

New skills in **process manufacturing**

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Executive summary

Aim of study

This study of the changing nature of work in the process manufacturing industry was undertaken with the close co-operation of Manufacturing Learning Australia, the national industry training advisory body (ITAB) which covers industries in the Australian and New Zealand standard industry classification (ANZSIC) subdivisions 25, Petroleum, coal, chemical and associated product manufacturing, and 26, Non-metallic mineral product manufacturing. The main purpose of the study is to examine how the nature of work has changed in these industries, how these changes have affected operative-level workers and how the vocational education and training (VET) system has and should respond to these changes.

According to the Australian Bureau of Statistics (ABS 1998), these industries were among the most technologically innovative in their survey of technological change in the period 1994–97. While the survey did not focus on the issue of skills related to these technological changes, it did find that, for those programs of technological innovation that were abandoned, more than a third of these failures were attributable to a lack of suitably skilled workers.

This report examines the changing political philosophies and especially the enterprise-based industrial relations system that has enabled much of the job redesign examined in the study to occur. It also considers some of the recent social theory on the nature of work that might have influenced the way changes have been implemented.

Methodology

Structured interviews were conducted with training or human resource managers in 16 of the 17 firms invited by Manufacturing Learning Australia to participate in the study. A total of 17 workers selected from these firms were also interviewed using a structured questionnaire. The firms represented a cross-section of large, medium and small enterprises across four States, New South Wales, Victoria, South Australia and Western Australia.

Findings

The study found that 12 of the 16 firms had introduced major workplace changes within the last five years. The most common motivation for these changes was an increasingly competitive business environment. In most firms these workplace changes involved some form of multiskilling of operative-level workers, greater levels of responsibility and decision-making, and mastering of additional skills. Having greater responsibility and undertaking increased decision-making were roles acquired by many workers as a result of the elimination of supervisory positions and, in some instances, the change to a 24-hour, 7-days-a-week roster.

While the level of innovation in job design was substantial, it was noteworthy that the firms studied did not display other characteristics of the changing labour market. In particular, most employment was male, full-time and permanent, mirroring the traditional manufacturing model. Outsourcing of some functions had however occurred, particularly in the maintenance area. Contract and part-time work was rare, and very few females were in the operative jobs most affected by the job redesigns. Although the ABS (1998) study found that technological innovations led to employment increases in

about half of the firms introducing new technologies, the findings from the sample of firms in this study found an overall reduction of about 1500 positions within the last five years.

The job changes, especially multiskilling, had increased the requirement for underpinning knowledge in most of the firms visited. Operators were generally responsible for a wider range of functions and, as noted, often did not have immediate access to a line supervisor. As a result, in many instances they were required to solve operational problems and to anticipate difficulties. These changes meant that many operators were required to have a much greater level of understanding of the broad processes they were controlling. Rather than simply knowing that pushing a particular button achieved a particular outcome, they now needed to understand both why this outcome occurred and how that process related to the broader production process. In some sectors this change implied that workers needed a better fundamental understanding of the chemistry and physics of the processes they were controlling.

Another important change to many operators' jobs was the elimination of line supervisors and, in some cases, their replacement by work teams. Where work teams had been established, workers and managers generally believed that additional skills in communication, team working and, in some cases, conflict resolution were needed. Many operators had undertaken further training associated with their job redesign, especially through one of the training packages relevant to the industry. Most employers and workers made favourable comments on the relevance of the training packages and had found them sufficiently flexible to accommodate the needs of specific enterprises.

The wide range of types of production encompassed within process manufacturing means that generalisations about the implications for the training system are hazardous. The oil refineries, chemical manufacturers and plastic moulders, along with four other firms that fit into none of these categories, exhibited to some extent, the job redesign features described in this report. It was however, also apparent that the changes in the plastics area had been generally less dramatic than in the other areas.

There are clearly some consistent developments in the firms that have implemented job redesign. Most operator jobs have become more multiskilled and a range of common underpinning and soft skills has emerged as being more important.

New skill requirements

It seems therefore, that training programs for operator-level jobs in this sector should address both these emerging soft skill demands and underpinning skills in the basic sciences of physics and chemistry. Specific soft skills would include:

- the development of enhanced oral and written communication skills
- team working and conflict resolution skills
- skills in adjusting to workplace change
- problem-solving skills

These skills, combined with the basic underpinning knowledge of physics and chemistry, are industry- rather than enterprise-specific skills. While the preferred mode of delivery has been on the job, it seems likely that there will be growing demand for these skills to be regarded as entry-level skills for operators. Given that the current workforce in these industries is ageing, it also seems likely that there will be a wave of new demand for operators in process manufacturing over the next five to ten years.

One question raised by this study is whether training provision in the process manufacturing sector should continue to be dominated by on-the-job, enterprise-focussed national certificates delivered mainly under the new apprenticeships program. One alternative would be the provision of more broadly based courses, providing greater labour mobility, made available through public provision to those not already employed in the industry.

Introduction

This study has been undertaken in conjunction with the national ITAB covering the process manufacturing sector, Manufacturing Learning Australia (MLA). It encompasses a group of industries grouped in the Petroleum, coal, chemical and associated products manufacturing and Non-metallic mineral products manufacturing industry subdivisions (ANZSIC 25 and 26, respectively).

The purpose of the study is to analyse the occupational changes that have occurred in these industries, and to determine the extent to which the VET system has adjusted to meet any such changes. The main emphasis has been upon 'operative'-level occupations, occupations which in the past have often been described as 'semi-skilled'. The enterprises selected for inclusion represent a cross-section of the industry and included large, medium and small firms in metropolitan and non-metropolitan areas from four States (New South Wales, Victoria, South Australia and Western Australia).

Four training packages cover the industries represented by the Manufacturing Learning Australia ITAB:

- Chemical, hydrocarbons and oil refining (PMA 98)
- Plastics, rubber and cablemaking (PMB 98)
- Manufactured mineral products (PMC 99)
- Laboratory operations (cross-industry) (PML 99)

Of the firms included in this study using training packages, most were using the first two listed.

The researchers would like to express their thanks to all participants in the study who were most generous in the time and information they gave. The researchers would also like to acknowledge the assistance provided by the Executive Officer of Manufacturing Learning Australia, Jeremy Gilling, for advice on the design of the research study, in facilitating contact with the industry and providing comments on the final draft report.

Background

The changing nature of work

There is evidence that the organisation of work is changing across the globe. In its recent *World employment report* the International Labour Organisation (ILO) summarised the factors contributing to the changing organisation of work in the following way:

> *Globalization had already spurred an internal transformation of the enterprise, resulting in changes in the organization of work toward flatter hierarchies and project-based teams. The need for a more rapid response to volatile product markets and declining product life cycles has also been behind the trend toward greater outsourcing. The emerging era of 'digital globalization' is accelerating these organizational changes. Enterprises in the most globally competitive industries have experienced both a decline in the time devoted to strategy formulation and a qualitative change in the nature of competitive advantage. 'Time-to-market' has arisen as a critical competitive asset. This in turn compels companies to rely on the creativity, knowledge, and ability to acquire new knowledge of their core employees.*
>
> *Evidence shows that major gains in enterprise performance only occur where the use of the new technologies has been combined with wide-ranging changes in work organization. Evidence also shows that the most widespread use of the new technologies exists in enterprises that have adopted the most thorough range of work organization changes, such as the decentralization of decision-making, and the organization of work into semi-autonomous, task-oriented teams.* (ILO 2001)

This project has sought to investigate some of the issues raised by the ILO in an Australian context, within a selected range of generally technologically sophisticated manufacturing sectors, with an emphasis on the skills area addressed by the VET sector.

While there is a considerable body of Australian literature on workplace-based training (for example, Hager 1997), much of it focusses on individual learning and assessment or measuring the benefits of training to the enterprise. This project aims to examine the nature of recent occupational changes in process manufacturing industries and the relationship between changing occupational and skill mixes, and the extent to which the vocational education and training system has responded to changing training needs within a group of technically oriented manufacturing industries. The study focusses on selected occupations which would typically be addressed by the VET sector.

The changing nature of work, and the implications of the rapid pace of that change for the timely provision of suitable skills, is one of the central issues facing the VET sector. New technologies have changed both the nature of technical skill requirements and have also reshaped work organisation, emphasising the need for so-called 'soft skills' in communication, teamwork and other human interaction. For example, in its pre-Budget submission the Australian Industry Group (AIG 1999) argued (p.22) that both globalisation and technological change are 'fundamentally changing skill requirements and the strategies of enterprises in meeting them'. In its submission the AIG contends that '… higher level skills are required at all occupational levels as are generic and interpersonal skills. These are resulting in requirements to upskill the existing and future workforce'.

The AIG went on to recommend that resourcing of training outside new apprenticeships was needed and that further support for industry-based strategies is required to complement the Australian National Training Authority (ANTA) strategy.

Technological innovation in process manufacturing

According to the ABS (ABS 1998) the two industry subdivisions represented in this study, Petroleum, coal, chemical and associated product manufacturing (ANZSIC 25) and Non-metallic mineral product manufacturing (ANZSIC 26), were the highest and third highest manufacturing industries respectively undertaking technological innovation in their 1996–97 survey. More than 42% of enterprises in Petroleum, coal, chemical and associated products manufacturing reported innovations, while nearly 36% of enterprises in Non-metallic mineral product manufacturing reported such changes.

