Industrial Capabilities in Victoria*

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Abstract

This paper presents the key findings from a small qualitative survey of the main factors associated with the creation and usage of five industrial capabilities in leading Victorian sectors. The capabilities included advanced manufacturing technologies (AMT), design, information and communications technology (ICT), biotechnology and environment technologies. Eighty-eight companies and organisations were interviewed for the study. It was found that the main requirements for the successful creation of a capability was the ability of the company to recruit and retain the best graduates from universities and technical schools, the ability to offer training to these graduates and the ability to financially support high and consistent levels of R&D over time. The main requirement for the successful use of a capability was effective company networking, work cultures conducive to excellence, supportive government regulations and the provision of complementary specialised training.

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1. Introduction

Industrial capabilities are the distinctive human and physical technologies that form the foundation of the competitiveness of a firm or industry. They are the main source of absolute advantage for an economy, and, accordingly, knowing the factors that drive them is a prerequisite for developing policies to augment productivity and economic growth. The aim of this paper is to explore the main factors that are associated with the creation and use of selected capabilities in Australian, and specifically Victorian, industry.

Since there is very limited empirical information on these capabilities in Australia, this study gathered primary data from a series of semi-structured interviews of companies and industry organisations across Victoria.[1] A total of 78 companies and 10 industry organisations were interviewed over the period October to December 2002. The interviews concentrated on capabilities arising from domestic R&D – especially in the fields of biotechnology, information and communications technology (ICT), advanced manufacturing (AMT), design and environmental technologies.

Section two of this paper discusses evidence from international literature on the role of industrial capabilities in promoting productivity growth within enterprises. The third section describes the survey and section four reports on the findings from the company survey. The fifth section presents policy implications.

2. Related literature

The analysis of productivity, and hence sources of economic growth, is a complex and multifaceted problem; both micro- and macroeconomic considerations are important for an in-depth understanding. The growth accounting literature, for example Whelan (2000), Oliner and Sichel (2000), Jorgenson (2001) and Jorgenson and Stiroh (2000), represents an aggregate, 'top-down' perspective. On the other hand, recent microeconomic empirical productivity studies represent a disaggregated and 'bottom-up' view. It is along the latter perspective that we organize the semi-structured, non-random survey of firms in Victoria. This paper seeks to provide a picture of how real-world firms in Victoria are currently operating and how they see their industry developing through the creation, use, and interactions of industrial capabilities.

Recent productivity studies using firm or establishment level data reveal great heterogeneity in productivity performance across firms, and this is true even within the same industry. Some firms/establishments are substantially more productive than their peers, and the differences tend to persist over time. See, for example, Bartelsman and Doms (2000) and

Brynjolfsson and Hitt (2000). In Australia, the Productivity-Commission (1999) study also finds great diversity in productivity performance among the various sectors of the Australian economy, and even within manufacturing, TFP growth is highly variable. This suggests that firms' productivity performance is unlikely to be determined by a few dominant factors; a host of interrelated and complementary factors are likely to be important and industrial capabilities play an important role in determining how these factors successfully interact. Several key industrial capabilities are identified in the literature including ICT, AMT and training. These are examined in more detail below.

2.1 ICT

In assessing the impact of ICT on productivity, Brynjolfsson and Hitt (2000) emphasize the role of complementary innovations. They argue that ICT has a significant impact on the productivity performance of the economy because it facilitates complementary organizational investments such as business processes and work practices. These investments, together with investment in ICT, arguably led to the recent productivity upsurge in the US economy.

In a sample containing multiple US industries, Black and Lynch (1997) find that the manner in which new work practices are introduced has a significant and positive correlation with productivity. They also find that manufacturing plants with a large percentage of non-managerial employees who use computers tend to be more productive. This is consistent with evidence presented by Krueger (1993), who shows that workers who use computers on-the-job earn 10 to 15 per cent higher wages. In addition, wider computer use in the 1980s can account for one-third to one-half of the increase in the rate of returns to education. These results suggest that a close relationship exists between work organization and technology use. Indeed, Bresnahan (1999) and Bresnahan et al. (2002) document how changes in ICT capabilities can lead to a cluster of changes in work organization and firm strategies that also increase the demand for skilled labour in the US.

2.2 Institutional arrangements, regulation and government intervention

Another factor behind recent productivity growth in US firms, emphasized by Foster et al. (2001), is the reallocation of outputs and inputs across firms in the same industry. To understand aggregate productivity dynamics, these authors examine a large body of empirical work in the

US that make use of firm-level longitudinal data, and find that reallocation varies secularly, cyclically, and across industries. Other studies that reach the same conclusion include Bartelsman and Doms (2000) and Haltiwanger (2000). The latter study claims that, for the US manufacturing sector, roughly half of TFP growth over the course of a decade can be accounted for by the reallocation of outputs and inputs away from less productive to more productive businesses. These results suggest that work cultures, institutional arrangements, regulations, and government interventions that inhibit resource reallocation can have significant detrimental effects on productivity growth. Conversely, factors that facilitate resource reallocation will have beneficial effects on productivity and growth.

