 20–29
   - Population with tertiary education per 100 population aged 25–64
   - Broadband penetration rate (number of broadband lines per 100 population)
   - Participation in life-long learning per 100 population aged 25–64
   - Youth education attainment level (% of population aged 20–24 having completed at least upper secondary education)

2. INPUT – Knowledge creation:
   - Public R&D expenditures (% of GDP)
   - Business R&D expenditures (% of GDP)
   - Share of medium-high-tech and high-tech R&D (% of manufacturing R&D expenditures)
   - Share of enterprises receiving public funding for innovation

3. INPUT – Innovation & entrepreneurship:
   - Small and Medium Enterprises (SMEs) innovating in-house (% of all SMEs)
   - Innovative SMEs co-operating with others (% of all SMEs)
   - Innovation expenditures (% of total turnover)
   - Early-stage venture capital (% of GDP)
   - ICT expenditures (% of GDP)
   - SMEs using non-technological change (% of all SMEs)

4. OUTPUT – Application:
   - Employment in high-tech services (% of total workforce)

THE EUROPEAN INNOVATION SCOREBOARD *continued*

- Exports of high technology products as a share of total exports
- Sales of new-to-market products (% of total turnover)
- Sales of new-to-firm not new-to-market products (% of total turnover)
- Employment in medium-high and high-tech manufacturing (% of total workforce)

5. OUTPUT – Intellectual property:

- European Patent Office patents per million population
- US Patent and Trademark Office patents per million population
- Triadic patent families per million population
- New community trademarks per million population
- New community designs per million population

This scoreboard concentrates on a comparative analysis of innovation performance between EU countries, and also between the EU, the USA and Japan. This scoreboard attempts to move more towards incorporating output/outcome elements. It also attempts to measure innovation efficiency by measuring the ratio of EIS composite indexes for inputs to outputs (care is needed as some output measures, such as patents, are still not indicative of actual economic outcomes).

CANADIAN SCOREBOARD INDICATORS (GODIN)

Indicators have been developed for each of the Canadian provinces. The themes are R&D, education, scientific and technological culture, knowledge, technologies, commercialisation (of university research), economic environment and some other miscellaneous personal health and income measures. (Godin 2004)

Godin (2004) suggests adding indicators that would help assess the provinces' specificity. For example, a predominance of 'high-tech' measures would not be useful in a state which generates much of its GSP from the more 'low-tech' industries.

MASSACHUSETTS INNOVATION ECONOMY

This index (MTC 2007) covers 20 indicators organised into 3 theme areas: economic impact (sales, wages, occupations and incomes), innovation process (business development, technology development and research) and innovation resources (human and economic resources).

THE 2002 STATE NEW ECONOMY INDEX (PROGRESSIVE POLICY INSTITUTE, WASHINGTON D.C.)

This index ranks the States of the US on a number of criteria. There are five theme areas: knowledge-based jobs, globalisation, economic dynamism, digital economy and technological innovation capability. It includes indicators such as education levels, percentage of workers in professional/managerial jobs, internet usage, foreign investment and export focus of manufacturing. It is useful in terms of showing where US States are relative to each other across a range of criteria, and underlines the strengths and weaknesses they have in the New Economy context. In terms of technological innovation measures specifically, the index includes high-tech jobs, scientists and engineers per capita, patents, industry investment in R&D and venture capital.

THE GLOBAL CREATIVITY INDEX

Florida (2004) suggests the central themes to nurturing an innovative economy in his view are technology, talent and tolerance (the 3 Ts).

> 'Both technology and the talented and creative people that create it are highly mobile economic resources…the more tolerant or open a nation or region is, the more talent it is able to mobilise and attract'. (Florida and Tingali 2004 pg. 12)

THE GLOBAL CREATIVITY INDEX *continued*

Florida indicates:

1. Technology – is key to economic growth.
2. Talent – human capital, also key to economic growth, is measured as a % of workers in 'creative class' occupations, which is different to many scorecard indicators. The 'creative class' includes scientists, academics, artists, business managers, legal and health professionals.
3. Tolerance – openness to new people and ideas, the ability of nations and regions to mobilise their own creative capacities and compete for creative talent.

