THE UNIVERSITY OF ADELAIDE
AUSTRALIA

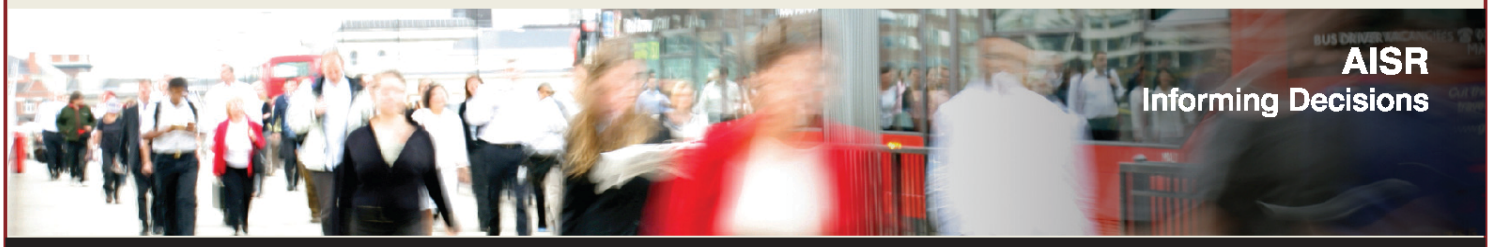
AUSTRALIAN INSTITUTE FOR SOCIAL RESEARCH

South Australian Workforce Futures Online - *online workforce forecasting in the South Australian minerals and resource sector*

John Spoehr and Simon Molloy

August 2010

Prepared with assistance from the:
Institute for Minerals and Energy Resources



CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

1 EXECUTIVE SUMMARY

Across many government and private organisations there is a pressing and ongoing need for accurate forecasts about a range of economic variables because these are critical to policy and strategy formation. As Australia has weathered the global downturn and economic growth strengthened, discussions regarding skill shortages have again become prevalent in the general media and amongst government policy makers. Concerns about skill needs are also becoming more frequently expressed by employers. If governments choose to participate in workforce planning and skills development, the need for skills demand forecasting is inescapable. Decisions about what mix of skills will be available in the future need to be made in the present. This is because the development of skills takes time, in many cases three to four years or even more. On-the-job knowledge and experience takes additional time to accumulate. The accuracy of forecasts is important because significant resources must be committed to alternative skills well ahead of the periods in which they will be employed.

In the case of workforce forecasts, we are attempting to anticipate the composition of skills that will be demanded in the future. The aim is to forecast the collective or aggregate outcome of multiple independent decisions by multiple employers. This paper focuses on workforce forecasting for the South Australian minerals and resources industry. The forecasts for the resources sector that are discussed in this paper have been undertaken using a variety of approaches including: econometric models of the whole economy; projections based on the behaviour of proxy variables such as mineral output; and by aggregating the results of surveys of employers' hiring intentions – in effect, aggregating their independent forecasts of their own future requirements. These methods have their strengths and weaknesses: econometric and proxy variable methods produce results relatively cheaply (for any particular single sector) and can be updated frequently but do not typically produce results that are detailed enough for skills development decision-making. On the other hand, survey-based methods yield usefully detailed results but are relatively expensive to execute and therefore are done infrequently and usually by different parties using inconsistent methodologies.

In order to assess the efficacy of forecasting methods, one needs to be able to define what accurate forecasting means. The only sense in which a forecast can be said to be correct, is if, subsequently, it turns out to be an accurate prediction of variables which can be accurately and objectively measured in the future. Even in cases where such accuracy is achieved it is not immediately possible to say to what extent the success is due to good luck rather than good method. If, over time, a particular method consistently produced accurate results, then it could be said to be accurate, but such cases are extremely rare, particularly at the level of detail required for workforce planning. Nonetheless, the potential rewards from developing improved forecasting methods are potentially large and the search for such methods is a continuing endeavour.

Technological and methodological innovations have given rise to new possibilities for forecasting methodology. Over the last 10 to 15 years the cost of conducting surveys has declined significantly through the development of on-line methods and methodologies to conduct and aggregate responses have also improved. Developments in areas such as 'information aggregation systems' or 'prediction markets' have given rise to new methods that offer improvements in the accuracy of responses from informants. The overall concept behind these methods is to extract the maximum amount of usable information from participants in the field.

In this paper we propose a method to implement an information aggregation mechanism for the purposes of skills forecasting in the South Australian resources sector – South Australian Workforce Futures Online (SAWFO). It is intended that this proposal be starting point for discussions with key stakeholders and that it be the basis for a significant research effort in the skills forecasting area initially for the resources sector in South Australia.

Why the South Australian resources sector and why an 'information aggregation' approach? The resource sector is particularly important for South Australia's economic development. It is a high growth and high margin economic activity, generating significant revenues for the State government and represents a valuable diversification of economic activity which balances the dependence of the South Australian economy on manufacturing, services, agriculture and government expenditure. Importantly, for the purposes of the proposed research, the resource sector is tractable because there are relatively few employers among whom the importance of a skills development strategy is widely recognised. In addition, much valuable ground work has been undertaken by the State Government and organisations such as SACOME and RESA. This ground work forms the basis of the collaborative environment and approach which are critical preconditions for the type of research being proposed in this paper.

Online information aggregation systems enable multiple distributed participants to engage online in a live forecasting interaction and feedback environment and process. These aggregation environments and processes are specifically designed to encourage individuals to contribute accurate and timely information about specific forecasted variables. The research project would involve regular scheduled forecasting sessions in which the participants would interact via a web-based interface. In information aggregation systems the aggregated forecasting results of the group are generally 'pushed' back to the group in real time enabling individuals to reconsider their views on the basis of knowledge about what the rest of the market 'is thinking'. This process of forecasting, aggregation, reflection and reconsideration is designed to extract the most accurate information individuals in the group have at their disposal.

A range of participants would be enlisted from mining and skills development sectors. This could include representatives from mining companies, recruitment consultants, the VET sector, unions, government and workforce specialists. The overriding object is to encompass a set of individual who have relevant knowledge about the mining industry, its growth and skill needs, the labour force etc.

Another critical component of the proposed research project is building a 'culture of review'. Participants will be encouraged to examine both their own and aggregate forecasts in the light of actual data as it becomes available. One of the intentions of the research project will be to build an understanding of forecasting techniques and concepts which are valuable in their own right.

By collecting and comparing forecasts and data over a three-year period we will build an understanding of the dynamics and causal factors associated with skills demand that will have enduring value for workforce planning and the development of new policy.

2 INTRODUCTION AND BACKGROUND

Prior to the global financial crisis significant skills shortages were emerging in the Australian resources sector driven by strong demand from China and India. These skills shortages have now re-emerged as Australia faces its largest ever investment boom driven primarily by export demand for resource sector outputs. The Australian Bureau of Agricultural and Resource Economics (ABARE 2009) reports that as at October 2009 there were 74 advanced major resources projects in Australia with a value of $112.5 billion and 267 less advanced projects with a value of $238.3 billion.

It is arguable that labour and skills rather than capital that are now a binding constraint on the capacity of the Australian resources sector to expand to meet international demand. The ageing of the workforce raises additional concerns about labour supply with the retirement rate of the baby boomer cohort set to accelerate over the next five to ten years. Interest in reliably forecasting the demand for skills within the resources sector is set to increase.

It is in this context that this paper reviews workforce forecasting methodologies and practice with particular emphasis on the South Australian resources sector, identifies gaps or weakness in existing methods and outline directions for future research. The workforce forecasting literature appears, at times, schizophrenic. On one hand there is a deeply considered literature which argues that accurate workforce forecasting is bedevilled by slippery definitions and by data that aren't telling us what we think they are, while on the other, there is enormous pragmatic effort devoted to creating projections of skill demand and supply and formulating policy prescriptions for governments' involvement in addressing workforce issues.

Workforce forecasting involves the estimation of future labour supply and demand. Workforce forecasting can be undertaken at the level of individual organisations, industries and regions and nationally by private organisations and governments. One of the important uses of workforce forecasting is to inform the allocation of training expenditure and effort by government and industry.

In this paper we primarily consider workforce forecasting for the mineral and resource sector in South Australia. Resources are becoming increasingly critical for South Australia's economic development. South Australia does not have a resource dominated economy to the extent that either Western Australia or Queensland does but the resources sector forms an essential component of South Australia's diversified economy. The potentially very rapid growth of mining in South Australia raises the possibility that skill shortages may constrain the sector's growth in the near future.