2.3 AMT creation and use

The separate relationships between work organization, human capital and the various capabilities/factors affecting productivity growth have received much attention in recent empirical firm and plant level research. Some papers have suggested that the diffusion or use of new technologies is at least as important as its creation in driving productivity growth. Naturally, a crucial question is how new technologies diffuse through the economy. Many case studies have found an S-shaped pattern of diffusion: relatively few early adopters are followed by greater use by the remaining population. However, this pattern is far from being uniform across industries. At the plant-level, McGuckin et al. (1998) find that diffusion differs substantially across different technologies, although they show that technology use is positively associated with superior productivity performance. In the Netherlands, Bartelsman et al. (1998) find that technology intensive manufacturing firms were more likely to be more productive and hire more workers, even after controlling for the costs of the technology-adoption decision. Doms et al. (1997) find that manufacturing plants that adopt more new technologies tend to employ more-educated workers and pay higher wages. The use of advanced technologies is also positively correlated with the fraction of workers employed in scientific, engineering, managerial, and precision-craft occupations.

2.4 Training

To the extent that technology usage is closely related to the skill levels of workers, firms with more skilled labour should therefore also experience better productivity performance. After examining plant-level data

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of US manufacturing businesses, Black and Lynch (1997) find that the average education of non-production workers has had a significant impact on establishment productivity. Black and Lynch (1996) estimate that raising the average educational level of non-production workers by 10 per cent (approximately one more year of schooling) would increase productivity in manufacturing by 8.5 per cent while in non-manufacturing by 12.7 per cent. In a later study, Black and Lynch (2001) report an increase in productivity of approximately 4 per cent for all industries. The importance of education, training and skill upgrading is also underscored by research in labour economics showing the wage gap between skilled and unskilled jobs is widening, yet employment of skilled workers has increased steadily relative to unskilled workers. It is clear that technological progress in the past few decades has changed the structure of wages and employment in favour of skilled workers. Recent studies include Autors et al. (1998), Adams (1999), Bartel and Sicherman (1999), Berman et al. (1998), and Machin and van Reenen (1998), among others. (See Acemoglu (2002) for a comprehensive and up-to-date review). This literature also finds that employment of skilled workers is positively and closely correlated with capital and R&D intensity, which are in turn associated with the introduction of new technologies, especially those that are ICT-related (Falk and Seim 2001). There is also some evidence of a virtuous cycle of growth and innovation, in that firms with highly skilled workforces are more likely to innovate, and employ new technologies more efficiently. Consequently they become more profitable, which in turn allows them to pay higher wages necessary for the hiring of skilled workers.

Bruinshoofd et al (2001), and Hollanders and ter Weel (2002) further find that knowledge spillovers across industries and sectors of the economy are positively related to skill upgrading. This is particularly so for workers in low-tech industries. They believe that the use of new technologies created in other industries is an important avenue for skill upgrading in low-tech industries, whereas the creation and development of new technologies is generating skill upgrading in the high-tech industries.

These and other results highlight the importance of labour quality, R&D, and their interactions in generating economic growth. The size of the skilled workforce determines the rate of innovation and therefore, the growth rates of productivity and output, and these in turn promote skill upgrading and expand the size of the skilled workforce. However, because knowledge spillovers are an important feature of skill upgrading, it is likely to be undersupplied and government intervention in knowledge creation (eg R&D) and knowledge acquisition (eg skill training) may be necessary.

On the effectiveness of state-funded training activities, Mason and van Ark (1994), in a detailed comparison of productivity performance of matched samples of engineering plants in Britain and the Netherlands, find that output per worker is 25 to 30 per cent higher in the Netherlands. They attribute the difference to the Dutch system of state-funded vocational education and training, which substantially raises the trainability of workforce, both as new entrants to the labour market and subsequently as adult workers who may need retraining and skill upgrading. As a result Dutch employers are able to carry out training and attain required standards more quickly and cost-effectively than is possible in Britain. Dearden et al (2000) report a statistically and economically significant effect of training on industrial productivity using British data. They find that returns to training vary greatly across industries according to the proportion of skilled workers in their workforce. A one percentage increase in training increases productivity by only 0.05 per cent in industries with only 10 per cent of highly-skilled employees, whereas the increase in productivity is approximately 0.4 per cent when the proportion of the highly-skilled was 20 per cent. This suggests that training is more important for industries that have more skilled labour. Similar findings are also reported by Bartel (1995), who analyses a large US manufacturing company database and finds that company training positively affects both wages and performance of professional employees.

These studies show that the dynamics and interactions of factors influencing productivity growth are complex phenomena. An understanding of the interplays between human capital, technologies, and organization are important. However, the literature is fairly recent and much work is yet to be undertaken before a clearer understanding can emerge. Importantly, most of the studies have been relying on quantitative data on firms or establishments, hence largely from a perspective that is shaped by the researcher. The current survey is one of few studies that offer a perspective from managers and those actively involved in the running of the firms. In this way, the survey results from this study can contribute to the growing literature on how various human and technological factors interact in advancing productivity growth.

