THE KNOWLEDGE BASED ECONOMY:
A REVIEW OF THE LITERATURE
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Introduction

This research project seeks to extend our understanding of the impact of the knowledge based economy on the content of work and training. It does this by acknowledging multiple perspectives on how economies grow and by embracing new definitions of skills, knowledge and training that reflect recent research.

There is no universally accepted definition of the knowledge based economy. As a concept, it is very loosely employed and embraces a number of quite different visions of the economy and society. One view, most evident in OECD publications, sees it as very much bound up with the high skills/high performance/high value added scenario as the only way for firms to compete in a globalised economy. Another view, found principally in the scientific and technical community, tends to view it more narrowly as applying to knowledge intensive industries where knowledge itself is the core competence. The latter is typically found in software and internet companies, computer hardware and chip manufacturers, computer and electronic equipment sectors, and health care technology.

A third view, the one adopted in this paper, is that all sectors of industry are becoming more knowledge intensive in the very broad sense of that term. Knowledge is seen as a potential generator of productivity improvements in areas as diverse as quality, customer service, variety, speed and technical improvement, as well as innovation in products, processes and organisational structure and behaviour. As companies alter the way their organisations are structured (flatter, non-hierarchical, team based, multi-skilled) in order to compete more effectively, so too workers have needed to obtain a more complex range of cognitive and intellectual resources.

In this project, we define a knowledge based economy as one that is increasingly dependent for its growth on the input of knowledge as a value-added input to the economic system. This is reflected in a change in the basis of ‘competitiveness’ for economies, organisations and individuals. This is realised in four interrelated ways. First, such economies experience a changing structure exemplified by new industries, occupations and organisational arrangements. Second, there is a change in the types of skills required, with a rise in the importance of generic skills, including the ability to work more autonomously, monitor their own output and behaviour, work as part of flexible teams, adapt to change, solve problems and think creatively. Third, the economy requires new forms of knowledge and places increased importance on the creation and application of knowledge in networks or clusters of companies/enterprises, and within ‘communities of practice’ where workers are required to work together in new and more complex ways. Fourth, innovation becomes more important as a means to increase economic competitiveness, and knowledge management becomes increasingly the key to sustainable competitive advantage, requiring individuals, firms, regions and indeed complete economies to acquire, create and use knowledge as the key productive resource.

Since the 1960s there has been a growing awareness of the decline of the importance of the control of resources for wealth creation, the emerging dominance of specialist knowledge and competencies, as well as the management of organisational competencies and knowledge. Drucker (1993) has pointed out that in the eighteenth century the basis for economic development was machines and factories and new industrial technologies. This knowledge was applied to tools, processes and products. The early part of this century was marked by the development of new forms of knowledge characterised by systems of embedded knowledge applied to human work. This was the knowledge of systematic routines. In the late 20th century new forms of knowledge are now becoming necessary and specialised knowledge workers are growing in number. These workers are unlike previous generations of workers, not only in their high levels of education, but because for the first time they own the organisation’s means of production – knowledge.

Drucker has further suggested that as a result, new models for organisations are required, and traditional ways of thinking about structures (e.g. hierarchies, decentralisation, matrices and so on) need to be discarded. In their place new ways are needed to view and construct organisations based around specialised workers, team based work, flat management structures and flexible practices. In summary, what has been occurring in advanced economies in the last two decades has been a movement away from organisations needing routinised knowledge and low skills, towards those requiring knowledge workers able to manipulate symbolic knowledge.

As there has been growth in the knowledge based economy the stability of traditional production systems, product markets, company structures and corporate relationships have been shaken by the fast rate of technological change.

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¹ A more detailed account of findings from the literature will be provided in the project’s final report.
Technological innovation and access to knowledge and skills are seen by many as increasingly drivers of innovation, and their application has become central to the competitive strategy of firms. Kanter (1995) has argued that future success will come to companies that can meet global standards and tap into global networks. Similarly, it seems likely that the cities and regions that will be most successful in the 21st century will be those that are best at linking businesses to the global economy. Hobday (1995) has pointed out that technological innovation has played a significant role in the economic transformation of many Asian countries. We have already seen that entire industries and geographical regions can be invigorated by technological change. For example, it has been estimated by Cooper (1993) that new products less than five years old account for 52% of sales and 46% of profits for US firms. At all levels, it appears that competitiveness increasingly depends on technological innovation and new knowledge.

Cairney (2000) has suggested that regions seeking to compete more effectively within a world economy will need to develop ‘soft structures’ that support knowledge creation and learning and that enable firms to collectively strengthen a region’s capacity for knowledge creation and innovation. Key institutions such as universities, VET providers, regional development organisations and business chambers are amongst the most important institutions within regions. Such organisations act as key knowledge creators and trainers, as well as a means to collect relevant knowledge in the international domain and vehicles for communicating this effectively through a variety of mechanisms and relationships.

The concept of the learning region has emerged to describe those places that offer an institutional environment that encourages both private and social learning at four different scales: the individual workers, the individual firm, groups or clusters of related firms and government bodies. Learning regions are less dependent on the individual excellence of their educational institutions as they are on the extent to which their key institutions, organisations and industry are able to trade, support and jointly create knowledge and knowledge networks. The success of key regions throughout the world has been due in no small measure to social or collective learning processes, in which the role of the region is to animate the formation of ‘interaction relationships’ between individual firms and between firms and other regional institutions. Such regional organisations should also be thought of as learning organisations themselves in that they actively seek to emulate and learn from successful experiences of counterpart agencies in other regions and nations.

Marceau et al (1997) have argued that a learning economy is both knowledge and innovation intensive and is usually technology driven. Regions that will make economic progress are those that have high rates of innovation and learning that are greater than those of their competitors are. Growth in real terms will be produced by activities based on knowledge generation through investment infrastructure, human capital, innovation, research and development and advanced training.

Two different paradigms exist for understanding knowledge and skill. They both have implications for how the relationship of individuals, enterprises and networks of enterprises to the knowledge economy is viewed. One paradigm is based on an understanding of knowledge and skill as dependent on conceptual skills and cognitive abilities, primarily of individuals (but the learning organisational literature also has a counterpart in what Blackler calls embodied knowledge). The second and emergent paradigm suggests that the appropriate unit of analysis is neither individuals nor organisations, but ‘socially distributed activity systems’ . That is to say, knowledge is not something that resides in the heads of individuals but that it is mediated, situated, provisional and pragmatic.

Recast in this way, knowing (rather than knowledge) is:

- manifest in systems of language, technology, collaboration and control (i.e. mediated);
- located in time and space and specific to particular contexts (i.e. it is situated);
- constructed and constantly developing (i.e. it is provisional); and
- purposive and object-oriented (i.e. it is pragmatic) (Blackler, 1995).

Rather than studying knowledge as something individuals or organisations supposedly have, these new theories and approaches study knowing as something that they do and analyses the dynamics of the systems through which knowing is accomplished. The learning theories that inform this work are activity theories and social learning theories (Engestrom, Lave and Vygotsky). The distinction is important for VET, because one implies business as usual, with its focus on individuals and an increasing role in upskilling individuals. The other directs attention towards networks or clusters of companies/enterprises, or ‘communities of practice’ (i.e. people who need to work together in some way, but who may be distributed through an organisation or in different organisations.)
These issues and the definition of the knowledge economy that has framed this research leads inevitably to the need to structure our investigation with due consideration to 3 related factors:

- the nature of organisations in knowledge economies;
- the forms of knowledge required in emerging knowledge based economies; and
- the impact that this need for new knowledge has on the ‘content’ of work.