Overall, this ABS survey found that 26% of manufacturing businesses in Australia had undertaken at least one technological change in the period July 1994 to June 1997. This was however, a decline from the previous three-year period when 32% of businesses reported such changes. The ABS believes the decline was attributable to a drop in innovation in small businesses (<10 employees).

While those businesses undertaking innovation represent 26% of all manufacturing businesses, they account however, for about 'two-thirds of the total employment and three-quarters of the total turnover of all manufacturing businesses' (ABS 1998, p.6).

During that period the Petroleum, coal, chemical and associated products manufacturing industry recorded the highest level of innovation in the areas of both product and process. In a similar survey three years earlier these industries were also among the top three sectors of manufacturing innovation.

The Petroleum, coal, chemical and associated product manufacturing industry was the equal highest sector in the survey (with machinery and equipment) to use advanced technology in the area of communications and control systems, with 19% of enterprises using advanced processes in this area. It was also the second highest user of any form of advanced manufacturing technology and was expected to maintain this position over the following year.

An interesting finding of this ABS survey was that, of those businesses reporting an employment impact from technological change, more than half reported an increase in employment resulting from the change. Production staff were more likely than technical staff to have initiated ideas for technological innovation and were more likely to have been associated with the innovation throughout the project's implementation.

It should be noted that this ABS survey sought information on barriers to starting innovation projects in manufacturing enterprises. Only one category of barrier related to skills, that is, 'Insufficient funds to recruit skilled staff'. There were no data reported on whether access to training or retraining was a barrier to introducing innovations. The lack of skilled staff was however, a moderately significant reason for abandoning innovation projects, with 37.5% of enterprises reporting this outcome. (Financial factors were usually the major barrier.)

The study also aims to test the finding of Smith et al. (1995) which concluded from a series of enterprise case studies, that '… the training system does not appear to be geared to facilitate the requirements of both the enterprise for specific training programs, and the individual for more general career-oriented training requirements'. The study should also reveal whether one of the policy recommendations made by Smith et al. (1995, p.7), that 'access to individual modules within formal courses should be enhanced. Individuals should be able to combine these modules with other necessary modules to gain qualifications', has made any impact within this sector.

The study also aims to test one of the assumptions about work becoming increasingly divided between 'core' workers and 'peripheral' or 'contingent' workers (for example, Marginson 1999) accompanied by a growing demand, using his terms, for cognitive and interactive skills, replacing demand for motor skills.

Work organisation and social change

In recent years a body of sociological literature has developed which examines the relationship between work organisation and the socio-economic context in which employment is situated. The following section examines several perspectives on the changing social philosophies that have driven the political environment in which these changes have occurred. Of relevance to this study are both changes in industrial relations, which have allowed greater flexibility in job design at the enterprise level, and the encouragement of a competitive training market to allow a more flexible training response to changing patterns of demand for skills.

The change from centralised to enterprise-based industrial relations is one expression of a free market political perspective that seeks to reduce direct regulation of institutions by the government and is designed to increase individual responsibility and reduce government's role in welfare.

Using the term 'advanced liberalism' Rose (in Barry, Osborne & Rose 1996), characterises one of the basic elements of this philosophy as the client as customer. In the employment context (as in other areas) individuals seek to 'enterprise themselves' in order to 'maximise their quality of life through acts of choice …'. Rose (1999, p.144) describes this political philosophy as 'not a politics of economic abstentionism: on the contrary it is the politics of economic activism'. In other words governments intervene in markets to create the organisational conditions for entrepreneurship in the expectation that most individuals will seek to expand their life choices.

In the workplace context this translates to more flexible working conditions and the redesign of jobs to provide greater financial and personal returns. Governments operating under this philosophy do not, as is often perceived, seek to withdraw (abstentionism) from markets but seek to create conditions under which individuals might pursue their individual goals. The impact of these changes upon individuals, workplaces and occupations is varied and the subject of substantial debate.

This notion of the 'actively responsible individual' (Barry, Osborne & Rose 1996, p.57) can also be seen to underlie the 'mutual obligation' notion in the welfare system. In this context free market and neo-liberal philosophies have been influential in seeing the breakdown of centralised industrial relations systems in Australia, resulting in workplaces where more flexible job content can be developed under enterprise agreements and other instruments.

Allied to these industrial relations changes were reforms to skill formation policy accompanied by the establishment of a national training market. From 1985 on, employability (that is, a focus on the individual assuming greater responsibility for their own employment prospects) became a key concern. This philosophical individualisation has occurred in tandem with the growth of 'non-standard' modes of employment, that is, employment other than permanent and full-time.

The combination of these influences has produced workplaces where the development of new work arrangements can be implemented much more readily than under the previous centralised and collective models.

While the philosophy of advanced liberalism sees individuals maximising their life style by exercising greater choice in the workplace, the growth of non-standard work under the same philosophy appears to be limiting the choices of an increasing proportion of the workforce. For example, an increasing proportion of those working part time would prefer longer hours. On the other hand, actual working hours for full-time males, in particular, appear to be lengthening.

Many of the changes in work practices and design described in this study reflect the manufacturing techniques developed by Toyota, known as 'lean production'. It was of note, perhaps, that none of the participants interviewed used this term to describe their own workplace changes. While many enterprises worldwide have adopted this approach, there has been considerable philosophical and ideological opposition to this

production approach. An American publication (Post & Slaughter 2000) for example, presents a socialist critique of lean production in the following terms:

> *Lean production is the cutting edge of the corporations' and governments' attempt to reorganize social life. Lean production judges everything and everyone on the basis of speed and productivity. If anything or anyone does not fit the needs of speed and productivity, they are disposable—whether they are a good, service or whole categories of people. They are told that they, and they alone are responsible for their success or failure in the new 'lean and mean' world of the new millennium.* (Post & Slaughter 2000, p.1)

Other critics have questioned whether these workplace changes have in fact empowered workers. Writing in the American *Journal of Occupational Health Psychology,* Landsbergis, Cahill and Schnall (1999) concluded that:

> *The studies reviewed provide little evidence to support the hypothesis that auto manufacturing workers are 'empowered' under lean production. In fact, auto industry surveys and case studies suggest that lean production creates intensified work demands and work pace. Increases in decision authority and skill levels are very modest and/or temporary, while decision latitude typically remains low.*
>
> (Landsbergis, Cahill & Schnall 1999, authors' abstract)

A more recent perspective on the issue of skills is that raised by Mournier. He believes that skills are defined through changing social relationships. Drawing on a paper by Mournier (2001), Schofield (2001), in a recent paper to the ACTU, asserts that one of the central issues for the VET sector is the nature of skills:

> *What is emerging is a growing restlessness about what is happening to skill itself—as distinct from the skill formation system we have built …*
>
> *This restlessness is currently circling around questions of whether we are achieving higher skills levels or lower skills levels, why is there so much under-utilisation of skill, is actual skill utilisation upskilling or downskilling the workforce, why are not all firms embracing a high-skill/high wage equilibrium? Mounier argues that skill is given its content through changing social relationships, mainly labour relationships, and as such are socially built and defined.* Changing skills are not a consequence of the changing nature of work but rather the reverse—redefining skill is a necessary condition and a lever for transforming forms of employment and labour relationships *so that labour reallocation between industries, jobs, regions and countries is fostered …*
>
> (Schofield 2001, p.5, our emphasis)

Thus recent thinking in social theory, changes in industrial relations and allied reforms to skill formation policy and approaches to training have provided the background for the focus of this study. In particular this study examines the impact of technological and other workplace changes which have changed how work is done and the extent to which training systems have responded to changing industry needs. The study considers, in the industry areas under review, whether narrowly defined jobs are disappearing, to be replaced by fewer jobs with more broadly defined content.

Skills have in the past been organised into groups, which are called occupations or jobs. Writing for the American Society for Industrial and Organizational Psychology (SIOP), Church (undated) asks whether the notion of the job is outdated. He quotes another American psychologist, Howard, in *The changing nature of work* (in Church undated) who said 'the job is, after all, an artifact of the industrial age, created to package work in factories and bureaucratic organizations … [it] is disappearing in favor of an amorphous collection of work' (pp.520, 523). Such a perception would be consistent with the VET perspective of generic skills displacing technical or motor skills. This is another theme explored in this study.

Methodology

This project has been undertaken in two parts. Initially discussions were held with the Executive Officer of the national industry training advisory body, Manufacturing Learning Australia (MLA), which covers the process manufacturing industries. After consultation with MLA the researchers selected 17 firms from a list of enterprises known to the ITAB as suitable for inclusion in the study. Firms were selected for the following reasons: because they were national, because they represented the significant industry groups within the ITAB's coverage, and because they were representative of small, medium and large firms from metropolitan and regional areas. As a result, firms located in NSW, Victoria, South Australia and Western Australia were included. Firms in other States were not included as funding did not permit additional travel.

The main sectors within the ANZSIC subdivisions 25 and 26, petroleum refining, basic chemical manufacturing, other chemical product manufacturing, plastic product manufacturing, glass and glass product manufacturing and cement, lime, plaster and concrete products manufacturing, which account for almost 80% of employment in the group, were all represented in the sample. The sample did not however, include any firms from the ceramic product manufacturing sector which, at the 1996 Census, accounted for about 6.7% of employment in the process manufacturing group.

