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Introduction

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Innovation, the introduction of something new to a company, to a market, or to the world, has been central to theories of economic growth for more than fifty years. The recognition of its importance in Australian political life is a little more recent. In 1982, soon-to-be federal Minister for Science Barry Jones published *Sleepers, Wake! Technology and the Future of Work* (Jones, 1982), identifying innovation as a crucial element of Australia's economic future, and calling on Australian policy makers and business leaders to invest in R&D to confront the challenges, and exploit the opportunities, presented by science and technology. All four subsequent federal governments created councils to advise on science and technology. Various state governments have pursued innovation aggressively, particularly in the last decade.

Notwithstanding, as we saw in the foreword to this book, Australia is falling behind other OECD countries in its rates of business innovation (Gans & Hayes, 2006; Gans & Stern, 2003), and has for some years been slipping down the World Economic Forum's Global Innovation Index (World Economic Forum, 2006). Indeed, for more than three decades, business and political commentators have noted the apparently low rates of innovation in the Australian economy. Contrary to the expectations derived from a model which links innovation closely with economic growth, however, the economy is

booming. The Australian economy has grown at above the OECD average since at least the early 1990s, if not before (Department of Industry, Tourism and Resources, 2007).

There are two ways in which the paradox of high growth accompanied by low innovation might be resolved. One possibility is that there are a few economic domains—mining, merchant banking, hospitality, specialist agriculture, professional services, and one or two others—in which Australian businesses innovate at the same rate as the best in the world. These domains do not have high rates of patenting, and so Australia fares badly on the innovation indices, which are patent-based (see Heath chapter this volume; Gans & Hayes, 2006; Gans & Stern, 2003). The rest of the economy also innovates, but mainly by adopting practices and technologies developed overseas, and by developing new products and services to meet the needs of customers (Smith, 2006). It does so at a sufficient rate to remain reasonably viable. In fact, while it might appear that the rate of innovation in these other sectors is low, it is growing rapidly because Australian firms are learning how to respond to the structural changes in the Australian economy introduced by the Hawke and Keating governments in the late 1980s and early 1990s. It is also growing because two of the major inhibitors of innovation in the Australian economy—its small size and its physical and cultural distance from markets—are being ameliorated over time, though not completely, by the communications revolution.

The second possibility isn't nearly so optimistic. Under that view, the growth in the Australian economy up until about 2000 was driven principally by the freeing up of resources as a consequence of the Hawke-Keating structural adjustments, and from that time it was driven by the massive escalation of demand for resources as a result of the burgeoning Chinese and Indian economies. That, in turn, has fuelled huge demand for domestic construction. Consequently, while the mining industry and one or two others are globally competitive, most of the innovation that has occurred in the economy has simply been the importation of techniques from overseas as Australia catches up. However, there are fundamental barriers to innovation as a consequence of the structure of the economy and our dependent post-convict culture. Consequently, the current boom will be short-lived and will be followed by inexorable decline.

One method by which to resolve the apparent contradiction of high wealth coupled with apparently low rates of innovation, or indeed to establish whether this presents an ongoing barrier to economic growth, is to identify the causes of this apparently low rate of innovation. Much of the causal analysis published in Australia so far is surprisingly superficial, and often based on gross international comparisons. For example, observers of the Australian economy have often compared it to a distant burgeoning economy (typically Silicon Valley), observed obvious differences, and surmised that those differences are the source of the problem. For example, commentators often note the paucity of venture capital in Australia, and immediately blame Australian investors—particularly superannuation funds—for their inability to embrace high-technology opportunities. Such a causal analysis suffers from two problems. First, we don't really know if there is a shortage of venture capital in Australia or whether the problem lies in identifying good opportunities for investment. Second, if investors cannot identify opportunities, there may be several reasons: the lack of necessary skills to embrace high-technology opportunities; a shortage of infrastructure to deliver those opportunities; or structural factors that make Australian investment opportunities unattractive.