This research is dependent on a full understanding of the issues outlined above, and a conceptual framework that leads us to think differently about the knowledge based economy and the production of knowledge workers. We see the need to look at knowledge, knowledge production and training of knowledge workers in new ways. We argue later in this review that this emerging understanding of how the knowledge economy is developing has significant implications for VET and its relationship to the needs of individual workers, companies and industry clusters for lifelong learning to be facilitated.
The Evolving Concept of the Knowledge Based Economy

More recent writing and policy pronouncements on the knowledge based economy emphasise its potential application to all businesses in all sectors. It has become accepted wisdom that firms must incorporate knowledge management into their core business strategy to ensure they remain competitive. Knowledge is seen as a potential generator of productivity improvements through innovation and creativity across the board — whether in relation to product quality, customer service, variety, speed or technical improvements (e.g. see Neef, 1998).

The movement towards enhanced importance for knowledge as a driver of economic growth is widely seen as a response to the processes of globalisation, technological change and the intensification of international competition. Official thinking by OECD as well as governments of industrialised nations posits knowledge as the main driver of growth, wealth creation and employment (OECD, 1996; DfEE, 1999; OfEE, 2000), with learning, skills enhancement, innovation and enterprise as the cornerstones of the new economy. The phrase ‘knowledge based economy’ has become shorthand for the emerging set of economic activities, structures and arrangements that are the result of these global processes.

Some view the knowledge economy as synonymous with the shift into a new high skills, high performance, mode of working, reflecting a belief in a workplace change led response to global pressures. This shift in thinking requires both changes in work organisation as well as more workers to whom high levels of discretion have been delegated in order to produce high specification, customised goods and services. Current thinking is that the skill profile needs of a high performance work organisation can no longer be served by skills needs derived from traditional conceptions of work. The skill requirements of emerging technology and innovative work organisation require a new combination of content skills, process skills, cross functional skills, social skills, self-managing skills and complex problem solving skills.

A variant on this view holds that the knowledge economy is not so much concerned with higher skills as with the needs of business enterprises for a broad range of general aptitudes, abilities and skills that can be applied to the increasingly cognitive demands of jobs and the new ways of thinking and managing. In this modern economy, all workers will need to become lifelong learners. A widely held belief is that they will need the intellectual resources to be self-managing, to engage in continuous learning and to master new skills and behaviours in order to meet the ever changing needs of more dynamic product and labour markets (Drucker, 1999). For Brophy (1998), everyone in the workplace can be creative, it need not be the preserve of the few. Hopkins and Maglen (1999) echo this optimistic vision of the knowledge based economy and the opportunities and benefits it offers to successful lifelong learners of the future.

These diverse understandings of the defining characteristics of the knowledge based economy can be summarised as:

- new industries and organisational structures which are heavily dependent on knowledge;
- changing occupations and skill structures which privilege particular kinds of knowledge production (i.e. knowledge workers);
- highly intensive workplaces, requiring a range of new forms of knowledge and generic skills and competencies;
- an increased importance for innovation in order to sustain the competitive advantage of individuals, firms, regions and economies.

Having said all of the above we need to stress that much of the writing on the knowledge based economy has a polemical flavour and is contested. The widespread growth of knowledge based economies is a vision for the future rather than an empirical reality. What is being articulated in much of the literature is an action agenda and strategy aimed at moving economic activity in the developed world out of the old Fordist and Taylorist paradigms into a new high skills, higher performance mode of working. There is an emerging consensus, however, that nations and in fact cities and regions must find their own appropriate response to this new paradigm.

The High Skills/Low Skills Economy

Researchers and policy makers alike pose a strategic choice for nations between a high skills economy and a low skills economy, the consensus being that industrialised nations must choose the first route to remain globally competitive. Germany and Japan are often singled out as archetypal examples of the ‘high skills’ economy, while the UK exemplifies the ‘low skills’ route (Ashton and Green, 1996). Australia’s small domestic market and proximity to countries with large supplies of relatively cheap labour is widely seen as propelling it towards the high skill route. However, comparison of vocational qualifications profiles of workers in different industry sectors suggests that on that particular variable, Australia is closer to the UK than to countries like Germany (Maglen and Hopkins, 1998).
There is a growing body of research and analysis which points to the more complex issues involved in remaking a country's industrial future. Writing more than a decade ago, Finegold and Soskice (1988) introduced the notion of the low skills equilibrium to explain why in Britain both employers and the workforce were unwilling to invest in the skills needed for a modern economy. In shifting the focus of debate from supply side to demand side factors, they raised the possibility that employers' characteristic attitudes towards skill might be a rational response to the institutional conditions. For example, short-term financial markets, an adversarial industrial relations system, and a low supply of skills in the labour market in which they operated.

Finegold and Soskice's seminal idea that a nation might be trapped in a self-reinforcing network of societal and state institutions which interact to stifle the demand for improvement in skill levels has had an important influence on VET policy and research, in the UK as well as globally. First, it has drawn attention to the importance of multi-stranded and systemic approaches to tackling issues of skill deficit, and reskilling of the workforce, requiring enabling government action that goes well beyond the VET policy domain. There appears now to be a general consensus that creating a high-skills economy goes far beyond the relatively simple issues of skill supply and means addressing major structural items. Second, in highlighting the significance of demand side factors, it has prompted a major line of research enquiry centred on micro-behaviour in product strategies at the enterprise level, and the implications such choices have for the distribution of knowledge and skill throughout the workforce. A recurring theme in this research concerns the rationality of employers' decisions to compete on the basis of low cost/low value (and hence low skill, low investment in training) where their strategic marketing analysis supports such a product strategy.

The corollary to a low skills equilibrium, namely a high skills equilibrium, has also been a focus of research interest. This has been most evident in studies of skill formation and political economy in newly industrialised economies (Ashton and Sung, 1994; Green et al. 1999), as well as comparative studies in which Germany is often the archetypal case (Culpepper, 1999). This research has served to highlight the cultural specificity of many skill supply mechanisms and their location within broader systems of production, industrial relations, inter-firm networks, industrial capital, corporate governance and politics (Kepp and Mayhew, 1999). The world economy may be becoming more global, but education and training remains an area where skill supply systems continue to differ quite radically from one country to the next.

A decade on, Finegold (1999) has moderated his stark categorisation of a national economy as either predominantly a high or a low skill equilibrium, seeing this now as a major over-simplification of reality. Not only are there significant high skill regions or industries existing within otherwise relatively low skill economies (e.g., in the Third Italy, or the UK's pharmaceutical and aerospace sectors), but the classification of sectors or regional economies as either high or low skill may itself be misleading. International comparisons of economic performance suggest that there are at least three meaningful skill segments in most countries (intermediate or medium, as well as high and low skill) and that the requirements for success in each skill segment may be very different (Crouch et al., 1999).

Finegold's research findings are illuminating in another respect. His study showed how skill development operates differently in a high skills equilibrium economy than in the traditional economy. This supports earlier work by Stevens (1999) who predicted low levels of employer investment in formal training in firms in these high-technology regions. For the scientists and engineers who are the key drivers of knowledge and wealth creation in these high skill regions, informal learning was seen to offer greater utility than formal learning. The understanding that seems to be emerging from the analysis of turbulent, high skill environments is that there:

- is a dynamic interplay between the high labour mobility of employees within these firms in a free market environment;
- are collective social learning processes and a flow of tacit knowledge surrounding innovation made possible by such mobility;
- is a willingness of individuals to enter a new employment relationship in which 'employability' (the continuous development of marketable skills) has replaced employment security; and finally
- there exists a critical mass of other employers all demanding a similar skill set where individuals can work without having to move location.