3. The company survey

While the overseas literature summarised above has informed our view on what issues might be relevant for firms, in our 'bottoms up' study the interview team sought to give managers broad scope in raising factors that they considered important to the success of their company, especially with respect to the specified capabilities. In particular, the study sought to reveal both generic and specific (local institutional arrangements) factors and issues which managers believed were important.

Qualitative information was collected through one-hour, face-to-face interviews (except for five telephone interviews) with either the Chief Executive Officer (CEO) or senior manager of industry organisations. Resources for the study limited these interviews to 78 companies that produce or use the five capabilities and 10 industry associations related to those companies. In every Small and Medium Enterprise (SME) but three, the CEO was interviewed. For large companies, senior managers were interviewed. Five non-metropolitan interviews were done by telephone, given the difficulties of access. Companies in the survey were selected from approximately nine industry groups or clusters, as detailed in Table 1. The interview success rates were 100 per cent for industry associations and training bodies and 57.1 per cent for companies.

Table 1. Companies interviewed by industry cluster

Cluster	Name	Number of interviews
Rail manufacture and services	Rail	10
Automotive components manufacture and related training institutions	Automotive	10
Dairy R&D and manufacture	Dairy	6
Horticulture R&D, farming and processing	Horticulture	8
Packaging R&D and manufacture	Packaging	8
Software development companies	Software	8
Biotechnology R&D start-up companies and their financiers	Biotechnology	9
Wineries and vintners	Wine	10
Miscellaneous professional services		6
Training providers		3
Industry Associations (related to above clusters)		10
TOTAL		88

The advantage of selection by clusters is that it permits more than one view of how a particular capability operates in a given market. Industries that were interrelated, and potentially part of the same value added chain, were specifically chosen. There is, for example, a link running from biotechnology and food R&D through to vineyards, dairy and horticulture, to packaging.[2]

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While the interview method has the benefit of being an open approach, it has several limitations compared with a randomised structured survey. First, the limited number of interviews makes it difficult to generalise to the whole economy. Secondly, the clustering of the survey population further reduces the randomness of the data and weakens our ability to generalise outside the clusters. Thirdly, about two-thirds of the survey population was chosen from government contact lists and this may result in a bias towards companies which have an interest and penchant for networking and information sharing with government.[3]

Table 2. Companies interviewed by employment size

Number of employees (FTE)	Freq.	Percent
10 & under	9	12.3
10-50	22	30.1
51-100	9	12.3
101-500	22	30.1
501-1000	3	4.1
Over 1000	8	11.0
TOTAL	73	100

Table 3. Companies interviewed by creation and use of designated capabilities

Cluster	Creates capabilities	Uses capabilities
Rail	AMT, design, professional services, environmental technologies	AMT, design, ICT, professional services
Automotive	AMT, design, professional services	AMT, design, ICT, professional services
Dairy		AMT, Biotechnology, environmental technologies, ICT, professional services
Horticulture		Biotechnology, environmental technologies, ICT, professional services
Packaging	Design, environmental technologies	AMT, biotechnology, environmental technologies, ICT, professional services
Software	ICT, design	ICT, professional services
Biotechnology	Biotechnology, environmental technologies	ICT, professional services
Wine		Biotechnology, design, environmental technologies, ICT, professional services
Professional services	Professional services	ICT, professional services

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Table 2 shows the size of the companies interviewed, as measured by the number of full-time equivalent employees. Most companies are SMEs, with only eight companies with a workforce of more than a thousand employees. It is therefore no surprise that many of the concerns expressed in the survey are typically those of SMEs.[4] The relationship between clusters and capabilities is shown in Table 3. It should be noted that some degree of subjective judgement to arrive at the relationship was relied upon.

4. Survey findings

The survey findings are divided into two parts, the first part consists of discussion arising from the non-structured, open-ended questions. Responses elicited from managers had several recurring themes, among them were the dominant motives for creating capabilities, the conditions for the successful creation of capabilities, and the typical behaviours of companies that used the capabilities. In each case, managers referred to capabilities that were perceived as most relevant to their production process.

4.1 Motives for creating and using capabilities

Companies were found to pursue the creation of new capabilities with differing levels of vigour. Competition, especially that resulting from lower levels of protection (tariffs, preferential government purchasing), was a major factor affecting this dynamism.

According to managers the *creation* of most of the capabilities, in almost every company we interviewed, depended on the company's ability to:

- recruit the best graduates from the relevant university courses;
- offer substantial training to these highly skilled graduates;
- retain a sufficient number of skilled staff over time to provide corporate memory, technology transfer and the correct mix of experienced and inexperienced R&D workers; and
- finance and support high and consistent levels of R&D over time.

These factors are clearly related and interdependent. High and consistent levels of finance for R&D enhance the company's reputation and ability to attract and retain the best graduates, through salary or training advantages. If the innovation process is successful, the company will subsequently become stronger financially, *ceteris paribus*.