One of the biggest challenges in workforce planning is that it inescapably involves forecasting about future demand for skills and qualifications in sufficient detail to inform current training decisions. This is because it takes significant amounts of time to 'produce' skills and qualifications. If it takes three or four years to complete a particular course of training then, in deciding whether to invest in this particular skill we are interested in not the current demand for that skill but in the demand in three or four years time. Therefore the quality of the forecasting of the demand for skills and qualifications is of central importance in workforce planning and in the formation of governments' policy responses. Having emphasised the need for accuracy it is important to point out that is unrealistic to expect forecasts to consistently produce accurate results across unpredictable movements in the business cycle. A more realistic goal is to produce forecasts that consistently produce results which are of the correct magnitude and direction in the absence of significant turning points in the business cycle.

3 WORFORCE FORECASTING APPROACHES

Any effort to project the future demand for skills inevitably requires making judgements about the future. As recent economic experience indicates, future economic phenomena are intrinsically unpredictable. In general, changes in the business cycle, the international trading environment or major socio-political events can impact on the fortunes of particular industries and even countries. More specifically to skills markets, particular industries may grow at unpredictable rates, new technology may change the skill compositions of industries, and the skill sets that employers require in specific occupations are likely to change over time.

There is a wide variety of techniques used in various countries to project future skills demands. A key technique used in many first world countries, including Australia, is general equilibrium modelling of the economy. Computable general equilibrium (CGE) models are a class of economic model that use actual economic data to estimate how an economy might react to changes in policy, technology or other external factors, and how it is expected to evolve over time. They are able to simulate the effects of different 'shocks', including on the demand for labour.

Peng, Spoehr and Windsor (2005) survey workforce planning models, including their skills demand forecasting components. The models are all large scale quantitative economic models. They examine models from Australia, Canada, USA, the Netherlands, Germany and the UK. These models employ a variety of methodologies and deal with labour demand and supply to varying extents. The demand for labour is linked to the supply of labour most obviously through *replacement demand*. This is the demand for labour generate by exits from the workforce due to illness or retirement. This source of demand is of increasing concern as the population ages.

Most of the models are macroeconomic models with significant sub-components for the labour forces. The MONSAH model is generally regarded as the most advanced model in Australian and provides relatively highly disaggregated forecasts of labour demand for 158 industries and 340 occupations.

The majority of the models adopt a 'top-down' methodology meaning that they begin with a model of the macroeconomic and estimate shares of economic activity to industries and calculate labour demand as a function of this activity. An exception to this discussed by Peng et al is the process developed by the Australian Medical Workforce Advisory Committee (AMWAC) to plan for specialist medical occupations in Australia. This is an industry-specific technique which focuses on supply inflows and outflows and it is a largely a 'bottom-up' approach that is based on industry-specific data. Peng et al notes that:

> *the process is supported by: the participation and commitment of key stakeholders; timely access to reliable and relevant data about the medical workforce and future demand for services; sophisticated methodologies and calculation tools supported by mechanisms to gather qualitative information; and an appropriately resourced organisational structure to oversee and conduct the planning.(Peng et al, 2005)*

Peng, Spoehr and Windsor then discuss reviews of these models by the Australian National Centre for Vocational Education Research, Hamburg Institute of International Economics and Access Economics.

The conclusion of this analysis is that there are several challenges or 'gaps' in skills demand forecasting models:

- the level of disaggregation – more disaggregation is desirable but accuracy declines is top down models at higher levels of disaggregation and a relatively high level of disaggregation is required for the development of workforce planning policies especially those that are industry-specific

- demand forecasts generally do not take sufficient account of demographic changes, in particular, the impacts of ageing in the workforce
- reliance of underlying assumptions about occupational structures and definitions and/or industrial structures which have the potential to change significantly even within relatively short forecasting periods (two to three years) and lead to inaccurate forecasts
- inability to accommodate the changing skills composition of occupations and/or the emergence of new occupations.

A further study of the accuracy of CGE models found that the reliability of projections fails at more detailed levels and as the length of the forecast period rises (Richardson and Tan, 2007). Richardson and Teese (2008) argue that:

> *…model projections should be used judiciously to inform the planning policy. In our judgement, they are best used to assist the VET sector to align the broad structure of its offerings to the anticipated future needs of the economy, including replacement demand. It is unreasonable to expect such models to be able to provide accurate projections of detailed occupational demand at a regional level five to ten years in the future.*

The OECD (2008, p.24) cautions "skills forecasts are often unreliable and should not be the foundation of central planning". Furthermore, "Skills Australia believes planning should add value to anticipating and preparing for global directions, not micro managing the specifics of demand or supply for all occupations" and "efforts should concentrate on selected occupations where there is good intelligence the supply is critical, lead times are long or where infrastructure may be required" (p.19).

Many OECD countries, such as Canada, Germany, the Netherlands and the United States, forecast future skills needs mainly by occupational categories. However, these forecasts are often unreliable. Labour market demand depends on factors that are volatile and difficult to predict, such as technological innovation, global economic conditions, and government policies. Richardson and Tan (2007, p. 9) conclude:

> *Our own comparisons of projections with outcomes for the MONASH model confirm that, over a nine-year period, its projections diverged substantially from the actual outcomes for a number of occupations. Indeed, even at the major occupational group level, the direction of change was in some cases incorrect—projecting growth when there was decline and vice versa.*
>
> *In addition, even when it is possible to forecast the future occupational mix – e.g. so many cooks and so many childcare workers – this does not necessarily translate into an equivalent mix of training requirements, except on the assumption that all cooks need training as cooks, and all childcare workers need training as childcare workers. In fact, people trained in one field often work in another, and this may be a good thing, as it allows for the evolution and development of careers and for the cross-fertilisation of fields and ideas. (2008, Hoeekel, Field, Justesen and Moonhee)*

These considerations suggest the need for a cautious approach to quantitative planning and avoiding complete reliance on quantitative projections of demand even in the short term. We now turn to a brief survey of recent workforce analysis of the resources sector in both South Australia and Australia.

4 WORKFORCE FORECASTING FOR RESOURCES: NATIONAL AND SOUTH AUSTRALIAN CONTEXT

In this section we examine key findings from recent literature on resources sector labour force trends. This includes national studies dealing with the workforce as a whole and more specific studies on the resources sector.

Table 1 provides a chronology of relevant studies and the methods that have been adopted to undertake them.

Table 1: Studies related to labour market forecasts

Date	Author/Organisation	Title	Method
2004	Western Australian Department of Education and Training	Argus Report (2004) Western Australian Development Projects: Employment Demand and Predicted Skill Requirements 2003-2007	Industry wide survey
2006	Department of Further Education, Employment, Science and Technology and the Department of Trade and Economic Development	Estimated Demand for Labour in the Mining Sector: 2006-2014 (undertaken by SACES)	State survey
2006	Chamber of Minerals and Energy of Western Australia, the Minerals Council of Australia and the Department of Education, Science and Training	Staffing the Supercycle: Labour Force Outlook in the Minerals Sector, 2005 to 2015	National level projections based on output growth
2006	National Institute of Labour Studies	The Labour Force Outlook in the Minerals Resources Sector: 2005 to 2015	National level projections based on output growth
2008	Minerals Council of Australia, Molloy, S and Tan, Y	The labour force outlook in the Australian minerals sector 2008 to 2020	National level projections based on output growth
2009	Department of Further Education, Employment, Science and Technology	Skills for Jobs: Priorities for developing South Australia's workforce: the Training and Skills Commission's Five Year Plan for skills and workforce development	NA
2009	SACOME	Resources Industry Skills Survey	State survey
2010	National Resources Sector Employment Taskforce	Australian Workforce Futures A National Workforce Development Strategy Skills Australia	State survey

4.1 NATIONAL CONTEXT

In this section we examine a range of nationally focused reports on the resources sector workforce. The first, *Staffing the Supercycle: Labour Force Outlook in the Minerals Sector*, was funded by the resources sector and the Federal government and undertaken by the National Institute of Labour Studies. This report provides an indication of the scale of potential growth in the sector. Two significant documents published in March of this year indicate the high priority attached to workforce forecasting by the Federal Government: *Australian Workforce Futures: A National Workforce Development Strategy* by Skills Australia March 2010 and *Resourcing the future* by National Resources Sector Employment Taskforce March 2010.

4.1.1 STAFFING THE SUPERCYCLE: LABOUR FORCE OUTLOOK IN THE MINERALS SECTOR, 2005 TO 2015

In August 2006 the Chamber of Minerals and Energy of Western Australia, the Minerals Council of Australia and the Department of Education, Science and Training published Staffing the Supercycle: Labour Force Outlook in the Minerals Sector, 2005 to 2015. This report was a summary of an analysis undertaken by the National Institute of Labour Studies, The Labour Force Outlook in the Minerals Resources Sector: 2005 to 2015. This report estimated that total mineral resources sector employment (excluding petroleum products) would grow from 92,116 in 2006 to 162,276 by 2015, an increase of 70,161 persons employed. Of this increase it was estimated that almost 42,000 will be required in Western Australia, almost 15,000 in Queensland, and approximately 5,000 in both New South Wales and South Australia.