Comparisons with Germany and Japan underscore the difficulties the economies and skill formation systems both these countries face in creating an environment that is conductive to the formation of new high-tech firms. The same institutional factors that have made the VET systems so successful at the creation of large supplies of individuals with intermediate skills, means that they are poorly suited for the development of this type of
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individually driven, collective learning at the most advanced level.

Recent research suggests Australia has its own version of the low skills equilibrium. Curtain (1996) draws together the evidence from primary and secondary data sources which are indicative of a nation trapped in a low skills/low quality cycle. Comparative data on skill formation arrangements in the major industrialised countries, suggest major deficiencies in Australian skill formation practices, as well as low demand for high quality, intermediate skills in the Australian economy. The focus on the production of low-level, standardised skills through the apprenticeship system has laid the basis for occupational markets. Employers in the past supported this method of generic skills acquisition because their need for high level, enterprise specific skills was minimal.

Three sets of survey results cited by Curtain produce a consistent finding, namely that Australian enterprises see no link between skill formation practices and high performance, and many small and large enterprises fail to approach their training requirements on a systematic basis. The narrow focus on operational issues means training and skills upgrading is often divorced from an integrated ‘bundle’ of strategy at the enterprise level that links skills upgrading to other changes in the workplace. A consequence of this narrow focus is that enterprises are unlikely to foster the high-level, intermediate skills that are the basis of German and Japanese export sectors.

In the same paper, Curtain identifies those structural features of the Australian economy that contribute to a low skills/low quality outcome. These are: the small size of firms, the comparatively low level of technology used by manufacturing industry and a short-term planning focus of most enterprises. Related to these factors are the attitudes of managers, employees and unions that have been shaped by these structural factors. A contributing factor is the limited value-added downstream processing of primary commodities and narrow import substitution orientation fostered by high levels of protection.

What is Happening to Occupations and Skills?

The changing skill map
Ideas about what constitutes a skill have been broadening over the decades. Until fairly recent times, the idea of skill was seen as involving either high level educational qualifications and analytical capacities or ‘hard’ technical abilities, combining physical dexterity, spatial awareness and technical ‘know how’. In the main, people saw ‘skill’ as referring essentially to the technologist, the scientist, the technician and the craftsman. By the decade of the 1980s ‘skill’ had already begun to shade over into the realm of values, behaviours and dispositions. What policy makers and indeed employers have in mind today when they talk about ‘skill’ is considerably broader than in the past. Skill has expanded to include a veritable galaxy of ‘soft’, ‘generic’, ‘transferable’, ‘social’, and ‘interactional skills’, that are frequently indistinguishable from personal characteristics, behaviours and attitudes which in the past would never have been conceived of as skills at all (Payne, 1999).

Critics of this broadening of the skills concept (e.g. Gellner) observe that ‘skill’ is now so loosely defined that it stretches across both ‘high’ and ‘low’ skill sectors of the economy, allowing policy makers to claim that we are all part of a high skill knowledge economy. The sleight of hand whereby we are all ‘skilled’ in the new economy devalues the currency of skill when in the past to be skilled implied some level of real market power and personal discretion over one’s work.

In the literature, we find two different responses to the ambiguity and diffuseness, which now surrounds the concept of skill. In the UK, there is some questioning as to whether VET has a role to play in preparing workers with these ‘soft’ skills, on ethical and social grounds. Many of these desirable personal characteristics are bound up with the cultural capital of different social groups, as well as on pedagogic grounds to do with their transferrability (the so-called ‘generic’ skills require contextually specific knowledge and understanding). Others are uncomfortable with the idea that the VET system should concern itself with developing ‘motivation’ in the context of jobs which are poorly designed, lacking in discretion, monotonous and closely supervised. New research indicates, for example, that in parts of the ‘style conscious’ service sector, ‘trendy’ bars, hotel and retail outlets may be searching for ‘aesthetic labour’, where having the ‘skill’ is about having the face, body, image and grooming that fits the corporate image and sells (Nickson et al, 1998).

There is a second issue to do with the changing skill map and the way in which it maps onto occupations. It is common to talk about multi-skilling and the upskilling of the workforce in response to technical change, new work practices and the introduction generally of the ‘modern workplace’. Loose use of the term multi-skilling however confounds two distinct skilling processes. These have been referred to as task intensive and task extensive technical change (Skills Task Force, 1999). In the first of these, technical change raises the ability of workers who perform an occupation or task to perform another (eg a worker now needs to know about
computers in order to do his or her job). Task extensive change embraces both skilled workers who get better at doing other skilled tasks (ie skilled/skilled), and skilled workers who get better at doing other unskilled tasks (skilled/unskilled). Skill broadening and multi-skilling in practice is often of the second kind. For example, computerised letter sorting machines lower the demand for letter sorters and raise the demand for computer programmers and machine installers. The rise in the general level of education is likely to be associated with task-intensive technical change since it raises the initiative and ability of all involved in whatever task they perform.

Green and Felsteed (1998) constructed an index of the change in average skills required for a job (the requirements are required education, training time and learning time). They used UK survey and case study data to calculate the extent to which overall skill upgrading in that country has been accounted for by:

- changes in the occupational composition of the workforce; and
- changes in upskilling within occupations.

They calculated a rise between 1986 and 1997 in the required skills. Half of the rise in skills required was due to occupational changes. But half was due to skill upgrading within occupations. Splitting their sample into 1986-92 and 1992-7, there was no strong evidence that upskilling has gathered pace.

The overall message from their survey and case study data seemed to be that for a great many occupations, vocational skills are fading in importance relative to multi-skills. When this fading becomes especially large, the occupation ceases to be a distinct category. If that happens in very specific ways and two occupations meld into one, it is probably not a profound problem, but when many different occupations all blur into each other, the system becomes almost meaningless. The latter is not happening at present but may occur in the future.

In their assessment of skill changes in the Australian economy, Tegart, Johnston and Sheehan (1998) similarly observed that on the traditional understanding of ‘skill’, the employed workforce is not becoming more skilled. Employment growth is strong not only in managerial and professional occupations but also in some low skill occupations, while employment is falling in many traditional skilled occupations. Significantly, employment is growing rapidly in many person-based or information-intensive occupations not previously regarded as skilled, but which clearly involve skills of value to modern employers. Tegart and his colleagues suggest that this continuing change in the nature of the skills in demand is a major challenge both for policy and for educational and training institutions.

Skill Taxonomies

Robert Reich (1991) in The Work of Nations proposed a three-way classification of occupations that was intended to capture new and emerging patterns of work in times of rapid economic and technological change. The terms he coined for these three categories were symbolic analytic services, in-person services and routine production services. “Symbolic analysts” are workers for whom problem solving and the application of specialised knowledge is critical and includes IT professionals, consultants and cultural workers. “In-person services” are workers within the growing service sector and include shop assistants, waiters, receptionists and so on. “Routine production services” cover the traditional ‘blue collar’ occupations and repetitive jobs within high technology firms including data processing. Reich claimed in his work that the future wealth of nations would be increasingly tied to the ability to increase the proportion of symbolic analysts.