Obviously, selecting firms known to the ITAB is likely to present firms favourably disposed towards training and to have considered their own training needs, and in fact several firms were specifically included because of their known commitment to training. The researchers do not regard this as a shortcoming in the methodology. Given that the purpose of the project is to examine problems emerging for the VET system as a result of innovations in the organisation of work, using firms advanced in their attitude to training is not seen to be a disadvantage. We are not claiming that the firms selected are representative of the industry in terms of their use of training or their rate of introduction of new technologies. If in fact they are 'cutting edge' in their training needs, then they provide a useful picture of the needs that will emerge more widely in the coming years.

The initial stage of the project also included an analysis of a range of ABS population census and labour force data on the industry subdivisions covered by the study (ANZSIC 25 and 26). The ABS labour force survey showed that the two industries employed about 160 000 people, of whom about 27% were females. This level had remained about the same since 1996 according to the labour force survey, although the 1996 census showed a lower number, about 125 000, employed. The statistical profile of the industry is included in this report as appendix 1.

The Executive Officer of MLA wrote to each firm describing the nature of the research project and inviting their participation. The researchers contacted the firms by phone and/ or email to organise appointments for face-to-face interviews. The researchers sought interviews with training managers, HR managers or the senior executive of smaller firms without a specialist training manager. At the time of arranging these interviews the researchers also requested an interview with representative operative-level workers. One firm declined to participate in the study. Because several firms participating requested anonymity, no firms are identified individually in this study.

Stage two of the project involved a series of face-to-face interviews with managers and workers in the 16 firms. Structured questionnaires were used in the interviews with separate questionnaires for managers and workers. Most firms agreed to the request for separate interviews with selected operative-level workers. However, busy schedules or unforeseeable emergencies in some firms, especially smaller firms, meant that interviews with workers were not always possible. Several firms agreed to ask workers to complete

the questionnaire at a later stage and to post it back to the researchers. Stamped, reply-paid envelopes were provided for this.

Three of the 16 firms were located in non-metropolitan areas, while another two were located in a fringe area of a metropolitan area. Six of the firms were located in NSW, four were in Victoria, three were in South Australia and two were from Western Australia. Total employment in the 16 firms amounted to about 3700 or nearly 2.5% of the total industry employment. Three-quarters of the 16 firms fell within the ANZSIC subdivision 25 and accounted for about 3000 (or more than 80%) of the 3700 employees in the scope of the study. This means that the sample under-represents ANZSIC subdivision 26, which accounted for about 31% of the group's employment at the 1996 census, but only about 19% of employees in the firms included in this study. The level of innovation did not appear to vary between the firms in these two subdivisions in the sample.

As noted, each firm was asked to make one or more workers available for interview. Not all firms were able to meet this request. There were however, 17 worker interviews completed. Questionnaires were also left with several firms for workers to complete at a later date; however, these were not returned in time for inclusion in the analysis.

The questionnaires were slightly modified after two pilot interviews were conducted in the initial stage of the project. The final questionnaires used are attached (appendix 2). Two researchers visited 14 of the firms while one researcher visited the remaining two. Additional interview notes were made during the interviews when some respondents provided lengthy and detailed responses to some questions.

Table 3 in appendix 1 summarises some of the characteristics of the firms included in the study. More details cannot be provided as some firms wished to remain anonymous.

Findings from the interviews

Workplace change and job redesign in process manufacturing

While the industries under consideration figure prominently as technological innovators, the extent of workplace change evident among the 16 firms studied varied considerably, with many traditional aspects of manufacturing employment still evident. Full-time permanent employment was by far the dominant mode of employment and males substantially outnumbered females in this traditionally male industry sector. These firms therefore are not representative of some aspects of the new workforce where high levels of part-time and casual employment are more common.

There had been significant job redesign in operator-level jobs in 12 of the 16 firms studied over the previous five years, although some of these firms were still in the process of implementing these changes. A further firm was planning to introduce changes in the near future, offering operators a substantial salary boost in return for increased responsibilities. Responding to increased competition was the most frequent motivation for the changes mentioned. Almost as important however, were reasons associated with improving the operator's ownership of the job and giving the operator a better customer focus. The availability of new technology was the least common factor cited.

Those firms reporting no significant job changes in recent years gave several reasons for not having redesigned their job structures. Under an enterprise agreement to introduce a range of job changes one firm had been unable to arrive at a satisfactory outcome. The remaining two firms, both in the plastics industry and both relatively small, reported no new available technology, and hence no motivation to make radical changes to a system already working efficiently. One of these firms produced short-run, customised plastic products and was satisfied with its workplace arrangements. Its workforce was comprised of several skilled die setters, who set up the machines for each job, and lower-skilled operators who operated the machines. There were, they believed, no obvious productivity gains to be made from job redesign.

A number of the firms reporting significant job redesign noted that the changes had led to substantial increases in productivity (obviously the most important aim of the exercise), with several firms reporting that productivity had more than doubled as a result of the changes. The degree of consultation between operators and management before the introduction of job changes in some cases appeared to have contributed to the success or otherwise of the exercise.

Most job change in the firms studied had occurred in 'operator'-level jobs. Traditionally these jobs have been classified as 'semi-skilled process workers' or in similar terms. In almost all cases the redesign had involved a shift from a narrowly defined, single operation job to one that involved a number of processes. Particularly in those firms characterised by 'flow' rather than 'batch' processes (that is, petroleum, chemical and associated products), a universal impact of multiskilling was the need to interact with a computer.

It should be noted that most contacts used the term 'multiskilling' as a shorthand description of jobs that now encompassed a broader range of functions than previously. Such language implies that the workers had acquired additional skills as part of the job redesign process. While this was generally the case, and, as described, many workers

had undertaken or were undertaking training specifically related to the changed nature of their jobs, others expressed concern that their skill levels were not necessarily commensurate with their duties. Hence the term 'multi-tasking' is probably a more accurate general term to describe the nature of the job changes observed although not one that is in general usage.

Managers interviewed believed that the main drivers of these job changes were increasing competition, the availability of suitable technologies, especially computer-control, and the new industrial environment under enterprise agreements which allowed jobs to be more readily redesigned. In many cases these changes had been accompanied by job losses—referred to as 'demanning'—and by the removal of at least one layer of management. In other firms some non-core functions had been contracted out, further reducing their direct employment.

The researchers estimate that around 1400–1500 jobs had been lost from these firms over the last five years, although these losses were confined to only about half of the firms. (This figure excludes normal turnover through attrition and retirement etc.) High levels of job losses did not appear to be directly related to the level of job redesign. On the other hand, there were several firms in which the process of entering an enterprise agreement had been protracted (or still unresolved). Part of this difficulty could have been related to a desire on the part of the workers to protect both existing employment levels and existing work practices.

Even among firms not reporting job losses, staff turnover rates appeared to be very low, with many of the firms having recruited very few new workers in recent years. Many of the workers interviewed were long-term employees aged over 40. Age in fact emerged as an important issue, with some managers seeing the age of their workforce as a barrier to more substantial job redesign. These firms believed that older workers were more resistant to change and that their usually lower levels of formal education and training made them less receptive to acquiring new skills.

On the other hand, some firms regarded having an older, experienced workforce as an asset. Several of these firms described in detail how they made the process of job redesign less threatening to older workers. This process included worker participation and consultation, and optional participation in retraining.

Workers expressed a range of responses to the workplace changes where these had occurred. Many were positive about the changes, mentioning an improved understanding of the production process and greater autonomy resulting from flatter management structures.

There were however, widespread concerns among workers that the job was becoming more difficult, with too wide a range of tasks to be mastered. Because the multiskilling had produced a more challenging workplace, some workers felt that there had been a loss of 'deep' skills. Some workers also indicated that they had been required to master too many skills. An oil refinery worker with 15 years service described his duties and his reaction to the job changes in the following terms:

> 'Setting up and maintaining the process condition … set up pressure, temperature, monitoring safe conditions in the crude, PTR, & utilities plants and TDC (distribution) … In plant testing, minor maintenance, rotating around the (control) board, around everything … it is difficult to maintain an intimate knowledge of all processes, there is a feeling of information overload—this is a problem—certain aspects of the job are leaving me behind, the pace of change is radical, and certain aspects are so unfriendly.'

In one firm the skills of riggers, previously a separate occupation, had been rolled into the operator classification. Two of the remaining operators had been riggers and they reported that they were regularly required to explain to other operators certain specialised rigging skills that had not been adequately incorporated into operator training. They were concerned that, when they retired, such skills would be lost.

In most cases of multiskilling, higher-level maintenance tasks had been incorporated into the operator's role. In one case operators were expected to undertake regular maintenance of vehicles. A former mechanic, now working as one of the operators,

reported that inadequate training was exposing operators to potentially dangerous situations through failure to understand certain maintenance tasks related to braking systems. He reported that he was regularly asked to undertake maintenance tasks supposedly part of the regular operator's role.

One of the operators described the changes in his job in the following way:

> 'Fifteen years ago the entire day was spent looking after machinery, pressures, temperature checking and preparing the plant for maintenance. Today we identify the equipment problem, put the job up on the computer, prepare the permit for the maintenance contractor and finally prepare the plant in a safe manner for the contractor, to make sure its not contaminated or connected.'