To really understand the causes we need to make an assessment of the innovative capacity of Australian firms (see also Dodgson & Innes, 2006; Liesch, Steen, Middleton & Weerawardena, 2007). To do so, we need to conduct detailed, highly contextualised analyses of businesses and their attempts to innovate. With this in mind, a team at the Melbourne Business School decided to conduct a carefully grounded set of studies examining innovation in the Australian context. The Melbourne Business School approach was to choose eight representative and notable cases of innovation in Australia with a view to trying to understand how the participants went about managing innovation, where they were successful, where they weren't, and, particularly, why they experienced the successes and failures they did. To those eight cases were added two more, written by Professor Jonathan West for Harvard Business School, and a final case written after the others, but for the study, by Sam Burshtein at Macquarie University. This book presents the insights we have gained across the eleven cases.

Like the Steen et al. (2007) study, we draw our sample from companies in the 'born to be global' category. That is, the products they developed were all aimed at global markets, or are 'new to the world' (Basri, 2006). Some involved the commercialisation of university research, but most did not. Some have been tremendously successful, but others have been very disappointing, given their potential. However, even the disappointments are highly successful companies by Australian standards. With the exception of Kinasia, they are still in operation twenty or more years after founding, and they are surviving in global markets. In six of the cases (International Catamaran, Ausmelt, Compumedics, GBC Scientific, BHP Falcon and VESDA) their leader (inventor, chief executive, project leader) won the Clunies Ross medal, which is a prize given by the Australian Academy of Technological Sciences and Engineering to 'people who have, often against difficulties and always with persistent commitment, made important contributions to science and its application for the economic, social or environmental benefit of Australia' (Australian Academy of Technological Sciences and Engineering, 2008). For three of the cases (Kinacia, Proteome Systems, extended wear contact lenses), the technological development is too recent, but they are potentially in contention for the medal in the future. That is, all of the cases presented in this book had the potential to be world-beating innovations that could propel the companies to dominance in their industries globally. In some cases they succeeded, while in others they did not.

We hope the book will make two contributions. First, we hope it will broaden the thinking of researchers about Australian innovation to help them understand areas in which Australian innovation activities might differ from those in other countries, and consequently identify important areas for careful, systematic research with a distinctly Australian character.

Second, for entrepreneurs and those who support them, we aim to identify issues relating to innovation in business practice that may be relevant to their own activities. By familiarising themselves with the experiences of other innovative Australian entrepreneurs, they can more easily identify opportunities for innovation in their own circumstances and adjust their commercial behaviour accordingly.

The book is divided into three major parts. The first presents the eleven cases. These are presented as long histories of the companies,

ventures or products, without analysis. Instead, the analyses are combined in one chapter. We decided on a combined analysis because we believe that general themes, drawn from across the cases, would be more useful to the intended audience than particularistic conclusions drawn from each case. Finally, the third part of the book contains commentaries on the cases and analysis by five prominent Australians who have divergent perspectives on the problem of innovation in Australia, and strong investment in encouraging it. Those commentators are Rowan Gilmore, CEO of the AIC, Ian Heath, former CEO of IP Australia, George Pappas, Chairman of the Committee for Melbourne, Malcolm Thornton, an investment director at Starfish Ventures, and Evan Thornley MLC, Parliamentary Secretary to the Premier of Victoria with responsibility for innovation. The book closes with some policy and research suggestions.

Background to the Research

Data collection

This book has its origins in a closely related project to develop teaching materials about innovation in Australia. The teaching project, which was funded by the Victorian Department of Industry, Innovation and Regional Development, was a collaborative effort between the Melbourne Business School and the Australian Institute of Commercialisation to produce twelve teaching cases about innovation in Australia. This then led to the establishment of a research project, which was additionally funded by IPRIA, aiming to draw lessons from the research that was done into the eight Victorian cases, along with International Catamaran, Proteome Systems and Kinacia.

Each analysis was developed into a case study, which formed the basis for the chapters in this book. The eleven cases are summarised below.