For the successful *use* of capabilities, there were four factors that were consistently mentioned as necessary. They are:

- effective networking, formal and informal, to discover the broad nature of changes in capabilities;
- specialised training for relevant workers to gain post-qualification skills in using a new capability. However, for companies to benefit from such training, low staff turnover is needed;
- government regulation on environmental standards was important, especially for the use of environmental capabilities. Apprehension of future government regulation and pressure from consumer groups and downstream companies have encouraged many companies, from farming to packaging, to adopt more environmentally sensitive practices; and
- conducive work cultures that will facilitate the adoption of a new capability. For physical technologies, eg ICT, using a capability can involve regularly adopting a new invention. For the soft or human technologies, to change the work culture in itself is using the capability (for example many environmental technologies are changing work practices).[5]

4.2 Specific problem areas

In addition to the above general ways of operating, there were recurring problems in some industries and across some types of company. These included the problems of variable demand for output, small domestic markets, the particular problems of SMEs, suboptimal incentives within the training system, rigidity within the trades, skill gaps for professional engineers and specialist biotechnology managers.

Problem of variable demand

Discussions with managers supported the notion, prevalent among the evolutionary industrial organisation approach and the corporate strategy literature, that R&D is a highly path-dependent activity (Nelson and Winter 1982, Dosi 1988, Cohen 1995, Antonelli 1995).

Skills, both technical and commercial, which accumulate over time are embodied in individual workers and the organisational culture. The best way to maximise the effective use of these accumulated skills and to reap external benefits for the broader economy is to have a steady level of funding. Unfortunately, this has been difficult to achieve for most of our capability areas. Either highly variable product demand (such as in the rail industry), or chronic funding shortages (for example in biotechnology), has led to uneven levels of retained earnings and variable R&D budgets. When the funding horizon is short or uncertain, skilled R&D workers leave their industry. At a later time, when demand resumes, companies reported that subsequently they found it hard to find experienced people. Often, but not always, it is the most flexible and energetic people who leave the industry as their opportunities are greater elsewhere. Essentially, a variable approach to R&D funding is not efficient from the perspective of the whole economy.

Small domestic market

Many medium to large companies already dominate the domestic market and are forced to go international through export or foreign direct investment (FDI) in order to expand and reap economies of scale. This need for expansion provides an excellent opportunity for the further use of locally created capabilities. Problems of the small domestic market are compounded when State Governments give preference to local suppliers and, some companies, especially in rail, indicated that this practise still exists despite its inconsistency with the Australian and New Zealand Government Procurement Agreement and national competition policies.

Particular problems of SMEs

Almost regardless of industry, many of the challenges facing companies can be attributed to their size and inability to reap economies of scale, not so much with respect to operating unit costs, but as to overhead investments. The latter includes training programs, the collection and sorting of information, networking, companies' ability to affect government policy, companies' influence on education and training providers, and their (cost-efficient) access to government grants and subsidies. This does not imply that SMEs are an inefficient mode of production.[6] SMEs are the genesis of large companies and often provide the critical innovative margin in a market that sets the pace for other companies (Auerbach 2000). Innovation was often accredited to the energy, insight and flexibility of SME managers, senior managers and specialised workers. It is possible that current institutional arrangements within governments and the education sectors with respect to overhead infrastructure capabilities and costs favour large organisations.

Many managers reported that the compliance requirements for achieving tax concessions or government grants were too demanding and uncertain to warrant their pursuit.

SMEs appear to benefit disproportionately from industry promotions (overseas and local) and many companies requested that further government effort be made in this area. Where it existed, the supportive role of the governments through the Victorian Industrial Supplies Office and selected trade missions and industry exhibitions was mentioned in a favourable light. The major exception was software companies, who felt that they did not receive this form of government support.

Some of the industries dominated by SMEs did not have an active body that looked after the business and environmental interests of its affiliates. The horticulture industry, for example, appears to have a need for an entity that can effectively garner companies' requirements for training needs, R&D issues, marketing problems and offer general networking in a way that does not impact significantly on SME resources. It is common for farm and company managers to be unaware of what they do not know and not have the time to keep up with changing institutions and government structures.

Incentives within the training system

Examples given by managers suggest that strong pecuniary incentives do not exist within the Tertiary and Further Education (TAFE) sector for institutes to devise new courses to meet emerging skill requirements relevant to their jurisdiction. Further comments indicated that even if accreditation was achieved, new funds were not provided and redundant staff were still the financial responsibility of the institutes. The supply of places for courses does not appear to be demand-determined (demand, that is, by potential trainees) and this has been claimed to impact on pre-apprenticeship training. Since the latter is considered a more efficient way to deliver Australian Qualifications Framework (AQF) III level training, this inflexibility is detrimental to the economy. However, there was hope that recent reforms to address these issues would ameliorate this problem.

Rigidity within the proclaimed trades (training and work)

Demarcation rigidity among the proclaimed trades, for both training and work practices, is legendary.[7] While many companies agreed that it improved during the 1990s, demarcation rigidity remains an issue for efficient work operations. Since many capabilities require multi-skilled workers, demarcation issues are a notable impediment to their creation and efficient use. There appears to be an emerging trend for the larger of the surveyed companies to circumvent trade level training and seek their technical skill training at the diploma and advanced certificate level instead. From the companies' point of view, this seems to be the most logical action, but if successful, this could lead to the demise of manufacturing-based apprenticeships. Solving the training inflexibility does not however solve work-based demarcation conflicts. One company suggested that this issue would be improved if single rather than multiple unions existed at workplaces.