Apart from multiskilling, one of the other important changes in job design was the removal of a level of management at the supervisory level immediately above the operator level. There were at least two important consequences from this change.

First, operators in many firms no longer had an easily accessible supervisor available to solve day-to-day operational problems. In many situations this was compounded by the operation of 24-hours-a-day, 7-days-a-week rosters. As a result operators were required to be their own problem-solvers. In fact this was one of the workplace changes most frequently cited by managers. Workers, too, generally agreed with this description of how their job had changed. Managers believed that an important element in workers better being able to resolve production problems lay in their developing 'underpinning' knowledge of the fundamental processes at work. In oils and chemicals, for example, this involved the workers having better knowledge of the fundamental physics and chemistry behind the processes they were controlling.

Second, the removal of a layer of management, or other factors, including multiskilling, had led to the introduction of work teams and thus the need for greater skills in communication and team-working. Several firms had formalised teams to the extent that regular team meetings were held to plan rosters, leave and other work-related matters. This in turn meant that skills in meeting procedures were becoming more important. It was clear however, that in some firms teamworking had not been a success. According to the workers in several such firms, conservative attitudes among management had not helped in implementing effective teamwork.

> 'Multiskilling requires teamwork. Communication and problem-solving skills are now important, but training has not included these skills. The conservative culture of management does not encourage specific skills gained in training being put into practice.'

One firm had addressed the team-building challenge by appointing mentors to each work group whereby workers work in teams with a team leader and mentor who is usually a staff person. The mentor assists the team leader to mould the team into a cohesive self-directed team. The operators in this firm are led by team leaders who earn a $50 allowance for the 'soft skills' they employ. Supervisors and leading hands support the team leaders. It is a flat structure made up of manager, team leader and multiskilled operators.

Technology had affected methods of communication in several firms. Just as computers have radically changed communications in white-collar occupations, so too is email now starting to have an effect in this area of manufacturing. The introduction of computer-based production control and monitoring systems in most of the firms examined has meant that workers are increasingly communicating with each other via email. And, as is the case with office workers, email is used by some as a replacement for face-to-face communication. Perhaps because of the relative newness of this technology, some workers were ambivalent about its value, with some suggesting that using email in preference to face-to-face communication could inhibit good communication.

In some firms, such as oil refineries, where workers are required to move over a large physical area, two-way radios have been in use for some time. Workers regarded the availability of such technology as a substantial improvement in working arrangements.

The availability of new communication technologies and the replacement of some formerly physical tasks with computer-controlled robotics led to an overall reduction in the physical effort required in most operator-level jobs in the firms surveyed. In one firm 12 operators were controlling and monitoring 24 robotic machines. As a result of robotics the main task of the operators had changed from a simple machine operation role to one requiring more advanced skills in setting up new dies for the change in output required in the firm's relatively short production runs.

As noted earlier, this physical effort had been replaced with, in some instances, greater demands on workers to understand the basic processes for which they are responsible. There is also an increased requirement for workers to think more about what they are doing. Again this need to understand fundamental processes, especially in the firms producing chemicals and petroleum products, was a common theme. A number of the HR managers believed this required their operators to have greater understanding of the basic physics and chemistry behind the processes they were controlling.

A further theme that arose during more detailed discussions with HR managers, especially in Victoria, was that there was growing pressure on both firms and operators as a result of environmental and workplace health and safety legislation. Again, some chemical and oil companies believed that a better understanding of fundamental chemistry, together with an appreciation of the consequences of environmental contamination, made it easier to gain their workers' co-operation in adhering to safe and responsible work practices. In Victoria at the time of the interviews the government was discussing the introduction of stronger industrial health and safety legislation, including the introduction of the crime of industrial manslaughter.

These legislative changes appeared to be another factor contributing to the growing complexity of operator-level occupations in the process manufacturing industry.

In the first chapter of this report an American author was quoted as saying that the notion of a job 'is disappearing in favor of an amorphous collection of work'. The researchers do not think this description can be accurately applied in the case of the industry under review. Clearly however, the AIG's contention that '… higher level skills are required at all occupational levels as are generic and interpersonal skills. These are resulting in requirements to upskill the existing and future workforce' is supported by the findings in most firms examined in relation to operator-level jobs. Operator-level jobs in most of the process manufacturing firms visited are becoming more complex, are requiring greater emphasis on both 'underpinning' and 'soft' skills, and are becoming more enterprise-specific.

From a worker's perspective

Many of the operator-level workers at the workplaces visited had a record of long service, with each, on average, having 13 years service. Half had worked 15 years or more with their current employer. As a result, companies did not have young workforces, with the majority of workers over 35 years old. In five cases the average age of employees was 42 years or older.

Seventeen workers were interviewed, either individually or in groups. All except one of the workers interviewed were male. Half were transferred internally to their current jobs; half were externally recruited.

Production workers felt that they had taken up changes better than managers. This belief was generally backed up by training/human resource managers interviewed. Managers not connected directly to the production process were seen by workers as showing a resistance to the increased responsibilities of workers, or in some cases had not fully understood the nature of change occurring on the factory floor. The culture of the firm and the attitude of managers appeared to have a significant impact on the uptake and success of workplace changes and training effectiveness. Workers were aware of these differences and their attitudes to change were tempered by this aspect of the work environment.

Many workplaces also reported the positive take-up of training packages by their employees, both old and young, Australian and migrant workforces. Employees had the

feeling that they had to acquire new skills or they would be 'left behind'. Some were keen to get a qualification, to throw away the label 'unskilled' or 'semi-skilled'.

> 'G., a first-generation migrant aged 61, had taken on the training package. He had worked for the company for 40 years, his only job in Australia. Starting from nothing he had sent his children through university, and "set them up". He wanted the "piece of paper" (the national certificate) to show his children that he too had a qualification.'

Workers' reactions to workplace changes

Workplace changes were characterised by multiskilling, computerisation, increased responsibilities, problem identification and solving, rostering, teamwork, ordering, invoicing and first-line maintenance.

At every plant where workers were interviewed they talked about multiskilling taking place in their workplace. In some cases it meant that they were involved in a larger slice of the production process, such as undertaking production planning, ordering raw materials, identifying and correcting problems, taking responsibility for first-line maintenance, invoicing customers and rostering work on the production line. In other cases it meant being multiskilled across several production processes in the plant, with higher qualifications, grades and sometimes wages being credited to those covering a greater range of operations.

Significant among the additional skills being gained were computer skills. The use of computerised monitoring was one of the greatest changes taking place in the workplace.

The use of central consoles for monitoring the production process, and accuracy in pinpointing technical problems, have changed both physical and theoretical aspects of operators' jobs. In many cases workers are rostered through computer tasks and plant work. Team members take it in turns to staff the computer. They subsequently undertake tasks such as first-line plant maintenance.

> 'Five years ago the job was done manually; end to end the shift comprised lifting and shifting the sheets along the line. Now it involves pushing a mouse. Requires you to think more about the process—to manipulate the sheets with thoughts—through the mouse rather than through physical manipulation.'

The use of robotics on the plant floor is also widespread, with refinery technicians, moulders or operators being responsible for their operation.

> 'The moulding plant appeared to have few workers, with individual plant operated robotically and dies set up to be changed at the conclusion of short runs. Manual and unskilled operators were not to be seen, with the preparation for die changes being undertaken by skilled operators ahead of time.'

The use of email was novel for many workers. Seen as a two-sided tool, it improved communications on one hand, but wasted time with unnecessary information, and inhibited personal contact with co-workers.

Computerised systems extended to ordering parts and materials, and invoicing. These administrative duties were generally not welcomed by operators.

> 'For example, to order parts and supplies operators now have to generate an order and go and get it … Operators tend to hoard supplies to use.'

> 'Duties changed due to technological change—more automated and computerised and "automatic", for example, invoice generation.'

Many of the companies interviewed had either contracted out much of their maintenance work, changed the duties of their tradespeople, and/or incorporated more maintenance

tasks into the duties of operators. All approaches shaped production line operators' tasks. Through multiskilling they had taken on first-line maintenance, identifying problems and finding solutions, roles which could involve simple maintenance work to prevent or repair damage, booking contractors to correct a problem and preparation of plant for contractors. At one site visited, maintenance was normally carried out by contract staff. Because of safety issues, especially where chemical processes are volatile or toxic, the identification and preparation of plant by process workers carries a lot of responsibility.

In some cases workers were pleased with their increased responsibility. However, workers who moved from narrow specialised occupations to multiskilled occupations were fast to identify their lack of empowerment. A firm previously employing raw millers, kiln burners and cement millers had consolidated these occupations into centre controller and operator positions. Another occupation, boilermaker, has disappeared within the company over the last two to five years.

These changes, from specific job-skilled to multiskilled, have meant that operators now walk around the plant observing the manufacturing process rather than being seated at a control panel. There had been control panels for each part of the process, now there is one central control, and they communicate via two-way radio with tradesmen more effectively to diagnose and solve problems. The change has resulted from the introduction of digital control technology that allows all functions to be monitored centrally by the centre controller. The introduction of the technology resulted in the loss of ten workers. Operators are now primarily regarded as problem-solvers. Communication, teamwork and problem-solving skills are all seen as more important for the operators in their new roles. This has made the trades' jobs easier as operators undertake first-line maintenance and tradesmen less routine jobs.

