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Pathways to knowledge work

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Executive summary

This study looks at how the occupational structure of the Australian labour market has evolved over recent years, and how individuals have fared in the process. Underlying aggregate-level change are tens of thousands of stories of individuals coping with adjustment: stories of young people deciding whether to continue their education and training beyond schooling, of mothers wanting to re-start their career after some years where it had been on hold, and of older people receiving redundancy notices and scouring job advertisements asking for skills they don't have.

How do we make sense of those stories, and detect the underlying factors which explain change and the paths that people have followed? This study takes an avowedly statistical approach to the matter, comprising two principal components. The first is an examination of changes in the occupational composition of the labour market between 1986 and 2001. The second is a retrospective investigation of the factors that enabled some individuals to find themselves working in 1997 in jobs that might be categorised as 'knowledge work'.

Knowledge work is the bridge between the two components. There has been ample discussion about the emergence of a knowledge economy, but its consequences for the world of work rarely form part of those discussions and, where they do, are put in relatively benign terms: a knowledge economy is constituted of knowledge workers (which must be a good thing).

The transition towards a knowledge economy is best seen as a further stage in the evolution of technological change, exemplified by the rapid diffusion of advanced information and communication technologies. As history has shown, the consequences of technical change for work are likely to be ambiguous. Putting it simply, the fact that more knowledge may now be incorporated in the production process and the delivery of services does not necessarily mean that more knowledge is required on the part of workers. Knowledge can be codified into a machine or piece of software, the application of which may require little in the way of cognitive skill. At the same time, others will be involved in research and development and the process of codification, undoubtedly tasks requiring a high level of knowledge and cognitive skill. In the first instance, therefore, the question of whether more or less knowledge was now required of workers had to be addressed.

Did knowledge work become more prevalent between 1986 and 2001?

Data were obtained on the occupational composition of employment in 1986 and 2001 from the Census. They show that employment grew most rapidly in professional jobs and in intermediate clerical, service and sales jobs, up by 534 000 and 480 000 respectively. Over the same period the number of tradespersons fell by 13 000 and there was very little growth in the number of advanced clerical and sales workers. These results are broadly consistent with those of other studies, which have been characterised as the 'hollowing out' of the middle of the pay and skill distributions of employment.

Given these changes, what can be said about whether knowledge work became more prevalent? There are two ways of tackling this question.

The first is by using an ordinal skill ranking of jobs, with five discrete levels of skill. Assigning employment to the appropriate level in both periods, it can be seen that the share of employment in the two highest skill categories rose considerably, that in the middle skill level fell substantially, and those in the two lower skill categories rose and fell by offsetting amounts. The overall effect has been an upward shift in the skill profile, mostly a result of a redistribution of the composition of employment in the upper skill levels—those generally requiring a post-school qualification at certificate III/IV level or better.

The second approach used was to measure whether there had been a rise or fall in cognitive skill levels. A reliable source was identified giving a cognitive skill score for specific occupations. By multiplying this score by the number of people employed in that job, then summing across all jobs and dividing by total employment, a measure of the average cognitive skill was obtained. The results of this analysis show that there was a very small rise in the average cognitive skill score between 1986 and 2001, less than 2%.

Both approaches to the question suggest that while there has certainly been a good deal of flux in the occupational structure of the Australian labour market, it would be difficult to characterise this as a move towards more knowledge work.

The real advantage of using the Census data, however, is not to replicate aggregate level studies, but to look in much finer detail at how the occupational structure of the labour market is changing.

Jobs on the rise and jobs in decline

Popular accounts of change place a great deal of emphasis on information technology, both in terms of job generation and essential skills for job aspirants. In so doing, they tend to overlook the everyday character of much paid work.

In 1986, the top three employing jobs in rank order were sales assistants, secretaries and personal assistants, and cleaners. In fact, 15 years later those same three jobs held exactly the same rank, collectively accounting for 860 000 jobs—roughly one in ten of all jobs held at that time. Computing professionals more than tripled in number from 41 000 in 1986 to 129 000 in 2001, but the number of sales assistants increased by 197 000 over the same period, more than double the number of new computing professionals.

Another way of identifying new job opportunities is to identify those occupations growing fastest. Occupations which grew rapidly in both absolute and percentage terms included computing professionals, project/program administrators, general clerks, and child-care and special-care workers.

Job growth was strongest in areas that disproportionately employed women and where the jobs in question were disproportionately part time, and was therefore relatively disadvantageous to men in full-time work. Among the 25 occupations which had grown fastest in absolute terms over the 15 years to 2001, 27% were held by men working full time, well below the 44% which prevailed across all jobs.

Many occupations saw declining numbers employed over the 15 years to 2001. While it was the case that jobs were lost across the entire skill spectrum, they were most heavily concentrated in the skilled trades where 26 separate trades saw a decline in employment numbers. This included toolmakers, welders, panel beaters, carpenters, bricklayers, butchers, shearers, and printers.

What are the underlying forces behind the changes?

It is not possible to adequately understand the dynamics of change by observing two points in time, but there is some consistency in what has happened across a range of fields to identify three different kinds of change which appear to have occurred.

First, in a number of fields jobs have become 'professionalised', reflecting growing sophistication in service delivery. The emblematic example here is nursing. The number of registered nurses rose by 26 000, while the number of enrolled nurses fell by 9000. Other examples are rising numbers of accountants, human resource professionals and library technicians, while the number of bookkeepers, personnel clerks and library assistants has declined or stagnated. In these latter areas, technological improvements have complemented the delivery of higher quality services.

Second, productivity gains due to technological improvement leads to the shedding of jobs. This is seen clearly in agriculture and mining where many occupations that are central to these industries saw a decline in employment numbers between 1986 and 2001. These ranged across skill levels. There are also specific occupations which are becoming obsolete due to technological improvements. Examples of this over the period are keyboard operators (due to the widespread take-up of the personal computer), switchboard operators (due to automated dialling systems) and typesetters (due to printing from camera-ready copy and other innovations).

Third, general productivity gains, in turn, generate new jobs which are best seen as the product of affluence—among the rapidly growing jobs have been dietitians, financial advisors, massage therapists, fitness instructors, travel agents, cleaners and waiters. These new jobs range across all skill levels.

It should be clear from these examples that the emergence of a knowledge economy has had considerable, but ambiguous, effects on the character of jobs undertaken in that economy.

How individuals fare over the life course

The other main aspect of the study was to look at the individual factors associated with attaining higher level jobs. Our source for doing so was the work and education histories of around 1700 employed people aged between 15 and 55 who were surveyed in 1997.

Around six in seven people had changed occupation between their first main job when they entered the labour market and their present job, and in doing so just over half had also changed broad skill ranking. Over the course of their working lives, 38% were when surveyed employed in a job with a higher skill ranking than when they started, and 16% were in a lower skill ranking. (While much of the upward move will be a result of upward movement associated with skills acquired with experience, the data source does not allow this to be quantified.) Older men were the most likely to have moved up the skill ranking, while a downward move was most common among younger men and older women.

Looking more specifically at 'knowledge work', which is defined here as occupations requiring an above-average level of cognitive skill, there are two broad paths to acquiring such a job—the first is to begin one's working life in this position, the other is to move into it. At the time of the survey, 59% of those working were identified as knowledge workers. This was made up of 37% who began their working lives in this group and remained there and 22% who moved into it.

Men were far more likely than women to commence their working careers as knowledge workers and remain there: 47% compared with 28%. The differential was considerably more marked for people who began work in the 1950s where there was a 34 percentage point

difference in favour of men. Since then, it has progressively shrunk over each decade to be 9% among those who began work in the 1990s.

The most important determinant of whether a person began their working life in a knowledge job and stayed in such a position was education. Around three in five men with a post-school qualification did so, compared with three in ten of those who completed 12 years of schooling and two in ten who did not. For women, the major factor was whether they were degree qualified. All other women had a lower than average likelihood of commencing work as a knowledge worker. Only 3% of women who did not complete 12 years of school (and without post-school qualifications) started work as a knowledge worker and have remained there. This group also had the smallest flow into knowledge work during their working lives—just 16%.

In general, there was little association between people's background characteristics, their education and work experience and whether they moved into knowledge work (where they had not begun their working lives in this group). Older women were more likely to do so, which may be related to workforce withdrawal and re-entry after raising children, as the flow into knowledge work was highest for women with children beyond school age. This phenomenon may also be associated with some re-skilling, as women who attained post-school qualifications *after* labour market entry were more likely than others to move into a knowledge job.

Knowledge work and vocational education and training

In the 15 years up to 2001, changes to the occupational structure of the labour market generally worked against holders of vocational education and training (VET) qualifications. The bifurcation in expanding job opportunities by skill ranking meant that many of the middle-level skill jobs that might normally be filled by VET graduates were not available.

To be more specific, a very large number of skilled trades saw a decline in employment levels, so that overall the number of tradespersons fell, with job numbers 300 000 lower in 2001 than they would have been had job growth since 1986 kept pace with the overall average. This would have presented limited openings for either newly qualified apprentices or those wanting to pursue a career in one of the affected trades.

There would also have been diminishing opportunities for VET graduates in many of the fields which became 'professionalised'. Nursing provides a prime example here with the compositional shift away from enrolled nurses towards registered nurses. To work as an enrolled nurse generally requires completion of a vocational qualification compared with a university degree for registered nurses.

While a university degree provides the surest passport to attaining a knowledge job, it has also been the case that vocational qualifications generally improve the odds of doing so, more so for men than for women, and more so for those with a skilled rather than basic qualification. Among men with skilled vocational qualifications, 78% were working in a knowledge job in 1997, compared with 45% for women with a basic vocational qualification (which is below the all women figure of 50%).

There has been a fair level of skill 'wastage', in the sense of those with post-school qualifications never having the opportunity to deploy the skills acquired in a knowledge job. This has especially been the case for women, with 30% of those with a skilled vocational qualification and 48% with a basic vocational qualification never working in a knowledge job.

Over the last five years there has been a rapid expansion in the number of people participating in the VET system, whether through new apprenticeships or in technical and further education (TAFE) and equivalent courses. The question must be whether recent cohorts of VET graduates have been able to obtain work which takes full advantage of the skills they have acquired, or whether they too will experience skill wastage.

1 Work and skill in the knowledge economy

A changing economy, a changing labour market

The Australian labour market, in common with that of most industrialised countries over recent times, is very different from what it was just a generation ago. The main features of this change are:

- rising participation rates of women (and, perhaps a corollary of this, declining participation rates of men)
- much greater heterogeneity in working-time arrangements, with those working a standard full-time week now constituting a minority of total employment
- an increase in the average age of labour market entry, a consequence of rising school retention rates and greater rates of participation in tertiary education
- a large decline in award protection and union membership, as labour markets have been 'de-regulated'.

Underlying all these changes is the continued evolution of the economy from labour-intensive agrarian/commodity production through labour-intensive Fordist manufacturing to labour-intensive flexible service provision. More than three-quarters of Australian employees now work in service industries of one kind or another. This evolution has been observed by many commentators in the past, an early Australian example being *Sleepers wake!* (Jones 1982). What to label this economy, or how best to conceptualise it, has itself altered over time. The label 'knowledge economy' was coined by Peter Drucker in 1969. Others since then, notably Daniel Bell, continued to discuss its emergence using terms such as the 'information age', but it was not until the widespread take-up of the personal computer and the advent of the Internet in the 1990s that the term 'knowledge economy' gained currency.

What is the knowledge economy? To Drucker (1969), '[w]hat matters is that knowledge has become the central "factor of production" in an advanced industrial economy'. Around 30 years later, the United Kingdom Department of Trade and Industry (1998) spoke of the knowledge-based economy in highly similar terms, as being one ...

> in which the generation and the exploitation of knowledge has come to play the predominant part in the creation of wealth. It is not simply about pushing back the frontiers of knowledge; it is also about the more effective use and exploitation of all types of knowledge in all manner of economic activity. (p.2)

The differentiation of a 'knowledge economy' from an 'information age' is a subtle shift from the form of delivery and exchange (information) to the mode of production (knowledge). It implies a much *wider* context than a focus on information and communication technologies, but these technologies have played the fundamental role in enabling knowledge to be codified, and in allowing information processing gains to spread across all sectors of the economy.

This project is concerned with understanding the nature of work in this knowledge-based economy. Is it true that the knowledge content of work has altered in recent times? While the

amount of knowledge embedded in production and service delivery has increased, the net effect on *workers* is, on a priori grounds, ambiguous. If the knowledge content of a particular task has been codified (e.g. as a piece of software), it is not at all obvious that the application of this software represents an increase in the knowledge required to undertake the work.

Take as a real-life example the act of acquiring a personal loan, a job once performed by a bank branch manager. That person would, within broad parameters defined by the bank, make an assessment as to whether a loan applicant was credit worthy and had an ability to service the loan. In many institutions nowadays, that decision is made by a computer. The bank has been able to codify its risk parameters and the factors needed to assess risk into a piece of software. Compiling and inputting that information is now the province of a more junior clerk, freeing-up part of the time of the branch manager, a productivity gain which the bank might wish to realise by reducing the number employed. Overall, the demand for high knowledge input into codifying risk assessment has risen, as has the demand for low knowledge input into collating the information required to apply the software, while the demand for the accumulated knowledge of managing finance has diminished.

There is considerable evidence that the playing-out of these underlying forces is leading at the aggregate level to an emerging 'hour glass' shape to the labour market. Gregory (1993) was one of the first to identify the 'hollowing-out' of the middle, pointing to the relative loss of jobs in the middle of the earnings distribution. Cully (1999) also found this pattern when examining the changing skill mix of the workforce, finding relative growth at the top and at the bottom of the distribution, with relative decline in the middle. Updating Gregory's initial work, Borland, Gregory and Sheehan (2001, p.15) found the number of Australians earning between $700 and $1400 per week fell by over 8% during the 1990s, a period during which the workforce grew by 17%. They go on to remark '[t]his is not so much the disappearing middle as the disappearance of growth in the whole top half of the earnings distribution, other than for very high-income earners'.

Wooden (2000) critiques such accounts on the grounds that they do not take into consideration the hours worked. That misses the point—the amount of work done may, in total, require more skilled input (in terms of hours) than previously, but there is a real cleavage in the *range* of jobs on offer, with full-time, high-paid work concentrated at the top end, and part-time, low-paid work concentrated at the bottom end.

Debates on rising inequality and the 'hollowing-out' hypothesis fall back on changes in the demand for labour, principally the relatively lower demand for unskilled labour and the relatively higher demand for high-skilled labour. There is something of a consensus that the source of change is the use of information and computer technologies, the so-called 'skill-biased technical change' hypothesis. This has been advanced in many United States studies (see Card and DiNardo 2002 for a critical review) and in Australia by, among others, the Productivity Commission.