The NILS study included a survey of mines to determine the first-digit occupational structure of the mining workforce. The results are shown in Table 2 (note, the Argus Report, 2004, was a WA study which included the petroleum sector).

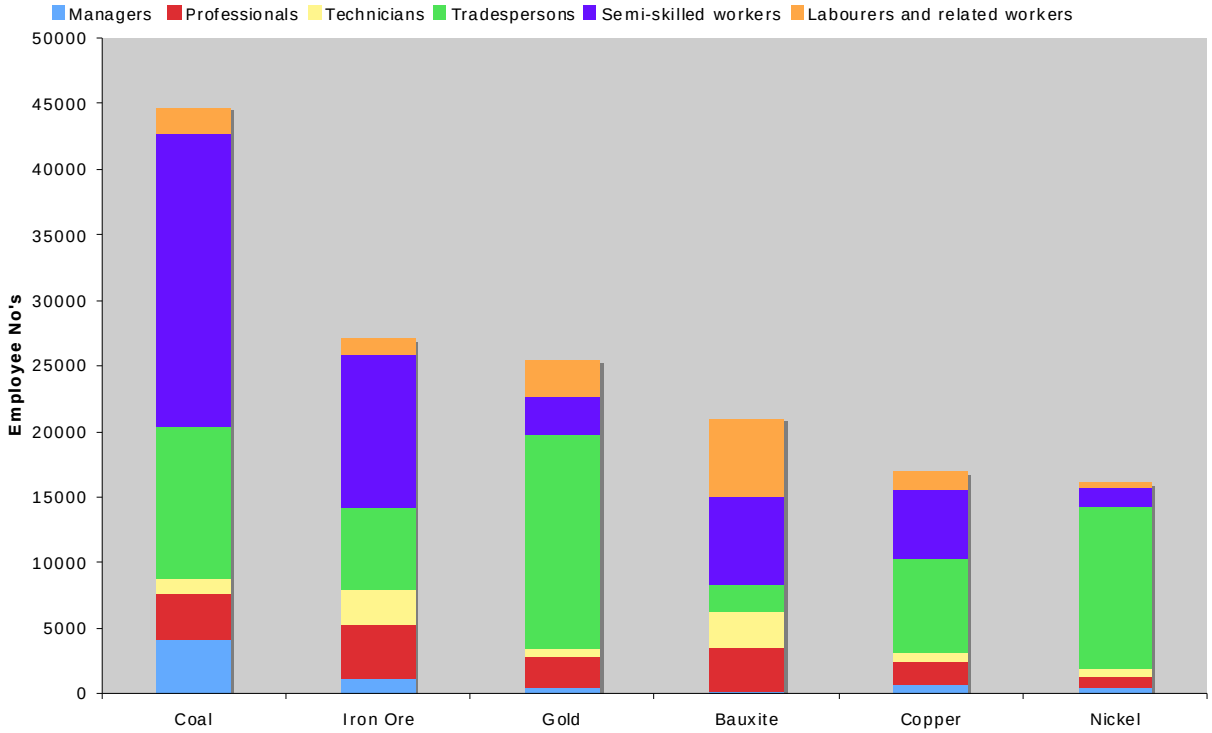
Table 2: Occupational Structure by commodity

OCCUPATIONAL CATEGORIES	*Argus Report*	COAL	IRON ORE	BAUXITE	COPPER	GOLD	NICKEL	URANIUM	LEAD	ZINC	W/AVERAGE
Managers	*5*	9.2	4.3	0.4	4.7	1.8	2.3	0.3	1.5	1.5	4.7
Professionals	*25*	7.8	15.2	16.4	9.6	9.5	5.9	3.8	12.7	12.7	9.6
Technicians	*13*	2.6	9.6	12.6	4.5	2.2	3.1	1.5	5.9	5.9	4.5
Tradespersons	*21*	26.0	22.9	10.4	42.0	64.6	77.4	84.2	72.0	72.0	42.0
Semi-skilled workers	*32*	49.9	43.8	32.0	30.9	10.8	8.9	0.5	3.7	3.7	30.9
Labourers & related workers	*4*	4.5	4.3	28.2	8.3	11.1	2.4	9.8	4.4	4.4	8.3

Source: National Institute of Labour Studies 2006, p 21

Note: Lead and Zinc were calculated together since we received raw data for the commodities in combined form only.

Figure 1: Occupational structure by six commodities for 2015



Source: National Institute of Labour Studies 2006, p 23

It is clear that there are significant differences between the proportions of the occupational classifications across the commodities. This reflects different extractions techniques, particularly whether open cut or underground methods are used, and the extent to which processing occurs at the mine.

The 2006 NILS report was updated in 2008 with projections to 2020 (Molloy and Tan, 2008). This report projected an additional 86,000 employees would be required by 2020.

The implications of this analysis for workforce forecasting for the South Australian resource sector are that:

- the South Australian share of total employment growth is relatively small
- the growth of employment in the sector will be high, potentially very high if the Olympic Dam Expansion project is started
- the occupational distribution is highly dependent on extraction methods and processing activities.

4.1.2 AUSTRALIAN WORKFORCE FUTURES

Australian Workforce Futures sets out a national vision for Australia's workforce capability for a “productive, sustainable and inclusive future.” The objectives outlined in the report are:

- sustaining economic growth through increased productivity by increasing skills and avoiding skills shortages
- increasing workforce participation rates in target groups where participation is low
- improving adult literacy and numeracy
- improving existing skills utilisation to boost productivity

- ensuring the tertiary education sector has resources to deliver appropriate skills
- developing a partnership approach to workforce development including the establishment of a Workforce Development Observatory.

The report undertakes quantitative modelling labour supply and demand under three scenarios – Open Doors, Low-trust Globalisation and Flags – representing high to low levels of the participation in the global economy. The modelling projects that supply shortfalls of 240,000, 120,000 and 35,000 respectively by 2015 under the scenarios. This 'big picture' analysis is followed by a discussion of where to direct workforce forecasting efforts. Workforce forecasting is acknowledged as being a multilevel activity with primarily responsibility for skills development being with industry itself. Other important participants are industry skill councils and state industry training advisory boards which have important roles played in gathering direct inputs from industry especially in regard to recent and emerging trends.

The Skills Australia Report also emphasises the need for a common planning framework. While there is a strong logic to a common approach particularly to avoid duplicating effort and to ensure that their collections are consistent, some stakeholders emphasise the need for idiosyncratic approaches in particular industries and locations. For example, the minerals Council of Australia, reflecting concerns about the resource industry workforce, emphasised the need for a particular approach to thin markets in regional and remote areas (Skills Australia 2010, p20).

Skills Australia concludes:

> *In all, consideration of planning for future skills suggests the need for a four-pronged approach with each prong the province of different sectors and organisations:*
>
> - *Monitor broad demand and supply trends—public authorities including DEEWR, Skills Australia and research bodies*
> - *Undertake local forecasting, investigating and reporting—education sector, state governments and regional bodies*
> - *Disseminate information and the know-how to use it—Skills Australia, DEEWR, state governments*
> - *Identify specialised occupation groups and develop responses according to findings—Skills Australia and all levels of government.*

Skills Australia also suggests an emphasis on specialised occupation defined as "one where specialised skills, learned in formal education and training, are needed at entry level and the impact of market failure is potentially significant." (Skills Australia 2010, p21).

4.2 STATE CONTEXT

This section summarises several important reports on workforce forecasting in South Australia.

4.2.1 SOUTH AUSTRALIAN CENTRE FOR ECONOMIC STUDIES

SACES released its report, Estimated Demand for Labour in the Mining Sector: 2006-2014 in February 2006. The report was commissioned by Primary Industries and Resources South Australia, the Department of Further Education, Employment, Science and Technology and The Department of Trade and Economic Development.

The analysis in the report takes a 'bottom-up' approach and aggregates survey responses from 15 companies in the South Australian mining sector. At the time of the report's release there was still significant uncertainty about the timing of construction and development at the Olympic Dam site. The report estimated that if the currently proposed expansion occurred that Olympic Dam would contribute an additional 3 per cent to GSP.

In terms of aggregates, the report projects that "Direct employment in the mining sector for all respondents is expected to rise from 3,720 to 7,600 persons by 2010 and to peak at 8,900 in 2011-12" (SACES, 2006, pii) SACES forecasts that the mining workforce will grow at around 7.6 per cent annually up to 2014 and that the demand for skilled tradespersons will increase by approximately 8.9 per cent per annum. The indirect impact on employment is estimated to be an additional 13,200 employees, giving a total forecast increase in employment of 17,200 persons South Australia-wide to 2014).