Multiskilling also took the form of learning the operation of a greater number of production lines within a site. This meant a wider understanding of the different technologies used and different materials being processed and, for example, related chemical reactions. Some operators embraced such multiskilling, believing that it had brought about increased job fulfilment. Increased levels of variety, a greater understanding of the whole production process at the site, and pay incentives made for increased job satisfaction. In some cases, multiskilling was seen as a process whereby staff levels diminished. Furthermore, flatter structures and a loss of supervisory levels occurred as a result. Complex demands of responsibility and teamwork were made on employees. As the negative consequences of these changes workers cited increased stress and concerns about responsibility, safety, losing deep skills and coping.

While workers could see benefits of multiskilling through increased satisfaction and pay, they opposed it when it was associated with extensive downsizing of the workforce. Job security was obviously an issue. Some workers saw no option but to keep up with the changes, such as an increased number of operational areas, new technologies and responsibilities. They feared slipping behind and losing their jobs in the future.

> 'Changes over the next few years will be difficult. More redundancies will happen because of technology, but the plant is not changing. The job is becoming more dehumanised, aspects of the job are divorced from each other, there is more emphasis on technical training for an elite group of people, a reduction of skills for others who are becoming "grease monkeys".'

Paradoxically, some workers saw multiskilling in some operational areas as going full circle, with designated, specific roles for those achieving broader technical competencies and a complex understanding of the production processes, and the remainder being left behind. Again this perception seemed to depend to some extent on the management of workforce changes at the company level.

Hopkins and Maglen in a study of the work of operatives, reviewing four industry sectors, concluded with the following question:

> *In the introduction we questioned whether the purpose of lifelong learning in relation to employment, for those working at the operative level, was solely to keep up to date with the routine operation of new technologies. Or is it, as it is for many others in the workplace, also to support the ongoing development of cognitive and interpersonal skills and the ability to use and indeed, enjoy knowledge in new ways?* (Hopkins & Maglen 1999, p.15)

> 'The job had changed with "more responsibility, more equipment to cover". Shifts that used to have 91 workers now have 42 for the same amount of work. They didn't have to control the system or handle problems; now the centralised system is more accurate.'

Hopkins and Maglen concluded:

> *The study found that management in the enterprises in all four sub-sectors— footwear manufacture, wire products manufacture, four and five star hotels and chain based supermarkets— has aimed to minimise variation by tight control on the work that takes place and the way that it is executed. Except where self-managing teams have been instigated, work, as much as is practicable, is composed of routine tasks with minimum opportunity for choice of action. However, the non-predictability of many aspects of the work of operatives prevents it being only a series of reproduced tasks. In addition, some of the businesses recognise that people who make the product or deliver the service are well placed to contribute creatively to innovation, in the development and adaptation of processes and products.*
>
> (Hopkins & Maglen 1999, p.15)

Generally the findings from this study indicate that process manufacturing, as a technologically innovative sector, is more likely than the industries surveyed by Hopkins and Maglen to have implemented work teams and to have reduced the level of routine work.

At some sites enterprise agreements had been introduced smoothly, with employees owning the changes and participating in their development. In some cases national training packages had been introduced simultaneously with enterprise agreements, giving employees time to accept and adopt the new agreement. Such changes often involved aligning new job classifications with completion of certificates II–IV related to national packages.

In other enterprises, on the other hand, industrial disputes had clouded the introduction of enterprise agreements and associated training packages.

> 'Previously we had an award with 13 classifications and accompanying demarcations. The new structure came up with a seven-level class system, broad banding classifications G1–G7. Two interstate plants were the first to go over. We took two years before the workers agreed to adopt it. This took place last October.'

Multiskilling and new responsibilities have required new 'soft skills' in the eyes of the operative workforce. One specific example is the management of shift and holiday rosters—an increased level of responsibility on team leaders or teams on the shop floor. While workers liked the opportunity to set their own work times, and the flexibility to organise amongst 'mates' their working shifts to meet special needs, they also found it hard to negotiate in some cases, such as in peak holiday periods.

> 'Previously grade 5 and 6 were supervisors who told you what bits of your job to do. Now we have no supervisors at this level. We work as a team across the grades. Main area of teamwork is organising rosters. Workers decide who is going to do what job on that shift.'
>
> 'There are some difficulties with holiday rosters—some people always want the same holidays.'

While most changes had seen an increased use of teamwork and adoption of joint responsibilities, one company had instituted 'one-man teams' for remote work 'on the road'.

Typically companies had introduced flatter work structures over the past two to three years. Some workers welcomed a level of autonomy and responsibility in their new roles. Others felt the burden of extra responsibility through reduced supervisory levels.

Another area of multiskilling taking place relates to the introduction of training packages into companies. Four employees who were interviewed were training co-ordinators/

workplace assessors. Three had been transferred from the shop floor or had been given additional training duties and responsibilities.

Workers' attitudes on workplace changes were dependent on their perceptions of the reasons for change, the attitude of management and related corporate culture. Some were positive; some were cautious while others were hostile to the changes.

In summary

Workers report the changes have resulted in:

- working less as individuals on one aspect of production and working more as a team on all aspects
- greater responsibility of team leaders for more diverse aspects of production
- a sense of pride in one's work and empowerment as teams have become responsible for the management of production
- workload increases, less supervisory support and reduced staffing levels

Workers saw changes as meaning:

- more job satisfaction
- much greater responsibility for safety, which in a dangerous industry was a real concern
- no significant financial advantage
- a massive learning curve, basically working the same plant, but through a new medium without a lot of training—it will be a struggle for some

Workers saw changes affecting their job security:

- company going back on the commitments they had made during enterprise bargaining negotiations
- a greater emphasis on a team-based approach—management introduced this too early before people were ready and it failed
- continued reduction of workplace personnel, with responsibility of technicians increasing

The training system and changing industry needs

In the majority of firms visited operator-level jobs have become more complex through multiskilling and other job redesigns. These changes have resulted in jobs that, while still regarded as 'semi-skilled', have many of the features of skilled occupations. Operators are increasingly being required to master a wide range of skills, including planning, technical, communication, and, in some cases, customer relations skills. They are also increasingly being expected to be willing to acquire new skills as new technology emerges, such as skills in using computers.

Almost all of the operator jobs observed in the firms surveyed were covered by national training packages. Nevertheless, a minority of firms had developed their own, enterprise-specific training arrangements. In addition, a number of enterprises had modified national training packages to meet their own needs. Generally the relevant national training packages were well-regarded. It was apparent that the existence of the Australian Qualifications Framework has facilitated the definition of new occupational levels and the matching of these new occupations with training packages.

The limitations of the methodology should however be kept in mind when judging the high level of take-up of training packages. As noted previously, the firms were generally selected on the basis of being known to the national ITAB and as having a positive attitude towards training. It is obvious that such firms are likely to be kindly disposed towards the adoption of training packages.

The firms in the study used a range of approaches to formal training. Nine of the 16 firms were currently using a national training package for operator level training, while one firm was planning to use a package in the near future. Five firms were using TAFE for operator training. Most training was undertaken on the job with TAFE the usual training organisation (RTO), although several firms encouraged operators to undertake formal off-the-job courses. Three firms were critical of TAFE for not providing formal, institution-based courses relevant to their industry, although two of these firms were in non-metropolitan locations, making traditional TAFE provision more difficult. On the other hand, there were several firms which regarded TAFE as the preferred provider of on- and off-the-job training.

Three firms were also critical of the quality of provision from private providers, although many firms used private providers only for limited areas of training, such as computer skills and safety training. Ten of the firms used private providers but at least four of these firms would be described as limited users.

Most firms provided incentives to their operators to undertake off-the-job training in the form of paid or unpaid time off or reimbursement of fees. In some cases firms tied advancement to completion of national certificates. Off-the-job training undertaken by operators and supported by employers tended to be related to promotional positions rather than to the operator's current core job. Commonly cited off-the-job courses were frontline management initiative (FMI) courses, workplace assessor courses, OH&S courses and computer courses.

Future skill needs

Employers were asked to identify which skills or competencies were likely to become more important in the future. Most firms believed that teamworking skills, communication skills and problem-solving skills would be increasingly important in their workplaces. In addition, many firms identified 'underpinning' technical understanding of their processes, especially in chemical and oil companies, as increasingly important in the multiskilled environment. This requirement usually translated into better basic education in chemistry and physics. Several firms noted that recent recruits to some of their operator positions were university graduates who already possessed this knowledge. There was a view, particularly among the chemical industry firms included in the study, that a least some chemical operators within their firms would need to reach an AQF IV standard to adequately understand the chemical processes they were managing.

Moreover, some of the longer-term employees interviewed seemed to acknowledge their shortcomings in these basic areas, a number believing that they were in danger of being overcome by the emerging technical demands of their jobs.

When discussing future skill needs the impression given by those firms which had undergone major job redesign was that the last few years had seen the main changes. Future changes would be simply, it seemed, more of the same; that is, there would be more multiskilling, increased emphasis on teamworking, greater need for workers to understand the underlying processes they were involved in and thus a greater need for applied scientific knowledge.