Common to these accounts is a neglect of the *supply* side of the labour market. Pryor and Schaffer (1999) present convincing evidence for the United States that show the supply of qualified workers (i.e. college educated) has outstripped the demand for such workers in the period 1970–96. Simultaneously, the supply of unqualified workers has increased more slowly than jobs for workers of that education. Even though demand for qualified workers increased relative to unqualified workers, the consequence once supply changes are taken into account has been a 'bumping-down' effect as unqualified workers are pushed further down the job 'queue'. At the same time employers have come to increasingly demand high-level cognitive skills. These are correlated with higher educational qualifications, but imperfectly so, meaning that there is range of cognitive ability for any given strata of qualification. They find proof for this in a wage premium being earned by those with high cognitive skill *within* education strata.

Autor, Levy and Murnane (2001) arrive at a similar conclusion in their study which clearly distils advances in education from changes in skill. They are able to show that the net effect of

the changing job composition in the United States has resulted in more complex jobs, and that this explains the relative increase in demand for people with college-level education. Thus, technological change is skill biased, but to cognitive skills, not to what is acquired through gaining qualifications as such.

Research questions

The preceding discussion suggests that it is by no means clear that the transition to a knowledge-based economy has been, or will be, as beneficial as many of its protagonists suggest—at least for the world of work. A number of awkward questions are raised, ones which this project attempts to grapple with, such as:

- ✧ What does it mean for people's careers—is there still a way to rise from the bottom to the top and, if so, is this based on the attainment of qualifications or experience?
- ✧ Many of the jobs in the middle of the skill distribution have traditionally been filled by those who have been through the vocational training system (e.g. apprenticeships in the trades). If such opportunities are disappearing, then where are VET 'graduates' to go?
- ✧ In seeking to improve the education and skill base of the workforce, is there a danger that some people will be 'over-educated' for the work they obtain (i.e. if growth in post-school qualifications exceeds growth in skilled jobs)?

The importance of knowledge

'Knowledge' as an element in the discourse of political economy has become pronounced in the past decade. It has come from two distinct directions, at the intersection of which lies the concept of 'knowledge work'.

The first is in debates over changes in the economy, commonly referred to as the 'new' or 'knowledge economy'. It is widely accepted that many Organisation for Economic Co–operation and Development (OECD) countries witnessed an improved economic performance in the second half of the 1990s, reflected in sustained productivity growth in excess of long-run averages. This was the case not only for Australia, but also for the United States, and some European countries (e.g. Ireland, Norway). Speculation as to the source of this growth centred on two main possibilities—trade or technology. There is considerable evidence pointing to knowledge as an increasingly important component of production. Indicators include the amount of gross domestic product allocated to research and development and the share of information and communication technologies in employment, production and exports (Houghton & Sheehan 2000).

The second area where knowledge has loomed large has been in debates over education. This, too, ties in with economic performance with a body of research positing a causal link between levels of education and performance. There are, as Mournier (2001) shows, two separate strands to this—one which links skill formation to productivity and thereby economic growth, another which sees national league tables of educational attainment as a determinant of a nation's competitiveness. More generally, skill formation is part of the suite of 'supply-side' solutions towards developing a high-skill, high-wage economy (Crouch, Finegold & Sako 1999). This includes increasing school retention rates, expanding the extent and range of vocational training available, and the introduction of lifelong learning, all of which enhance the knowledge base of the nation.

What this means for individual workers is that the acquisition of knowledge and its deployment in work is likely to have become more important, both within existing jobs and in newly created jobs. From this insight we get the concept of the knowledge worker.

In its most recent World Employment Report, the International Labour Office (2001) has focussed on knowledge work and the impact that information and communication technologies are having on work. The report defines knowledge workers as highly skilled and, by implication, the non-knowledge worker as not. They go on to quote favourably an OECD report as saying a knowledge worker is someone whose job it is to generate ideas (Arnal, Ok & Torres 2001). This does not allow for the fact that the application of cognitive abilities, such as problem-solving, is present in varying degrees in *all* jobs. At what threshold point does this become sufficiently high that it warrants the label 'knowledge work'? There is a need to tease out the underlying suppositions.

Knowledge, skill and occupations

To adequately unpack this knowledge/non-knowledge dichotomy we need to examine the slippery notion of skill. According to Mournier (2001, p.2), skills 'are socially built and defined', and are done so in the spheres of work and of education. The two are inter-dependent but also develop autonomously—rising levels of literacy, for example, do not make Fordist production methods any more or less effective. He posits three 'logics' of skills, constituting:

- ✧ technical skills, as required by equipment and productive methods
- ✧ behavioural skills, as required by the ability to function as a dependent worker
- ✧ cognitive skills, determined by the level of education and training.

Having established this, he then argues against empirical studies which conceptualise and measure skill along the same lines. This is unrealistic and flies in the face of many good empirical studies of skill change.

Operationalising skill in empirical studies

Recent years have seen a number of important studies of skill change, partly motivated by attempting to explain the relatively deteriorating position of low-skilled workers. These studies, mostly by economists, intersect with an earlier branch of research by labour process theorists who, following Braverman (1974), have attempted to identify whether changes in work organisation are generally 'de-skilling'.

In almost all of these studies, it is the job or *occupation* of workers which is observed, and it is this which is used as the basis for constructing measures of skill. There are two broad approaches taken.

The first is to construct a hierarchy of skill by grouping occupations into particular skill categories, so as to form an ordinal measure. In its simplest form, this is reduced to a dichotomy of skilled/unskilled. For example, the Productivity Commission has published two recent staff research papers (De Laine, Laplagne & Stone 2000; Laplagne, Marshall & Stone 2001), both of which define highly skilled workers as those in a managerial, professional or para-professional occupation, with all remaining workers defined as 'other'. Berman, Bound and Machin (1998) do something similar in their cross-national study of employment composition in manufacturing, by defining production workers as unskilled, and non-production workers as skilled.

A major problem with the dichotomous approach is that it fails to pick up the variation in changing employment composition *within* the unskilled group—this was the basis of the argument in Cully (1999), who drew on the 1996 revisions to the Australian Standard Classification of Occupations (ASCO) to look at employment change across five categories of skill.

As this classification (and the ordinal skill ranking) will be used throughout the report, it is worth exploring. As shown in table 1, the conceptual underpinning to this ordinal measure of skill is provided by the structure of educational qualifications in Australia. Thus, most occupations in the major groups of managers and professionals 'have a level of skill commensurate with' having attained a university degree, or they have sufficient work experience to have brought them up to that level of skill (Australian Bureau of Statistics 1997, p.9), while those in the lowest skill level—elementary service and sales workers and labourers— need only have completed compulsory schooling to be equipped for the job.

A possible critique of the ASCO schema is that it is based on a qualifications framework, and has no underlying conceptual basis of what constitutes skill. Elias and McKnight (2001) provide the clearest justification for grouping occupations in this way as a proxy for skill—it works as a heuristic device, most particularly in explaining variance in earnings.

Table 1: ASCO major groups, skill level and typical education and experience

Major group	Skill level	Education and experience
Managers	I	Bachelor degree or higher, or at least 5 years relevant experience
Professionals	I	
Associate professionals	II	Diploma/advanced diploma, or at least 3 years relevant experience
Tradespersons	III	AQF Certificate III or IV, or at least 3 years relevant experience
Advanced clerical & sales	III	
Intermediate service	IV	AQF Certificate II, or at least 1 years relevant experience
Intermediate production	IV	
Elementary service	V	Compulsory schooling or AQF Certificate I
Labourers	V	

Note: AQF – Australian Qualifications Framework

Source: Australian Bureau of Statistics (1997)

So long as it is done 'at the aggregate level, where perhaps only three or four categories of skill may be defined, occupational classifications appear to provide a robust method for the measurement and analysis of skill' (Elias & McKnight 2001, p.538).[1]

The second broad approach has been to place some type of valuation on skill—again, as inferred from the occupation held—so as to develop a scale or index (which, as a continuous variable, is more readily amenable to statistical analysis than an ordinal measure). In the United States, this approach was pioneered with the Dictionary of Occupational Titles which conceives all jobs as made up of three discrete skill elements: cognitive, interactive and motor. These directly map onto Mournier's three 'logics' of cognitive, behavioural and technical skills. A notional score on each element is assigned to each occupation (on the basis of job evaluation studies) and this information can then be used in a variety of ways to analyse skill by occupation. A major problem with this approach is that the scores are assumed to be invariant across time (or, at least, between revisions).

Several researchers, in the United States and in Australia, have drawn on the skill indexes incorporated into the Dictionary of Occupational Titles to examine what the changing composition of employment means for the deployment of skill. For Australia, Pappas (1998) follows a two-stage process where he identifies the American occupation in the Dictionary of Occupational Titles that is the closest equivalent to its Australian counterpart, and assigns to it the relevant score. He then aggregates these results up to 15 occupational groups, weighting by the employment share of each individual occupation. He shows that between 1976 and 1996

[1] These two authors, based at the Institute for Employment Research at the University of Warwick, were advisors to the United Kingdom Office for National Statistics in its most recent revision to classifying occupations.

there has been an overall average increase in jobs requiring higher levels of cognitive and interactive skills, and a relative decline in jobs requiring motor skills.

The United States has recently updated its occupational classification, now called O*NET (Occupational Information Network) in its revised form. This is bewildering in its complexity. For each of 1120 occupations, there are 483 variables in the occupational details 'domain'. Knowledge is one of eight areas in the occupational details domain. There are 33 identified components of knowledge (such as mathematics, biology, physics, media and so on). For each component all 1120 occupations are ranked on a 0 to 100 scale for two areas: the importance of that area of knowledge to the occupation and the level of knowledge required. This produces a matrix of 73 920 cells.

It is something of an understatement, therefore, to state that the O*NET is extremely rich in information content, and opens itself up to a wide variety of applications for analysing knowledge work. The first application of O*NET in an Australian context is by Sheehan and Esposto (2001). They follow the earlier approach of Pappas by assuming that these United States measures can be applied directly to the Australian labour market, simply by matching occupational titles.

Although the Dictionary of Occupational Titles and the O*NET are rich sources, there must be some doubt about the applicability to Australia to caution against their more general use. First, even accepting the accuracy of individual researchers' judgement, we cannot be sure that work done under a given title in the United States directly corresponds to that in Australia. How do we know, for example, that the work of librarians in the United States is identical to that in Australia? Second, except at the time of periodic revision, the skill scores remain fixed, but work redesign and reorganisation may well see skills required to do a job alter over time. For example, the use of CADCAM software in manufacturing may well have increased the level of cognitive skills required of tradespersons, and lowered the level of motor skills required. Third, as we will go on to show below, there are many instances where there is no United States occupation which can be directly matched to the Australian one. Cumulatively, these account for a considerable proportion of employment (19% in 2001). For these reasons, we generally eschew this second approach in favour of the first, i.e. use of an ordinal measure of skill.

Does skill=knowledge?

The final question to be addressed is whether skill can be used as a synonym for knowledge and, therefore, for an understanding of knowledge work to be gleaned from a detailed study of changes in the occupational composition of employment. The first point to be made is that skill is abstracted from the individual; it is defined by the nature of the job task. Individuals may be more skilled or knowledgeable than the job requires but, if so, this is mainly due to failures in the matching process of the labour market. Autor, Levy and Murnane (2001) are clearly right in their approach which distills between the two.

There is no established literature yet which clearly conceptualises knowledge work. In lieu of this, treating the skill required to do a job as equivalent to the knowledge required to do it seems a reasonable basis on which to begin an analysis of knowledge work. Some confirmation of this is provided by following Pappas (2001) and assigning his 'cognitive skill' scores (derived from the 1991 Dictionary of Occupational Titles) to individual occupations, then weighting these by 2001 employment levels to produce a score at ASCO major group and skill level. The cognitive skill measure developed by Pappas is the mean value of the rating given to a job's relationship to data (as opposed to 'things' and to 'people'), the level of specific vocational

preparation and the level of general education development required.[2] It provides the clearest link to the application of knowledge in work.

The results of this exercise are shown in table 2. The Pappas scores have a direct read-across from the Dictionary of Occupational Titles to ASCO for about three-quarters of all occupations. Occupations for which there is no direct Dictionary of Occupational Titles equivalent are (all) managers and mostly residual occupational categories in the other major groups (e.g. 'other health professionals'). After weighting by employment levels, 89% of non-managerial employees in the 2001 Census are taken into account. The results in table 2 are sufficiently stark that we need not be concerned about the excluded employees. It very clearly shows a strong positive association between the five ASCO skill levels and the employment-weighted cognitive skill measure, ranging from a score of 3.33 in the lowest skill group, and rising monotonically with each level to 8.29 in the highest skill group. In addition, the standard deviation *within* each skill level is low—between 1.05 and 1.40—suggesting a high degree of homogeneity in cognitive ability required.

Table 2: ASCO skill level and the Pappas cognitive score, 2001 Census employment-weighted data

Skill level	Major group	Pappas score	
		Group level	Skill level
I	Managers	–	8.29
	Professionals	8.29	
II	Associate professionals	6.35	6.35
III	Tradespersons	6.03	5.84
	Advanced clerical & sales	5.28	
IV	Intermediate service	4.82	4.36
	Intermediate production	3.40	
V	Elementary service	4.24	3.33
	Labourers	2.24	

Source: Author's calculations based on 2001 Census data and Pappas (2001, appendix)

To summarise the discussion and the use of terminology in this study:

- ✧ Skills can be analysed by examining the skill content of jobs held (i.e. rather than skills acquired by individuals through education and training).
- ✧ Ordinal skill rankings, such as the five-level ASCO ranking, present an effective tool for analysing changes in the labour market.
- ✧ High-skilled jobs are those in the upper reaches of this ranking scheme (i.e. I, II), while low-skilled jobs are in the lower reaches (i.e. IV, V).
- ✧ Cognitive abilities are required in all jobs to varying degrees and, in principle, can be measured on a continuous scale.
- ✧ There is a very high correlation between average cognitive skill scores (taken from the United States Dictionary of Occupational Titles) and the ASCO skill ranking.
- ✧ A 'knowledge worker', for the purposes of dichotomous analysis later in this report, is one who is in a job where the cognitive skill score is above the average of all employed.

[2] By specific vocational preparation is meant the lapsed time required by a typical worker to learn the techniques, acquire the information, and develop the facility needed for average performance in the job. General education development is a measure of knowledge, whether acquired formally or informally, needed to perform the job in terms of reasoning, mathematics and language. See technical notes in the appendix for details.

Analytical approach and report outline

The preceding discussion has highlighted the problematic issues in defining skill and knowledge. This report follows the pragmatic lead of Elias and McKnight (2001) in stating that sufficient evidence has been provided here of a very high correlation between the cognitive ability required for a job and the ordinal skill ranking.