Of the projected increase in direct employment SACES estimated that 3,990 persons would require a VET qualifications with 1,459 (37 per cent) of these classified as trades and related workers.

SACES makes the observation that there are significant differences in the occupational composition of mining activities in the construction and operation stages and that, in numerical terms, trades, semiskilled and unskilled workers dominate.

Table 3: Employment profile for construction and mining activities

CLASSIFICATION	CONSTRUCTION	MINING/PRODUCTION
Managers & Administrators	1.7	5.0
Professionals & Assoc. Professionals, Technicians	8.7	35.0
Tradespersons and Related Workers	68.6	21.0
Clerical	2.3	3.0
Labourers, production & Transport Workers	18.6	36.0
TOTAL	100.0	100.0

Source: SACES 2006, p2.

Another key characteristic of the mining workforce is summed up in a quote from DEFEEST:

> *"... most people are in "ordinary" occupations not in specialist mining occupations. They may work in an atypical environment but by and large they are transport workers, plant operators, office workers, electricians and so on. ... there are probably fewer than a thousand people in identifiably mining specialist occupations. Secondly, ... are in relatively low skill areas, that is, overall the level of technical skill required by the industry (or at least that part of it which can be imported by external training providers) is not high relative to other industries. In fact, many of the occupations are common to many industries".*

These are important characteristics to observe and have significant implications for industry workforce forecasting. One implication is that it is not necessarily the case that if employment grows rapidly in the industry a large training effort will be required because existing workers in other industries already have the required skills or that the required skill level is on average actually quite low and therefore skill development in the form of on-the-job training as an important role to play. The other implication is that levels of employment growth in industries which use similar skills will be critical. If industries that use similar skill sets are also grown rapidly than the overall level of training required is likely to be large in those areas of skill overlap and, conversely, if growth in similar industries is flat or negative, the demands of training may be very low.

SACES has developed a 'major impacts estimation model' that enables "input of the number of direct employees in South Australia associated with major mining and resource processing projects" (SACES 2006, p3) and provides outputs of:

- the total gross employment requirement;
- the estimated gross requirement at 4 digit ASCO level;
- the estimated gross requirement by the VET sector;
- a summary of increase in employees by industry; and
- further detail on occupations by industry.

SACES also points out that for major mining projects a significant proportion of employees are sourced from interstate and that there are specialist skills associated with each type of resource for which the markets are national or even international. SACES's demand estimates also include non-mine support staff.

Estimates of direct demand are given in Table 4.

Table 4: Employment in the Mining Sector, 2005-2014

OCCUPATIONAL CATEGORIES	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Management Employees	61	64	65	58	58	60	70	70	70	71
Professional Employees	312	375	390	379	387	392	413	407	397	399
Business & Admin – Assoc Professionals	357	367	382	386	385	412	416	419	459	462
Trades and Related Workers	654	920	921	830	1,028	1,589	2,164	2,016	1,394	1,413
Misc Clerical Workers	87	94	105	101	104	109	115	118	121	123
Intermediate Production and Transport	1,265	1,372	1,387	1,385	1,606	2,697	3,037	2,937	2,552	2,587
Labourers and Related Workers	817	968	920	903	1,173	1,822	2,156	1,716	1,586	1,615
Employee Numbers	**3,552**	**4,165**	**4,182**	**4,055**	**4,754**	**7,094**	**8,384**	**7,696**	**6,592**	**6,683**
Additional Contractors	167	925	1,078	628	521	521	521	521	521	521
TOTAL	**3,719**	**5,090**	**5,260**	**4,683**	**5,275**	**7,615**	**8,905**	**8,217**	**7,113**	**7,204**

Source: SACES 2006, p18

Table 5: Occupational Classification and Training Requirement 2005-2014

ASCO	Occupational Classification	Total Gross Requirement	Requirement – Other VET
1000	Management Employees	1421	303
2000	Professional Employees	2647	178
3000	Business & Administration, Assoc Prof	2069	573
4000	Trades and Related Workers	2441	1459
5000, 6000, 7000	Misc. Clerical Workers	4573	718
7000	Intermediate Production & Transport	2482	536
9000	Labourers and Related Workers	1554	223
TOTAL		17188	3990

Source: SACES 2006, p20

In April 2008 SACES released a follow-up report, Mining industry baseline employment data. This report was based on a survey of broader scope including 65 respondents from miners/explorers, contractors to the mining industry, labour hire firms supplying the mining industry and members of the Global Maintenance Upper Spencer Gulf (GMUSG) heavy engineering and maintenance group of companies. Rather than longer term projections, this report was focused on the growth in employment by occupation from 2007 to 2008. It found that the highest demand occupations were likely to be:

- engineers
- geologists
- electricians
- boilermakers
- fitters
- truck drivers.

4.2.2 DEPARTMENT OF FURTHER EDUCATION, EMPLOYMENT, SCIENCE AND TECHNOLOGY

In May 2009 DFEEST published the South Australian Training and Skills Commission's five-year plan for skills and workforce development, Skills for Jobs. This report projects that over the next five years in South Australia 134,000 new job openings will be created, including replacement jobs with around a quarter in the business and financial services sector, 20% in wholesale, retail and personal services; and around 13% in health and communities services (DFEEST 2009, p1). This emphasises the extent to which the resources sector employs relatively few people notwithstanding its rapid growth rate and economic contribution.

The report finds that "South Australia will need to deliver 260,000 post school education and training qualifications over the next five years. The greatest areas of demand are for Certificate III level qualifications (86,000) and Bachelor degree or higher qualifications (67,000)" (DFEEST 2008, p1). The Commission believes that the publicly funded education and training system is broadly capable of meeting this demand although it suggests that there may need to be a redistribution of funding towards Certificate III and away from Certificate II level courses.

The Commission summarises the priorities for development of skills as:

> *Industry has identified a general shift to higher level skills but also emphasised the importance of core generic transferable skills. Literacy and numeracy skills and science and maths are seen as high priorities. Other common issues raised in our consultations were:*

- *the need for clearly articulated career paths, and the importance of high quality careers advice*
- *the need for improved collaboration and co-ordination between government and industry; and between education and training sectors*
- *the need for more direct involvement of industry in workforce forecasting and development, supported by independent advice*
- *the difficulties that industry is experiencing in attracting and retaining skilled workers – despite the temporary reprieve provided by the economic downturn*
- *the opportunities to attract potential workers from under-represented groups*
- *concerns about the quality of training outputs, and the complexity of the current system.*

These generic concerns about skill creation processes are all so largely reflected in discussion about skills development for the resources sector as we will see below.

The Commission observes that in the "mining and engineering sector" the Olympic Dam expansion and the air warfare destroyer project will mean rapid growth. The modelling suggests that the sector will account for 4.7% of the total demand for qualifications over the next five years, with the majority of demand for qualifications at the Certificate III level. It is estimated that the sector will receive 2.4% of the total supply of publicly funded qualifications over this period" (DFEEST 2009, p27).

Emerging from the Commission's analysis, the following priorities provide a context for discussion about the skill development strategy for the resources sector in South Australia:

- *developing a clear position on the elements of a tertiary education and training system that balances the needs and preferences of students with the future demands of the economy and industry*
- *examining ways in which the tertiary education and training system can be better integrated to respond to the skilling needs of clients*
- *identifying what improvements can be made in promoting pathways between elements of the education and training system*
- *examining the skills required for the 'new economy'*
- *exploring opportunities for government and industry to work together to better recognise and utilise the skills of the existing workforce*
- *developing a position and preferred model for quality assurance of the tertiary system in South Australia.*

4.2.3 SOUTH AUSTRALIAN CHAMBER OF MINES & ENERGY (SACOME)

The SACOME Resources Industry Skills Survey Results 2009 reports the results of a survey of 20 organisations in SACOME's membership base. The survey was "designed to determine workforce demand requirements across the resources sector in South Australia. SACOME recognises the need to forecast demand in order to prepare for the next upturn and to ensure that our Members are not faced with a skills shortage such as that of recent years".

SACOME's report indicates that 89.5% of respondents find that traditional means of sourcing labour such as Internet websites, newspaper advertisements, recruitment agencies and word-of-mouth, adequately meet the needs of respondents leaving a little over one tenth of respondents who find these methods insufficient.

Respondents believe that Australian universities are able to "provide sufficient numbers of graduates to meet their needs with respondents in the main sourcing graduates from the local universities" (SACOME 2009, p2). Respondents advised that their main competitors in attracting labour are other South Australian companies followed by Western Australian companies. Competition from Queensland and overseas is also present but of lesser significance.