Hence the main conclusion the researchers have drawn from the study is that future VET provision needs to address two distinct areas: 'soft' skills and underpinning technical understanding in areas of basic science. Apart from the need to understand the underlying science of the processes, a better understanding of basic scientific principles was seen as providing a sounder basis for workers' understanding of the occupational health and environmental protection issues associated with the products with which they were working. Generally, as noted earlier, employers were happy with the training packages relevant to their sector. They believed that the flexibility available within the packages was appropriate, although some firms had had to undertake substantial rewriting of material to make it relevant to their specific needs.

Implications for the training system

Historically, the TAFE system has had limited involvement with the industries covered in this study, attributable in part to the relatively modern nature of these industries and their lack of a 'declared' trade status. As a consequence, the large body of workers contacted in this sector had not undertaken formal TAFE courses related to their operative-level occupation. Many of the firms however, still employed tradespersons and were familiar with TAFE and other VET providers of off-the-job training. Moreover, several of the operatives interviewed possessed trade or other formal VET qualifications.

As noted, five of the firms surveyed were using TAFE as the RTO delivering on-the-job training for their operators, while three other firms were using TAFE for other training provision. Because the majority of operatives had had no previous exposure to formal institution-based training, many firms believed that entirely on-the-job provision was the best mode of training delivery.

Training managers expressed a wide range of opinions about the quality of training providers. TAFE was the main provider of operator training under the various national training packages. Private providers were more likely to be used to provide shorter or specialist courses. Three firms were critical of TAFE, generally on the basis that TAFE lacked the flexibility to deliver training specific to their enterprise. All of the firms which expressed negative views of TAFE were based in one State. However, the limited size of the sample prevents drawing any conclusions from this finding.

The strongest approval of TAFE provision was articulated in firms where TAFE had developed a close working relationship with the firm and had customised training to meet the enterprise's needs.

The wide range of types of production encompassed within process manufacturing means that generalisations about the implications for the training system are hazardous. The oil refineries, chemical manufacturers and plastic moulders, along with four other firms which fit into none of these categories, exhibited, to some extent, the job redesign features described in this report. It was however, also apparent that the changes in the plastics area had been generally less dramatic than in the other areas. The main area of job redesign in plastics firms surveyed related to the need to change dies quickly to accommodate short production runs and just-in-time delivery.

In the chemical and oil firms, safety and environmental issues were important contributors to job redesign. However, it appeared that the main factor stimulating change was the availability of computer-controlled production processes. In this context the operator is removed from direct observation of a small part of the production process to a more remote observation, via virtual tools, of a larger slice of the production process. In turn this change requires better abstract thinking skills, better understanding of the underlying principles of the physical and chemical processes being controlled, greater autonomy and usually greater skills in working in a team environment. Moreover, several of the management and worker interviewees expected that these skills would become more important in the foreseeable future.

In the occupations observed at the 'operator' level both the wages structure and the job content in most of the firms visited appeared to the researchers to be at least the equivalent of many of the traditional skilled trades. It seems therefore, inappropriate that these jobs are still generally classified as 'semi-skilled'.

From the description of workplace changes occurring in this sector, it is apparent that there are several, sometimes divergent, trends influencing the nature of training required in the future. There are clearly some consistent developments in the firms which have

implemented job redesign. Most operator jobs have become more multiskilled and a range of common underpinning and soft skills have emerged as being more important.

Hence, it is seems that training programs for operator-level jobs in this sector should address both these emerging soft skill demands and underpinning skills in the basic sciences of physics and chemistry. Specific soft skills would include:

- the development of enhanced oral and written communication skills
- team working and conflict resolution skills
- skills in adjusting to workplace change, and
- problem-solving skills

These skills, combined with the basic underpinning knowledge of physics and chemistry, are industry- rather than enterprise-specific skills. The implications therefore, extend beyond the traditional boundaries of VET. Entrants to the process manufacturing industry in the future will need to have attained senior secondary school standard in physics and chemistry as a minimum.

While the preferred mode of delivery has been on the job, it seems likely that there will be growing demand for these skills to be regarded as entry-level skills for operators. Given the age distribution of the current workforce, it seems likely that there will be a new demand for operators in process manufacturing over the next five to ten years. Certificate III or IV level courses incorporating these skills would seem to be appropriate for such new recruits. In all probability, both on- and off-the-job provision will be necessary. The degree of industry specificity would need to be determined at the local level in order to meet local industry needs. It would seem however, that such provision would provide a relatively broad basis for many areas of process manufacturing.

The industry provides an example of one of the challenges of VET policy—labour mobility, discussed by Mournier (2001) in his recent review of French vocational education literature. Should provision in the process manufacturing sector continue to be dominated by purely on-the-job, enterprise-focussed national certificates or should more broadly based courses, providing greater labour mobility, be developed through public provision and be made available to those not already employed in the industry?

Mournier (2001) regards the specificity of VET as a crucial policy question:

> *… VET policies have to be considered as autonomous decisions, and their concern should be devoted to strengthening their role in regulating the labour market for economic and social purposes. As it stems from our conclusions, a coherent strategy, congruent with economic and social objectives, must be outlined. This strategy has first to answer a crucial question about whether mobility or immobility of workers has to be encouraged, so that economic growth and social equity objectives can be achieved.* (Mournier 2001, p.42)

This study suggests that within the confines of the 'process manufacturing' sector there is a body of generic skills, both 'hard' and 'soft', being required across many enterprises. The study does not address the question of whether these skills are common across other industries and hence whether inter-industry mobility is enhanced. The study suggests that some of these generic skills are perhaps more properly regarded as basic educational requirements, for example, underpinning knowledge of chemistry and physics. While it seems likely that the provision of at least some of these generic skills is occurring through training packages, and thereby perhaps assisting labour mobility, it was also clear that, in some cases, a loss of deep skills was occuring. This loss of deep skills might have the effect of reducing mobility of individuals with traditional trade skills.

It is also apparent that there has been substantial attrition, often through retrenchment, within this industry over the last five years. It would be unrealistic to expect this situation to change over the next five years. It is therefore prudent to ensure that, as far as possible, workers in these industries acquire broadly based skills that enhance their capacity to operate in other industries.

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Appendix 1: Statistical profile of the industry

Industry coverage

This study examines a subset of the industries covered by Manufacturing Learning Australia, one of the national industry training advisory bodies. The industries included in this study all occur in the ANZSIC subdivisions 25 and 26, which are described as:

25 Petroleum, coal, chemical and associated product manufacturing

26 Non-metallic mineral product manufacturing

The following table shows the industry groups (the second lowest disaggregation used by the Australian Bureau of Statistics) that occur within these two subdivisions, along with total employment in each as at the 1996 Population Census. A table in the appendix shows employment within each industry class (4-digit code, the most disaggregated measure available.)

Table 1: Employment by industry group

	Employment		
Industry group	Males	Females	Persons
250 Petroleum, coal, chem. & assoc. prod. mfg undefined	2 613	743	3 356
251 Petroleum refining	4 171	643	4 814
252 Petroleum & coal product mfg nec*	878	150	1 028
253 Basic chemical manufacturing	10 459	2 436	12 895
254 Other chemical product mfg	16 203	11 264	27 467
255 Rubber product manufacturing	6 422	1 262	7 684
256 Plastic product manufacturing	19 704	8 913	28 617
260 Non-metallic mineral product mfg undefined	1 861	185	2 046
261 Glass & glass product mfg	6 152	1 692	7 844
262 Ceramic product manufacturing	5 886	2 430	8 316
263 Cement, lime, plaster, concrete product mfg	13 616	1 803	15 419
264 Non-metallic mineral product mfg nec*	4 152	917	5 069
Total	**92 117**	**32 438**	**124 555**

Source: ABS 1996 Census of Population and Housing
*nec = not elsewhere classified

Since 1996 employment in manufacturing has declined by about 4% (using ABS labour force estimates as at November 1999.) The ABS Labour Force Survey data show larger numbers employed in these subdivisions in November 1995 and 1996—almost 160 000 in November 1996. Again, using the Labour Force Survey, employment in the two subdivisions combined does not appear to have changed greatly between 1996 and 1999, with Petroleum, coal, chemical and associated product manufacturing declining slightly and Non-metallic mineral product manufacturing rising slightly.

Females made up just over one quarter (26%) of persons employed in the two subdivisions, considerably lower than their overall share of employment. The 1996 census data indicate that English language proficiency was relatively high in these industries, with almost 80% of workers at the 1996 Census indicating that issues of English language proficiency were not applicable.

Table 2: Employment by industry sub-division

Industry sub-division	Nov 96	Nov 97	Nov 98	Nov 99	Nov 00
Petroleum, coal, chemical & associated product	110.2	97.9	106.2	106.0	104.7
Non-metallic mineral product	49.6	44.5	48.7	53.2	42.5

Source: ABS Labour Force Survey, 1996–2000

Occupational profile

About 25% of all employees in the two subdivisions are classified as intermediate production & transport workers, the largest occupational category. This study focusses on workers in this category, together with some in the tradespersons & related and labourers & related categories. Together these three groups (bolded in the following table) comprise more than half of the employment in the two subdivisions. The following table shows the major occupational groups in the two subdivisions. A table in the appendix provides a detailed (6-digit) occupational breakdown of these two industry subdivisions.