The Cases[1]

Ciba Vision: The extended wear contact lens project

Dr Adrian Hunter, Head of R&D at Ciba Vision, led the development of the extended wear contact lens, as a joint project of Ciba Vision, Novartis central research laboratories, the CSIRO and the CRC for Eye Research and Technology. The lens was regarded as the 'holy grail' of

optometry: a contact lens which could be left on the eye for thirty days without removal, and without causing redness, swelling or irritation. These lenses have very high oxygen transmissibility. This ensures that the eye receives adequate oxygen while the wearer is asleep, when oxygen flow is inhibited by the closing of the eyelids, reduced tear flow and reduced eye movement. They also float on the tear film.

GBC Scientific Equipment

GBC Scientific Equipment (GBC) was founded in 1978 to manufacture atomic absorption spectrometers—devices which use the absorption of light to measure the concentration of a particular metal within a sample. Founded on little more than three colleagues' shared belief in the viability of the technology, and a deep understanding of the industry, GBC survived early financial trouble and ongoing internecine struggles to become an ongoing player in the global market for atomic analysis instruments.

Compumedics

Compumedics supplies advanced diagnostic devices for sleep-related conditions to a global market. Founders David Burton and John Murray developed the first paperless system to collect and store the data generated during sleep apnoea diagnosis. The result was equipment that executed digital data capture, storage and preliminary analysis, obviating sleep doctors' reliance on analogue chart recorders. Burton and Murray's first system was installed at Melbourne's Epworth Medical Centre in 1988. The company grew to $35 million in revenues in 2002 and remained at about that level until 2008. It floated on the ASX in late 2000.

BHP Billiton: The Falcon™ Gravity Gradiometer project

The Falcon™ Gravity Gradiometer detects gravity anomalies—differences in the size of the gravitational force between two locations. It can be used to map mineral and hydrocarbon deposits. The system is flown in a single-engined aircraft and generates maps of gravity fields showing geological details as small as 50 metres. It is so sensitive that it can measure the gravitational force from a three-year-old child standing several metres away. It is the result of a ten-year, US$30-million collaborative development project conducted by BHP Billiton and Lockheed Martin.

Ausmelt

Ausmelt is a publicly listed Australian company engaged in the development of technology for use in the mining and metallurgy industries. It was originally incorporated to commercialise smelting technology developed by company founder Dr John Floyd in the late 1960s, and refined over the next ten years. Floyd's invention, the top submerged lance smelter, involved using an upright cylindrical smelting bath with a vertical submerged lance through which gases were applied to the ore. Compared to traditional flat bath techniques, Floyd's approach was faster, contained the reaction better, produced higher quality reaction products and could deal with more difficult ore bodies. The company's technology is hailed internationally as ground-breaking, and is seen as one of the most important innovations in metallurgy in the past fifty years. The company has been, at best, moderately successful commercially.

Computershare

Computershare is the largest operator of share registries in the world. Started as a partnership between Chris Morris ands Ken Milner in 1978, the company was established to provide specialist computer bureau services to Australian share registrars. It subsequently expanded, first by buying and operating the registry management organisations itself, and then by enhancing the services it offered to the companies whose registries it managed. Its technology and services are at the forefront of the global industry. Computershare supports over 100 million shareholder accounts globally. The company's headquarters are in Australia, including R&D and technology development.

Vision Systems: VESDA™ smoke detectors

VESDA™ is a smoke detector which works by continually drawing air into a pipe network with a highly efficient aspirator. A sample of this air is then passed into a laser detection chamber for smoke detection. This is known as aspirating smoke detection. VESDA smoke detectors are significantly more sensitive than traditional smoke detectors, and so are used extensively in applications where very early detection of fires is valued—such as in computer centres, art galleries and high-technology manufacturing. The technology was developed by the CSIRO and commercialised by a start-up (IEI Pty Ltd). It was subsequently acquired and sold by Vision Systems Pty Ltd.