Maglen and Shah (1999) building on and enhancing the classification put forward by Reich (1991), developed a new occupational framework entailing a major reclassification of existing disaggregated occupational categories contained in ASCO. The adoption of such a hybrid model allowed them to track the changes that have been going on within and between the jobs people do, based on retrospective analysis of a ten-year series of Australian labour force annual data.

The authors reported some key findings from their analysis. In broad terms, the impact on employment of globalisation of the world economy, and of Australia’s increased exposure to it, and of the attendant rapid technological change and organisational restructuring, has been more negative than positive.

Within the sluggish employment growth over the decade to 1995/6, all of the stagnation and decline in employment were in categories most vulnerable to globalisation, technological change and restructuring. On the other hand, much of the growth that did occur, was in those occupational categories not directly open to global forces and which did not directly add to the competitiveness of the Australian economy. Moreover, within the insulated in-person service occupations, the strongest growth of all has been at the lowest skill end of the employment spectrum, and mostly in casualised form.

Maglen and Shah go on to draw out some preliminary implications of their study for VET, foreshadowing the need for more work in this area. First, they note that VET has a key role to play in preparing people both as in-person service workers and as conceptual symbolic analysts. For the former, high level interpersonal skills, not just technical competencies should be given priority in course design and
program development and delivery. And for the latter, institutional priority needs to be given to the already significant source of education and training for a range of conceptual symbolic analysts, especially in the creative arts, media, multimedia and information technology arenas.

While the work of Reich and others who have claimed significant shifts in the nature of work has been criticised in recent times as having over stated the growing importance of symbolic analysts and knowledge workers (e.g. Williams, Cutler, Williams & Haslam, 1987), it nevertheless offers insights and new frameworks for consideration and testing.

The market value of generic skills

Many commentators have argued that ‘key skills’ are becoming more important in modern workplaces in the context of current technical changes and rising global competitiveness. Most obviously, information technology (IT) skills are argued to be an increasing and pervasive demand in all industries. However, a range of skills have become more valuable. As trade pressures increase, it has been argued that companies need increasingly to have the capacity to innovate and keep ahead of competition. Since rigid old-style forms of work organisation cannot achieve this, there is increasing demand for the skills associated with ‘flexible’ workplaces.

Good communication — whether with customers or within organisations — has positive value for the firm, and hence the associated skills are scarce. Problem solving skills are now important throughout the workforce, not just for managers. HR professionals are said to regard social skills as being as important as more easily quantifiable academic qualifications. Workers are said to need to be able to work independently, at a range of tasks, planning their own time, as well as to fit in and contribute to teams.

These various attributes, both technical and social, are commonly referred to as ‘core skills’ or ‘generic skills’ or ‘key skills’, though the jargon concepts and precise typologies differ from one country to another. Employers, it is commonly stated, are articulating a demand for many or all core skills. The International Labour Office has recently linked this increased demand in the industrialised economies in part to changes in work organisation, and in part to changes in technology (Nickson, D. et al., 1998). If key skills are proposed to be in increasing demand, one might expect to find that they too enjoy a premium in the labour market.

A recent study in the UK (Skills Task Force: Research Paper 8) subjected the assertions made about key skills to the test of the labour market, using some newly designed generic skills indices derived from a nationally representative survey comprising 2,467 people. The main findings were that:

- computing skills are highly valued in the current British labour market, attracting an average premium of some 13%;
- professional communication and problem-solving skills are also highly valued, raising women’s pay by around 5% and men’s by 6%;
- to a lesser extent, verbal skills also carry a pay premium for women, but planning, and client and horizontal communication skills have little independent association with pay;
- jobs involving greater task variety earn more pay, presumably because of the increased range of skills needed. There is however no strong evidence that greater autonomy is positively rewarded;
- there is also some tentative evidence that where work is specifically organised on the basis of teams there is a pay premium.

On the basis of these findings, the authors drew some conclusions about the operation of the skills market for generic skills. Though the findings referred to the past, they conjectured that there will be little or no reduction in the expansion of demand for IT skills in the foreseeable near future. The implication for government is that there are clear incentives for individuals to acquire computing skills providing the costs are less than the gross returns.

Similarly, the findings suggest that there is a functioning market for some of the key skills said to be in increasing demand, notably, problem solving skills, and professional communication skills, and the skills associated with taking on a variety of tasks (an aspect of multi-skilling).

In Australia, Field and Mawer (1996) investigated the generic skill requirements of high performance workplaces that are successfully pursuing programs of continuous improvement. Based on a study of nine workplaces spanning office and customer service, manufacturing and other (vehicle repair and warehousing), the case study data gathered by the authors point to a convergence of views among employees and managers about the five areas of skills and attributes that employees in high performance workplaces need.
These are:

- an intellectual and attitudinal core;
- routine technical skills;
- generic skills (the key competences);
- learning;
- empowerment.

The outcome of this essentially descriptive study was a model of skills in high performance enterprises.

In the light of Australia's recent economic performance, it is important for us to ask the basic question: are Australian firms adopting product development strategies that demand high skills levels? Furthermore, is the high performance workplace a reality or a growing prospect? As well, is this the direction being chosen by a majority of sectors and firms, or is it very much a minority movement?

There appears to be broad policy agreement in Australia (evident in the publications and deliberations of ANTA, DISR, and industry bodies) that the only sustainable source of competitive advantage for a developed economy is one based on a highly educated and skilled workforce. In an analysis of the new manufacturing in Australia, Pappas (1998) observes that many Australian firms are remaking themselves through the development of new combinations of production and service activities. They are highly skilled in many aspects of modern manufacturing. These include, project management, software development and application, the development of new products and processes, materials sourcing and management, quality control and testing, design and marketing, distribution and transport, cost control, accounting and financial management. As production costs fall as a share of total costs and as new manufacturing and communication techniques reduce the importance of local economies of scale, these competitive strengths grow in importance. The challenge as they see it, is to integrate Australian expertise into global production/services clusters, both large and small.

The Importance of Innovation

Innovation theory

Understanding innovation is crucial for understanding the dynamics of 'knowledge based' economies. Indeed, our work suggests that increased innovativeness is one of the defining characteristics of a knowledge based economy and that this has implications for organisational structure, the nature of work, and training.

In modern innovation theory, networking, inter-dependency and learning through interaction lie at the heart of the innovation process. The seminal insight of contemporary literature, informed by studies of the world's most successful national and regional economies, is that innovation is not a linear process as previously assumed, but has been more accurately shown to be non-linear, iterative and interactive. That is, innovation is a dynamic social process involving complex interactions between various actors and institutions that actively seek to learn from one another. To successfully innovate, companies are becoming more dependent on complementary knowledge and know-how in firms and institutions other than their own (Roelandt and Hertog, 1999), as well as on knowledge arising from ongoing dialogue and interaction between producers and consumers.

Consistent with this view, innovation is not understood primarily as a process leading to fundamental breakthroughs or 'the big bang', but one that is continuous, day-to-day, and strongly shaped by past insights, decisions, responses to events, and technological choices. Furthermore, it is now recognised as a process that is virtually inseparable from the production process itself, the site of many important product and process improvements (Gertler, 1999). Innovation and knowledge management have become inextricably linked, as the key to sustainable comparative advantage lies in a firm's capability to acquire, create, diffuse and use knowledge as the key productive resource.