This empirical approach is two-pronged. First, changes in the occupational composition of employment between 1986 and 2001 are examined using Census data. The reason for using Census data is that it allows for a far more fine-grained examination of occupations than can be obtained from Labour Force Survey data. While the aggregate picture may reveal that knowledge work is increasing in importance, the nuance needs to be understood. This is the basis of chapter 2.

The second prong is an examination of longitudinal data to explore what happens to individuals over time. This involves using a unique data set, the 1997 Negotiating the Life Course Survey, which contains work and education histories for over 2000 people. This is the subject of chapter 3.

The final chapter discusses the implications of the preceding chapters for the vocational education and training system. These need to be teased out from what is a broad, whole-of-economy approach to employment and skill change.

2 A detailed look at occupational change, 1986–2001

This chapter begins with an empirical analysis of changes in employment data using the 1986 and 2001 Census, and a further explanation of the construction of the Australian Standard Classification of Occupations. ASCO is a hierarchical classification which permits analysis to be conducted at varying levels of aggregation. The classification is used in all Australian Bureau of Statistics (ABS) collections, and many other quasi-official, administrative and independent collections.

Box 1 illustrates the hierarchical structure of ASCO 2 (i.e. second edition), showing how the occupation is the building block. An occupation is defined as 'a collection of jobs which are sufficiently similar in their main tasks to be grouped together for the purposes of the classification' (Australian Bureau of Statistics 1997, p.5). There are 986 occupations which aggregate up to 340 unit groups, 81 minor groups, 35 sub-major groups and, finally, the now familiar nine major groups. Thus, parliamentarians and councillors form a discrete occupation, which when grouped with judges, magistrates and tribunal members form the unit group of legislators and government-appointed officials, one such unit group in the major group of managers and administrators. In this report the focus is principally at the unit group level (which, for shorthand, is referred to as occupation) and the major group level.

Box 1: Example of major, sub-major, minor and unit groups and occupations of ASCO 2

1 MANAGERS AND ADMINISTRATORS
- 11 GENERALIST MANAGERS
  - 111 GENERAL MANAGERS AND ADMINISTRATORS
    - 1111 Legislators and government-appointed officials
      - 1111-11 Parliamentarian or councillor
      - 1111-13 Judge
      - 1111-15 Magistrate
      - 1111-17 Tribunal member
      - 1111-79 In group but not elsewhere classifiable
    - 1112 General managers
      - 1112-11 General manager

Using occupational data from the Census

The two Censuses provide a different perspective on occupational change to that obtained from the monthly labour force survey. The very great advantage in using Census data is that analysts can explore occupational change at fine levels of detail—specifically, at the unit group level (what we call 'occupation' for shorthand). The sample sizes of the Labour Force Survey and other household surveys are too small to provide reliable estimates of employment by occupation except at highly aggregated levels.

There are some problems with using the Census data. First, occupational classifications change over time. In 1986, occupation was coded to ASCO 1 (i.e. first edition), while since 1996 it has been coded to ASCO 2. To analyse change a consistent coding frame is required. In making an assessment of change, this report sought to draw on the ordinal skill ranking introduced in the second edition. Thus, the 1986 data to ASCO 2 had to be converted. This required using the 1996 concordance matrix provided by the ABS when occupation was dual coded (i.e. to both ASCO 1 and ASCO 2). This means assuming the matrix ratios are stable over time, almost certainly untrue but the consequences of which are minor (i.e. it can be assumed that they are relatively stable over the ten-year period between 1986 and 1996).

Second, it should be noted that while people are placed into neat 'boxes', these boxes may well contain a good deal of variation in job content and responsibility—a glaring example would be shop managers (ASCO code 3311). Moreover, these boxes are of unequal size. For example, there are 67 different unit groups which make up the major group of tradespersons but only 34 which make up intermediate production and transport work, with the result that the 'average' occupation in the tradespersons group was around 15 200 compared with 19 400 for the intermediate production group.

Third, some people either leave blank or refuse to answer the relevant questions—as, indeed, they do in all kinds of surveys. In 1986, this accounted for 2.62% of those in employment. In 2001 the percentage was slightly lower at 2.47%. Given the consistency in measurement error, the simplifying assumption has been made that this can be treated as random and, therefore, ignored.

Fourth, as it is a self-completion questionnaire, details which are provided are often scantier than would be obtained from a personal interview. This means that some people cannot be categorised to their precise occupation, although they may be able to be assigned to a higher grouping. Overall, there were 324 300 people in 2001 who were not able to be categorised to unit group level. To deal with this problem an iterative process has been gone through, assigning those unclassified at a sub-level in proportion to the distribution of those who *have* been assigned at that sub-level. After this was done for all people coded to minor groups, it was then repeated at the sub-major group level, then finally at the major group level. (See the technical notes in the appendix for an example.) A similar process was followed for the 1986 data.

The end result of this preliminary data work is a data set of the occupational distribution of employment in 1986 and 2001, all of whom are assigned to unit group level with a consistent classification schema, ASCO 2. This data set was used to look at occupational change between 1986 and 2001, initially examining change at a highly aggregated level.

Aggregate change

Table 3 draws on the Census data to examine broad changes (i.e. at the major group level) in the occupational composition of employment between 1986 and 2001. Taking managers as an example, in 1986 they accounted for 8.9% of employment, rising to 9.5% of employment by

2001, an increase in their share of 0.5 percentage points (after rounding). In total, managerial jobs increased by 202 700. Of this amount, 44 400 can be attributed to their rising share of employment; that is, if employment across *all* occupations had grown by exactly the same percentage, the number of managerial jobs would have risen by 158 300. The additional sum (of 44 400) represents the contribution of the compositional shift.

Table 3: Change in the occupational composition of employment, 1986 to 2001

	Employment share 2001 Census	Employment share 1986 Census	Change in share	Change in employment	Change due to share effect
	%	%	%	('000s)	('000s)
Managers	9.5	8.9	0.5	202.7	44.4
Professionals	18.7	15.5	3.2	534.1	260.0
Associate professionals	12.0	11.1	1.0	274.0	77.9
Tradespersons	12.5	16.2	-3.7	-13.3	-301.2
Advanced service	4.2	5.2	-1.0	7.7	-84.5
Intermediate service	16.7	13.8	2.9	480.4	236.6
Intermediate production	8.1	10.0	-1.9	26.1	-150.6
Elementary service	9.5	8.9	0.6	208.1	50.9
Labourers	8.8	10.5	-1.6	52.3	-133.5
Total	**100.0**	**100.0**	**0.0**	**1772.1**	**0.0**

Source: Author's calculations based on 1986 and 2001 Census data

Employment grew most rapidly for professionals and for intermediate clerical, sales and service workers—between them, they account for roughly three in five of the (net) new jobs created over the past 15 years.

Tradespersons was the only major group whose number fell in absolute terms, by 13 300. The much more significant figure, however, is that in relative terms 301 200 jobs in this group were 'lost' as employment growth lagged behind the average. There was also a *relative* decline (i.e. a fall in the share of employment) in the employment of advanced clerical and service workers, intermediate production and transport workers, and labourers and related workers.

What do the changes say about knowledge work?

The results presented above are ambiguous about the thesis of expanding levels of knowledge work. True enough, the number of people employed as professionals and associate professionals expanded by over 800 000, but the number employed in intermediate and elementary service provision went up by almost 700 000.

The question posed in the heading can be answered more precisely by using the two 'tools' outlined in the previous chapter—the ordinal skill variable which underlies the ASCO framework, and the cognitive skill index developed by Pappas based on applying the Dictionary of Occupational Titles to Australian data. The results of this are shown in tables 4 and 5.

The first column of table 4 shows the change in employment share between 1986 and 2001 for the different skill levels. Thus, the highest skill group accounted for 24.4% of employment in 1986 and 28.2% in 2001. In the intervening 15 years the share of employment at this skill level had therefore grown by 3.8 percentage points. The increase in employment share of the top two skill groups is entirely offset by the 4.8 percentage point decline in employment in the middle skill group, made up of tradespersons and advanced service workers—as can be seen in table 3, nearly 400 000 jobs were 'lost' in this group by job growth lagging well behind average. In the two lower skill groups, there were small offsetting changes.

The data in table 4 broadly support an increasing knowledge work thesis, with the share of employment in the top two skill groups rising from 35.5% in 1986 to 40.2% in 2001, while the share of employment in the two lowest skill groups remained constant.

Table 4: Change in the skill composition of employment, 1986 to 2001 (%)

Skill level	1986 share of employment	2001 share of employment	Change in employment share
I	24.4	28.2	3.8
II	11.1	12.0	1.0
III	21.4	16.7	-4.8
IV	23.7	24.8	1.1
V	19.4	18.3	-1.0

Source: Author's calculations based on 1986 and 2001 Census data

Qualifying this statement is that much depends on how skill level III is regarded. The definition here (see table 1) suggests a level of skill commensurate with having completed an Australian Qualifications Framework Certificate III or IV (e.g. a traditional apprenticeship) or at least three years experience. Most of the studies investigating whether technical change is skill biased (where skill is defined in dichotomous terms) have treated these jobs as *unskilled*. One defence of this might be that such jobs require more in the way of motor skill than cognitive skill. However, when applying the Pappas scores—see table 2—we observe that the average cognitive skill required of tradespersons (6.03) lies above the average for all jobs (5.49), although the same is not the case for advanced clerical and sales workers (5.28).

A slightly different tack is taken in table 5, which shows how the average cognitive skill required at each level altered between 1986 and 2001. The main figure of interest here is the total figure which shows that the average cognitive skill score for all in employment rose from 5.40 in 1986 to 5.49 in 2001, a modest increase of 1.7%.[3] The relative loss of jobs in the middle of the skill distribution, where the average cognitive skill score lies *above* the average total score has, in conjunction with the relative expansion of jobs at the bottom of the skill distribution, offset the rise brought about by the expansion of jobs at the top.

Table 5: Change in the cognitive skill score of employment, 1986 to 2001 (employment weighted average)

Skill level	1986 cognitive skill score	2001 cognitive skill score	Change in cognitive skill score
I	8.26	8.29	0.03
II	6.29	6.35	0.06
III	5.89	5.84	-0.05
IV	4.41	4.36	-0.05
V	3.18	3.33	0.15
Total	**5.40**	**5.49**	**0.08**

Source: Author's calculations based on 1986 and 2001 Census data and Pappas (2001, appendix)

Taken together, the evidence from both of these tables suggests that across the employed workforce as a whole, there was a slight shift towards knowledge work. The more correct characterisation though is to point to the bifurcation (or 'hollowing out') of the skill distribution, which confirms the results of other studies not based on the Census. The real

[3] The 2001 figure may be biased downward because employment growth between 1986 and 2001 was stronger among those occupations for which there is no cognitive skill score, 54.4% roughly double the overall average of 27.9%. As these occupations are concentrated towards the higher end of the skill distribution, their non-inclusion might have the effect of lowering the average score. Any bias can be assumed, however, to be small—by assigning the average major group score to those occupations in the group with a missing value, the outcome remained the same, i.e. 5.49.

advantage of using the Census, however, is to examine change at a finer level of detail, which remaining sections in this chapter do.

Changes in leading occupations

Table 6 shows the 25 occupations which accounted for the most employees in 1986 and 2001, ranked according to their size in 2001. In 1986, these jobs accounted for 38.4% of all jobs, a figure which had risen to 40.5% in 2001.

The rankings show a reasonable amount of stability over the 15-year period, more so at the top where the three top employing occupations were the same rank in 2001 as they were in 1986. Indeed, those three occupations (sales assistants, secretaries and personal assistants and cleaners) accounted for more than one in ten of all jobs in 2001.

The result for general clerks requires explanation. In 1986 there was no 'general' clerk occupation, and people who identified themselves as clerks without providing any further detail were not assigned to a four-digit occupation. In 2001 people in this same situation appear to have been coded as general clerks. For comparative purposes, the 1986 figure should be regarded as wrong in substantially understating the number.[4]

A notable feature of table 6 is the spread of the top employing occupations across the skill levels. The most heavily represented were those in the highest skill group and those in the second lowest group, both with eight occupations each, but all skill groups were represented.

There were six occupations which had not featured in the top 25 employers in 1986, but which had risen to this status in 2001. Three were from the top skill group (computing professionals, sales and marketing managers and general managers), two were from the second lowest skill group (general clerks and waiters) and one from the second highest skill group (project and program administrators).

Among the remaining 19 occupations in the top 25 in 2001 there were eight which had moved up the rankings since 1986, three which had preserved their ranking, and eight which had fallen. Of those occupations moving up, three came from the highest skill group (registered nurses, primary school teachers and accountants), while five came from the lowest two skill groups (storepersons, receptionists, sales representatives, checkout operators and cashiers, and accounting clerks).

The 14 occupations which had fallen in rank—six slipping outside the top 25, and eight which had remained but at a lower rank—were spread across the skill groups. All four tradesperson occupations (motor mechanics, electricians, carpenters and metal fitters and machinists) that had been in the top 25 employing occupations in 1986 had slipped down or out of the list altogether by 2001.

Among the top-employing occupations there are two in 1986 and four in 2001 for which there is no cognitive skill score. Disregarding these occupations in both periods, no change was found (as with the aggregate analysis) of any note in the cognitive skill required among the top-employing occupations. In 1986 the employment weighted average score was 5.37, and this fell slightly to 5.32 by 2001.

[4] The ABS advises that, as a result of structural change in the labour market, 'applying a concordance may produce unlikely results for some occupations'. In this case, however, changes in coding procedures appear to be at fault. In 1986, there were 174 400 clerks assigned to code 5000, meaning they had been identifed as clerks but a lack of detail meant they could not be allocated to more precisely defined clerical occupations. In 2001, there were just 4500 unallocated intermediate level clerks. A clear inference to draw is that the 'new' occupation of general clerks had become a residual category for clerks where no further detail was provided on the nature of the work. If this is accepted, the 1986 estimate of just 1200 general clerks should be regarded as wrong. It also means that the 1986 estimates for other clerical occupations will be overstated (by about one-sixth) as the 174 400 clerks with no further description have been re-allocated among them in line with the procedure described in the technical notes in the appendix.