Florida devised a US City Index to rank large US cities and (separately) small US cities on their relative performance in these measures. He also created a Global Creativity Index in conjunction with Irene Tinagli in *Europe in the Creative Age, 2004* to compare the US with EU countries.

The Global Creativity Index (Florida & Tingali 2004) comprises the sum of the scores on the following three indexes divided by the maximum possible score:

1. Euro-Talent Index – education achievement, number of researchers per head of population.
2. Euro-Technology Index – R&D expenditure and patent numbers (total and 'high-tech' categories).
3. Euro-Tolerance Index – based on surveys of attitudes (towards minorities), values (traditional versus modern/secular) and self expression (the extent to which a nation's citizens value individual rights and self expression).

CHAPTER 5 THE TASMANIAN INNOVATION SCORECARD

INTRODUCTION

The development of a Tasmanian Innovation Scorecard was undertaken as a collaborative project with the Tasmanian Department of Economic Development and Tourism in 2006. The project arose from a request from the Tasmanian Innovations Advisory Board to the Department for measures of innovation that could be included in a Tasmanian Innovation Index or Scorecard. Based on the research summarised in the preceding chapters of this paper, the following recommendations were made concerning the development of a Tasmanian Innovation Scorecard:

1. An innovation scorecard rather than an innovation index should be developed.
2. A range of measures across the innovation spectrum should be incorporated into the scorecard.
3. Theoretical and conceptual validity, empirical reality, comparability, relevance, availability and cost of data collection should be considered when constructing the scorecard.
4. Measures of tolerance and an innovation culture should not be included in the initial scorecard, but should be considered for future revisions.
5. The scorecard should be designed with consideration to the structure of the Tasmanian economy.
6. Where possible, the scorecard should include indicators which are relevant to the Tasmania *Together* process (see more detail on page 16).
7. The scorecard should include relevant elements of the Australian Innovation Scorecard.

THE TASMANIAN ECONOMY

The ABS State Accounts figures (for Industry Contribution to Total Factor Income by State) (ABS, 2007c), show that manufacturing is the largest single contributor to total Tasmanian factor income. Of the total, 15% comes from manufacturing industries, which is about the same as for Victoria and South Australia and above the Australian average of 11%.

Given the contribution of manufacturing to the Tasmanian economy, it is likely that it is also a major contributor to innovation in Tasmania. The ABS publication *Innovation in Australian Businesses, 2005* (ABS, 2006b) indicated that the manufacturing sector in Australia is a major source of innovation with 42% of manufacturing business having implemented an innovation during the survey period, against an average of 34% across the entire Australian economy.

Other major contributors to the total Tasmanian factor income do so at levels similar to that in other states and territories. Mining in Tasmania makes up 5% of total Tasmanian factor income, which is similar to the other states except for Western Australia, Northern Territory and Queensland. Retail trade contributes 7% of total factor income, compared with the national average of 6%. ABS figures for counts of businesses from the ABS Business Register in 2006 also show the make up of industry by firm size does not vary significantly between Tasmania and Australia as a whole (ABS, 2007e).

There are a few areas where there are substantial differences between the Tasmanian economy and that of other States and Territories. Agriculture, forestry and fishing contribute approximately 5% of total Tasmanian factor income, compared to the national average of 2%. Other industries in which Tasmania's percentage is significantly higher than the national average are Health and Community Services at 9% (national average 7%) and Electricity, Gas and Water Supply at 5% (national average 2%).