The nature of innovation

Innovation has many different meanings, and is often employed very loosely. A definition offered by Bryant et al. (1996) in a strategic analysis of business innovation in Australia, is that 'innovation involves the application of new ideas in any of the activities of an enterprise, or in its commercial outputs. The most consistently innovative firms possess clear business strategies; are open to the adoption of new technologies and forms of organisation; undertake continuous improvement, creative design and research and development (R&D); and are thus better enabled to commercialise new ideas successfully'.

Innovation is elsewhere defined as any change that adds value, where 'value' is interpreted broadly in terms of improving productivity, sales, customer service, etc. For the Business Council of Australia, 'innovation is something that is new or improved, and done by an enterprise to create significantly added value either directly for the enterprise or indirectly for the customer' (1993).

Two main approaches to innovation are found in the literature, each carrying different implications for management and policy. One view of innovation has been characterised as 'the strategic leap' or the 'step change'. This approach involves developing significantly new
products and services unrelated to existing activities that create new business units. It is often based on distinctively new technology, opening up opportunities to sell to different classes of customers in different markets. Businesses adopting this approach typically operate in markets where their competitive advantage depends on new functionality and higher product and service performance and where product life cycles are short.

The second view of innovation emphasises continuous, incremental change. The 'innovating thrust' approach involves building emergent strengths through focused systematic improvements to products, services and supply services. It also involves the occasional 'step-change' represented by new products, services or processes that fit closely with the enterprise.

As might be expected, given the elasticity in the concept of innovation, there are many different ways it can be measured. A common approach is to take R&D expenditure as a proxy for innovation. Many studies however take a broad brush approach and assume that a change represents an innovation. Defining the boundaries of minor (incremental) and major innovations is difficult, and some studies rely on respondents' own assessments of when a major change has occurred.

It is clear that successful innovation does not just depend on R&D but on the presence of a whole set of complementary assets. These include such things as:

- effective supply chain management;
- being able to enhance relationships with customers;
- assessing and improving marketing and distribution capabilities; and
- the ability to marshall the necessary capital.

In both approaches, successful innovation is influenced by the abilities of firms to learn. The factors that are important here relate to ease of communication and the effectiveness of channels of information and skills transmission between and within organisations. As Bryant et al. (1996) note, management and a strategic outlook are of great importance since these set much of the scope for the external linkages and the positive internal attitudes that will promote learning.

At the same time, there is overwhelming evidence that in-house R&D is essential for effective innovation. For most firms, the key contribution of R&D effort is the building up of a firm's capabilities, technological competences and their capacity to absorb and make use of new knowledge.

Macro level data on R&D expenditure in the Australian manufacturing sector indicates that the cost of R&D is on average about one third of that of innovation overall (ie, on acquisition of technology, training, tooling-up, industrial engineering, manufacturing start-up and marketing). This is taken as a general indication of the dominance of an incremental approach to innovation (Bryant et al. 1996).

The Innovation Study Commission (Carnegie and Butlin, 1993) gathered information from 120 enterprising businesses operating in Australia. It found examples of enterprising businesses developing new-to-the-world products, services and supply processes although these represented a small minority of the innovation that occurs in enterprises in Australia. More than 90 percent of the innovating enterprises observed were characterised as applying the 'innovating thrust', whereby their emergent strengths grew out of the existing businesses. The Commission considered that this approach was particularly relevant to the circumstances of businesses operating in Australia.

The most successful innovating businesses in Australia in the early 1990s were focused in two directions. First, they focused on achieving high levels of customer satisfaction by identifying the customer's needs for new performance functionality and aligning product and service development on those needs. Second, they focused on ensuring that their supply system gave them a long term profitable base in a highly competitive world.

**Innovation in Australian firms**

An Innovation Study Commission on Australian innovating enterprises, established by the Business Council of Australia in 1991, identified five 'success factors' that account for sustained success with innovation. These five key elements (which are largely the product of consistent, concentrated effort by people in the enterprise), comprise focusing on customers, building a competitive supply system, sustaining leadership, building in systematic approaches to innovation, and committing scarce resources to competition. These five elements strongly connect the three themes of employee relations, applied technical development and high quality management. For the majority of enterprises, innovation is not essentially about science and technology, but rather, systematic general improvement of performance. In the view of the Commission members, "although seeding small, high technology enterprises can be highly successful, by far the greatest returns for the general body of Australian business can be found in undertaking customer-focused enterprise innovation" (Carnegie & Butlin, 1993). The outward manifestations of creative and systematic enterprise innovation include:
• better supply processes;
• new and better products and services;
• combining new processes and new products;
• technological breakthroughs;
• acute marketing judgement;
• across-the-board improvements.

More recent research (Rogers, 1995) has drawn on evidence from the 1990 and 1995 Australian Workplace Industrial Relations Surveys (AWIRS) to investigate the characteristics of workplaces that are associated with innovation intensity. Using change as a proxy for innovation, the study constructed a typology of low, medium and high innovation intensity based on a fourfold categorisation of change. These categories were: introduction of new product or services; changes to how work is done; management reorganisation; and investment in new equipment. The research mapped the workplace characteristics (workplace size, firm size, union presence, employee-management relations, age), environmental factors (commercial, declining demand, unpredictable demand) and management methods (suggestion schemes, share ownership programmes, task forces and quality circles) associated with the different types of workplace change. The results suggest that better employee-management communications are associated with more change, and that workplaces with higher levels of training undergo more change. The basic workplace characteristics (part of large firm, ownership, management-employee relations and union presence) also have associations with some of the measures of change. There is some limited evidence that poor external demand conditions reduces the likelihood of new product and process innovation.

Two broad conclusions emerged from an analysis of the data by industry. First, that there are significant differences between industries in the propensity to change. Second, that these differences are not consistent across the measures of change. For example, the mining industry appears less likely to undergo product change but more likely to undergo a restructuring of how work is done and to consider process change.

Oliver (1999) has suggested that companies which are rated as strongly and strategically innovative have many characteristics in common:

• high annual commitment to R&D, science of technology base to business products;
• skills in managing scientific R&D processes, including patents or rapid continual innovation, management of multidisciplinary innovation teams, systematic approaches to innovation, technology diffusion throughout the company including management and Boards;
• high levels of interaction, usually proactively, with the R&D sector and with universities for knowledge and skills, collaborative approach to business development and growth;
• global integration through multiple joint ventures, agreements to manufacture, distribute and in R&D in a mix and match with overseas market entry requirements;
• commitment to quality, world's best practices and search for continuous improvement;
• commitment to attracting a steady flow of the best and brightest people and retaining them through rewards such as employee share schemes, and keeping the quality of technology 'where it is at';
• high growth through global integration strategies and through R&D, innovation and acquisition;
• long term strategies, pursuit of a vision;
• competitive allocation of resources in-house;
• ability to change rapidly;
• supply of capital; and
• high percentage of exports with global sales and support infrastructure.

What innovation theory and research concerning innovation has shown is that the innovativeness of individual workers, companies, clusters or networks of companies and regions is an important factor in the development of knowledge based economies. As we have also outlined above, successful innovation does not just depend on R&D or new technology. It also depends on the utilisation of a whole set of complementary assets including work practices, organisational behaviour, the development of soft structures (e.g. supply chain management and customer relationships), and market assessment and strategic decision making.