SACOME asked respondents to identify occupations expected to be in demand in the next 12 months classified according to level of experience (Graduate, Midlevel and Senior).

Table 6: Demand for occupations in the next 12 months, SACOME 2009 survey

Graduate	Midlevel	Senior
Earth-moving plant operators	Diesel fitters	Mechanics
Maintenance workers	Earth moving plant operators	Mining engineers
Boilermakers	Boilermakers	Project managers
Civil engineers	Electricians	Earth-moving plant operators
Diesel fitters	Mechanical engineers	Boilermakers
Electrical engineers	OH&S specialists	Civil engineers
Electrical fitters	Technical support staff	Diesel fitters
Fixed plant operators		Drillers
Instrument technicians		
Laboratory analysts		
Mechanics		
Mechanical fitter and turners		
OH&S specialists		
Production coordinators		
Technical support staff		

Source: SACOME 2009, p4

SACOME also asked respondents to identify occupations in demand over a three to five-year time frame.

Table 7: Demand for occupations in the next 3 to 5 years, SACOME 2009 survey

Graduate	Midlevel	Senior
Electrical engineers	Technical support staff	Electrical engineers
	Petroleum engineers	Geologists
	Geologists	Mining engineers
	Fixed plant operators	
	Electrical engineers	
	Earth-moving plant operators	
	Drillers	

Source: SACOME 2009, p5

4.2.4 RESA INDUSTRY WORKFORCE ACTION PLAN 2009 REVIEW

The RESA Industry Workforce Action Plan (IWAP) 2009 Review provides an overview of the resources industry in South Australia and reports on consultations based on one-on-one interviews with "key industry personnel, to obtain their views on current workforce issues affecting their operations, now and in the future" (RESA: 2010).

The IWAP provides many valuable qualitative insights about the characteristics of the demand for and supply of labour in South Australia. Notable findings include:

- a range of professional, para-professional and trades occupations are in high demand and positions are difficult to fill (the Report provides a list of 14 specific occupations)
- there is a shortage of engineering and earth/geo sciences in the tertiary education pipeline
- some training for 'specialist positions' is now been undertaken in house or overseas
- there is currently no shortage of applications for apprenticeships
- in general, employers are not experiencing a shortage of applications for semi-skilled and entry level positions although there are concerns about literacy and numeracy skills
- employers are concerned about competition for skilled employees from Queensland and Western Australia
- a significant proportion of professional and high skill employees are approaching retirement
- employers want experience as well as skills.

Table 8 is reproduced from the RESA report. It provides valuable data that assists developing a more detailed understanding of the high demand occupations where shortages may be expected to emerge.

Table 8: Summary of current and future resource industry (in demand) occupations/Skills

	Senior Management & Administration	Professional/Graduate *Note 1	Associate / Para-Professional	Technical/Trades *Note 1	Semi Skilled **Note 2
Operating Companies	Experienced Mine Managers. Operations Managers. Production Managers. Finance Specialists. Commercial Contract specialists.	Engineers (experienced mechanical and electrical). Project Managers. Metallurgists. IT Specialists. Environmental Scientists. Petroleum Engineers. Reservoir Engineers. Geophysicists. Geologists/Geoscientists. Power Generation Engineers Clean Coal Specialists	Geotechnical. Technical support. Planners. Project control & Costing	Mechanical equipment fitters. Electrical fitters / Instrumentation. Diesel Fitters/mechanics	No particular current shortages identified.
Contractors	Snr. Operations Managers.	Experienced Project Managers.	Estimators. Schedulers.	Civil Trades Supervisors Electronics Technicians	
Equipment and services Suppliers		Mechanical, electrical, civil, structural engineers	Estimators. Planners/Schedulers.	Mechanical and Electrical. Boilermakers. Electronics technicians. Diesel Fitters/Mechanics.	
Engineering design & Consulting	Experienced Senior Managers	Engineers (mechanical, electrical, structural). Project Managers Environmental Scientists.	Designers/Draftspersons		
Recruiting and Labour Hire organisations	Experienced Senior Managers	Engineers (mechanical, electrical, structural). HSE Specialists	Technical Support	Mechanical and Electrical (industrial).	
Training providers	Experienced Senior Training Managers	HSE Specialists		Specialist (resources industry) trainers	

*** Note 1: A number of Resource industry Operating companies and Contractors stated that there was an urgent need to increase the number of Indigenous and female graduate/professional engineers and technical/Trades personnel employed in the resources sector.**

**** Note 2: No particular current shortages were identified, but most employers confirmed their ongoing support of "entry level training" initiatives - to ensure a "pipeline" of job ready workers with appropriate skills would be available, as required.**

4.3 WHAT CAN WE LEARN FROM THESE STUDIES AND SUBMISSIONS?

This section has examined a diverse group of documents regarding workforce and skills demand forecasting for both South Australia and Australia. The forecasting studies range from an Australia wide top-down study at a relatively high level of aggregation (the NILS study) to South Australian-specific forecasts of demand that are bottom-up and disaggregated down to the level of specific occupations (SACOME and SACES).

A number of lessons emerge from this discussion:

- Australia-wide top-down studies provide relatively robust forecasts (although not always) but these are generally not sufficiently detailed to be useful to identify specific demand for particular occupations in particular industries.
- More detailed bottom-up studies do provide sufficient detail but their findings are sensitive to economic and industry fluctuations of activity and therefore their forecasts can quickly become out of date
- Bottom-up studies require large amounts of data to be generated by firm surveys and this data is expensive to collect and therefore such studies tend to be conducted on a one-off or ad hoc basis. They are also problems with concerns about confidentiality which make some firms reluctant to participate.
- There is broad agreement about which occupations are expected to be in high demand and short supply based on the detailed bottom-up studies
- Useful information regarding qualitative aspects of labour demand and supply can be collected using surveys of mining companies, for example, the fact that, while the numbers of persons available for employment in low skill occupations appear to be sufficient, there are concerns about literacy and numerously skills. This type of information is useful in policy formation.

4.4 SUMMARY OF CHARACTERISTICS OF THE SOUTH AUSTRALIAN RESOURCES LABOUR FORCE AND POLICY IMPLICATIONS

The various publications on the resource sector workforce discussed in the previous section enable us to develop several conclusions about the nature of the demand for skills by the resource sector in South Australia. The SACES report published in 2006 and other publications that examined the potential skill bottlenecks for the sector can now be examined in the light of subsequent studies such as the SACOME survey and the recent RESA report. It needs to be emphasised that there are significant factors influencing the demand for labour that have been in a state of flux and make the world a different place from what it was in 2006 when the initial reports were written. These factors include the GFC and ongoing doubts about economic recovery and about the sustainability of China's growth, ongoing uncertainty about the timing of the Olympic Dam expansion and, most recently, the proposed Mineral Resource Rent Tax. Nonetheless, we have more and better data about the state of demand for labour from the resources sector and which particular skills and occupations are in most demand and in short supply. Based on these reports the following observations on the South Australian resources labour market can be made:

The overall numbers are relatively small but fluctuate considerably. Compared with the total labour force in South Australia the absolute numbers of persons required by the resource sector are relatively small. For example, DFEEST estimates that the mining *and engineering* sector combined will account for 4.7 per cent of the total demand for qualifications over the next five years (DFEEST 2009, p27).

ABS estimates of employment in mining in South Australia are given in Table 9 (ABS Cat. No 6291.0.55.003). Table 10 and Figure 2 provide state comparsions from the same source. It can be seen that the proportion of employment in South Australia in the mining industry has flucuated between a high of 1.6 and 0.8 per cent

over the past five years with the most recent level being only 0.9 per cent in May 2010. The number of employed in mining has fallen from a high of 12,400 in February 2007 to 6,800 most recently.

The estimate of employment from SACES (DFEEST 2006) for 2006 was 5,090 compared with an average for the four quarter ABS estimates of 10,400. This difference is due to the fact that the SACES estimate was based on a sample of firms rather than the whole industry. Nonetheless, it is noteworthy that the SACES projections are characterised by relatively steady growth up to the peak year of construction for the Olympic Dam project in 2011. The Olympic Dam Expansion is still not underway and the GFC has also impacted mining employment although this effect appears, at this stage at least, to be relatively transitory.