Training for professional designers and engineers.
One of the most consistent problems companies and professional bodies raised was the lack of work experience skills among graduates from industrial designers and other engineers. Pre-employment practical experience was considered important to acquaint the new worker with the latest technologies, familiarise them with the shop floor and initiate awareness of commercial realities.

Shortage of experienced leading edge technology managers.
The emerging industries such as biotechnology, Venture Capital (VC) funds management and multi-media IT product development identified severe and chronic shortages of technically competent people who had successfully managed commercial organisations.

4.3 Ancillary issues

The second part of the survey consists of several structured questions that are related, albeit indirectly, to the creation and/or use of the capabilities. These questions ask companies to assess the importance of (i) factors affecting their decisions to locate in Victoria, (ii) factors most critical for the growth of the industry, (iii) avenues through which companies learn about new technologies, and (iv) types of government support that can assist their industry and their competitiveness. The level of importance was ranked using a 7-point Likert scale, with the anchor point 1 denoting 'Not at all important', through to 7 denoting 'Very important'. The tables below present an unweighted average of these responses by the selected clusters.

Reasons for locating in Victoria
Companies were asked to rate the importance of selected reasons for locating in Victoria. Companies which had been established here for many years were asked to assess the importance of these reasons for remaining in Victoria. Table 4 which summarizes the scores, shows that most companies chose to locate in Victoria, or chose to remain in Victoria, because it was the home to both the original entrepreneur and subsequent managers. Most managers believed that Victoria's excellence as a place to live was a major attraction and this was true for all industries except horticulture and packaging. The rail industry was most influenced by the Victorian Government's approach to business, while automotive

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component manufacturers were heavily influenced by proximity to major customers. Dairy manufacture was influenced by proximity to suppliers (dairy farms), and the packaging industry was influenced by both the location of major customers (food and beverage manufacturers) and efficient transport routes.

Table 4. Reasons for locating in Victoria by industry cluster (1=not important, 7=very important)

Cluster	Rail	Auto	D	Hort	Pack	Soft	Bio	Wine	BS	Total
Good place for managers to live	5.4	4.8	6.0	3.5	3.6	5.4	5.5	5.1	6.4	5.0
Proximity to your major customers	4.0	6.8	3.0	4.1	5.1	3.3	2.8	3.7	5.4	4.4
State government's approach to business	5.3	3.7	4.0	4.3	3.3	3.9	4.0	2.9	3.4	3.9
Proximity to efficient transport routes	3.4	4.1	3.7	6.0	5.1	3.0	1.6	4.2	2.2	3.8
High standard utilities, communications infrastructure	4.3	3.1	4.7	5.0	3.9	4.4	1.5	4.0	4.8	3.8
Availability of skilled or scarce labour	3.2	4.5	4.0	2.9	5.0	5.0	1.9	2.8	5.2	3.7
Proximity to good business support services	4.0	3.1	5.7	3.8	3.0	4.1	2.4	3.1	5.8	3.6
Proximity to research organisations	3.0	3.3	3.0	2.6	2.5	2.6	3.5	2.1	4.4	2.9
Proximity to your suppliers	3.1	3.3	6.0	2.9	2.8	1.8	2.0	2.5	3.4	2.8
No. of companies	10	10	6	8	8	8	9	10	6	88

Note: Auto = Automotive, D = Dairy, Hort = Horticulture, Pack = Packaging, Soft = Software, Bio = Biotechnology, Wine = Wineries, BS = Business services

Factors important for future growth

Companies were also asked to rate the importance of factors likely to be relevant for their industry's future growth. The average scores are presented in Table 5. As expected, most companies believed that an increase in consumer demand was the most important factor.[8] The second most important factor was the development of export markets. Many companies are currently dominating a mature domestic market and export or FDI remain almost the only sources of further leveraging their comparative advantage. Industry networking and the availability of (suitable) skilled labour were rated the next most important factors and these ratings held almost uniformly across clusters. Not surprisingly, given the dominance of many companies in relation to the small domestic market, only companies in the biotechnology area wanted to see more

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firms in their industry. Biotechnology companies compete in international markets for products, finance and labour, and rarely compete with other domestic companies. However, their ability to reap industry or cluster economies, associated with deep local industry labour and finance markets, is limited by the number of similar companies in the Australian and Victorian economy.