THE TASMANIAN COMPETITION INDEX

The Tasmanian Department of Economic Development and Tourism hoped that the scorecard could be an input into the Tasmanian Competition Index (Tasmanian Government, 2007). This index is prepared annually by the Tasmanian Department of Treasury and Finance and aims to provide comparisons of a broad range of factors affecting business. It provides aggregated data which allow comparisons to be made between states and territories by aggregating data to reflect the situation that new firms may be expected to face. The analysis is general in its approach and does not reflect the specific costs or market conditions that would exist for any one firm. Rather, it is intended to be a guide to relative advantages and disadvantages in general.

The comparisons focus on the situation that would be faced by a representative firm establishing in a particular jurisdiction rather than the situation faced by existing firms. Therefore, where some costs, such as electricity costs, were agreed in contracts under earlier market conditions that are not likely to be applicable now, those costs are not included in the analysis.

However, it is difficult to report on Tasmania's innovation performance within this index due to the number and range of indicators required and the difficulty of reducing these to a single indicator. One finding from the project was that the Competition Index could actually be considered as a possible component of the future innovation scorecard as a measure of an innovative culture.

TASMANIA TOGETHER

The Tasmanian Department of Economic Development and Tourism also hoped that the scorecard would develop a set of innovation measures for inclusion in Tasmania *Together* 2020 (Tasmania Together Progress Board, 2006). Tasmania *Together* 2020 is a pioneering process that allows the people of Tasmania to say what they want for their long-term social, economic and environmental future. It includes 12 goals and 143 benchmarks that help shape government policy, service delivery and budgets into the future and are being adopted by local government, business and industry, and community groups. This system of community goal setting and measurement of progress is enshrined in law and is monitored and reported on by an independent statutory authority, the Tasmania *Together* Progress Board.

One of the findings of the scorecard project is that innovation is a difficult concept to measure, and that a scorecard is likely to be a more informative approach. There is a limit to the number of indicators on a particular topic that can be included in Tasmania *Together*, so it is not feasible for the full range of indicators needed for measuring innovation to be included there. It is possible however, to include some of the relevant indicators from Tasmania *Together* in an expanded scorecard.

THE TASMANIAN INNOVATION SCORECARD

The structure of the Tasmanian Innovation Scorecard is based on the Australian Innovation Scorecard, while the indicators in the scorecard are based on Tasmania *Together* and Australian scorecard indicators and ABS data. The indicators which follow were selected following discussions with the Tasmanian Department of Economic Development and Tourism, the Tasmanian Innovation Advisory Board and the ABS Innovation and Technology National Statistics Centre. Wherever possible indicators were only included if data are available for them, but a few exceptions were made for indicators that were especially relevant to Tasmanian Government initiatives and where

THE TASMANIAN INNOVATION SCORECARD *continued*

data are expected to be available in the future.

- Knowledge creation
    1. Level of R&D expenditure as a proportion of Gross State Product (ABS cat. no. 8112.0 and 5220.0) (Tasmania *Together* indicator)
    2. Scientific and technical articles per million population (DEST Research Income & Publications Data and ABS cat. no. 3101.0) (Australian scorecard indicator)
- Human resources
    1. Proportion of workforce with tertiary education (ABS cat. no. 6227.0) (Australian scorecard indicator)
- Finance
    1. Innovation expenditure as a proportion of total business expenditure (ABS cat. no. 8158.0) (Australian scorecard indicator)
    2. Source of funds for innovation (ABS cat. no. 8158.0)
- Knowledge diffusion
    1. Private and public investment in fixed capital formation (ABS cat. no. 5220.0) (Tasmania *Together* indicator) (Australian scorecard indicator)
- Collaboration in R&D
    1. Proportion of Tasmanian businesses with some collaboration (ABS cat. no. 8158.0)
    2. Source of ideas or information (ABS cat. no. 8158.0)
- Market outcomes
    1. Growth in GSP and export value (ABS cat. no. 5220.0) (Tasmania *Together* indicators)
    2. Proportion of income generated from sales of new or improved products (ABS cat. no. 8158.0)
    3. Proportion of businesses innovating (ABS cat. no. 8158.0)
    4. Level of value added by manufacturing industries per head of population (ABS cat. no. 8221.0 and 3101.0) (Tasmania *Together* indicator)

Current available indicators are detailed in the following table.