Table 9: ABS estimates of employment for mining and all industries in South Australia

	Total of full and part-time employment, Mining industry '000	Total of full and part-time employment, All industries '000	Percentage of employment in mining in South Australia
Feb-2005	8.8	737.1	1.2%
May-2005	8.0	742.0	1.1%
Aug-2005	8.2	742.6	1.1%
Nov-2005	9.3	748.5	1.2%
Feb-2006	9.3	750.3	1.2%
May-2006	10.1	754.1	1.3%
Aug-2006	11.7	759.8	1.5%
Nov-2006	10.7	766.9	1.4%
Feb-2007	12.4	765.6	1.6%
May-2007	9.4	766.0	1.2%
Aug-2007	9.7	771.4	1.3%
Nov-2007	10.7	782.2	1.4%
Feb-2008	9.7	786.9	1.2%
May-2008	7.9	782.1	1.0%
Aug-2008	10.4	785.8	1.3%
Nov-2008	10.4	798.0	1.3%
Feb-2009	8.0	791.4	1.0%
May-2009	6.6	795.6	0.8%
Aug-2009	6.4	778.1	0.8%
Nov-2009	7.2	797.6	0.9%
Feb-2010	7.8	806.1	1.0%
May-2010	6.8	802.8	0.9%

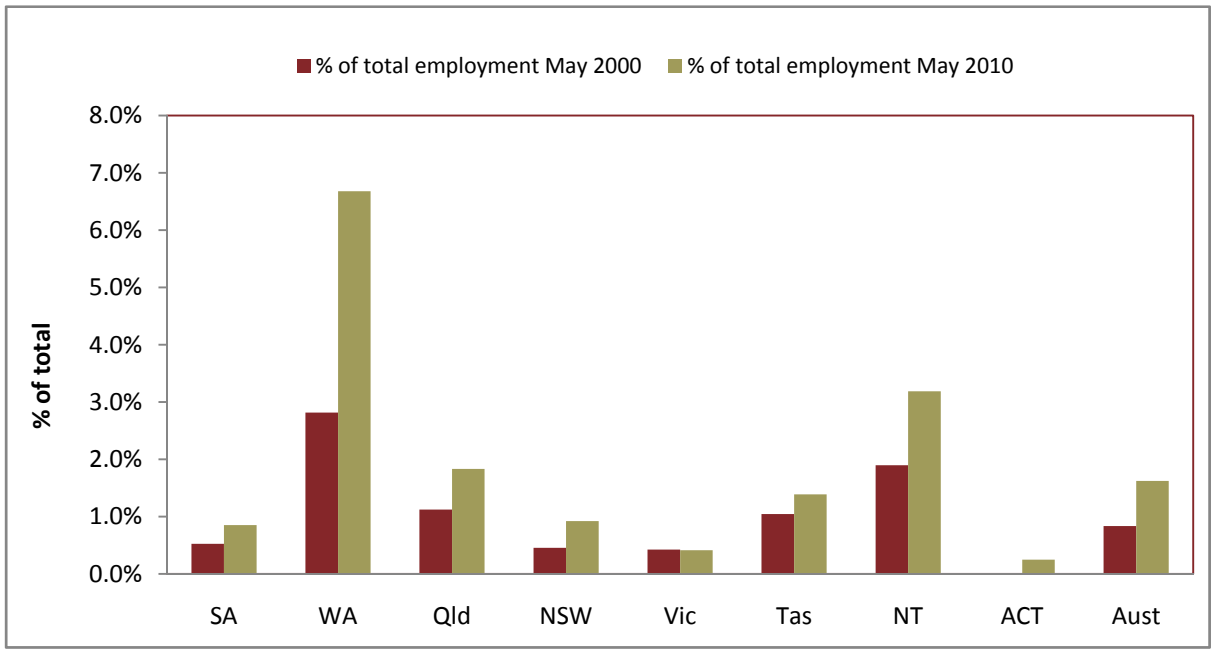
Source: ABS Cat. No 6291.0.55.003 - Labour Force, Australia, Detailed, Quarterly, May 2010, Table 5

The divergence between the SACES projections and the actual path of mining employment indicates that longer term projection of specific skills demand faces, not only problems of irreducible uncertainty as typified by the GFC but also, especially in the South Australian context, a 'small numbers' problem. The larger firms in the South Australian mining sector can make a significant difference to total employment and the changes to the scheduling of major projects can lead to projections to become suddenly obsolete.

It is also important to observe that large surveys are inevitably carried out at a point in time which will obviously be at a particular moment in the economic cycle. This approach can, again, lead to projections that quickly become outmoded by movements in the cycle.

These observations lead to the conclusion that, where more detailed demand projections are required, a process of ongoing sampling of demand would be preferable.

Figure 2: Mining Employment as a percentage of total employment



Source: ABS Cat. No 6291.0.55.003 - Labour Force, Australia, Detailed, Quarterly, May 2010, Table 5

Table 10: Mining employment comparisons

	SA	WA	Qld	NSW	Vic	Tas	NT	ACT	Aust
mining employment									
% of total employment May 2000	0.5%	2.8%	1.1%	0.5%	0.4%	1.0%	1.9%	0.0%	0.8%
% of total employment May 2010	0.9%	6.7%	1.8%	0.9%	0.4%	1.4%	3.2%	0.2%	1.6%
absolute change May 2000-May 2010 (000s)	3.3	54.1	23.2	18.0	2.0	1.2	2.4	0.5	104.6
% change May 2000-May 2010	94.2%	211.6%	123.5%	130.1%	21.4%	56.9%	140.5%	-	139.8%
total employment									
absolute change May 2000-May 2010 (000s)	130.8	284.7	616.2	423.3	550.8	36.4	38.3	32.1	2,112.5
% change May 2000-May 2010	19.5%	31.4%	36.9%	14.0%	24.9%	18.1%	43.1%	19.1%	23.6%

Source: ABS Cat. No 6291.0.55.003 - Labour Force, Australia, Detailed, Quarterly, May 2010, Table 5

Notwithstanding this somewhat muted growth story for mining South Australia there are more positive signs. PIRSA produces a summary of the South Australian mining sector called South Australia's Mining Pipeline (PIRSA, 2010). It shows 12 major mines active in South Australia and 29 projects which are at some stage of feasibility study which represents substantial growth. If this growth is sustained or even accelerates in the

absolute numbers of new employees required by mining may begin to become significant relative to the South Australia labour force.

It is also important to consider increases in indirect employment that will follow from increasing direct mining employment. This indirect increase in employment, however, will not, in general, cause an increase in demand for mining industry specific skills although it may cause some increase in competition for a range of trades from sectors such as construction and civil engineering.

The fundamental point is that, given that mining industry employment is at around 8,000, and that this figure is already higher than the sustained level after 2014 estimated by SACES, the *increment* in total numbers of employees required for the mining industry going forward is relatively small compared with the size of the South Australian labour force and total number of employed persons. Implications of this are discussed further below.

This conclusion, however, needs to be viewed in the context of the ageing of the workforce and net replacement rates in general. DFEEST argues that a supply demand crunch will occur around 2014. There is a risk that the rising demand for resource workers will coincide with a general decline in supply economy-wide. The capacity of workers to respond to incentives to work longer will be constrained by increasing age and health status and mediated by the adequacy of retirement incomes. Other factors will also play out including work/leisure/care preferences and pressures.

There appears to be an adequate supply of low and semiskilled workers. Whereas four or five years ago it was not clear that the large number of relatively low skilled workers required for the resources sector could be supplied, it is now emerging that there is sufficient supply – RESA reports that no particular current shortages are identified for semi-skilled workers. Again, as stated in the previous point, the numbers required by the resources sector are relatively small compared to the size of the South Australian labour market. The skill sets of low and semiskilled workers will, in general, be more portable across industries than specialist high-level skills such as geo-engineering.

Within the labour force there are considerable numbers of persons employed in occupations that do not use their qualifications. There is therefore significant capacity for semiskilled workers and even trades persons to migrate to the resources sector to meet increasing demand. Of course, this will only happen if pay and conditions in the resources sector are sufficiently attractive. There will clearly be the some industry-specific and job-specific training required but it seems unlikely that raw numbers will be a constraint on the expansion of the sector. It is more likely that supply problems are associated with remoteness, mining specific high-level skills and the need for experienced skilled workers.

It should be also noted that there is the potential for significant supply problems for a number of trades that are important to the resources sector. This is most likely to be the case if a wave of construction activity at mine sites occurs simultaneously and is even more likely if this occurs at a time of heightened construction activity in general. This perspective on the issue of labour supply is more state-wide than industry-specific and underscores the need for the training and education system to be responsive to changing industry structures and economic growth rates in the State.

Another factor that is of significant concern to resource industry employers is the approaching ‘retirement cliff’. A significant proportion of mining engineers are in their mid-to late 50s and are therefore approaching retirement. This concern is mirrored in other sectors of the economy and

The various categories of skill shortages are diverse and require distinctive responses. The high level categories for skill shortages can be described as:

- professional mining specialist qualifications - mainly university graduates

- managers, including project managers with specific experience in the resources sector.
- a few types of tradespersons – some particular trades are in persistent short supply, typically those associated with electrical and electronic systems, construction, boilermakers and mechanics.