Table 6: Top employing occupations, 1986 and 2001

2001 Rank	Occupation	Skill level	Cognitive skill index	Employment 2001	Employment 1986	1986 Rank	Growth in employment ('000s)	Growth in employment (%)
1	Sales assistants	4	4.28	473 778	276 329	1	197.4	71.5
2	Secretaries & personal assistants	3	5.12	199 920	195 215	2	4.7	2.4
3	Cleaners	5	1.80	188 365	159 501	3	28.8	18.1
4	General clerks	4	4.90	171 336	1 201[a]	321	170.1	14 162.5
5	Shop managers	2	6.19	165 538	152 161	4	13.3	8.8
6	Registered nurses	1	7.70	144 852	118 774	7	26.1	22.0
7	Storepersons	4	2.35	129 910	91 774	11	38.1	41.6
8	Computing professionals	1	8.27	128 850	40 692	33	88.1	216.6
9	Primary school teachers	1	7.98	120 301	81 429	12	38.9	47.7
10	Truck drivers	4	3.64	116 828	101 770	8	15.1	14.8
11	Receptionists	4	4.90	115 657	72 123	18	43.5	60.4
12	Secondary school teachers	1	7.98	112 356	94 810	10	17.5	18.5
13	Accountants	1	8.83	109 522	58 824	25	50.7	86.2
14	Livestock farmers	1	na	106 914	126 687	6	-19.8	-15.6
15	Sales representatives	4	6.19	104 019	59 889	23	44.1	73.7
16	Sales & marketing managers	1	na	101 290	40 271	34	61.0	151.5
17	Office managers	2	5.12	100 247	73 288	15	27.0	36.8
18	Project & program administrators	2	na	92 131	23 884	60	68.2	285.7
19	General managers	1	na	91 618	33 557	44	58.1	173.0
20	Checkout operators & cashiers	5	5.79	88 863	58 857	24	30.0	51.0
21	Accounting clerks	4	5.50	84 931	61 603	22	23.3	37.9
22	Motor mechanics	3	6.52	84 894	77 976	14	6.9	8.9
23	Waiters	4	3.99	83 662	36 585	39	47.1	128.7
24	Kitchenhands	5	2.13	78 133	66 039	19	12.1	18.3
25	Electricians	3	7.54	76 802	73 019	16	3.8	5.2
26	Carpentry & joinery tradespersons	3	6.23	76 097	78 772	13	-2.7	-3.4
27	Metal fitters & machinists	3	7.25	74 876	99 478	9	-24.6	-24.7
28	Bookkeepers	4	5.50	72 642	72 171	17	0.5	0.7
32	Keyboard operators	4	5.12	60 246	129 577	5	-69.3	-53.5
34	Stock & purchasing clerks	4	5.57	55 796	62 564	21	-6.8	-10.8
36	Crop farmers	1	na	54 746	64 869	20	-10.1	-15.6

Notes: a See footnote 4.

Source: Author's calculations based on 1986 and 2001 Census data and Pappas (2001, appendix)

What comes out strongly from this analysis is the prosaic nature of much of the top 25 employing occupations, in *both* periods. The overall character of employment shows little change. Aside from computing professionals, it is doubtful whether any of the other occupations would immediately come to mind in conjuring images of work in the knowledge economy. There was, however, a fair bit of movement in and out of the list and up and down the rankings which suggests the need to change the focus to flows.

Fastest growing occupations

An alternative way of examining change is to identify the fastest growing occupations over the period. Table 7 presents information on the 25 fastest growing occupations in two separate ways, in terms of absolute growth and of percentage growth. The table does not rank the occupations, but lists them in ASCO order within major groups.

Each of the fastest growing occupations in absolute terms saw an expansion in employment numbers of at least 23 000 over the 15-year period. They are found at the top and bottom of the skill distribution, but not in the middle. The fastest growing of all were sales assistants and general clerks (but see footnote 4), followed in third place by computing professionals.

The fastest growing occupations in percentage terms all doubled in size between 1986 and 2001. Most were located at the top and middle of the skill distribution, in part because there are more discrete unit groups for professionals and tradespersons than there are at lower skill levels. That is, although many occupations did grow rapidly by this measure, in several cases they did so off a very low base—for example, wool, hide and skin classers grew from 403 persons in 1986 to 1310 in 2001.

Five occupations feature in both lists—one each from the professionals group (computing professionals) and associate professionals group (project and program administrators), and three from the intermediate service work group (general clerks, child-care workers, and special-care workers).

The table incorporates the cognitive skill score and this largely confirms our earlier analyses of growing occupations ranging across the spectrum in terms of knowledge work. It is also revealing, however, that well over half the occupations which are growing fastest in percentage terms have no direct read-across in the Dictionary of Occupational Titles. For some, this may be because the absolute numbers employed in that occupation are relatively low, but for others it may reflect their 'newness' as an emergent occupation (e.g natural therapists).

The occupations which have grown fastest in absolute terms are disproportionately made up of women and part-time workers. Of all in employment in 2001, 45.8% were women and 33.5% worked part time. Among the 25 occupations which had experienced the fastest growth in absolute terms, 62.4% were held by women, and 44.2% of these jobs were part time. Just over one in four of these jobs (27.0%) were held by men working full time, compared with 44.2% in the employed population as a whole in 2001. This is consistent with what we know from a range of other sources about the main parameters of job growth in past decades (Borland, Gregory & Sheehan 2001).

This list of fastest growing jobs concurs a little more with newspaper and popular accounts of job change, with 'symbolic analysts' such as those involved in marketing, advertising, business and organisation analysts, and financial dealers and brokers joining the ranks of computing professionals. Set against this is the much less-reported but very substantial increase in lower skilled service jobs, most of them involving part-time work. Between them, sales assistants and checkout operators and cashiers saw an additional 227 500 people in employment, taking the total in 2001 to 562 600 of whom 391 000 worked part time.

Table 7: 25 fastest growing occupations, 1986 to 2001 (ASCO code and cognitive skill score shown in parentheses)

Absolute growth		Percentage growth	
General managers (1112, na)	58 061	Human resource managers (1213, na)	290.8
Sales and marketing managers (1231, na)	61 019	Engineering managers (1221, na)	215.9
		Information technology managers (1224, na)	379.0
		Child care co-ordinators (1295, na)	193.6
Accountants (2211, 8.83)	50 698	Computing professionals (2231, 8.27)	216.6
Marketing and advertising professionals (2221, na)	26 852	Other business/information professionals (2299, na)	194.2
Computing professionals (2231, 8.27)	88 158	Natural therapy professionals (2394, na)	195.7
Human resource professionals (2291, 8.83)	30 594		
Business and organisation analysts (2294, 9.11)	26 741		
Registered nurses (2323, 7.7)	26 078		
Primary school teachers (2412, 7.98)	38 872		
Financial dealers and brokers (3212, 8.27)	24 683	Financial investment advisers (3213, 8.27)	281.4
Office managers (3291, 5.12)	26 960	Project and program administrators (3292, na)	285.7
Project and program administrators (3292, na)	68 247	Customer service managers (3392, na)	355.8
		Massage therapists (3494, na)	380.5
		Sportspersons, coaches and related workers (3993, 5.68)	229.2
		Library technicians (3997, 5.12)	280.0
		Other miscellaneous associate professionals (3999, na)	266.8
		General mechanical engineering trades (4111, 8.6)	1 568.9
		General fabrication engineering trades (4121, na)	6 628.3
		Wool, hide and skin classers (4613, 3.93)	225.4
		Defence force members nec (4991, na)	196.0
		Credit and loans officers (5912, 5.5)	258.3
General clerks (6111, 4.9)	170 135[a]	General clerks (6111, 4.9)	14 162.5
Receptionists (6131, 4.9)	43 534	Child care workers (6312, 2.86)	309.5
Accounting clerks (6141, 5.5)	23 327	Special care workers (6313, 2.86)	325.5
Inquiry and admission clerks (6191, 4.9)	37 843	Hospitality trainees (6324, na)	na[b]
Sales representatives (6211, 6.19)	44 130		
Education aides (6311, 5.01)	28 645		
Child care workers (6312, 2.86)	53 720		
Special care workers (6313, 2.86)	45 569		
Waiters (6323, 3.99)	47 077		
Storepersons (7993, 2.35)	38 135		
Sales assistants (8211, 4.28)	197 449	Office trainees (8116, na)	na[b]
Checkout operators and cashiers (8291, 5.79)	30 006	Sales and service trainees (8297, na)	278.8
Cleaners (9111, 1.8)	28 864		

Notes: a See footnote 4.
b There were no hospitality trainees or office trainees in 1986.
nec – not elsewhere classified.

Source: Author's calculations based on 1986 and 2001 Census data and Pappas (2001, appendix)

Within group changes

The final way to approach the issue of occupational change is to look more broadly at occupations which are growing or in decline. This is shown in table 8, with occupations grouped into major groups and ordered by ASCO code. Growing occupations are defined as those that grew by at least 25 000 or by 100% or more over the period, of which there were 81. Declining occupations are defined as those that fell in number, of which there were 84. These thresholds are somewhat arbitrary, but adequately capture the feel of the changes at both ends of the distribution.

What is most revealing about the table is that *all* major groups include occupations which are growing and declining, though the balance of whether there are more growing than declining is entirely consistent with the evidence presented thus far. For example, in the professionals group there were 26 occupations which had grown by at least 25 000 persons or 100%, while only three occupations had declined. In contrast, tradespersons saw 26 occupations in decline and just four where numbers had grown by the threshold levels.

Within the groups there are some interesting observations that can be made. The numbers of managers grew strongly across most minor groups, with the one exception of farmers where each occupation within the minor group saw a decline in numbers over the period. It was among professionals where there was a large number of growing occupations, but this was not entirely uniform. Only one of the 15 occupations involving science, building and engineering featured among those growing by the threshold level, compared with eight of the 12 business and information occupations. Several specialist health professions and artistic professions grew by more than 100%, in many cases off quite low bases (e.g. speech pathologists and authors). Many of these jobs have very high concentrations of female workers—indeed, in 2001 women held 59% of the jobs in the list of growing professional occupations.

Among associate professionals, there were also more occupations growing than there were in decline. Occupations involving building or engineering either grew modestly or declined in number, but most involving business or administration work grew substantially. It is also interesting to note that those occupations involving health or welfare did not feature as they did among their more professional counterparts. While registered nurses grew by 22%, enrolled nurses *fell* by 32%, an emblematic example of the shift towards higher skills within fields of service delivery.

Tradespersons present an opposite picture to that of other major groups thus far discussed, with the number of declining occupations far exceeding that of growing occupations. The decline was evident across all sub-major and minor groups, and is a depressing catalogue of skill wastage. In several occupations employment in 2001 was down by more than a third on what it had been in 1986. This was the case for sheetmetal workers, metal casters, metal finishers, vehicle body makers, electrical distribution workers, graphic typesetters, wood machinists, footwear makers and power generation plant operators.

The major group of advanced clerical and service workers saw only one occupation increase in number by the threshold level (credit and loans officers), while two declined. The decline in the numbers of desktop publishing operators, from 3149 in 1986 to 1909 in 2001, is difficult to reconcile with the growing use of computing technology. However, as with the example of nurses above, the decline here may be offset by gains at higher skill levels (e.g. designers and illustrators rose from 13 348 to 36 309).

For intermediate clerical, sales and service workers, there have been a considerable number of growing and declining occupations. What is most interesting about the occupations in decline is that with the exception of hotel service supervisors, they are all clerical occupations. In contrast, the growing occupations in this group are predominantly those to do with service work.

Table 8: Growing and declining occupations, 1986 to 2001 (figure in parentheses indicates absolute growth)

Major group	Growing occupations	Declining occupations
Managers	Legislators & government appointed officials (2886)	Mixed crop and livestock farmers (-8632)
	General managers (58 061)	Livestock farmers (-19 772)
	Human resource managers (18 789)	Crop farmers (-10 122)
	Engineering managers (8 343)	Aquaculture farmers (-383)
	Production managers (15 020)	
	Supply and distribution managers (12 637)	
	Information technology managers (23 248)	
	Sales and marketing managers (61 019)	
	Education managers (11 891)	
	Child care coordinators (4587)	
	Media producers & artistic directors (3686)	
	Other specialist managers (19 356)	
Professionals	Environmental & agrict. science professionals (10 924)	Chemists (-1060)
	Accountants (50 968)	Registered development disability nurses (-342)
	Corporate treasurers (772)	Sea transport professionals (-299)
	Marketing and advertising professionals (26 852)	
	Computing professionals (88 158)	
	Human resource professionals (30 954)	
	Business and organisation analysts (26 741)	
	Property professionals (5940)	
	Other business and information professionals (9714)	
	Registered nurses (26 078)	
	Speech pathologists (1734)	
	Dietitians (1230)	
	Natural therapy professionals (2561)	
	Other health professionals (2550)	
	Primary school teachers (38 872)	
	Special education teachers (7301)	
	English as a second language teachers (3477)	
	Welfare and community workers (16 278)	
	Counsellors (8020)	
	Psychologists (5826)	
	Urban and regional planners (3175)	
	Designers and illustrators (22 961)	
	Authors and related professionals (2507)	
	Film, television, radio and stage directors (3821)	
	Actors, dancers and related professionals (3724)	
	Other professionals (5327)	
Associate professionals	Medical technical officers (10 258)	Civil engineering associate professionals (-1182)
	Financial dealers and brokers (24 683)	Electronic engineering associate professionals (-9728)
	Financial investment advisers (15 654)	Mechanical engineering assoc professionals (-1928)
	Office managers (26 960)	Branch accountants and managers (-2567)
	Project and program administrators (68 247)	Sports and recreation managers (-415)
	Customer service managers (22 787)	Enrolled nurses (-9070)
	Welfare associate professionals (11 752)	
	Massage therapists (3989)	
	Sportspersons, coaches & support workers (13 008)	

Major group	Growing occupations	Declining occupations
	Senior non-commissioned defence force officers (1648)	
	Library technicians (4569)	
	Other miscellaneous associate professionals (6648)	
Tradespersons	General mechanical engineering tradespersons (4036)	Metal fitters and machinists (-24 602)
	General fabrication engineering tradespersons (1388)	Toolmakers (-1849)
	Wool, hide and skin classers (907)	Precision metal tradespersons (-834)
	Defence force members not elsewhere included (7273)	Structural steel and welding tradespersons (-3735)
		Forging tradespersons (-569)
		Sheetmetal tradespersons (-4678)
		Metal casting tradespersons (-1201)
		Metal finishing tradespersons (-1045)
		Panel beaters (-1743)
		Vehicle body makers (-1619)
		Electrical distribution tradespersons (-4113)
		Electronic instrument tradespersons (-11)
		Communications tradespersons (-9476)
		Carpentry and joinery tradespersons (-2674)
		Bricklayers (-2354)
		Meat tradespersons (-3333)
		Shearers (-238)
		Graphic pre-press tradespersons (-5540)
		Printing machinists and small offset printers (-1790)
		Binders and finishers (-359)
		Screen printers (-3)
		Wood machinists and turners (-1699)
		Clothing tradespersons (-861)
		Upholsterers and bedding tradespersons (-421)
		Footwear tradespersons (-1794)
		Power generation plant operators (-2431)
Advanced clerical and service workers	Credit and loans officers (14 759)	Insurance agents (-3201)
		Desktop publishing operators (-1240)
Intermediate clerical, sales & service workers	*General clerks (170 135)*	Keyboard operators (-69 331)
	Receptionists (43 534)	Money market and statistical clerks (-2537)
	Inquiry and admissions clerks (37 843)	Production recording clerks (-1677)
	Sales representatives (44 130)	Stock and purchasing clerks (-6768)
	Education aides (28 645)	Library assistants (-8417)
	Children's care workers (53 720)	Personnel clerks (-1388)
	Special care workers (45 569)	Hotel service supervisors (-90)
	Waiters (47 077)	
	Hospitality trainees (870)	
	Veterinary nurses (2957)	
	Gaming workers (3534)	
	Personal care consultants (10 060)	
	Fitness instructors (7896)	