The Knowledge Based Economy and Vocational Education and Training

Having looked at the nature of the knowledge based economy and the implications it is having for work, we need to ask what are the implications of a knowledge based
The Knowledge Based Economy: A Review of the Literature

Economy for vocational education and training system? The need for VET to respond to changes in industry requirements and to develop the workforce skills required by the new and emerging industries of the information economy is well recognised (see for example, ANTA 1998; Doyle, Kerr and Kurth 1998; State Training Board of Victoria 1998). As discussed in this review, one key implication is that knowledge-based economy demands new skills that differ from those derived from traditional conceptions of work. It follows, then, that such a skill formation process also needs to be supported by a vocational education and training system that has moved beyond one based on previous traditional conceptions of work (Berryman, 1993).

Having said this, it must be recognised that there have been a number of reforms to the VET system in recent years. These include:

- the implementation of a market approach to VET;
- increased emphasis on the workplace as the principal site for VET;
- the opening up of new pathways and options from school to work; and
- delivering VET through curriculums strategies associated with competency based training (CBT).

This research project has a direct interest in whether the changes introduced into the VET system in recent years have appropriately anticipated the demands of the knowledge-based economy. To fully assess this issue it is important to consider some key changes in VET over the last 20 years.

The implementation of a market approach to VET

In the late 1980s there was a radical shift from the traditional provision of VET programs in Australia. As part of the aim to increase the efficiency, flexibility, quality and responsiveness of VET, the Government promoted the development of a competitive training market within the VET sector, a sector which until the late 1980s operated largely under non-market conditions (Anderson, 1996). The policies and practices associated with this shift have had far reaching implications and have sparked considerable debate. Supporters for developing a market approach (e.g., Robinson, 1997) argue that the outcome will be a more efficient and effective VET system. Those against (e.g., Anderson, 1998) argue that given the Government's publicly-funded VET programs of market reform, giving precedence to the needs of industry can neither be sustained nor justified.

According to research conducted by the National Centre for Vocational Education Research (NCVER):

Research into training markets in Australia has been more about 'personal ideological positions on competition and market reform in the VET sector than objective analysis of relevant trends and developments'. There is currently insufficient empirical evidence to either support or refute claims that increased competition will produce the benefits being claimed by proponents or the severe drawbacks being speculated upon by opponents of the training market (NCVER, 1998, pi).

Some early analysis of VET markets in Australia was conducted by Allen Consulting Group for the Australian National Training Authority (ANTA) in 1994. Their findings identified six areas of poor performance in Australian training markets:

- on the demand side the initial issue is to encourage demand between enterprises and student individuals who feel that the return on their investment in training is worthwhile;
- on the supply side there is limited knowledge about the supply of training and how well it matches demand;
- the market is not accessible to all, especially small businesses;
- governments are sending mixed signals in setting the rules under which the market will operate;
- information to consumers about training products and how to distinguish them in terms of price, quality and service is poor; and
- the implications of this are that clear definitions of VET products and greater consumer awareness and product knowledge amongst enterprises and individuals is fundamental to the effective operation of VET markets (Allen Consulting Group, 1994, pp. 40-41).

It appears that these problems with market reform have not yet been resolved. In a recent study examining the question of how well the training market is meeting the needs of employers grappling with the challenges associated with globalisation, Hall, Buchanan, Bretherton, Barneveld & Pickersgill (2000) presented findings of case studies on two industries in New South Wales. One was a mature industry (metals and engineering) and the other an emerging knowledge based industry (information technology). From the data collected they found that for both industries:

- employers failed to make an adequate commitment to training investment and skills development within the workforce;
-...
• employers lacked knowledge about (i) the amount and type of training they required, (ii) the competency-based training and assessment reforms; (iii) the operations of the new training packages; (iv) the means by which group training companies, networks and cooperative schemes can be used to assist in supporting training; and,
• there was a tendency for employers to attempt to recruit already skilled workers, or buy in skills from labour hire firms, rather than to take on trainees, or train and develop the skills of existing or new employees.

It was concluded that emerging training markets in both these industries were not responding to the challenges companies face in grappling with globalisation. “Many of the reforms surrounding the push to an ‘industry training market’ assumes that price is capable of providing an adequate and efficient coordinating mechanism. This study reveals that too much is expected of this mechanism” (Hall et al, 2000). The authors suggest that price can play a role, though it needs to be supported by a range of more dynamic and effective mechanisms. Successful mechanisms tend to be regional and industry specific and involve the active participation of firms in a network or cooperative arrangement, enabling the training needs and burdens to be shared among firms.

The implications of these findings in relation to the knowledge based economy are profound. In an environment where knowledge rapidly changes, these difficulties are likely to be further exacerbated. At issue is the degree of information flow between Government and organisations and firms and VET providers. The finding that employers may be failing to commit appropriate investment in the workforce and in some cases simply attempt to recruit already skilled workers, is particularly problematic. Further research needs to be undertaken in other sectors of the knowledge based economy to ascertain if these findings are generalisable.

These conclusions also draw attention to the danger of viewing VET policy in isolation. The VET system is but one component contributing to national innovation and training. The role of VET in enhancing Australia’s social and economic well-being needs to be evaluated in the context of a range of other reforms.

VET in the workplace

A second major trend in recent years has been for an increased emphasis on the workplace as the key site for VET delivery. There are clearly advantages and disadvantages with such an emphasis. On the one hand, as work within a knowledge based economy becomes more intense and conceptually demanding, it becomes increasingly difficult to learn skills in decontextualised or simulated conditions. The advantage of locating VET within a workplace context is that it enables individuals to directly apply their training in the context of the job at hand. However, such environments can also be a disadvantage. What is being learned is most often skills needed immediately. Immediate needs are important, but are not necessarily helpful in terms of anticipating future or unmet skills needs in rapidly changing environments.

Often workplaces are also not set up to incorporate learning and training. The study by Hall et al (2000) reported earlier, also found that workplaces were generally poorly prepared to accommodate a workplace training focus, which is an integral feature of the new training packages. Moreover, workplace training raises the issue of workplace assessment and who is competent to assess the training occurring. In a survey of 23 peak industry bodies, which included employer bodies, unions and Industry Training Advisory Boards, the rigorousness of workplace assessment (and its moderation) has been identified as a key concern (Owen & Bound, 1998).

The knowledge based economy also signals an increasing diversity in the kinds of working arrangements people will accept. They include a growing number of people who are self-employed and who are not operating as wage earners. The number of people who are self-employed is rising and indicators support a continuation of this trend. Changes in employment arrangements in terms of outsourcing and the increasing contracting out of services mean that the place where work is undertaken may not even be in the workplace but rather from the contractor’s home office. Where do these people access VET if the focus is on a traditional workplace? This shift in the labour market, together with its increasing casualisation has implications for VET. Studies show that employers spend less dollars on training contingent workers (e.g., short-term, temporary, part-time, casual, contract) and expect these workers to be responsible for their own training.

What the above suggests is that the role of the workplace in relation to training needs to be carefully considered, and the complexity of industry sectors and variations in industry size and resources understood.

Competency-based training and the knowledge based economy

The fit between using curriculum strategies such as Competency Based Training (CBT) and the skills and knowledge required by today’s workforce has been discussed by a number of authors (e.g., Billett 1997; Graham 1998; Moy 1999; Mulcahy & James 1999). Billett (1997) suggests that there is a tension between CBT’s focus on outcomes rather than processes, and its attempts to deliver outcomes associated with adaptability and flexibility. Further, it is suggested that there is limited evidence that CBT itself is directly associated with the development of a
skillful and adaptable workforce. The key antagonism between CBT and the development of adaptability and flexibility is seen by Billett as vested in CBT’s focus on outcomes, rather than process, and its failure to understand that the educational intents may deny the very thinking and acting which determined performance. It is also claimed that the national focus and the means of implementation also misrepresents the complexity of vocational knowledge, its situatedness, the teaching and assessment of that knowledge, and the basis by which teachers commit themselves to their practice (Billett 1997, p.3-4).