Each of these groups has distinctive characteristics and solving supply problems in each case will require different responses. For example, with respect to the mining specialist university graduates are critical question is: how can the number of students enrolling in resource industry specific courses be increased?

The scale of development in South Australia is dwarfed by resource development in Western Australia and Queensland. RESA reports estimates of 'advanced projects' at a value of about $80 billion for Australia, $57 billion in Western Australia and $12 in Queensland with about $0.5 billion projected for South Australia (although, again, this figure does not include the potential Olympic Dam expansion). This has important implications for the viability of any strategy of a supply-driven nature in South Australia. The risk is that any increase in supply of skills from the South Australian training and education system will simply be absorbed by Western Australia and Queensland. Critical to an understanding of the extent of interstate labour migration is data on the relative pay and conditions for employees in resources across different occupational and qualifications categories.

Experience shortage rather than skills shortage. An unmet demand specifically for experienced employees rather than simply employees with the appropriate qualifications has been a feature of employer comments. This is important because experience cannot be quickly developed or supplied more rapidly by the training and education sector. Different responses are required. For example, and appropriate policy response to this particular problem would be to attract highly experienced industry specialists and sponsored our role as mentors within mining companies with the express objective of sharing their knowledge and experience with younger workers.

Interdependence with other policy objectives. The demand for skills needs to be viewed in the wider context of factors influencing attraction and retention of workers in isolated and remote communities where mining predominates.

4.5 PRINCIPLES FOR IMPROVING WORKFORCE FORECASTING FOR THE RESOURCES SECTOR IN SOUTH AUSTRALIA

From the discussion so far we can derive the following principles for improving workforce forecasting:

The assessment of industry skill requirements needs to be ongoing and systematic. Currently, workforce surveys and studies are conducted on a sporadic once-off basis. This means that it is difficult to build up a model of the factors that influence projected demand. Data needs to be collected on an ongoing basis using consistent methods so that a useful time series can be established. A greater understanding of the factors that influence the demands of skills needs to be developed further so that the impact on labour demand of changes in the environment can be better understood and anticipated. Another key benefit of collecting time series data is that enables an ongoing process of review of previous forecasts. This is a critical factor in building better forecasting capabilities in the long run.

The relationship between the South Australian labour market for resource skills and the Australian market needs to be better understood. It is of limited use to pursue a policy of increased training and education effort if graduates are likely to be attracted interstate. This is even more likely to be the case for high-skilled university-level graduates because they will be more likely to be career-oriented and therefore attracted to larger mining operations.

Supplement survey data with data from other sources. There are many other types of data that can assist in identifying skill shortages. As noted, the shortcoming of these data sources is that they are historical. Nonetheless, such data sources provide substantiation about the nature and extent of existing skill shortages and therefore provide useful data or more informed forecasting.

5 PROPOSED APPROACHES TO WORKFORCE FORECASTING IN THE SOUTH AUSTRALIAN MINERALS AND RESOURCE SECTOR

In this section we outline a number of approaches for improving workforce forecasting in the South Australian resources sector. These proposals are intended as a starting point for consultation and discussion with key stakeholders. They are not intended to be prescriptive but rather are intended to generate best possible forecasts of expected growth in demand for key critical occupations and qualifications in the resources sector.

5.1 SA WORKFORCE FUTURES ONLINE (SAWFO)

This section describes a new approach to skills and qualifications demand forecasting - an online forecasting tool that facilitates regular input by industry participants of expected growth in demand for the 'hit list' of critical resource sector occupations, skills and qualifications.

To understand the logic behind this proposal, consider the underlying methodology of top down and bottom up forecasting methods:

- **Top down methods** are based on the assumption that it is possible to design and manage an economy- or sector-wide model that predicts the aggregated hiring decisions of firms. The assessment of these models suggests that these models cannot reliably forecast skill demand at the level of occupational disaggregation required for workforce planning
- **Bottom up methods** have hitherto been based on the assumption that, in order to produce national, state or industry-wide forecasts of detailed occupational demand, it is necessary to survey individual firms (either on a census or sample basis) for their individual forecast demand and then aggregate these. This is, in fact, not the only method for obtaining forecasts of aggregate demand from employers.

Since top down methods attempt to model the behaviour of firms in terms of their responses to changes in economic variables, it is reasonable to suggest that it may be useful, perhaps even a superior approach, to ask firms for their own hiring forecasts and aggregate these. This is the basis for pursuing the bottom up or survey-based methods we have discussed.

An initial objection to survey-based bottom up methods is that good models may forecast firms' actual behaviour better than firms' own expectations about their own future behaviour. This is a reasonable objection that could be tested but it can only be tested if information about firms' own expectations is collected systematically and in statistically significant quantities.

Another set of objections concern firms' willingness to provide accurate information about their hiring intentions in a survey context. In fact, it is reasonable to expect that firms have an incentive to overstate their hiring intentions if they believe this will lead to government increasing their resourcing of the skills they believe will be in short supply. Firms may also have other commercial, strategic and/or tactical reasons to misstate their hiring intentions in a survey. Firms may be reluctant to make any statements about their hiring intentions because of confidentially concerns.

An alternative to asking firms about their own hiring expectations is to ask them for estimates of movements in future demand for particular occupations/skills/qualifications on a market-wide basis. Since governments are interested in aggregate skill demand for the purposes of developing and executing skills development policies, the hiring intentions of individual firms can be considered superfluous intermediate data if market-wide estimates can be obtained directly. Is this possible? A range of techniques which economists have been developing for over a decade would suggest the answer is 'yes'.

There are a range of well-developed and emerging techniques for collecting data about market-wide future expectations from individuals. These include methods to focus individuals on making better estimates such as 'calibration' which entails providing context and examples to individuals making estimates in order to minimise personal biases and using 'confidence intervals' to qualify estimates. These techniques have been shown to improve estimates of unknown variables made by individuals (Hubbard, 2007, p55). Such techniques have the potential to improve the accuracy of data provided by survey respondents.

More broadly, the forecasting methods that have been discussed thus far constitute a relatively small subset of all forecasting methodologies. For example, over the past 20 years significant work has been done in economics on 'information aggregation mechanisms' sometimes also called 'prediction markets'. One of leaders in this field, Charles Plott, (for example see, Plott, 2000) describes how markets in general behave as aggregators of information. Buyers and sellers contribute information in the form of their bids and offers and the output is the market price and the quantity traded in the market.

Information aggregation systems can be set up which mimic such market processes and are designed to gather information from participants about a wide range of future outcomes such as election results and unreleased movie box office earnings. These are typically deployed as online systems that create environments where participants can effectively 'place bets' on particular unknown outcomes. Key features of these systems is that they can let participants see the aggregate prediction being made by the market so that this can be compared with their own predictions and, in addition, participants are offered rewards or incentives to make the most accurate predictions possible. These types of systems had been demonstrated to be particularly powerful at extracting relevant information and predicting unknown future outcomes (Chen and Plott, 2002). There are some similarities between such information aggregation systems and The Delphi Method in terms of values of iterative and interactive forecasting techniques.

In the context of the South Australian resources sector, the objective of such a system would be to provide more accurate and detailed data about expected changes in demand for particular occupations. This system would embrace the principles described in relation to information aggregation mechanisms and techniques to encourage participants to provide the most accurate useful forecasts possible. The objectives of the system would be to encourage objectivity and minimise bias and collect forecasts on an ongoing basis. Thus, in comparison with modelling techniques the challenge becomes designing an information aggregation systems that extracts accurate unbiased information from informed stakeholders rather than attempting to build a model which provides more accurate results. It should be emphasised that the roles of alternative methods complementary enabling crosschecking of results derived by alternative processes.

In the output of this system would be a forecasted growth rate for each of the critical occupations/qualifications – the 'hit list' – in South Australia's resource sector.

How might such a system work in practice in the resource sector?

- Participants would include mining company executives and representatives of recruitment firms specialising in the resources sector. The main criterion for selecting participants would be the quality of their knowledge about the industry labour market conditions and the composition of occupations and qualifications required as well as an understanding of current skill supply conditions.
- Ideally online 'forecasting sessions' would be scheduled when the participants simultaneously inputted their projections using a structured interface. This structured interface would provide for the provision of estimates subject to confidence intervals rather than simple point estimates. Simultaneous participation would enable the real time aggregation of individual projections which would be fed back in real time to the participants. This real-time provision of feedback from the sector is a critical feature of information aggregation mechanisms. This enables participants to assess their projections on the basis of this feedback. This does not mean that all participants forecasts would converge on the aggregate forecast. A

particular participant might believe that he or she has particular information or knowledge not widely shared which enables them to make a more accurate forecasts of demand than the 'market' in general.