Proteome Systems

Proteome Systems is a listed Australian biotechnology company founded in 1999. By 2003, Proteome Systems was the largest privately held biotechnology company in Australia, with 120 employees. It developed a range of products that spanned the length of protein analysis. The company sold proteomic analysis platforms, the component instruments within the platform, and consumables. In addition, it had a host of drug discovery and diagnostics programs in niche disease areas. Proteome also provided consulting services, and had partnerships with IBM, Shimadzu, CRL, Millipore, Sigma-Aldrich and others. With the exception of a small sales presence near Boston, all of the company's operations were located in Sydney. The chapter discusses the history of the company up until the time it was listed on the stock market.

Micronisers

Nanotechnology is an emerging family of technologies enabling the manipulation of matter at the atomic level. Nanotech devices are so small they are almost impossible to conceive—the nanometre measures just one billionth of a metre (10^{-9}m). Micronisers Pty Ltd, an independent nanotechnology enterprise located in Melbourne, has been developing and commercialising nanosized particles since 1987. The company specialises in advanced milling and chemical processes to produce products at the molecular level: nanosized and submicron particles for use in the plastics, personal care, textile, coatings, veterinarian and pharmaceutical industries. While it is a low-cost producer of economically valuable products, it has been unable to grow its market effectively.

Kinacia

Researchers at the Australian Cente for Blood Diseases (ACBD) ascertained that the mechanism by which blood clots in turbulent flow, such as is found in constricted arteries, is different from the mechanism in laminar flow, such as at wound sites. Kinacia sought to develop drugs which would prevent the formation of clots in arteries—a major source of heart attacks and strokes—while not exposing patients to the increased general risk of haemorrhage associated with existing anti-clotting drugs such as Aspirin. Although Kinacia was successful in developing several high-potential drug candidates, the

business failed. The IP was eventually sold to Astra Zeneca for substantially less than the funds expended on the research. The chapter documents the first half the company's life, leading up to the decision to suspend a clinical trial.

International Catamaran

International Catamaran (Incat) created a new category of ships—lightweight, high-speed catamarans that are driven by water jets rather than propellers. The boats are large—about the size of six quarter-acre housing blocks side by side; fast, with a top speed in excess of 40 knots; and highly manoeuvrable, being able to move sideways and turn on their axis. When configured as vehicle ferries, they can enter a port, unload, reload and leave again in twelve minutes. The catamarans can be configured as civilian ferries and as military logistics and supply ships. The company grew at a tremendous rate until the severe downturn in tourism following the attacks on New York and Washington on 11 September 2001. Incat built ships were operating (and still operate) in North and South America, Australasia and throughout Europe. The 2001 attacks, however, left the company with excess inventory and reduced prospects of orders. Its banker refused to extend it extra credit, so the company went into receivership. It traded through the receivership and has subsequently grown back up to approximately its former size. The Hobart-based company has built more than 40 per cent of the world's vehicle and passenger ferry fleet over 70 metres in length.

The cases in context[2]

A common concern with analysis based on case-study data is the extent to which the resulting insights and conclusions can be generalised. One issue is the degree to which the subject of the case (or cases) can be seen as representative of the broader population to which the generalisation is being extended.

Certainly it cannot be argued that the cases presented in this book are a representative sample of innovation in Australia in a statistical sense. The vast majority of product and process innovations are minor and mundane, involving only small changes, and are classified as incremental innovations by researchers (Tushman, Anderson & O'Reilly, 1997). A key attribute of incremental innovations is that they fundamentally change neither an organisation's capabilities nor

the way it interacts with its markets (Abernathy & Clark, 1985). The overwhelming majority of such incremental innovations are in fact so minor that they are not even documented.

An Australian Bureau of Statistics survey found that only 35 per cent of Australian businesses were engaged in any innovation at all (Basri, 2006). The survey further divided innovation activity in Australia into three categories:

- new to the business
- new to Australia
- new to the world

Of the 35 per cent of businesses that reported being engaged in innovation, only 9 per cent (that is, just 3 per cent of all Australian businesses) engaged in innovation that could be characterised as 'new to the world'—in line with the rate reported from other OECD countries (Smith, 2006). Thus, the cases presented here cannot be seen as statistically representative of the Australian economy, or even of those 35 per cent of enterprises that engage in innovation.