Table 5. Factors important for future growth by industry cluster (1=not important, 7=very important)

Cluster	Rail	Auto	D	Hort	Pack	Soft	Bio	Wine	BS	Total
Increase in customer demand	6.1	6.5	6.7	6.5	6.3	5.6	5.1	6.2	6.4	6.1
Development of export markets	5.6	3.8	6.7	6.1	3.5	6.8	5.8	6.7	5.8	5.5
Availability of skilled labour	5.0	5.5	6.0	5.5	4.0	5.9	5.6	4.9	6.4	5.3
Industry networking	5.4	4.7	4.3	6.4	3.9	5.9	5.4	6.0	5.4	5.3
Better use of relevant R&D	4.2	4.7	5.7	5.1	4.9	5.3	4.6	4.8	4.4	4.8
Joint industry marketing efforts	5.4	4.3	3.7	4.0	2.3	5.1	4.8	5.9	5.8	4.6
Innovations from suppliers	4.1	4.8	5.3	4.0	5.3	4.9	3.5	4.5	4.0	4.5
More expenditure on product design	4.2	4.8	5.0	4.6	3.9	4.8	3.6	4.5	3.8	4.4
Victorian Government charges overall relative to other states	4.6	4.3	4.7	4.9	3	3.6	3	4.3	6.3	4.2
Deregulations or regulatory reforms	3.8	3.3	2.7	3.4	3.8	4.1	5.1	5.4	5.4	4.1
More expenditure on advanced manufacturing technologies	4.7	4.2	5.0	4.9	4.4	1.8	4.6	4.6	1.0	4.1
IR climate in the industry	4.6	4.8	5.7	2.9	5.1	2.0	2.5	3.9	5.2	4.0
More expenditure on IT	3.8	3.2	4.3	3.3	4.5	4.6	3.3	4.8	4.4	4.0
Better use of business consultants such as accountants, lawyers, financial advisors	3.3	2.5	3.3	3.3	2.9	4.0	3.3	4.1	3.2	3.3
Increase in number of firms to attain critical mass	2.2	1.8	2.3	3.0	1.3	3.9	4.4	3.4	2.2	2.7
Number of companies	10	10	6	8	8	8	9	10	6	88

Note: Auto = Automotive, D = Dairy, Hort = Horticulture, Pack = Packaging, Soft = Software, Bio = Biotechnology, Wine = Wineries, BS = Business services

Table 5 shows that the four factors, specifically related to the strategic capabilities, were not given particularly high ratings. For example, expenditure on information technologies (IT) or advanced manufacturing technologies (AMT) were rated around 4 on average, compared to increased demand (6.1), development of export markets (5.5), availability of skilled labour, or industry networking (5.3 each). One interpretation of this is that such expenditures were regarded as necessary for companies to remain viable, but were not sufficient for companies to gain an edge in their markets. Another interpretation is perhaps it is not so much the individual capabilities themselves that are important, but rather their interactions with other factors. In this view, the interaction between the capabilities is what allows companies to establish their markets more effectively (thus increasing both domestic and overseas demand), attract and retain skilled employees, and establish vital linkages within their industry.

Yet another possibility is that investment in these capabilities was perhaps near the optimal levels for these companies. Thus, the marginal benefit of, say, increased IT expenditure may be quite low. If the company's computer system were to crash, it may not be able to function at all. However, it does not follow that having twice as many computers or IT staff would make the company twice as productive. Table 5 also shows that automotive, dairy, horticulture, software and the professional service companies all believed that the availability of skilled labour is important for the future growth in their industries. Innovations from suppliers were not ranked as very important by all industries. The development of export markets was considered of high importance for all industries except automotive and packaging. For the latter, FDI was preferred given the weight and bulk to value ratio of their products. The IR climate was mainly an issue for dairy manufacture. Regulatory reforms were not rated highly by any industry and better use of relevant R&D was only rated as important by the automotive industry. Rail, horticulture, software, biotechnology and the wineries believed that their industries could benefit from more industry networking and more joint promotion efforts. Only business service companies considered Victorian Government charges, relative to other States, an issue.

Types of government support needed

Table 6 shows companies' assessments of the importance of different types of government support for their industry. R&D support was cited as the most important type of support, followed closely by support for training, and assistance with the development of export markets. Few companies wanted the government to coordinate marketing exercises, but as our qualitative results indicate, SMEs were keen for government to help promote their industry overseas.

Relatively little importance was placed on the role of government in intellectual property (IP) protection, but this varied by industry. The overall inconsequence of patents is consistent with overseas studies which have shown that patent protection is one of the least used forms of appropriating profits from an invention (Levin et al. 1987, Cohen et al. 2000). For the biotechnology companies however, IP protection was paramount. It was also moderately important for the engineering-based companies. Several SMEs commented that they did not have faith in the IP legal system. Government assistance with the development of export markets was considered the most important form of support for rail and wineries. Assistance with the training of specialised labour was a priority for automotive, dairy and packaging companies -- although the latter companies tended to place low importance on government support generally. R&D support was most highly valued by horticultural, software and biotechnology companies.