- The question of incentives is important. What would motivate mining companies and recruitment organisations to participate? One clear incentive is that by participating, each participant has the opportunity to observe the forecasting outcomes and gauge their own expectations against 'the market view'. It is possible, even likely, that this would be regarded as valuable intelligence by industry participants. A further question arises which is what is the motivation for participants to provide accurate forecasts, in particular, what incentives do participants have not to 'game' the system? One answer to this is that the process of review would provide feedback to participants about the accuracy of their forecasts. The review process would also inform the operators of the system about which participants provided the most accurate forecasts. Over time the input of these participants could be weighted more heavily than those who proved less able to forecast. The extent to which the accuracy of forecasts of particular participants would be shared among all participants is essentially a question of what approach would encourage the greatest long-term participation.
- The question of incentives can also be related to government policy responses. If the resources sector expects the government to assist it in response to skill shortages then it is not unreasonable for the government to expect this kind of input from the industry. The government may also consider policy responses which provide rewards to those companies that provide the most accurate and useful inputs.

Notwithstanding the potential interactions of this system with policy outcomes, this system is not policy prescriptive. In line with the principles described in the previous section, it is intended to build up a time series of best possible forecasts of growth in demand for particular occupations or qualifications and to develop a 'culture of review' concerning these forecasts.

It should also be noted that, once set up, the system could quickly generate new data about forecast occupational demand which would provide early results from the undertaking albeit results that were not yet checked against future actual outcomes. Some other concerns discussed above regarding incentives and bias could be addressed over time as the system was further developed. It should also be pointed out that a number of software providers operating of the shelf prediction market software have emerged meaning that the cost of developing the system is likely to be moderate.

In practical terms the problem of implementing such a system would appear to be relatively tractable in South Australia. The number of mining operations is relatively small, less than 20, and a significant amount of background work has already been undertaken, for example, by RESA.

5.2 OTHER AREAS OF RESEARCH

The previous section identified a proposal designed to produce more accurate forecasts about the particular skill shortages in the resource sector. There are a number of related areas for research regarding the growth in demand for skills in the resources sector. This type of information is important for policy design. There are, however, a number of other important areas that need to be researched before appropriate policy can be designed. These include:

What income differentials are required to attract employees to remote mining locations? This could be studied in a number of ways: the pay and conditions for similar jobs in remote and non-remote locations could be compared, pay rates for mining operations at various 'levels of remoteness' could be compared and/or surveys of employees with the appropriate skills could be conducted testing directly subjective preferences related to location and income. This is relevant to the development of policy responses to skill shortages. For example, training the tradespeople needed by the resources sector will not be effective if they regard the

disincentives to working in remote locations outweigh the benefit. Such workers will likely end up working in other industries such as construction in the cities.

What other factors besides remoteness influence employees' locational decisions? For example, how important are factors such as the quality of housing, local education, and other community and environmental amenity. How do differences in living costs factor in employees' locational decisions? What are the differences in living costs between remote and non-remote regions?

To what extent are the markets for various types of occupations national or local? How sensitive are interstate labour movements to differentials in pay and conditions and other factors? What are the existing differences between pay and conditions between mining regions around Australia? How integrated are labour markets at the international level? Answers to these questions are critical for policy design. If, for example, labour flows are relatively sensitive to differentials in pay and conditions between state and, on average, pay and conditions are higher in Western Australia and Queensland, then efforts to increase the supply of skills in occupations for which there is a shortage will be particularly ineffective. It is the equivalent of 'pushing on a piece of string' and would amount to South Australian Government expenditures supporting the development of the WA and Queensland mining industries. It should be emphasised that this problem is due to South Australia's relatively small industry in the context of much larger national industry and potentially highly integrated national labour markets.

What other factors besides pay and conditions influence the locational decisions of employees with critical skills? It may be, for example, that new graduates with highly mining-specific skills regard working interstate or overseas as an indispensible part of their professional development. If this were the case, or even if it is only partly the case, then increasing the training effort will produce more graduates but solve the supply shortages for the South Australian resource sector to a more limited extent.

What motivates students' choice of courses? What is attractive or unattractive about a professional qualification and career in the resources sector? What motivated the students who did choose mining-specific professional qualifications? Efforts to increase the numbers of students enrolled in professional mining qualifications need to boom bust' nature of mining play in students' decisions? Is this characteristic real or a perceived one? If it is real, are students making rational and informed decisions based on a desire to minimise risk.

What is the relative importance of qualifications and experience to mining companies? Does this relative importance change through the life of a mine – for example, is it more important at the beginning of a mine's life than in its later operational period? What the possible sources of experience that are not being tapped by mining companies, why are these not being tapped and is there a rationale for Government assistance? If experience and knowledge are critical and of high value to mining companies then it may be that these per se rather than qualifications or people per se are binding constraints on the development of the resources sector in South Australia. There may be arguments for the participation of governments in solving such problems. If governments can assist with the development of policies and mechanisms that effectively increase the dissemination of knowledge and experience throughout the State's resources sector this will likely promote the strategic economic development goals discussed earlier.

6 REFERENCES

Australian Manufacturing Workers Union, (AMWU), 2010, *Resourcing the future*.

Australian Bureau of Agricultural and Resource Economics (ABARE), 2009, *Minerals and energy-major development projects-October 2009*, www.abare.gov.au/interactive/09_Listings/pL09_Oct/

BHP Billiton, 2009, *Olympic Dam Expansion Draft Environmental Impact Statement*, Chapter 19.

Chamber of Minerals and Energy of Western Australia, the Minerals Council of Australia and the Department of Education, Science and Training, August 2006, *Staffing the Supercycle: Labour Force Outlook in the Minerals Sector, 2005 to 2015*.

Chen, KY, Plott, CR, March 2002, *Information Aggregation Mechanisms: Concept, Design and Implementation for a Sales Forecasting Problem*, Social Science Working Paper 1131.

Department of Further Education, Employment, Science and Technology and the Department of Trade and Economic Development, February 2006, *Estimated Demand for Labour in the Mining Sector: 2006-2014* (the report was also part-commissioned by Primary Industries and Resources South Australia and was undertaken by The South Australian Centre for Economic Studies).

Department of Further Education, Employment, Science and Technology (DFEEST), May 2009, *Skills for Jobs: Priorities for developing South Australia's workforce: the Training and Skills Commission's Five Year Plan for skills and workforce development*.

Hoeckel, K, Field, S, Justesen, TR and Moonhee, K, November 2008, *Learning for Jobs OECD Reviews of Vocational Education and Training AUSTRALIA,* p25.

Hubbard, WH, *How to measure anything: finding the value of intangibles in business*, John Wiley and Sons, 2007.

Lowry, D, Molloy, S and Tan, Y, National Institute of Labour Studies, May 2006, *The Labour Force Outlook in the Minerals Resources Sector: 2005 to 2015*.

Molloy, S and Tan, Y, 2008, *The labour force outlook in the Australian minerals sector 2008 to 2020* (commissioned by the Minerals Council of Australia).

National Resources Sector Employment Taskforce (NRSET), March 2010, *Australian Workforce Futures A National Workforce Development Strategy Skills Australia*.

Peng, X, Spoehr, J, and Windsor, L, *Labour Market Forecasting: How can projections better inform workforce planning and development?* Prepared for the Australian Research Council (ARC) Linkage Project, *Demographic Change, Ageing and the Workforce: An Integrated Model to Inform Workforce Development and Planning in Australia*, August 2005.

Primary Industries and Resources South Australia, Government of South Australia, June 2010, *South Australia's Mining Pipeline*.

Resources and Engineering Skills Alliance (RESA), Resources Industry Workforce Action Plan, 2010.

Richardson, S and Tan, Y, National Institute of Labour Studies, Flinders University 2007, *Forecasting future demands: What we can and cannot know*, National Centre for Vocational Education Research (NCVER) Research report.

Richardson, S and Teese, R, July 2007, A Well Skilled Future, NCVER Research report.

South Australian Chamber of Mines and Energy, (SACOME), 2009, *Resources Industry Skills Survey*.

South Australian DFEEST submission to NRSET, *Submission to the National Resource Sector Employment Taskforce.*

Thessaloniki, October 2008, *Cedefop working paper No 1 Systems for anticipation of skill needs in the EU Member States*.

Western Australian Department of Education and Training, April 2004, Argus Report (2004), *Western Australian Development Projects: Employment Demand and Predicted Skill Requirements 2003-2007.*