Recent research into CBT suggests a “shift in the nature of skills requirements at the enterprise level away from narrow technical skills and towards a new training paradigm that emphasises the need for developing broad sets of generic skills in the workforce in order to increase adaptability” (Smith, 1999, p. 115). Within a knowledge based economy greater value is placed on human resources and ‘intellectual capital’ (Ferrier, 2000). In fast changing workplaces, continuous training and retraining need to be underpinned by attitudes toward continuous learning. According to some researchers and policy makers (e.g. Berryman, 1993; Robinson, 1998), in the ‘new economy’, specific technical skills are likely to remain relevant for shorter periods of time.

A key implication for the VET system is that such fundamental changes will require training to be orientated toward continual skills upgrading as existing skills become obsolete with increasing rapidity. Moreover, the emphasis in some industries, for training aimed at immediate job-specific skills (Billett, 1998) is likely to be an inadequate basis to sustain future skill formation. This leads many researchers to conclude that generic skills will increase in importance.

An interest in generic skills is not new. Finn (1991) and Meyer (1992) each recognised the importance of to the VET system of a number of key skills:

- collecting, analysing and organising information;
- communicating ideas and information;
- planning and organising activities;
- working with others and in teams
- using mathematical ideas and techniques;
- solving problems;
- using technology;
- using cultural understanding.

In a recent industry specific study, examining generic competencies in the Australian construction industry, Crowley, Garrick & Hager (2000) noted that the skill requirements of the construction worker were changing and are underpinned by clusters of the generic competencies. The generic competencies of collecting and analysing information, teamwork, communication and planning and organising activities were evident in construction work of all kinds. However, as in other industries, the construction industry has yet to develop systems and mechanisms for facilitating the optimum transferability and recognition of such skills.

The trend of increasing workplace change has led some (e.g., Capelli, 1995, Manfred, 1995) to suggest that all individuals, not just high-performance, high-skill workers, now require the competencies and qualities previously associated with ‘more highly educated individuals’ (Manfred, 1995, p.165). The European Centre for the Development of Vocational Training (CEDEFOP) notes that it is expected that more holistic, self-reliant working and greater responsibilities for workers will require broad transferable and flexible skills (Manfred 1995). Smith and Marsiske (1997) (in Moy, 1999, p.12) identify three criteria as ‘important in job performance’:

- the amount of knowledge (verbal knowledge on technical details, procedural and strategic knowledge and practical knowledge);
- the level and nature of knowledge organisation (representation of problems, information access and storage);
- metacognitive strategies (knowledge about managing oneself and others, insight into one’s capabilities and limits) and application of this insight to on-the-job performance.

As Smith and Marsiske (1997) (in Moy, 1999, p. 12) outlined, such competencies are necessary for environments requiring “flexibility, adaptability and responsiveness”. Similar findings have also been reported in the United States. The Secretary’s Commission on Achieving Necessary Skills (SCANS) (1991) reported on a similar set of personal qualities required to succeed in high-performance workplaces, characterised by high-skill, high-wage employment.

The SCANS report (in Moy 1999, pp.10-11) found that school leavers and workers required solid three part foundation, or ‘fundamental skills’ comprising: basic literacy and computational skills; thinking skills (including creative thinking, decision-making, problem solving, learning to learn and reasoning); and personal qualities including responsibility, self-esteem, sociability, self-management and integrity/honesty. The report also recognised five ‘workplace competencies’, including the ability to manage resources, to work amicably and productively with others, to acquire and
use information, to master complex systems, and to work with a variety of technologies.

Hobart (1999) has added that ‘global’ workers need flexibility, problem-solving and decision-making ability, adaptability, creative thinking, self-motivation, and the capacity for reflection. People with global mindsets have the ability to look at the broader context, accept contradiction and ambiguity, trust processes rather than structure, value diversity and teamwork, view change as opportunity, and strive for continuous self-development (Ibid., p.43)

Some research overseas suggests that the best mix for VET within a knowledge based economy is training programs that include a mix of the following categories:

- generic foundation skills development;
- industry or occupation-specific skills in response to current needs; and
- specific skills development for the future (Wolf, 1995).

Other research in Europe suggests that workers’ involvement in innovation in the workplace may require new forms or combinations of technical skills, including design skills, and skills associated with the management of change. The use of critical-reflective learning is seen by many as essential for successful innovation and change, and these skills may need to be explicitly developed (Brown, 1995).

There is recognition as well of the value of a substantive knowledge base and this is accompanied by a perceptible shift towards investigation of more holistic approaches to learning and assessment in the development of vocational expertise. Soden (1993) has shown that good problem solvers have internal representations of fundamental principles relevant to their occupational area and these representations are connected to each other and to broader relevant knowledge. The whole thrust of such ideas is that in order to develop expertise in an occupational area it is necessary for learners to develop mental models, frameworks or networks that link knowledge and ideas from different subjects and domain areas.

In spite of this varied research and writing on the need for generic skills and more holistic approaches, Mulcahy & James (2000) found that a narrow technical view of competence is still alive and well. They found that distinctly different discourses of competency are developing in different industry sectors and between different workforce groups. They identified a discourse of competency for operational technical and trade staff as “specific skills for specific jobs”, but a broader view of competency for staff involved in managerial and professional work. They concluded that two broad models of VET are emerging: a training model, which emphasises competence in specific practices, and a developmental model, which emphasises competence in generic practices. Further, they identified a contradiction between what employers say they need and what they demand from CBT.

According to Mulcahy (1998, 1997) the skills and knowledge, which are codified in competency standards, are dependent on other skills and knowledge that are not necessarily codifiable (e.g. tacit skill, experiential knowledge). Two types of vocational knowledge are conceptual and procedural knowledge, each being used regularly both in routine and non-routine problem solving. Mulcahy and James (1999, p. 21) argue that “non-routine problem solving ... requires that cognitive structures be transformed, thus furthering and developing, as well as reinforcing, knowledge”. Problem solving and transfer require deep conceptual knowledge to enable the learner to abstract the necessary concepts and principles that form the basis of novel problem-solving and transfer across settings, a capacity that is associated with high levels of performance and expertise. However, Mulcahy and James suggest that the development of deep, robust transferable knowledge depends on the learner negotiating meanings with the environment and constructing knowledge. This raises the issue of the importance of learning in context and of the intersection between formal and informal learning.

A further implication arising from the knowledge based economy is the differentiation between individual and teamwork learning. The importance of teamwork in the knowledge based economy has already been discussed. A review conducted by Waterhouse et al, into the changing nature of work and its implications for vocational education and training, concluded that in the new economy, individual competencies may not be the most important outcomes to be training for in a VET system. Given the value placed on the ability of groups of people to work effectively together more attention needs to be given to the notion of ‘collective competence’ (Waterhouse & Sefton, 1998). The authors suggest there is a need to identify what group or team competencies might be.