Table 6. Types of government support needed by industry cluster (1=not important, 7=very important)

Cluster	Rail	Auto	Dy	Hort	Pack	Soft	Bio	Wine	BS	Total
R&D support	5.6	5.5	4.7	6.6	4.6	6.1	6.7	4.7	3.5	5.5
Training of specialist workers	4.4	5.8	5.0	6.1	4.9	5.5	5.9	5.0	4.5	5.3
Developing export markets	5.9	5.4	4.3	5.6	3.4	5.8	4.9	6.2	4.0	5.3
Protection of your inventions	5.2	4.6	2.7	4.7	4.8	4.9	5.1	5.0	4.0	4.8
Coordinating marketing exercises	5.6	3.4	3.0	4.3	2.4	5.1	3.4	5.2	3.5	4.1
Number of companies	10	10	6	8	8	8	9	10	6	88

Note: Auto = Automotive, D = Dairy, Hort = Horticulture, Pack = Packaging, Soft = Software, Bio = Biotechnology, Wine = Wineries, BS = Business services

Learning of new technologies

Companies were also asked to rate the importance of different avenues for learning about new ideas and technologies. Table 7 shows that informal networks were rated as the most important way companies learn about new technologies, processes and products. The second most important avenue was publications and technical meetings closely followed by formal cooperation and networking with other companies. Licensing

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patents or designs, reverse engineering, and external consultants were the least common avenues.[9] These general patterns were fairly consistent across the groups. Licensing of technologies was however important for dairy and packaging manufacturers. Publications and technical meetings were important for automotive and wineries. R&D was important for dairy and software companies and trade fairs, and joint promotion events were valued by wineries.

Table 7. Learning of new technologies by industry cluster (1=not important, 7=very important)

Cluster	Rail	Auto	D	Hort	Pack	Soft	Bio	Wine	BS	Total
Informal networks with other firms	5.3	4.9	5.0	5.9	4.5	5.1	5.6	6.2	7.0	5.4
Publications or technical meetings	4.8	5.2	5.0	5.1	3.6	5.4	5.1	6.4	6.5	5.2
Formal cooperation or networks with others	4.6	4.9	5.0	5.3	4.3	4.3	5.4	5.6	6.0	5.0
Independent R&D (in house or external)	5.0	4.5	5.3	5.7	3.5	5.5	4.6	4.4	4.5	4.8
Trade fairs and joint marketing events	4.8	4.6	4.0	5.4	4.8	4.9	4.3	5.6	2.5	4.8
Hiring skilled employees from other firms in industry	4.3	4.5	3.7	3.9	3.1	3.9	3.9	4.4	5.5	4.1
Government agencies (e.g., CSIRO)	4.7	3.6	4.3	4.3	2.3	2.5	3.7	4.8	2.0	3.7
Licensing technologies	3.9	2.9	5.3	3.4	5.0	3.9	3.7	2.1	4.0	3.6
Hired consultants	3.8	2.5	3.7	2.3	4.0	2.4	3.6	3.9	5.0	3.3
Reverse engineering	4.4	3.5	3.0	1.5	3.3	1.6	2.4	2.5	1.0	2.8
Number of companies	10	10	6	8	8	8	9	10	6	88

Note: Auto = Automotive, D = Dairy, Hort = Horticulture, Pack = Packaging, Soft = Software, Bio = Biotechnology, Wine = Wineries, BS = Business services

5. Policy implications

Specific policy concerns, for companies and the government, that flow directly from the survey findings are summarized below.

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5.1 Training, skill upgrading, and labour related issues

Long term industry retention of skilled workers

Most managers of companies which were active in the creation of relevant capabilities recognised that the leading edge development of these capabilities is a highly path-dependent activity. Vital to this development are skilled staff who persevere within their field and accumulate relevant sets of tacit skills. These workers provide corporate memory and enable the transfer of technology between experienced and inexperienced workers.

Retention of these workers is most likely when demand for output or external funding is relatively stable. Unfortunately, this has been difficult to achieve for most of the defined capability areas.

Governments have relatively few options for smoothing industry demand. However, they could particularly encourage export programs during economic slow downs. Client diversity, especially relating to international clients, is one option for companies to smooth their demand.

Scheme for financing workplace training

Companies can be caught in a low skill equilibrium when a low level of training hinders their ability to attract good workers and a lack of good workers affects their incentive to offer training. Low skill equilibria are partly attributable to inefficiencies in the system for financing enterprise training. Governments could consider introducing a voluntary training payment loan scheme, similar to the university HECS scheme, for employees who undertake training at an accredited provider. Employers would progressively pay back the cost of training, after the course had been completed and while the trained worker is back working for the company. If the employee quits the company, he or she, or possibly his or her new employer, would be liable for the remainder of the training repayments. This would insure the investing employer against the loss incurred through losing the trainee before he or she had repaid the cost of the investment.

Incentive structures for TAFE colleges

Pecuniary incentives within the TAFE sector for colleges to devise new courses to meet emerging skill requirements relevant to their jurisdiction should continue to be strengthened and monitored. Justification should be supplied for why the supply of places for courses is not demand determined (that is, by potential trainees).

Promotion of school-based technical courses

There appears to be a growing demand for technical workers with multi-trade skills. The apprenticeship system in not a suitable training vehicle for this new demand. Despite several decades of 'reform', it has not shown the degree of flexibility required to keep pace with the market in many areas. Furthermore, and perhaps as a consequence, factory-based apprenticeship appears to suffer from an image problem among youth. A study by Martino and Holden (2001) found that secondary school students in western Melbourne perceived apprenticeships as a last resort option. This will make it difficult for firms to obtain talented people from the technical training system. New school-based multi-disciplinary technical courses are being established in the AQF VI and V areas and these should be monitored to see if this form of training is successful. If they are successful, this style of course should be encouraged.