Table 3: Occupational profile (major ASCO groups)

	25 Petroleum coal chemical & assoc. prod. mfg	26 Non-metallic mineral prod. mfg	Total	%
Managers & administrators	11 527	4 693	**16 220**	13.0
Professionals	10 601	4 300	**14 901**	12.0
Associate professionals	6 125	1 619	**7 744**	6.2
Tradespersons & related workers	**10 243**	**6 098**	**16 341**	**13.1**
Advanced clerical & service workers	2 972	1 052	**4 024**	3.2
Intermediate clerical, sales, service workers	8 523	3 170	**11 693**	9.4
Intermediate production & transport workers	**21 163**	**10 514**	**31 677**	**25.4**
Elementary clerical, sales, service workers	1 271	470	**1 741**	1.4
Labourers & related workers	**11 420**	**5 872**	**17 292**	**13.9**
Not stated	369	182	**551**	0.4
Inadequately described	1 645	726	**2 371**	1.9
Total	**85 859**	**38 696**	**124 555**	**100**

Source: ABS 1996 Population Census

Within the intermediate production & transport workers category, the largest single occupation occurring in these industry subdivisions is intermediate machine operators, with almost 17 000 persons. This major occupational group has been the major areas of focus for the field investigations conducted in stage 2 of this study.

Educational qualifications

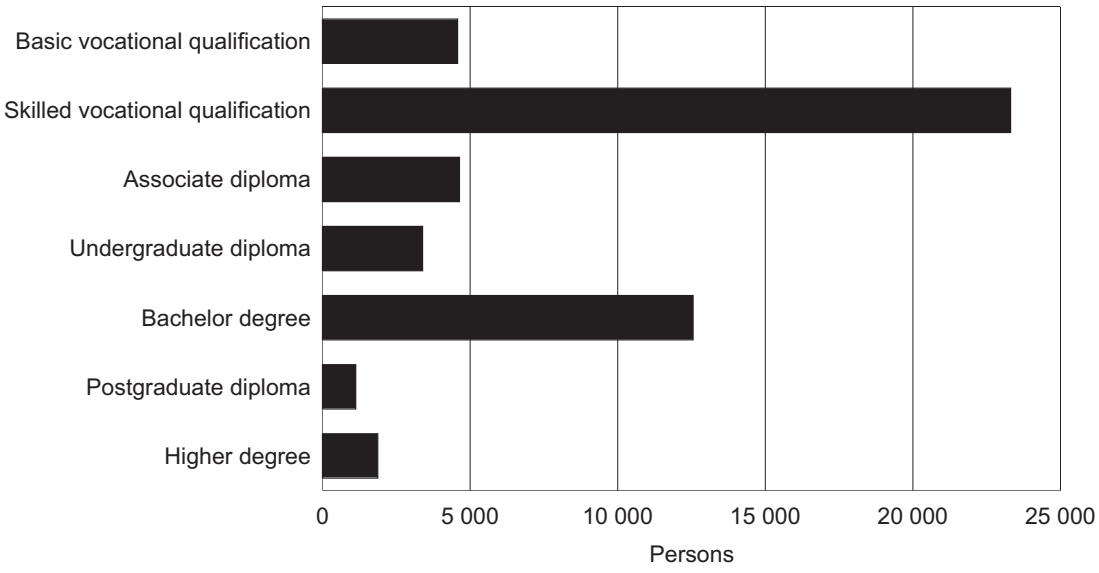
More than 60% (83 067) of those employed in the industry sectors (ANZSIC 25 & 26) did not possess formal educational qualifications. This indicates that the industries in this study had a slightly lower educational profile than all industries as at the 1996 Census, although it was close to the average for the manufacturing sector. The ABS Survey of Education and Training Experience (ABS 1997) revealed that workers in the manufacturing sector recorded a relatively low level of participation in non-award training courses (the fifth lowest out of the 17 industry divisions), with only about 35% of the workforce having undertaken a training course in the year preceding the survey.

Of those workers in the industries possessing some form of qualification, by far the greatest number, more than 23 000 or over 16% of all those employed in the industries, held a skilled vocational qualification.

More than 12 500, or nearly 8.7%, held a bachelor's degree. There were fewer than 5000 persons in each of the other categories of educational qualification.

The following figure shows the distribution of formal educational qualifications in the industries for those possessing some form of qualification.

Figure 1: Formal educational qualifications profile



The following table summarises some of the characteristics of the firms included in the study. The amount of data provided is limited in order to retain anonymity for those firms which made this request.

Table 4: Characteristics of firms included in study

Main sub-sector	Employ-ment	% of workforce f/t perm.	Metrop. (M) or non-metrop. (N)	Job loss last 5 yrs*	Job change last 5 yrs	Main reason for job changes
Cement, lime, plaster, concrete prod mfg	240	89	M	800	yes	Competition
Chemicals	280	93	N	0	yes	Competition
Plastic product mfg	800		M	0	yes	Improve customer focus
Petroleum	300	98	M	25	yes	Reduce labour costs
Glass	247	97	M	500	yes	Competition; customer demand
Petroleum	404	100	N	0	yes	Competition
Cement, lime, plaster, concrete prod mfg	103	98	N	10	yes	New technology
Other chemical product mfg	225	99	M	0	yes	Competition
Basic chemical manufacturing	350	100	M	Yes—unspecified	yes	Competition
Petroleum	390	100	M	0	no	na
Basic chemical manufacturing	140	100	M	Yes—unspecified	no	na
Other chemical product mfg	60	100	M	0	yes	In train; limited
Basic chemical manufacturing	38	85	N	0	yes	Improve ownership of job
Other chemical product mfg	50	80	M	0	no	na
Plastic product manufacturing	70	97	M	0	no	na
Cement, lime, plaster, concrete prod mfg	40	100	M	0	yes	New technology

* Job losses refer to large scale retrenchments etc. and ignore the loss of workers through normal turnover and retirement.

Appendix 2: Questionnaires

New Skills in the Process Manufacturing Sector
Worker Interview

This research is being conducted for the National Centre for Vocational Education Research to look at how jobs and training have changed. The following survey asks questions about work and training. This is a confidential survey and your answers will not be discussed with others. You do not need to write your name on the survey.

Please answer the following questions about you and your job.

1) Please tick (✓)
   Male ☐
   Female ☐

2) What is your job in this company?
.....

3) Have you held other jobs in this company, prior to holding this one?

Yes ☐
No ☐

If yes, what were the names of these jobs?
.....
.....

4) In your current job are you employed-
   Please tick (✓)

Full-time – permanent ☐
Part-time – permanent ☐
Casual ☐
Contract ☐
Other ☐

5) How did you get this job?
Please tick (✓)

External recruitment ☐
Internal promotion or transfer ☐
Other.....

6) How long have you been employed by this company?
Please tick (✓)

Less than 1 year ☐
1 to 3 years ☐
> 3 to 5 years ☐
> 5 years ☐
If greater than 5 years, how many years? .....

7) How long have you been employed in your current job?
Please tick (✓)

Less than 1 year ☐
1 to 3 years ☐
> 3 to 5 years ☐
> 5 years ☐
If greater than 5 years, how many years? .....

8) Do you normally speak a language other than English at home?
Please tick (✓)

Yes ☐
English only ☐

9) Do you have post-school qualifications?
Please tick (✓)

Yes ☐
No ☐
If yes, please describe.....

Occupational change

10) What are the main duties of your current job?
.....
.....
.....
.....
.....

11) Thinking about your current job, have your duties changed in any way over the last two years?
Please tick (✓)

Yes ☐
No ☐

If yes, please describe how your duties have changed
.....
.....
.....
.....
.....
.....
.....

12) What, in your view, has caused these changes?
.....
.....
.....
.....

13) Have you experienced any benefits as a result of these workplace changes?
Please tick (✓)

Yes ☐
No ☐

If yes, please describe.....
.....

14) Have you experienced any difficulties as a result of these workplace changes?
Please tick (✓)

Yes ☐
No ☐

If yes, please describe.....
.....

Have the following skills become more important in the past 2–5 years in this work role?

Communication skills

Yes ☐
No (stayed the same) ☐

Team work skills

Yes ☐
No (stayed the same) ☐

Problem-solving skills

Yes ☐
No (stayed the same) ☐

If yes, (to any of the three)-
What training, if any, has occurred?
(e.g. TAFE, in-house, external etc.)
.....

In your view how effective has the training been?
.....

15) What changes do you expect for this job/occupation in the future (say over the next five years)?
.....
.....

Training – Formal courses

16) Since working with this employer have you undertaken any formal training leading to a qualification? Please tick (✓)

Yes ☐
No ☐

If yes, please name the course/s
.....
.....

17) Where did you do the course? (e.g. TAFE, private provider, university courses, etc.)
.....
.....

18) What was your **main** reason for doing this course?
Please tick (✓)

To try for a different career ☐
To get a better job or promotion ☐
It was a requirement of my job ☐
I wanted extra skills for my job ☐
To get into another course of study ☐
For interest or personal reasons ☐
To keep my job ☐
Other reasons ☐
Please describe.....

Training which did not lead to a formal qualification

19) Since working with this employer which of the following areas of training have you undertaken? Please tick (✓). More than one may be ticked.

This list refers to structured training which did not lead to a formal qualification, either provided by the company (in-house or externally) or one that you have paid for yourself.

No training ☐ **(Go to question 20)**

Induction ☐
General supervision ☐
General computing ☐
Health and safety ☐
Personal development ☐
Management ☐
Technical ☐
Apprenticeship/traineeship ☐
Sales, clerical/office and personal services ☐
Plant and machinery ☐
Workplace language/literacy ☐
Other training (please describe)
.....