Major group	Growing occupations	Declining occupations
Intermediate clerical, sales & service workers (cont.)	Travel and tourism agents (13 735)	
	Other intermediate service workers (8976)	
Intermediate production and transport workers	Chemical production machine operators (1661)	Mobile construction plant operators (-3211)
	Paper products machine operators (2425)	Engine and boiler operators (-2616)
	Glass production machine operators (1031)	Crane, hoist and lift operators (-4247)
	Other intermediate machine operators (7485)	Engineering production systems workers (-3472)
		Pulp and paper mill operators (-287)
		Other intermediate plant operators (-4374)
		Sewing machinists (-8704)
		Textile and footwear machine operators (-2179)
		Train drivers and assistants (-2947)
		Blasting workers (-122)
		Structural steel construction workers (-159)
		Product quality controllers (-2776)
		Seafarers and fishing hands (-2068)
		Forestry and logging workers (-2984)
		Printing hands (-2330)
Elementary clerical, sales and service workers	Office trainees (2198)	Registry and filing clerks (-5626)
	Sales assistants (197 449)	Switchboard operators (-348)
	Checkout operators and cashiers (30 006)	Other elementary clerks (-5503)
	Sales and service trainees (1950)	Street vendors (-610)
		Sales demonstrators and models (-726)
		Caretakers (-1923)
		Laundry workers (-199)
Labourers and related workers	Cleaners (28 864)	Engineering production process workers (-6668)
	Packagers and container fillers (6349)	Meat and fish process workers (-6647)
	Handypersons (13 875)	Wood products factory hands (-6012)
		Other process workers (-1057)
		Mining support workers and driller's assistants (-887)
		Earthmoving labourers (-1036)
		Paving and surfacing labourers (-3155)
		Survey hands (-1914)
		Railway labourers (-4952)
		Construction and plumber's assistants (-712)
		Electrical & telecomm. trades assistants (-1564)
		Food trades assistants (-2536)
		Garbage collectors (-114)
		Freight and furniture handlers (-598)

Notes: Growing=absolute increase of 25 000 and/or 100%, italics=both.
Declining=absolute decline.

A large part of the explanation here is the computerisation of clerical functions. For example, the decline in the number of production recording clerks and stock and purchasing clerks is most likely attributable to the computerisation of inventory flows, such as bar code scanning.

Similarly, the very substantial decline in the number of keyboard operators can be attributed to the rapid take-up of desktop computers, which has helped to make typing pools obsolete as office workers of all skill levels have developed their own keyboard skills. Another explanation is that technology has complemented the delivery of higher quality service provision, as in library technicians and human resource managers growing in number while library assistants and personnel clerks have been on the wane.

The number of intermediate production and transport occupations that declined easily outnumbered those where employment grew by 100% or more. Six of the eight occupations which make up the sub-major group of plant operators declined. In contrast, four of the nine occupations which make up the minor group of miscellaneous intermediate machine operators all increased in number by at least 100% and none of the remaining five declined. This is notable because it offsets the decline in the number of tradespersons. For example, wood machinists and turners fell from 5382 to 3683 at the same time as wood processing machine operators rose from 5468 to 7391. What may be happening within manufacturing, counter to the examples provided above of advancing professionalisation in some service industries, is a general deskilling whereby technological advances in machining (e.g. CADCAM) allows employers to substitute semi-skilled for skilled labour.

The situation of elementary clerical, sales and service workers is somewhat similar to those at the intermediate level. Occupations in decline are mostly, but not exclusively, on the clerical side, while expanding occupations are on the sales and service side.

The final major group is labourers and related workers, among which there are many examples of occupations in decline. Most of these are in occupations concentrated in manufacturing, construction and mining. The substantial rise in cleaners and handypersons is consistent with growing numbers of waiters, massage therapists and fitness instructors in illustrating the diversity of new service jobs, and which collectively might be characterised as the product of affluence.

Conclusion

The information provided here gives a richer account of occupational change than can be gained from analyses of the labour force survey. What can be learnt from it?

First, the information is entirely consistent with those accounts showing a large relative expansion of jobs that are high skilled and those that are low skilled, specifically professionals and intermediate clerical, sales and service jobs. Second, while high-skilled jobs have expanded in number, it remains the case that the occupations which employ the greatest numbers of people are, generally, lower skilled. In the top 25 employing occupations there are just eight at the highest skill level. Third, these two findings come together when the most rapidly growing occupations are examined. Professional and intermediate clerical, sales and service occupations account for 16 of the fastest growing (in absolute terms) 25 occupations. Fourth, this broad pattern of growth in high-skilled and low-skilled jobs must be qualified. There are plenty of counter-examples of high-skilled and low-skilled occupations in decline, just as there are examples of jobs in the middle of the skill distribution which have grown. Some of these are suggestive of an underlying pattern of structural change within particular sectors—examples provided above included nursing, the human resource function, the demise of the typist and the role of machines in manufacturing. Some are consistent with the introduction of new technologies, especially the desktop computer, while others are consistent with a shift towards greater professionalism, especially in service delivery. Counter to that, there may be a deskilling trend in manufacturing, with machines and semi-skilled labour substituting for skilled trades work.

This study of Census data has limitations, the main one being that it captures just two points in time, and does not reveal anything much about the dynamics of change, or the drivers of it. To do that requires longitudinal data. The next chapter examines occupational change across the life course using such data.

3 Occupational change: An analysis of work and education histories

This chapter moves from the aggregate and net picture of change revealed by the Census to focus on what has happened to individuals. To do this a micro-data set showing the paths that individuals follow over time needs to be accessed. This will also help to address a number of questions that remain outstanding from the overview of issues in chapter 1.

Negotiating the life course

The data source for this chapter is the first wave of the Negotiating the Life Course Survey, conducted in 1997. It is among the first general population longitudinal surveys conducted in Australia. It was initiated by a group of Australian National University researchers frustrated at the lack of such data in Australia, a situation in contrast with many other countries.[5]

As is common in longitudinal surveys, the first wave was used to construct retrospective work and education histories, by asking respondents to recall episodes of work and of education dating back to the time that they were 15 years old. For each year since they had turned 15, people were asked to state whether they were working full time, part time or not at all, and whether they were studying, again full time, part time or not at all. Figure 1 presents an illustrative example. It shows that the person turned 15 in 1978, at which time he was working part time and studying full time. Between 1978 and 1997, he spent nine years in full-time work, seven years in part-time work and four years not working. In the same period he has also spent ten years in full-time study, three years in part-time study and seven years doing no study. There is only one year in which the person was neither working nor studying. This work and education history can be embellished with a lot of other information about the person. Besides standard demographic information, data reveal the level of schooling attained, post-school qualifications obtained, and up to four occupations in which the person may have worked.

It should be evident from this example that the data are at once highly informative but also quite constrained. For example, figure 1 shows that there are frequent changes in employment status, allowing a variety of measures of employment 'turbulence' to be constructed. However, it cannot categorically be said if these involved a change in job or not (e.g. the 1988 shift from part-time to full-time working). It is also not clear that there has been no change in employment in circumstances where status remains constant from one year to the next, e.g. a direct move from one full-time job to another. Short spells of unemployment (more strictly, not working) will also be missed as a person's status in any given year is what they were doing for *most* of the time. Most importantly, while a good deal of supplementary information about occupations worked in is known, these cannot be tied to particular points in time.

[5] Many other countries have had general population longitudinal surveys in place for many years, (e.g. British Household Panel Survey). In 2001, the Department of Family and Community Services provided the first batch of funding for a large-scale general population longitudinal survey known as 'HILDA' (the Household Income and Labour Dynamics in Australia survey).

Figure 1: An example of a work and education history

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Work	B15	B15	B15	B15	B15	B15	B15	PT	NW	NW
Education	B15	B15	B15	B15	B15	B15	B15	FT	FT	FT
	1981	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**
Work	FT	FT	NW	PT	PT	PT	PT	FT	FT	FT
Education	PT	PT	NS	FT	FT	FT	FT	NS	NS	PT
	1991	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**			
Work	FT	FT	NW	PT	PT	FT	FT			
Education	NS	NS	FT	FT	FT	NS	NS			

Key: B15=below 15, FT=full-time, PT=part-time, NW=not working, NS=not studying

It must also be acknowledged that retrospectively collected histories are prone to error in recall and are therefore inferior to longitudinal data which has been gathered over time.[6] While retrospective data of this kind are considered to be generally reliable enough for research purposes, it is also said to be the case that recall errors increase with the duration of the period being recalled (Dex 1992). A simple test of accuracy of data was conducted by comparing employment population ratios for different birth cohorts by sex for three different years: 1975, 1985 and 1995. These years were chosen to correspond to historical time series data available from the Labour Force Survey conducted by the Australian Bureau of Statistics. That is, those born between 1941 and 1950 were aged between 25 and 34 years in 1975. From the Negotiating the Life Course Survey, the employment population ratio for that cohort in 1975 can be calculated and compared with published ABS data in that year for 25–34 year olds. On the part of both men and women, those participating in the Negotiating the Life Course Survey consistently reported higher employment population ratios than in the Labour Force Survey. The degree of over-statement was higher among women. There was greater correspondence with the Labour Force Survey results in 1995 than in 1975, but older birth cohorts showed no greater tendency to diverge from these in the earlier time periods. In other words, the slight recall bias was evident for all cohorts.

A work history overview

A little over 2200 people took part in the first wave of the Negotiating the Life Course Survey. As is to be expected, many of those who did take part were not in work at the time of the survey. As this study is largely concerned with people who are in work, the most appropriate restrictions on the analysis had to be chosen. First, people who were not working when surveyed were removed.[7] Second, a view was taken on those whose primary activity was something other than working, but who were working part time. A common example of this is mothers who withdraw from full-time work to have and raise children, and who are working part time, often in lower status jobs than they had previously held (Dex 1987). Another is high school, TAFE and university students working part time in mostly casual jobs while they complete their studies. This project sought to follow people's career trajectories by looking at occupational change over time. The point of comparison against the '*present*' job is the '*first main job*, not including any part-time jobs you had while studying'. The sample was therefore restricted to one of those who had fully entered the labour market; that is, they had abandoned

6 One advantage they *do* have over data collected longitudinally is greater consistency in the use of coding frames and coding standards. The risk of spurious occupational change, due to the same job being coded to two different occupations over time, is much reduced.

7 Only 1% of the sample had never been in paid employment. The survey data might well be a useful resource for those wanting to study the reasons why people are not in the labour force.

full-time study at some stage since turning 15. This left a sample of 1688 persons. The sample was equally split between men and women, who ranged in age from 15 to 55 years.[8]

Table 9 summarises the work history of these people by sex and by birth cohort. A very high proportion, 74%, had at some stage not been employed since turning 15 years old. This figure conflates three principal factors: those who had been engaged in full-time study beyond compulsory schooling but have since entered the labour market;[9] those who have been unemployed; and mothers engaged in the full-time care of young children. On average, people had spent 19.0 years in employment and 3.8 years where they were not employed. There were large differences by sex and by age. Men born before 1971 had spent on average more years in (paid) work, and less years not in (paid) work, than women of the same age. Older persons, unsurprisingly, had many more years work experience than younger persons—though, for men, there was no difference for those born before 1971 in the average number of years where they had *not* been employed.

Two other measures of employment 'turbulence' are reported. The first is the average number of 'jobs' held. It should be clear from the foregoing discussion that the survey questionnaire did not allow the precise number of jobs held to be identified. The best that can be done is to equate changes in employment status (i.e. between full-time work and part-time work and vice versa, and from non-employment to employment) as tantamount to a change of jobs. This measure will clearly understate the true level of average jobs held. The second measure is the average number of occupations held, which is 'right censored' at four.[10] Most respondents, 86%, reported fewer than four occupations.

The average number of 'jobs' held over the lifetime was 3.1, and the average number of occupations where people had been employed for at least 12 months in each was 2.4. Women had a higher average number of jobs than men, no doubt reflecting the greater 'turbulence' in their work experience due to episodes of leaving the workforce to have, and rear, children. There was no difference between men and women in the number of occupations in which they had worked. Finally, older workers had, on average, held more jobs and worked in more occupations than younger people.

Table 9: Work history summarised, by sex and birth cohort

	Ever not been employed (%)	Average no. of years employed	Average no. of years not employed	Average no. of 'jobs' held	Average no. of occupations held
Men					
1971–80	58	6.3	1.6	2.2	1.8
1961–70	65	14.4	2.2	2.7	2.3
1951–60	61	24.2	2.1	2.9	2.5
1941–50	59	33.3	2.2	2.9	2.7
Women					
1971–80	62	6.4	2.0	2.4	1.9
1961–70	85	13.6	3.6	3.3	2.3
1951–60	90	20.0	6.4	3.7	2.6
1941–50	93	26.7	9.1	3.8	2.6
Total	**74**	**19.0**	**3.8**	**3.1**	**2.4**

Note: Base – Australians aged 15–55 in 1997 working post-labour market entry. N=1688
Source: Negotiating the Life Course Survey 1997

[8] People aged 56 years or more in 1997 were not included in the scope of the survey.

[9] This is either 15 or 16 years in Australia depending upon the state/territory of residence.

[10] Besides the 'present job' and the 'first main job', up to two other occupations where the respondent had worked for 12 months or more over the course of their working life could be included.

An education history overview

As seen in figure 1, a retrospective education history is compiled for each respondent. We can use that to construct a range of measures of education history. 'Education' encompasses any study leading to a formal qualification—it therefore does not include job-related training, whether provided by an employer or undertaken at an individual's own behest *unless* it leads to a formal qualification. The survey also asked respondents whether they held any post-school qualifications, then sought details on the first obtained after leaving school and when that was completed, followed by the 'highest' qualification obtained and when that was completed. These qualifications are coded to the prevailing (in 1997, since updated) classification of educational qualifications—holders of VET qualifications are those with either a 'basic' or a 'skilled' vocational qualification. The main features of respondents' education history are summarised in table 10.

As with the work histories, there are substantial differences between men and women, and between people of different ages. Older men are more likely than older women to have post-school qualifications, and they appear to have done so through part-time study rather than full-time study. The average number of years in full-time education beyond the age of 15 was largely invariant across sex and birth cohort, but men spent more years in part-time study than women for all birth cohorts except the youngest. Relatively few people (8%) reported that they had no engagement with the education system beyond the age of 15, and where this was the case they were more likely to have been older. The opposite applied to those with more than one post-school qualification. Just 2% reported that they had more than one qualification, and this was very largely confined to younger people.