Cadetships for professional designers and engineers

There was considerable interest in the introduction of work experience modules for university educated industrial designers and other engineers. Practical experience was considered important to acquaint the new worker with the latest technologies, familiarise them with the shop floor and initiate awareness of commercial realities. Successful examples of cadetships exist in Brisbane and Germany. The informal cadetship scheme, arranged through the Melbourne Development Board, was well regarded by one company that used it. The success of such as scheme would however depend on the details of the placements. Universities could consider taking the initiative to establish these cadetships.

Mentoring for specialised managers in the biotechnology fields

A mentoring scheme, whereby the mentoree shadows an experienced manager for some months, may be one way the gap in the market for research scientists with some commercialisation experience can be narrowed. Local experienced managers may agree to cooperate with such a scheme so long as the mentoree is not employed by a rival company. The mentor also gains through informal knowledge spillovers. Measures would need to be taken to ensure the mentoree returns to his or her original company for a pay-back period. The mentoree's salary would be the major cost of this scheme and the Government could consider using some funds currently earmarked for the biotechnology industry for this purpose.

5.2 Work organization and resource allocation

Changing work cultures

Changing work cultures is an important complementary step for many workplace innovations. However, considerable resources are often needed to change managers' and workers' views over the 'way things are done around here'. People learn and respond most easily to personal approaches. Programs wishing to make specific change in industries, from the adaptation of new technologies to participation in specific training or R&D programs, could benefit from the use of liaison officers who make personal visits to workplaces. Gaining the attention of business is difficult and any approaches should always have clear, concrete objectives.

Coordinate fragmented industries

Industries dominated by SMEs need active and well resourced bodies which will look after the business and environmental interests of its affiliates. In our small sample of industries, it was found that this was not always present. Personal contact and relationships are required for this role.

Reduction in skill based demarcation disputes through IR incentives

Skill based demarcation rigidities, while less prevalent than a decade ago, still detract from workplace productivity. The Government should continue to use its existing employment related programs to discourage these practices through penalties and incentives.

5.3 Government programs and regulation

Streamline Government compliance requirements

A systematic attempt by the Government should be made to simplify the application and reporting requirements imposed on companies who wish to participate in government programs and grant schemes. Existing requirements are too onerous for SMEs and for programs with uncertain outcomes.

Industry promotions by the Government

Many companies, from a variety of industries, were appreciative of industry promotions run on their behalf and requested that further government effort be made in this area. Many companies believed that representations by either the Government or industry promotion bodies did have an impact.

Environmental incentives

There is reasonable evidence that further creation and use of environmental capabilities depends on the existence or expectation of rising environmental standards. State Governments can, first, devise forward environmental industry plans which define time-tables for future regulations and laws so industry has a lead time to adapt in the most cost-efficient manner; secondly, use pecuniary incentives to change company and householder behaviours; and thirdly, enhance the operations of environmentally beneficial industries, such as public transport.

6. Conclusion

The issue of a selected set of capabilities should be cast within a wider perspective of the overall environment facing firms. In trying to isolate the effects of these capabilities on productivity, it is easy to obscure the multitude of interconnected factors contributing to the performance of firms and ultimately the economy. Even if certain selected capabilities can be shown to have a great impact on productivity growth, the contributions of investments in organization, human capital, and managerial quality cannot be understated. In this regard, the role of governments should first and foremost be the removal impediments to accessing and developing all productivity-enhancing capabilities. In promoting selected capabilities, one should perhaps concentrate on capabilities that have wide applicability and large spillover effects across the economy. A combination of investments in technologies and changes in organizations and work practices facilitated by these technologies should most likely contribute to productivity growth and improved economic performance.

Notes

1 Cohen (1995, p. 203) presents a brief survey of the limited literature.

2 These are clearly not the only clusters that could have been chosen. However, available resources and the need to sample a number of organisations in each cluster, limited the scope of the survey.

3 These firms may be more likely to apply for government grants, use government information services and sit on industry advisory committees.

4 However, as approximately one per cent of Australian businesses are classified as large (over 200 employees), the sample has greatly over-sampled large companies. (See Australian Bureau of Statistics cat. 8141.0, 1997-98, p.5).

5 The work culture refers to the generic, overarching philosophy of a work place such as shared worker values, priorities, rewards and accepted, and often tacit, norms of behaviour within a workplace. Work practices refer to rules and behaviours that are specific to a workplace.

6 While many determinants of innovation and R&D activity are related empirically to firm size, increasingly the applied literature has found that it is not size *per se* that confers the advantage but the underlying conditions of opportunity and appropriability (see Cohen et al 1987).
7 Demarcation issues are industrial relations issues and do not refer to government regulations and processes.
8 The main exception was the biotechnology-related companies.
9 Many companies may however understate the true important of reverse engineering.

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