However, even though ventures engaged in 'new to the world' innovation are scarce, they are considered critically important. They serve as nuclei for new industries and sectors, and so are essential for the country's development and future prosperity. Additionally, because such initiatives need to leverage substantial resources, they encounter particularly severe constraints. They can serve as indicators of the innovation strengths and difficulties found throughout the economy.

The cases presented here can also not be seen as representative of 'new to the world' innovation. First of all, we can say *a priori* that they are significantly more successful than the average. Six of a possible eight (we exclude the three for whom it is too early to judge) have won a Clunies Ross medal. Ten out of eleven remain solvent. Secondly, the ventures examined were chosen on the basis of availability, and so cannot in any way be considered a representative sample.

Yet while the companies themselves are not statistically representative of the broader population, it can be argued that the particular challenges they encountered—as well as their responses to these challenges—are representative. They reflect the experience of both the case authors and of people who reviewed the data and who have extensive familiarity with the history of new venture creation in

Australia (including the authors of the foreword and the five commentary chapters). All described the cases as being representative of their experience—in keeping with the naturalistic generalisation model proposed by Stake (1980). Further, to the extent that the behaviours presented reflect the complex interaction of multiple drivers, the similarity in the decisions taken by the case protagonists would support the argument that they conform to similar regulative rules (Evers & Wu, 2006). Regulative generalisation enables us to use the limited set of data to make inferences about the nature of those rules.

More broadly, the data and analysis presented here can serve as the basis for future research, identifying issues to be investigated in greater depth. This is in keeping with Yin (1994) who points out that '… case studies are the preferred strategy when "how" or "why" questions are being posed, when the investigator has little control over events, and when the focus is on a contemporary phenomenon within some real life context'.

The authors are confident that the book captures important aspects of the reality of innovation in Australia.

A précis of the findings

As a rough measure, these companies and projects score about three or four out of eleven. That is, all eleven had the potential, in terms of technical capabilities and possible market, to dominate their market niche globally. Yet, only three or four managed to achieve that, depending how you count. The data indicate that management failures impeded the remainder, in large part. To understand this, we divided the issues these companies faced into two broad domains: issues within the control of executive management, and issues beyond that.

In terms of issues within management control, consistent with prior work on innovation management (for example Dougherty, 1996), we found that the poorer performing companies tended to be much more focused on their technology than on the markets they were attempting to serve. This pervaded the organisation, its culture, its leadership and its behaviour in the market. Consequently, it was a self-sealing, self-reinforcing package. In the worst cases, the managers of the companies didn't really understand how their product created value for customers, and didn't realise they didn't understand. Other

problems endogenous to the firms were very poor management of the risks they faced, and poor control over IP.

None of the internal issues was terribly surprising. The really interesting findings lay beyond management control. There we found three things of particular interest. First, firm-level governance was tremendously important. The poor-performing firms had directors who appeared not to understand why the ventures were performing badly, often because they appeared to adopt a governance model which was designed for large corporations with stable revenue in a stable market. In the firms and projects that were governed well as high-risk ventures, none of the internal issues described above were important. Second, the financiers appeared to be pivotally important in determining the success or failure of the ventures. Some financiers absorbed a huge amount of risk from the ventures, and in so doing provided extra resources for growth, or at least shielded management from its mistakes. Other financiers focused on a timely and profitable exit, and in so doing moved risk into the venture. Finally, and not so surprisingly, market size mattered. The start-ups that were able to launch their product initially into the Australian market had a very easy job of marketing initially, and so could focus resources on their products and operations. Those that essentially had to launch into overseas markets, however, were physically and culturally distant from markets and understood their customer poorly. Consequently, they had to be much more sophisticated in their initial marketing than we might anticipate for an equivalent start-up overseas.

Notes

1 Versions of these cases designed for classroom use are available from case_studies_dept@mbs.edu.
2 I thank Sam Burshtein for his help with this section.