One in four (24%) of all respondents who had fully entered the labour market stated that their *highest* qualification was a vocational one. This compares well with official statistics showing 23% of those employed (excluding those still at school) in May 1997 (ABS cat.no 6227.0) to have a vocational qualification.

Table 10: Education history summarised, by sex and birth cohort

	No study after turning 15 (%)	Average no. of years in full-time study over 15	Average no. of years in part-time study over 15	Any post-school qualifications (%)	More than one post-school qualification (%)
Men					
1971–80	5	3.2	0.9	42	5
1961–70	6	3.8	2.1	63	2
1951–60	8	3.5	2.9	70	1
1941–50	14	3.5	3.7	72	1
Women					
1971–80	4	4.0	0.9	60	8
1961–70	5	3.9	1.3	61	2
1951–60	7	3.6	2.0	63	1
1941–50	14	3.4	1.7	61	0
Total	**8**	**3.7**	**2.1**	**61**	**2**

Note: Base – Australians aged 15–55 in 1997 working post-labour market entry. N=1688
Source: Negotiating the Life Course Survey 1997

In four out of five cases (79%) the vocational qualification was obtained *after* the person had entered the labour market—that is, after they had first commenced full-time work or abandoned full-time study. This was a slightly higher proportion than among those with other kinds of post-school qualifications—for example, 73% of degree holders completed their degree after having entered the labour market.

Table 11 shows educational attainment by birth cohort, and it contains a number of salient findings for this project. First, there are substantial gender differences. Younger women have higher educational attainment than younger men, but the reverse is true for older women. For example, among men born since 1971 there are 31% who did not complete 12 years of school, compared with only 14% of women of the same age.[11] Second, there are age differences in attainment. Older persons, of either sex, are more likely to have a degree (or better), though the difference is most pronounced with those born since 1971. With vocational qualifications, the opposite holds for women—that is, younger women are more likely to have obtained a vocational qualification than older women. This does not hold for men.

There are two factors at work here—one is that older people have had more time than younger people in which to gain post-school qualifications; the other is changes over time in the likelihood of acquiring post-school qualifications. These can partly be separated by identifying the proportion who had gained any post-school qualification before a given age by birth cohort. The results of this are shown in figure 2 using 25 years as the threshold. This shows clearly that the likelihood of acquiring post-school qualifications has become higher among more recent age cohorts.[12] For example, among those born between 1941–50 of whom two in three have a post-school qualification, 44% had attained this level by the time they were 25 years old. In contrast, 62% of those born between 1961–70 have a post-school qualification, but 53% had done so at 25 years of age. In other words, the higher educational attainment among older people is artificial, that is to say it is an age effect. Younger people are, on the whole, better educated at this stage in their lives than were those of earlier generations. The difference is less marked for vocational qualifications as these tend to be completed relatively early in people's working lives.

Table 11: Educational attainment, by sex and birth cohort

	Degree or higher	Diploma/ other	Skilled/basic vocational qualification	Completed secondary school	Did not complete 12 years school
Men					
1971–80	11	6	26	27	31
1961–70	26	8	29	18	19
1951–60	30	7	33	11	19
1941–50	36	10	26	5	23
Women					
1971–80	21	14	25	26	14
1961–70	34	8	20	19	20
1951–60	34	13	16	14	23
1941–50	35	8	18	7	31
Total	**30**	**9**	**24**	**15**	**22**

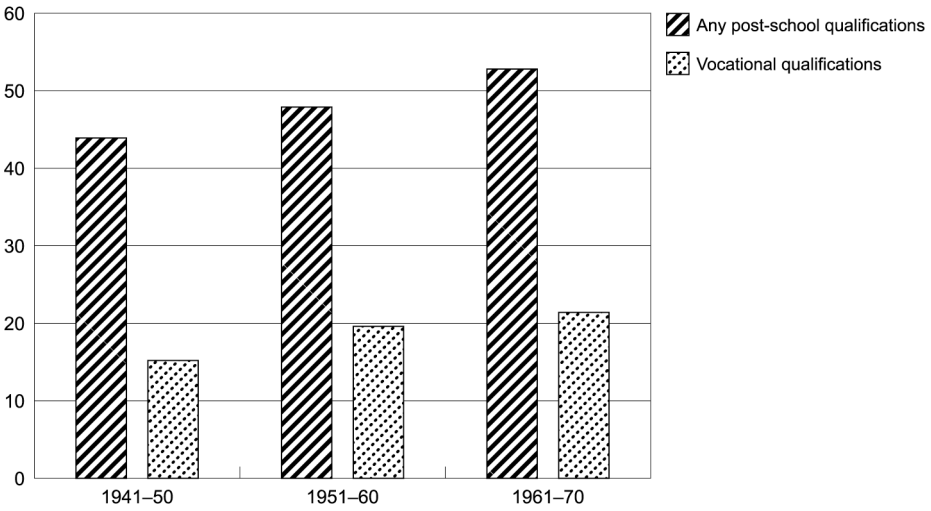
Note: Base – Australians aged 15–55 in 1997 working post-labour market entry. N=1688

Source: Negotiating the Life Course Survey 1997

[11] Note also that the sample is of employees who have 'fully entered' the labour market. This means those born since 1971 who moved from full-time secondary to tertiary education are *not* included. The effects of this education on labour market opportunity cannot yet be observed, and caution is required in drawing any inferences from these results.

[12] The 1971–80 birth cohort was excluded from this analysis as most were below the age of 25 when surveyed.

Figure 2: Whether obtained first post-school qualification before age 25, by birth cohort (%)



Note: Base – Australians aged 15–55 in 1997 working post-labour market entry. N=1688
Source: Negotiating the Life Course Survey 1997

Around two in five (38%) of those whose highest qualification was a vocational one completed it before they turned 20 years of age, compared with 24% of those whose highest qualification was a diploma and just 4% for those with a degree. These results are also reflected in the average age for completion of qualifications. The average age at which people obtained vocational qualifications was comparatively young, 22.8 years compared with 25.1 years for those whose highest qualification was a diploma and 27.4 years for those with a degree.

Occupational mobility over the life course

Despite the limitations of the work history data, it is possible to gain some broad understanding of the question of whether chances have improved over time by looking at lifetime occupational transitions. This can be done by comparing the first 'main' job held and the present job held, both of which are coded using ASCO 2. A summary figure (figure 3) shows the occupational distribution at the two different points in the life cycle. The underlying changes are shown overleaf in a matrix (table 12).

It is plainly evident from the figure that there has been an 'upskilling' over people's lifetimes. Just 2% began their working careers as managers, while 10% were employed as managers when surveyed. Similarly, one in five started off in a professional job, and that proportion had risen to one in four when surveyed. There are corresponding changes at the other end of the skill distribution where 22% began work in some elementary service or labourer capacity, but at the time of the survey this had fallen to 13%.

Table 12: Current occupation by first main occupation (%)

Current occupation	**First main occupation**									**% employed in that occupation as their current occupation**
	Managers	Prof.	Assoc. Prof.	Trades	Advanced service	Intermed. service	Intermed. production	Element. service	Labourers	
Managers	14	20	7	18	3	20	2	7	10	10
Professionals	2	57	5	5	3	17	2	7	3	25
Associate professional	1	9	16	21	4	27	4	14	5	13
Tradespersons	2	2	2	68	2	5	5	5	9	11
Advanced service	1	10	8	6	23	33	3	15	3	5
Intermediate service	0	7	4	7	6	49	4	20	3	16
Intermediate production	2	3	2	31	1	8	22	7	26	6
Elementary service	0	2	2	11	7	19	6	44	8	7
Labourers	0	2	0	19	6	15	8	18	33	7
Total	**2**	**20**	**6**	**18**	**5**	**23**	**5**	**13**	**9**	**100**

Note: Base – Australians aged 15–55 in 1997 working post-labour market entry. N=1688
Each row sums to 100%.

Figure 3: Current occupation and first main occupation (%)

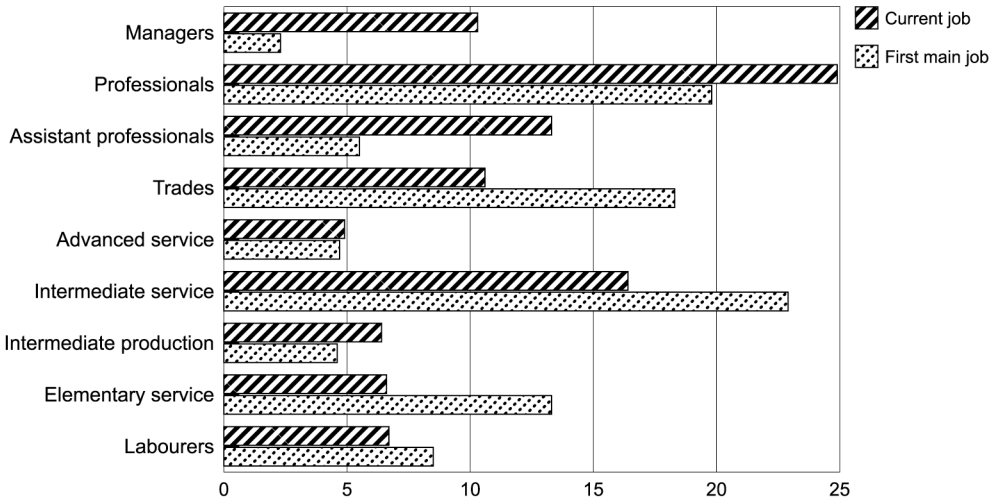


Table 12 provides details on the direction of the intra-occupational changes. Each row shows for a given current occupation what the starting occupation was—for example, among those who were managers when surveyed, 14% began their careers as managers, 20% as professionals, 7% as associate professionals, and so on. We can see from the table that there is a relatively high degree of occupational stability at the major group level—the 'diagonals' where there has been no change are especially high for professionals (57%), tradespersons (68%), intermediate clerical, sales and service (49%) and elementary clerical, sales and service (44%). It is least pronounced for managers (14%) and associate professionals (16%).

There are some revealing intra-occupation mobility movements highlighted in the table. The ranks of present managers are filled with people from all sorts of starting positions. There is relatively little advancement from intermediate production jobs and labourer positions through to tradespersons. This, together with the high degree of stability for tradespersons, suggests that apprenticeships (i.e. 'junior' tradespersons) remain the major pathway to this kind of work. However, in the production sphere more generally, there was considerable upward movement from unskilled labourers' posts to intermediate (or semi-skilled) production posts, with 26% coming from this source. The same type of movement is evident in clerical, sales and service jobs. For advanced clerical posts there was considerable upward movement from the ranks of intermediate clerical and service jobs (33%). Similarly, people starting in elementary clerical, sales and service posts moved disproportionately into the intermediate level (20%).

It is also apparent that there has been a reasonable degree of downward mobility. This is most pronounced among tradespersons. In their first main job, 18% of employees identified themselves as tradespersons, but when surveyed this had fallen to 11% in their current job. Where had these people gone? About one in five had 'slipped a rung' to now find themselves working in intermediate production jobs, while an additional one in ten were working as labourers.

This makes up the picture of aggregate change. The next step is to examine what happened at an individual level, by looking at the extent of any occupational movement. There are three different definitions, moving from narrow to broad:

- ✧ people who changed occupations over the course of their working lives (986 occupations)

✧ people who changed from one broad grouping to another (9 groups)

✧ people who changed their occupational skill ranking (5 skill levels)

The results are shown in table 13. It reveals a very substantial amount of occupational movement experienced by individuals at each of the different levels examined. In fact, 84% of people have changed occupations between their first main job and their present one—this is not so surprising considering that there are 986 categories. However, in seven out of ten cases (i.e. 59/84), this change involved a shift from one broad grouping to another. It is also revealing that most of these second kind of changes—nine out of ten—also involved a change in the broad skill ranking. The overall consequence is that over half, 53%, have moved up or down the occupational skill ranking over the course of their working lives. Unsurprisingly, the older the person the more likely they are to have experienced occupational movement. The only exception to this general pattern is among women born between 1941–50. Across birth cohorts, women have a highly similar experience of occupational movement to men.

It is important to focus more closely on the last of these indicators of occupational change, as this is suggestive of a high degree of mobility.

In table 14 the *net* change in the occupational skill ranking is shown. Each cell measures the percentage point change in the proportion employed in that skill ranking between the first main job and the one currently held. Taking the first cell as an example, 9% of men born between 1971 and 1980 worked in the highest skill ranking in their first main job. In their present job, 13% now work in one of these jobs, a net rise of four percentage points. Across each row, the percentage change sums to zero as the table is summarising the changing composition of employment within the cohort.

The table shows, consistent with the aggregate picture, a net effect of upward mobility over time. Overall, the proportion working in the most highly skilled jobs increased by a net 13 percentage points when comparing their first job with their present job. The proportion in the second skill ranking also increased by 8 percentage points. This combined 21 percentage point rise was offset by net falls in the proportion of those working in the bottom three skill rankings.

Table 13: Extent of occupational change between first main job and present job, by sex and birth cohort (row %)

	Change of occupation	Change at major group level	Change of broad skill level
Men			
1971–80	77	43	40
1961–70	85	59	54
1951–60	89	65	59
1941–50	93	70	61
Women			
1971–80	65	42	36
1961–70	80	52	49
1951–60	86	66	59
1941–50	85	61	56
Total	**84**	**59**	**53**

Note: Base – Australians aged 15–55 in 1997 working post-labour market entry. N=1688

Source: Negotiating the Life Course Survey 1997

Table 14: Net change in occupational skill ranking between first main job and present job, by sex and birth cohort (percentage points)

	I	II	III	IV	V
Men					
1971–80	+4	+2	-17	+8	+2
1961–70	+17	+6	-6	-4	-12
1951–60	+22	+8	-20	-1	-9
1941–50	+18	+14	-17	-6	-10
Women					
1971–80	+2	+8	-2	+1	-9
1961–70	+12	+4	+1	-6	-13
1951–60	+7	+11	-1	-12	-5
1941–50	+9	+8	-5	-6	-7
Total	**+13**	**+8**	**-8**	**-5**	**-9**

Note: Base – Australians aged 15–55 in 1997 working post-labour market entry. N=1688
Source: Negotiating the Life Course Survey 1997

The 'gains' were made by both men and women, but were considerably greater for older men. For younger men, the overall change was ambiguous, as the proportion in the middle skill ranking had fallen by a net 17 percentage points, offset by net increases at the top and bottom of the skill hierarchy.