1 TASMANIAN INNOVATION SCORECARD INDICATORS

Indicator	Date of Baseline Value	Baseline Value	Date of Most Recent Value	Most Recent Value
KNOWLEDGE CREATION				
Level of R&D expenditure as a proportion of Gross State Product (GSP)(a)	Year ended Jun 2003	1.5%	Year ended Jun 2005	1.5%
Scientific and technical articles per million population	Year ended Dec 2003	1 270	Year ended Dec 2005	1 339
HUMAN RESOURCES				
Proportion of workforce with tertiary education(b)	May 2005	15.3%	May 2007	14.9%
FINANCE(c)				
Innovation expenditure as a proportion of total business expenditure	Year ended Sep 2003	**0.7%	Year ended Sep 2005	2.1%
Source of funds for innovation:(d)				
Internal Sources	Year ended Sep 2003	78.3%	Year ended Sep 2005	*67.9%
External Sources	Year ended Sep 2003	^20.0%	Year ended Sep 2005	*45.9%
Commonwealth Government	Year ended Sep 2003	*1.4%	Year ended Sep 2005	3.0%
State or Local Government	Year ended Sep 2003	*0.2%	Year ended Sep 2005	2.9%
KNOWLEDGE DIFFUSION				
Private and public investment in fixed capital formation	Year ended Jun 2005	$4 326m	Year ended Jun 2007	$3 957m
COLLABORATION(e)				
Proportion of Tasmanian businesses with some collaboration	2004 and 2005	^20.5%	No further data available	
Source of ideas or information:				
Within this business	2001-2003	90.3%	No further data available	
Clients or customers	2001-2003	^68.9%	No further data available	
Professional conferences, meetings, fairs and exhibitions	2001-2003	^52.0%	No further data available	
Websites, journals	2001-2003	*40.3%	No further data available	
Suppliers of equipment, materials, components or software	2001-2003	^39.3%	No further data available	
MARKET OUTCOMES(f)				
Growth in GSP(g)	Year ended Jun 2004	3.5% p.a.	Year ended Jun 2006	2.7% p.a.
Export value	Year ended Jun 2005	$3 293m	Year ended Jun 2007	$3 451m
Proportion of income generated from sales of new or improved products	Year ended Jun 2005	3.2%	No further data available	
Proportion of businesses innovating	2001-2003	^26.5%	2004 and 2005	^30.1%
Level of value added by manufacturing industries per head of population	Year ended Jun 2004	$4 573.32	Year ended Jun 2006	$4 566.24

(a) Due to confidentiality issues, values are calculated excluding Private Non-Profit expenditure. This expenditure is relatively insignificant.

(b) Includes Bachelor or Postgraduate degree and Graduate Diploma or Certificate.

(c) In the 2005 Innovation Survey, businesses could select more than one source and so the percentages do not sum to 100%.

(d) The amounts shown are proportions of the total expenditure on innovation accounted for by each source of funding.

(e) Calendar years. Further data for these indicators are expected to be available from an AIRC survey.

(f) The AIRC at the University of Tasmania is conducting a census of all Tasmanian businesses with 5 or more employees and expects to be able to provide accurate data on market outcomes through data on sales generated from new or improved products.

(g) Estimate calculated by using the rolling three year geometric mean centred on the published year. The geometric mean calculates the constant average growth rate of a time series.

Note: ^ estimate has a relative standard error of between 10% and 25% and should be used with caution

* estimate has a relative standard error of between 25% and 50% and should be used with caution

** estimate has a relative standard error of greater than 50% and is considered unreliable

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