Further research is needed to identify what collective competence in action might look like and how it is manifested in various settings. Consideration also needs to be given to the relationships between individual
competencies and group or collective performance. They ask the key question, if social and collective competence is important, what are the implications for teaching strategies based on individualised conceptions of the learner and competence?

Delivery of VET is not simply hindered by structures developed to implement policy. It is also enabled and constrained by the delivery methods available and the capabilities of VET providers. A key area emerging in the VET literature is the issue of professional development of the VET industry and the capacity to develop creative and flexible materials that are of relevance to the target group. Pedagogically, research indicates a lack of creativity on the part of VET providers (see for example, Bennett, Priest and McPherson 1999; Grevelle 1998). VET providers have also been slow to take up the development of flexible delivery strategies (Spark & Associates, 1996; Kearns, 1998). In examining statistics on delivery methods used in Victoria and Queensland, Kearns (1998) concluded that less has been achieved than hoped, and that “flexible delivery on the whole, with some significant exceptions, remains in a marginal position with regard to mainstream VET provision” p. 78. VET delivery is still delivered largely through traditional classroom teaching with some indications of a trend towards self-paced learning (Kearns, 1998).

There are obviously a number of critical issues facing VET if it is to respond to some of these important training needs that industry faces in the 21st century. There is a tension between the provision of skills and competencies through the VET system that are centred on traditional occupation categories with the emerging need to consider how VET can play its part in the development of generic skills and the preparation of workers for lifelong learning.

While it is obviously necessary for individuals to have an increasingly sophisticated range of skills and knowledge in order to manage the future, it is the underpinning skills of learning to learn that “will become the bedrock capability of both individuals, and organisations” (EdNA 1999). This approach has been endorsed by Kearns et al.

We have concluded that there is a need for active promotion of learning organisation principles and for experiment and innovation in a range of contexts. These include enterprises of all sizes and VET institutions. Learning in the workplace is intimately linked to the other contexts for learning discussed in this report, so that the need exists for integrated policies and strategies that foster learning in this range of contexts. Forging strategic partnerships associating all stakeholders will be essential for this purpose. (1999, p.59)
Conclusion

The central concern of the knowledge based economy is the need for modern industrialised nations to adopt a high skills and knowledge driven approach to economic development competitive strategy. As our review has shown, this will involve the development of new occupations as well as skill and knowledge changes in existing ones. As well, it will be associated with changes in the structure of firms and the way they relate to other customers and competitors. This will also be associated with an increased demand for innovation within the individual worker, the firm, clusters of companies, regions and indeed complete economies. Our review has suggested that understanding innovation is crucial for understanding the dynamics of ‘knowledge based’ economies. In modern innovation theory, networking, inter-dependency and learning through interaction lie at the heart of the innovation process. Research has also shown that innovation is not a linear process, but is actually non-linear, iterative and interactive. Hence, innovation is a dynamic social process involving complex interactions between various actors and institutions that actively seek to learn from one another. To successfully innovate, companies are becoming more dependent on complementary knowledge and know-how in firms and institutions other than their own, as well as on knowledge arising from ongoing dialogue and interaction between producers and consumers. Training and education must do more than simply develop skills and specific knowledge, it needs to prepare workers for lifelong learning and to be part of the process of innovation in whatever industry employs them.

Research, both theoretical and empirical, suggests there has been an over-simplification of issues surrounding training. VET faces a far more complex set of inter-dependent issues in the future. Not only are there significant industry and firm level differences in the perceived strategic value of moving down a high skills/high value path, but international comparative studies also highlight systemic features which may constrain a nation’s intent to reposition itself in the global economy.

The general thrust of research findings is that movement towards a knowledge based economy (in terms of adoption of high performance workplace, upskilling of the workforce, occupational shift towards knowledge workers) is slower than many commentators predicted. Investment in human capital as the key to economic competitiveness appears not to be the only competitive strategy in a globalised economy, and indeed is not the favoured one by many firms. The tendency for researchers to focus on ‘best practice firms’ (echoed in the writings of the OECD and national governments) gives a misleading picture of changes in firms’ management practices across the board.

Occupations and skills are undergoing change. Boundaries are blurring between occupations, and the concept of ‘skill’ is expanding to reflect employers’ needs for a range of ‘soft’ skills. However, research findings reveal a varied picture. It would appear that there is not a single direction of change in skill levels, nor is the common depiction of skill polarisation an accurate one. Rather, the findings are again far more nuanced. Macro data on skills in the workforce is often at odds with findings from case studies and more micro level survey work.

International research findings indicate accelerating growth in the use of cognitive and interactional skills, and decline in the use of motor skills. Many studies of employer attitudes also reveal increased demand for ‘soft’ skills or generic competences. When tested in the marketplace, there is some evidence that employers are willing to pay a premium for IT, problem-solving and communication skills, although research also shows that demand for such skills is strong only if specified at the lowest levels of the workforce. The intangible nature of many of the skills supposedly valued by employers renders their market value particularly problematic.

The need for VET to respond to changes in industry requirements and to develop the workforce skills required by the new and emerging industries of the information economy is well recognised. One key argument raised in this brief review of literature is that the knowledge based economy demands new skills that differ from those derived from traditional conceptions of work. It follows, then, that such a skill formation process also needs to be supported by a vocational education and training system that has moved beyond one based on previous traditional conceptions of work. The VET system needs to re-examine its role and delivery strategies as we enter an age of increased demand for new knowledge, generic skills and workers who are equipped for lifelong learning.

As we have outlined in the introduction to this paper, our work is shaped by a definition of the knowledge based economy as one that is increasingly dependent for its growth on the input of knowledge as a value-added input to the economic system. An important concern for us therefore as we attempt to examine the changing nature of work and policy implications for VET is the extent to which there is evidence of:

- changing industry structure exemplified by new industries, occupations and organisational arrangements;
- changes in the types of skills required within firms and across industry sectors, and the importance of generic skills;
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- new forms of knowledge and increased importance within regional economies for the creation and application of knowledge in networks or clusters of companies/enterprises;
- changing organisational structures within firms and whether workers are being required increasingly to engage in 'communities of practice';
- innovation becoming more important as a means to increase economic competitiveness;
- knowledge management becoming increasingly the key to sustainable competitive advantage, requiring individuals, firms, and regions to acquire, create and use knowledge as the key productive resource; and finally
- how needs for training are changing in relation to purpose, content, process and outcomes.

Ultimately, our findings will need to be examined in the light of current government policy and practices in the VET sector. An important issue for our research to grapple with is the extent to which the current focus in VET on competencies and training packages for specific occupations is suited to the needs of emerging knowledge based economies. There are a number of other potential policy considerations for the Board that will arise from our research. These include the role that VET might play in stimulating the development of regions, the suitability of existing provisions to meet the needs of emerging industry structures such as networks and clusters, and the extent to which VET can meet the need for generic skills that tend increasingly to transcend employment classifications and industry sectors. More recent concern within the VET sector with market based approaches, increased emphasis on the workplace as a site for training, online delivery and alternative pathways for training, suggests a preparedness to consider change and adaptation to meet industry needs.

The role that vocational education and training is playing, or might play in the future, is obviously the central policy dilemma that drives this research. The research literature suggests that the education and training of a new generation of knowledge workers cannot simply be delivered from within traditional educational and training institutions and courses without change. The significant changes that are occurring in knowledge based economies require education and training institutions to adapt to and to play a key part in this change. How critical vocational education and training is to the development of more competitive regional economies and cities is the major policy consideration addressed by our research.
References


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