Net changes disguise the gross changes in both directions, which can also be established. Table 15 separates out the net effect to show the actual incidence of changes in skill ranking between the first and present occupation. Again consistent with the broad picture, the general trend is unambiguously one of upskilling over time: 38% of people had moved up the skill ranking between their first and present job, 47% had not changed their skill ranking, while 16% had seen a fall in their skill ranking over their lifetimes. This last group are clearly of some interest. They were more likely to be younger men and older women. Dex's (1987) study of women's work histories shows that downward mobility is related to episodes of labour force withdrawal (e.g. to have children), but the relatively high proportion of young men with downward mobility is puzzling. This, of course, need not be a permanent state as they were no more than 26 years old when surveyed, with most of their working lives ahead of them.

Table 15: Gross change in occupational skill ranking between first main job and present job, by sex and birth cohort (row %)

	Moved up	Stable	Moved down
Men			
1971–80	19	60	21
1961–70	38	46	16
1951–60	43	41	16
1941–50	48	39	13
Women			
1971–80	24	65	11
1961–70	38	51	11
1951–60	39	41	20
1941–50	38	44	18
Total	**38**	**47**	**16**

Note: Base – Australians aged 15-55 in 1997 working post-labour market entry. N=1688
Source: Negotiating the Life Course Survey 1997

Reverting back to the occupational focus, those most likely to have moved up came from the bottom of the skill distribution, those most likely to have remained stable came from the top,

while those most likely to have moved down came from the middle. The opening chapter of this report discussed the concept of the 'disappearing middle', essentially the diminished opportunities for tradespersons and advanced clerical work. People who began their careers in these two areas had much the greatest chance of slipping back than those in other occupations.

Pathways to knowledge work

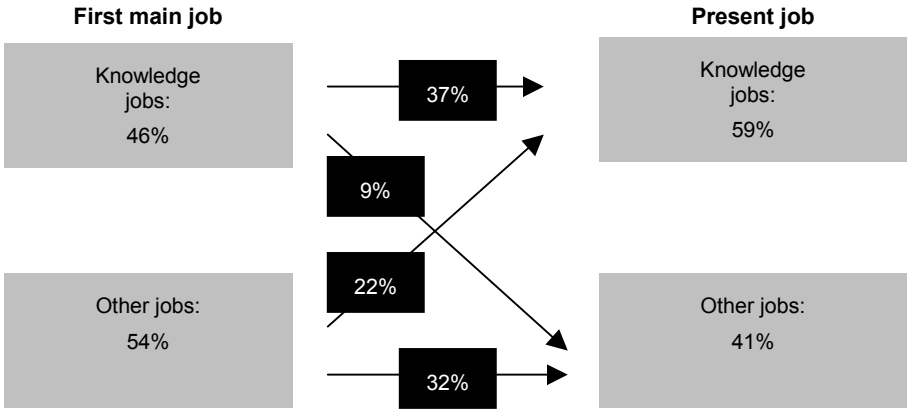
Chapter 1 examined the problematic concept of knowledge work. It argued that knowledge work lay along a continuum rather than being located in a mutually exclusive grouping from non-knowledge work. It also argued that both the skill ranking underlying the Australian system for classifying occupations, and the appropriation of the US Dictionary of Occupational Titles information on cognitive skill presented two useful empirical ways for analysing knowledge work. Table 2 revealed that the two are very highly correlated.

In the previous section it was shown that slightly under half of all employees had not altered their skill ranking over the course of their working lives—some of these would have started in a high skilled job, others would not. More than half of all employees did alter their skill ranking over time and a majority moved up, so that there are now more people in high-skilled jobs (see figure 3 and table 14).

What this suggests is that there are two broad paths to becoming a knowledge worker. The first is to begin one's working life in this position; the other is to find ways of moving up the skill ladder after having started in a lower position. This is illustrated in figure 4, which shows a definition of knowledge worker that is consistent with both the ASCO ordinal skill ranking and the Pappas cognitive score—employees in managerial, professional, associate professional and tradespersons jobs. These jobs require post-school qualifications, or commensurate on-the-job training and experience, and the level of cognitive skill lies above that required on average. This broad dichotomy illustrates the general patterns, but it should be remembered that all jobs require a greater or lesser level of cognitive skill.

Thus between 'then' (which varies over time according to people's age) and 'now' the ranks of knowledge workers rose from 46% to 59%. In the space of that time, 22% of employees who had started in other jobs were able to obtain knowledge jobs, while 37% remained in knowledge jobs throughout.

Figure 4: Flows into knowledge jobs over the working life



It is important to look separately at the characteristics of these two groups but first, for descriptive purposes, table 16 shows how they are distributed across the sex and birth cohorts. Except for the youngest employees, the proportion remaining in a knowledge job or moving

into one varies only slightly across age. The figures for young people are likely to be biased downwards because those who have moved straight from school into full-time tertiary education would not have 'fully entered' the labour market as is defined here. The sample of young employees is therefore disproportionately made up of people who have invested less time in education and training than those born before 1971.[13] In this case, the safest comparisons to make are with the three cohorts of people who were born between 1941 and 1970. These show, for men, that the oldest cohort has the highest proportion of employees who have remained in knowledge jobs, while the flow into knowledge work is relatively stable at around a quarter. For women the picture is less clear-cut. For both men and women, the flows into knowledge jobs from those who started in other jobs are largely unrelated to age, except for the youngest cohort (for which the results are biased downwards).

The other main finding from table 16 is that men are disproportionately employed in knowledge jobs because they disproportionately got there first, and continue to do so—although the differential has narrowed over time, from 23 percentage points among those born before 1951, through to 9 percentage points for the youngest cohort. That is, all the difference is in the proportion who have spent their working lives in knowledge jobs, rather than moving into them. On this score, the flows show no difference between men and women.

This report also examines what other aspects of people's background, and their work and education history, are associated with attaining a knowledge job at the outset of their working lives or rising to one during the course of it. The results of this analysis are shown in table 17. First, some background characteristics need to be considered, then a number of items of education history, and then some items of work history. Each cell of the table reports the proportion of men or women in a given category who began work in a knowledge job and have stayed at that level, or those who have risen to that level. For example, just over half (52%) of all men whose father came from a high skill background began work in a knowledge job (and have remained at that level).

Table 16: Pathways into knowledge work (row %)

	Stayed in knowledge work throughout	Moved into knowledge work
Men		
1971–80	36	9
1961–70	44	25
1951–60	50	22
1941–50	52	24
Women		
1971–80	25	12
1961–70	30	21
1951–60	27	26
1941–50	29	26
Total	**37**	**22**

Note: Base – Australians aged 15–55 in 1997 working post-labour market entry. N=1688
Source: Negotiating the Life Course Survey 1997

[13] More strictly, it will not be possible to be definitive about the first main job of those in the 1971–80 cohort until some time in the future when it can be observed what happens to people presently in full-time study who had not fully entered the labour market when the survey was conducted.

Table 17: Pathways into knowledge work—first main job to present job (row %)

	Stayed knowledge work throughout		Moved into knowledge work	
	Men	Women	Men	Women
Father's occupation (skill rank)				
I	52	40	27	22
II	43	29	25	20
III	48	21	17	22
IV	39	21	17	20
V	43	22	20	29
Country of birth				
Australia	43	30	22	21
Overseas, English-speaking	58	18	20	31
Overseas, non-English speaking	61	19	21	23
Parental status (when surveyed)				
Never had kids	38	31	19	23
Pre-school children	55	36	22	16
School age children	53	25	26	20
Older children	49	23	22	27
Total years of education				
Less than 12	26	5	24	20
12 to 15	41	14	19	23
More than 15	61	56	24	23
Educational attainment				
Degree	61	63	26	22
Diploma/other	54	20	27	29
Vocational	60	16	14	28
Completed school	30	11	21	22
Did not complete 12 years school	18	3	24	16
When qualifications obtained				
Before labour market entry	59	44	20	14
After labour market entry	58	33	22	32
Before and after	78	74	13	18
No post-school qualification	23	6	23	18
Decade entered the labour market				
1950s	48	14	15	42
1960s	51	24	23	25
1970s	48	29	24	22
1980s	44	30	21	22
1990s	41	32	13	8
Number of 'jobs' held				
One	76	48	na	na
Two	55	28	17	17
Three	41	25	22	24
Four or more	31	28	36	26
Total	**47**	**28**	**22**	**22**

Note: Base – Australians aged 15–55 in 1997 working post-labour market entry. N=1688

Source: Negotiating the Life Course Survey 1997

Dealing first with background characteristics, relatively little association with these and paths into knowledge jobs can be found. There is a slight positive association between the main occupation held by the person's father and a path into knowledge work. People whose parents were managers or professionals were more likely to have begun their working lives in knowledge jobs. Other than that, however, the chances seemed to be largely unrelated to what fathers did by way of work. The country of birth results run counter to what we would expect for men—that is, those born overseas were more likely to have begun work in a knowledge job than those born in Australia. Moreover, there is no real difference whether the country of birth was an English-speaking one or not. It may be that there has been some non-response bias in the survey in that those who came from a non-English-peaking background took part in the survey if they felt sufficiently confident about their English language abilities. This would tend to under represent migrants in low-skilled work.

The second raft of characteristics—those to do with education history—show the most significant associations. There are very strong associations between educational attainment and starting in a knowledge job, especially for men. Around six in ten men with a post-school qualification have been in knowledge work throughout their working lives, compared with three in ten of those who completed 12 years of school, and one in five of those who did not. These results are paralleled in years of education. For people with degrees, almost all end up as a knowledge worker, and this does not vary by sex (87% for men, 85% for women). But for women with other post-school qualifications, they have a much lower chance than men of starting and remaining in a knowledge job—especially, it must be noted, if they have a vocational qualification (16% compared with 60%). Those without qualifications have relatively low chances of ever working as a knowledge worker, especially women; 33% for those who have completed Year 12, and just 19% for those who did not go all the way through school. The completion of Year 12 can hardly be regarded as a relatively low level of education. However on its own, especially for women, it does not appear to be enough to gain access to knowledge work. The other general point to note about the education history is that those with two (or more) post-school qualifications are almost all in knowledge jobs (91% for men, 92% for women). In addition, attaining a qualification after labour market entry improves the chances of moving into a knowledge job: 33% for men compared with 28% for men overall, and 32% for women compared with 22% for women overall.

The third and final set of characteristics relates to labour market history. It was noted above that older men had a slightly greater chance of attaining a knowledge job at the start of their working lives than younger men. This is likely to be a period rather than an age effect, i.e. to do with the state of the labour market at the time they entered. When examined at this level, the finding becomes more subtle. For men this story still largely holds; that is, men beginning work in the 1960s had slightly better chances of both obtaining a knowledge job at the outset and moving into a knowledge job if they did not start there.

However, for women, the pattern is different. Women entering the labour market in more recent times are much more likely than those entering before them to have stayed in a knowledge job throughout their careers. Conversely, women who entered the labour market earlier have much the greatest chance of having moved into a knowledge job. The most reasonable interpretation of these results is that the gender segregation of knowledge jobs has diminished over time, most likely to do with increasing opportunities at professional level for 'traditional' women's jobs such as teaching and nursing, as well as the general expansion in public sector employment. This is consistent with the Census evidence on the changing occupational composition of employment presented in chapter 2.

For job movers there are also revealing patterns. It is no surprise that those who have only had the one job had the best chances of having stayed in a knowledge job throughout. After that, however, the forces work in generally opposing directions. The more a person changes jobs,

the more likely they are to be currently employed in a knowledge job, but the less likely they are to have begun work in such a job.

The one general conclusion to be drawn from this analysis is that there are much stronger sets of associations in starting and staying in knowledge work, than there are in moving into knowledge work. This holds for both men and women, other than the last set of characteristics to do with labour market history which suggest more of a change in the underlying dynamic of gender segregation. This is important. What the analysis suggests, very strongly, is that the best way to become a knowledge worker is to start in a knowledge job and then stay there (as the chances of moving out are relatively low). This is best achieved by obtaining a post-school qualification, finding a knowledge job and remaining in it.

If a person does not start in a knowledge job it is still helpful to obtain a post-school qualification, but it does not confer anywhere near as great an advantage as it does when first entering the labour market. Overall, however, the odds of moving into a knowledge job even if not starting in one are remarkably even across a very broad range of characteristics.

4 Discussion: Vocational education and training and knowledge work

The empirical analysis of the past two chapters has produced much of interest. Much of it, however, extends into far wider issues than vocational education and training. It is now time to concentrate the discussion to that domain, as far as we are able.

A review of knowledge work

The centrality of knowledge as a 'factor of production' was highlighted by visionaries like Peter Drucker more than a quarter of a century ago, taken up by the OECD approximately a decade ago, and is still largely neglected by policy-makers in education and employment.

This project has been concerned with identifying what effect the much-vaunted knowledge economy might have on the world of work. It is not disputed that there has been an extensive adoption of information and communication technologies, that expenditure on research and development has risen, and that 'weightless goods', such as software code and audio/video files, account for an ever-increasing level of economic activity. Each of these developments are of considerable import, and have been a major force in shaping trends in employment, but this report shows that the benign assumptions which underlie much of the discussion in this area should not be accepted.

The impact of new technologies on production and service delivery has always been ambiguous. Primary and secondary industries produce vastly more than they ever did, largely on the basis of mechanised production and economies of scale. Overall, the net effect in these industries has been labour shedding, but the additional income generated from technology-driven productivity improvements has spawned a raft of new industries—in leisure, tourism, and the outsourcing of activities previously done within the home (e.g. cooking). The consequences for the deployment of skill have also been ambiguous. Braverman argued that the introduction of Taylorist techniques denuded the role of the craftsman. The archetypal new factory of the service age is the call centre, often characterised by relatively low-skilled and low-paid employment with intensive computer monitoring/supervision (and a concomitant high level of labour turnover).

A parallel development in many industrialised countries over the past two decades has been a rise in income inequality, mostly a function of rapidly rising incomes at the top of the income distribution. Economists casting about for an explanation as to why this should be occurring developed a hypothesis which has come to be known as 'skill-biased technical change'.

This left some puzzles. If there were increasing returns to skill, how did that square with the fact that in many industrialised countries there had there been an enormous increase in the proportion of young people in particular, but also more generally in the population at large, undertaking studies at tertiary level. If higher level skills were more plentiful, why should there be a higher return to skill?

One answer, proposed by Pryor and Schaffer (1999), is that employers have increasingly valued *cognitive* skills. In their account, it is not technical change *per se* which is important, but the ability of workers to make creative use of the new technology. They offer four stylised facts for the United States which tell a consistent story that ties together these different threads:

- ✧ The number of people with formal qualifications has grown faster than the number of jobs requiring such qualifications.
- ✧ The number of jobs not requiring formal qualifications has grown faster than the number of people without qualifications.
- ✧ This has produced a 'bumping down' effect where those with the highest qualifications get the best jobs, and many of those without qualifications are bumped out of work altogether—for the United States, this has been especially the case for less well-educated black males.
- ✧ Over and above that, the demand for high-level cognitive skills has risen relative to the demand for other skills. Such skills are closely correlated with educational qualifications, but imperfectly so, leaving employers to devise other means of identifying these skills.