At many workplaces there is on-the-job training.

20) To learn more skills to do your job do you -
(Please tick (✓). More than one box may be ticked.)

Ask questions of co-workers or colleagues ☐
Teach yourself ☐
Have someone show you ☐
Watch others work ☐
Training on-line ☐
Other on-the-job training activities, please describe.....
.....
.....

In your view, how useful have the training courses been in meeting the training needs of workers in this occupation? (please circle)

I. Formal structured training leading to a qualification (e.g. Certificate, Diploma)

(a) TAFE

Not useful Quite useful Very useful Not applicable

Comments .....

(b) Private training providers

Not useful Quite useful Very useful Not applicable

Comments .....

(c) New Apprenticeship Scheme training (including traineeships)

Not useful Quite useful Very useful Not applicable

Comments .....

II. Other training not leading to a formal qualification

(a) In-house delivered by company staff

Not useful Quite useful Very useful Not applicable

(b) In-house delivered by external trainers (e.g. equipment suppliers)

Not useful Quite useful Very useful Not applicable

(c) Off site training

Not useful Quite useful Very useful Not applicable

(d) On-the-job training (e.g. being shown, teaching yourself, asking co-workers)

Not useful Quite useful Very useful Not applicable

Comments.....
.....
.....

21) How important do you think formal educational qualifications are for your current job? (Please circle)

Not at all important Somewhat important Very important

(a) If ticked "important", what course/qualifications are important to have for this job?

.....
.....

22) Are you aware of any assistance/support available to you from the company to undertake further study or training?
Please tick (✓)

Yes ☐
No ☐

If yes, please describe.....
.....
.....

Thank you very much for participating in this survey
Please post your survey back in the pre-paid envelope provided

New Skills in the Process Manufacturing Sector
Interview Schedule
Training/Human Resource Managers

This research is being conducted for the National Centre for Vocational Education Research to look at how jobs and training have changed. The following survey asks questions about work and training. This is a confidential survey and your answers will not be discussed with others. You do not need to write your name on the survey.

Please provide numerical information where available, if not available; please provide your best estimate.

1) What is your role in the organisation?
.....
.....
.....

Please turn to the Industry Table in Attachment 1 at the end of this Survey.

2) Which industry best describes the major work of your enterprise?
.....
.....
.....

3) Please describe your core business activity
.....
.....
.....

4) What is the current size of your workforce?
Please answer for this site. If the site comprises more than one location, please calculate for the workforce for which you have direct responsibility.
.....

5) What proportion of the workforce (for which you have direct responsibility) is-

Full-time – permanent .....
Part-time – permanent .....
Casual .....
Contract .....

Training in general

6) Which of the following areas of *structured training* are provided by your enterprise for employees?

Please tick (✓). This list refers to structured training not leading to a formal qualification, either provided in-house or by an external provider.

Induction	☐
General supervision	☐
General computing	☐
Health and safety	☐
Personal development	☐
Management and professional	☐
Technical and associate professional	☐
Apprenticeship/traineeship	☐
Sales: Clerical/office and personal services	☐
Plant and machinery	☐
Workplace language/literacy	☐

Other training (please describe)

.....

7) Has your enterprise put employees through formal training under the New Apprenticeship Scheme over the previous two years? (these may be existing staff or externally recruited)

Yes ☐
No ☐

If yes, please list number of commencements and occupational areas

a) Number of Commencements.....

b) Occupational areas .....

.....

8) Does the company provide assistance/ support to employees who undertake further formal education and training? (That is, through a course leading to a formal qualification e.g. TAFE, university courses)

Yes ☐
No ☐

a) If Yes, please list the employer support provided (e.g. study leave)

.....
.....

9) What forms of *unstructured (on-the-job)* training occurs in your enterprise to upgrade workers skills?
Please tick (✓). More than one box may be ticked.

Asking questions of co-workers or colleagues ☐
Teaching yourself ☐
Being shown how to do to the job ☐
Watching others work ☐
Other activities, please describe.....

Occupational change and associated training

Please refer to the table below entitled **"Occupations"**

10) What occupations do you currently employ? (Please list)

11) How do you classify these occupations?
(e.g. Professional, Technical, Administrative, Operative, Maintenance or Trades)

12) How many staff are employed in each occupation?

Table: Occupations

Current Occupations employed by the enterprise		Number of staff employed in each occupation
Title	**Classification**	

13) What, if any, occupations have disappeared over the last 2–5 years?
Please list the occupations

.....
.....
.....

14) Are there any new occupations which have emerged in the past 2–5 years?

Yes ☐
No ☐

If yes, please name the occupations
.....
.....

15) Which occupation do you consider has undergone the greatest amount of change in its work content?
Name of occupation.....

16) What were the previous skills and duties of this job/s?
.....
.....
.....
.....

17) What are the core skills and duties of this job now?
.....
.....
.....
.....

18) What have been the main reasons for the changes in this job?
.....
.....
.....

19) To what extent has this occupation required more “soft” skills over the past 2–5 years?
Please circle.
Communication skills
No change in skill level Increased skills required

Team work skills
No change in skill level Increased skills required

Problem-solving skills
No change in skill level Increased skills required

20) If yes, (to any of the three)-
What training, if any, has occurred to equip workers with teamwork, communication or problem solving skills?
(e.g. TAFE, in-house, external etc.)
.....

21) In your view how effective has the “soft” skills training been?
.....
.....

22) What are the typical entry points to this occupation? More than 1 box may be ticked.

External recruitment ☐
Internal promotion or transfer ☐
Formal qualifications ☐
Other.....
.....

23) Thinking about those occupations which the VET sector would normally target- What work skills or competencies do you see as becoming more important?
.....
.....

24) How important do you think formal educational qualifications (such as a TAFE qualification) are for this occupation? (Please circle)

Not at all important Somewhat important Very important

25) In your view, how useful are current training/ courses in meeting the training needs of workers in this occupation? (please circle)

I. Formal structured training leading to a qualification

(a) TAFE
Not useful Quite useful Very useful Not applicable

Comments.....

(b) Private training providers
Not useful Quite useful Very useful Not applicable

Comments.....

(c) New Apprenticeship Scheme training
Not useful Quite useful Very useful Not applicable

Comments.....

II. Other training

(a) In-house delivered by internal staff

Not useful Quite useful Very useful Not applicable

(b) In-house delivered by external trainers

Not useful Quite useful Very useful Not applicable

(c) Off-site training

Not useful Quite useful Very useful Not applicable

(d) Unstructured (on-the-job) training

Not useful Quite useful Very useful Not applicable

Comments .....
.....

Thank you very much for participating in this survey

Attachment 1

Table: Industry

Industry	✓ Please tick
Petroleum, Coal, Chemical and Associated Product Manufacturing (25)	
Coal Chemical and Associated Product Manufacturing, undefined	
Petroleum, Coal, Chemical and Associated Product Manufacturing, undefined	
Petroleum Refining	
Petroleum Refining	
Petroleum and Coal Product Manufacturing, nec	
Petroleum and Coal Product Manufacturing, nec	
Basic Chemical Manufacturing	
Basic Chemical Manufacturing, undefined	
Fertiliser Manufacturing	
Industrial Gas Manufacturing	
Synthetic Resin Manufacturing	
Organic Industrial Chemical Manufacturing, nec	
Inorganic Industrial Chemical Manufacturing, nec	
Other Chemical Product Manufacturing	
Other Chemical Product Manufacturing, undefined	
Explosive Manufacturing	
Paint Manufacturing	
Medicinal and Pharmaceutical Product Manufacturing	
Pesticide Manufacturing	
Soap and Other Detergent Manufacturing	
Cosmetic and Toiletry Preparation Manufacturing	
Ink Manufacturing	
Chemical Product Manufacturing, nec	
Rubber Product Manufacturing	
Rubber Product Manufacturing, undefined	
Rubber Tyre Manufacturing	
Rubber Product Manufacturing, nec	
Plastic Product Manufacturing	
Plastic Product Manufacturing, undefined	
Plastic Blow Moulded Product Manufacturing	
Plastic Extruded Product Manufacturing	
Plastic Bag and Film Manufacturing	
Plastic Product Rigid Fibre Reinforced Manufacturing	
Plastic Foam Product Manufacturing	

Industry	✓ Please tick
Non-Metallic Mineral Product Manufacturing (26)	
Non-Metallic Mineral Product Manufacturing, undefined	
Non-Metallic Mineral Product Manufacturing, undefined	
Glass and Glass Product Manufacturing	
Glass and Glass Product Manufacturing	
Ceramic Product Manufacturing	
Ceramic Product Manufacturing, undefined	
Clay Brick Manufacturing	
Ceramic Product Manufacturing	
Ceramic Tile and Pipe Manufacturing	
Ceramic Product Manufacturing, nec	
Cement, Lime, Plaster and Concrete Product Manufacturing	
Cement, Lime, Plaster and Concrete Product Manufacturing, undefined	
Cement and Lime Manufacturing	
Plaster Product Manufacturing	
Concrete Slurry Manufacturing	
Concrete Pipe and Box Culvert Manufacturing	
Concrete Product Manufacturing, nec	
Non-Metallic Mineral Product Manufacturing, nec	
Non-Metallic Mineral Product Manufacturing, nec	



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