There is a good deal of suggestive evidence that the account provided by Pryor and Schaffer for the United States is consistent with what has happened in Australia. Income inequality has risen. Jobs in the middle of the income distribution have fallen, while those at either end of the distribution have risen substantially. Educational attainment has improved, with higher proportions staying on to complete secondary school and rising numbers undertaking studies at tertiary level.

That, at least, is the 'big picture'. There are two sources of evidence to bring a much more nuanced portrait of change, using the changing occupational composition of employment as a lens by which to understand these changes. The first is to delve below the high-level aggregations which are usually used to discuss occupational change, by using the only source which allows for this, the Census. This enables the comparison of change over the 1986–2001 period. The second is to look at what happens to individuals over time.

There are two analytical tools allowing the assessment of what these changes mean for the nature of work. The first is the ordinal skill ranking which underlies the Australian Bureau of Statistics occupational classification. The second is the cognitive skill score based on applying United States Dictionary of Occupational Title measures to Australian data. Pappas (1998) pioneered this by matching Australian data on employment by occupation to the most relevant United States occupation. His scores are mostly employed as a device for validating the use of the ordinal skill ranking. That is, there is a strong positive association between this cognitive skill score and the ASCO ranking. In the final section of the last chapter the occupational classification and the Pappas cognitive score are used to group some occupations—managers, professionals, associate professionals and tradespersons—as knowledge workers. It is plainly evident that the use of knowledge in work lies on a continuum and encompasses several different dimensions, such as knowledge area or specialisation and the knowledge deployed on the job. However, this analysis of the dichotomy between knowledge and other jobs, and the flows into and out of them over time, revealed several major findings.

Implications for vocational education and training

Much of the discussion in the preceding chapters seems far removed from the world of vocational education and training. It is certainly true that a considerable weakness of the data available, one shared by many accounts of skill changes, is that it ignores tacit skills. It also ignores the fact that much of the skill needed to undertake a job is learnt at work, through

formal employer-provided training (most of which does not lead to a recognised educational qualification) and on-the-job training.[14]

The account presented here, moreover, is both broad brush and partial. It is broad brush in the sense that it takes a whole-of-economy view of employment changes, not just those where the VET system plays a role in skill development. It is partial in the sense that it has relatively little to say on the supply side of matters, such as how the VET system is responding to the changing shape of employers' requirements.

The analysis of employment change is consistent with other aggregate studies of occupational change, in revealing growth at the top end of the skill distribution, somewhat lower growth at the bottom, and considerably reduced opportunities in the middle. The more nuanced look at which occupations were rising and falling showed that high-skilled occupations on the rise were mostly in business and finance, health and education. Those related to science and engineering were generally stable or on the wane, and a very large number of skilled trades were in decline. These trends, were they to be sustained, would tend to reduce the number of job opportunities available for VET graduates. This is because many professional and associate professional occupations are 'regulated', either by statute or by professional associations. These regulations typically specify the entry requirements to these jobs and in most cases tertiary qualifications at degree level or better are the standard. This is the case for registered nurses by statute. It is also largely the case, for example, for accountants in comparison with bookkeepers. A continued decline in manufacturing jobs at tradesperson level (where there was a relative 'loss' of 300 000 jobs between 1986 and 2001) would also reduce opportunities for the mainstay of the VET system, the traditional apprentice.

Part of the reaction of the VET system to these changes has been to develop qualifications where there had previously been none, such as in retail and in hospitality. However, a 'hollowing-out' of jobs in the middle of the skill distribution, together with barriers to entry to certain jobs based on qualification criteria, may mean that even those with VET qualifications in work have limited opportunities to progress up a skill 'ladder'. For many, it is certainly the case that the beginning point is at the lower skill levels—a recent study by Toner (2002) estimated that nine in ten of the 177 000 people who commenced 'traineeships' in 2000–2001 were employed in the two lowest skill levels.

This question can be looked at retrospectively by going back once more to the Negotiating the Life Course Survey data, this time limiting attention to the quarter of employees with vocational qualifications. Figure 5 shows, separately for men and women, and for level of qualification, the paths that those with vocational qualifications have followed over the course of their working lives. It shows that a skilled vocational qualification provides a relatively sure pathway to knowledge work for men, with two in three men beginning work and remaining employed at that level, with a further one in eight rising up the job ladder. Just 3% of men with a skilled vocational qualification have never worked in a knowledge job. There are also 19% of men with a skilled vocational qualification who began in a knowledge job, but no longer work in one—these are, presumably, the losers of the downturn in manufacturing employment that began in the 1970s. The outcomes for men with a basic vocational qualification are less positive, though they are still superior to those of men who have completed 12 years of school and have no post-school qualifications (see table 17).

The paths that women with vocational qualifications have followed is rather different than that for men. Overall, it is much less favourable. About two in three women (65%) with a skilled vocational qualification presently work in a knowledge job (compared with 78% of men). Over 44% started in a knowledge job and have remained at that level. Much more disconcertingly, however, close to a third (30%) of women with skilled vocational qualifications have spent all

[14] Other evidence on these matters, though, suggests that there is a strong positive correlation between educational attainment and participation in job-related training.

of their working lives never employed in knowledge jobs—this represents a substantial level of skill 'wastage'. Women with basic vocational qualifications have fared even worse. They were much less likely than those with a skilled qualification to start in a knowledge job. Unlike men, a basic vocational qualification gave them no advantage over school leavers without qualifications. For those who did not start work in a knowledge job, they also had a high rate of upward mobility, at 30%. However, even more so than for women with skilled qualifications, there was a very high proportion (48%) who have never worked in a knowledge job.

Figure 5a: Job paths of men with vocational qualifications (%)

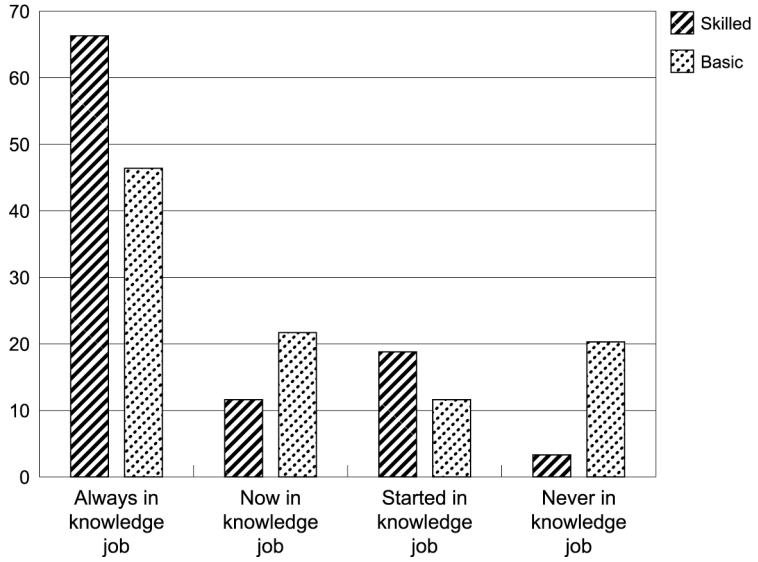
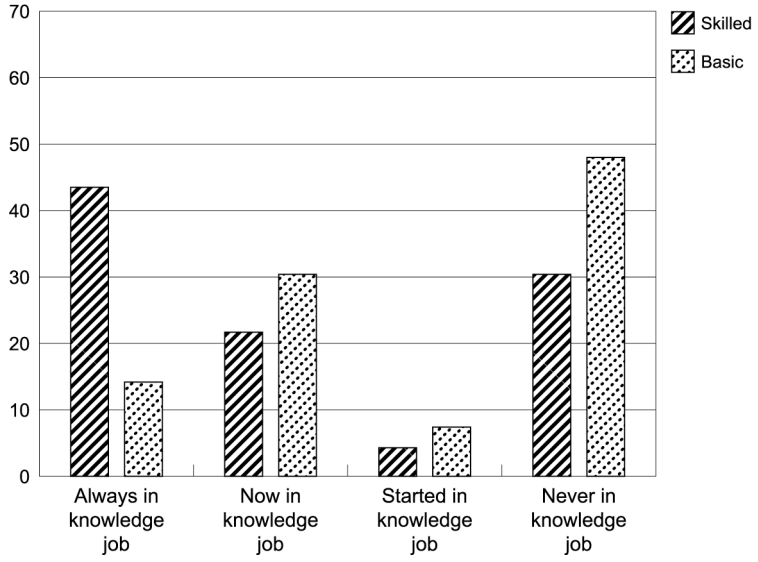


Figure 5b: Job paths of women with vocational qualifications (%)



Conclusion

The introductory chapter posed three research questions about the emergent knowledge economy and what it would mean for the world of work:

- ✧ What does it mean for people's careers—is there still a way to rise from the bottom to the top and, if so, is this based on the attainment of qualifications or experience?

- ✧ Many of the jobs in the middle of the skill distribution have traditionally been filled by those who have been through the vocational training system (e.g. apprenticeships in the trades). If such opportunities are disappearing, then where are VET 'graduates' to go?
- ✧ In seeking to improve the education and skill base of the workforce, is there a danger that some people will be 'over-educated' for the work they obtain (i.e. if growth in post-school qualifications exceeds growth in skilled jobs)?

Answers to these are necessarily qualified because, as with any study, there are deficiencies in the approach and in the data used. Moreover, no one study can attempt to definitively resolve such substantial questions.

The last chapter showed very clearly that the surest path to knowledge jobs (which are better paid, more likely to be full time, and intrinsically more stimulating) is to obtain post-school qualifications. People with such qualifications were much more likely to start their working lives in knowledge work and remain there. The only qualification to this general statement is for women with a basic vocational qualification, which did not improve their odds of getting into knowledge work over school leavers without qualifications.

The analysis in chapter 2 confirmed that of other studies in showing a substantial lessening of job opportunities in the middle of the skill distribution, particularly in the traditional trades. This is a situation that is extremely unlikely to alter, as the whole trajectory of manufacturing employment has been to move towards more capital-intensive production, through the introduction of labour-shedding new technology. The VET system has been expanding the range of courses that it provides, and there is now a fuzzy line between many of the courses offered in higher education and those in further education. It is unlikely that VET will deliver degree-level courses, the conventional gateway into professional jobs, in any considerable number, but they may do so at the associate professional level where diplomas are often required. There are also now a wider range of offerings at certificate III and IV level, especially 'traineeships' in areas such as retail, hospitality and clerical posts. As shown in chapter 2, these have been areas of high employment growth, but mostly concentrated at low skill levels.
In this regard, it is an open question, which is perhaps best left for another project to answer, as to whether the expansion of certificate III and IV qualifications for jobs at a relatively low skill level is the right response. The danger of over-education through VET may be a real one. In contrast, the situation for those with degrees, and here recent cohorts of women have made up much ground against men, are as favourable as they have ever been. The risk of a substantial societal dilemma remains. Educational attainment is progressively rising, but if it outstrips the growth of jobs at the top of the skill distribution, then the bumping-down effect which has been observed in the United States may also come into play here.

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Appendix: Technical notes

ASCO 1 and ASCO 2 Concordance

The second edition of ASCO was introduced in 1996, where occupation in employment was coded to both ASCO 1 and ASCO 2. This produced a matrix which showed what the composition of a given occupation was in 1996 based on 1986 occupations. This is easiest to see at the aggregated 1 digit level. For example, professionals in 1996 consisted of the following proportions of 1986 1 digit groups:

0.022965655 Managers and administrators

0.976372566 Professionals

0.36131132 Para-professionals

0.004799843 Tradespersons

0.027454386 Salespersons and personal service workers

0.000179896 Plant and machine operators

The concordance process was done at the 4 digit level, using the matrix available upon request from the ABS. More details on the concordance process are available in the ASCO manual (Australian Bureau of Statistics 1997).

Overall, there were 324 300 people in 2001 who were not able to be categorised to unit group level. To deal with this problem we went through an iterative process of assigning those unclassified at a sub-level in proportion to the distribution of those who had been assigned at that sub-level. After this had been done for all people coded to minor groups, it was then repeated at the sub-major group level, then finally at the major group level. Table 18 provides an example for chemists (ASCO code 2111). There were 5433 people specifically identified as chemists in 2001. An extra 553 were added to their number from proportionally re-allocating the 4752 natural and physical science professionals for whom insufficient detail was available to one of the six unit groups that make up the minor group 211. Chemists made up 16.5% of the minor group, 4.3% of the sub-major group and 0.4% of the major group. Doing each of these steps iteratively raises the number of chemists progressively to 6086.

Table 18: Example of re-allocating 'nfd's' to unit groups in proportional terms

2000 Professionals nfd	19 426	(+0.4%)		
2100 Science, Bldg & Eng Profs nfd	507	(+4.3%)		
2110 Natural & Physical Sci Profs nfd	4 752	(+16.5%)		
2111 Chemists	**5 433**	**5 986**	**6 008**	**6 086**

Note: nfd – not further defined

A similar process was followed for the 1986 data. This was complicated by the concordance, which had to be done at unit group level, sub-major group level and major group level. The 'excess' of employment at sub-major group level over the sum of employment at unit group level was then distributed proportionally as described. This procedure was then repeated at major group level.

Cognitive skill score

The appendix to Pappas (2001) details the procedure he followed to obtain measures of cognitive skill, motor skill and interactive skill at the unit group (i.e. 4 digit) level.

The source data is the United States Dictionary of Occupational Titles, from which Pappas identifies the relevant American title that most closely corresponds to the Australian equivalent. The justification for doing so is

> given the significant economic, institutional and technological similarities between Australia and the United States, the respective labour markets are likely to be comprised of jobs with similar skill requirements, evidenced by the similarity between the two countries in the tasks typically performed across occupations. (Pappas 2001, p.205)

Cognitive skill is the mean value for each occupation of:

- the rating given to a job's relationship to data
- the amount of lapsed time required by a typical worker to learn the techniques, acquire the information and develop the facility needed for average performance
- the level of formal and informal education required for satisfactory performance, constituting reasoning, mathematics and literacy.

A cognitive skill score is available for 252 occupations, which means there are missing values for 88 occupations. This is a high percentage in terms of occupations (26%), but in terms of (2001) employment it is lower, 19%, and lower still if the base is restricted to non-managerial employees (11%) as managerial occupations are not covered at all.

The employment weighted average score is given by

$$\Sigma_i^k c_i.L_i \Big/ \Sigma_i^k L_i$$

where i is occupation at the 4 digit level, and is grouped 1, …, k

c is the cognitive skill score and

L is employment

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