

Local Government Skills Forecasting model

Skills demand and supply forecasting – International best practise, with focus on water sector

WP-MDS-1

Report prepared for:

LG SETA
P O Box 1964
Bedfordview
2008

Prepared by:

CSIR – Modelling and Digital Science
PO Box 395
Pretoria
0001, South Africa

Contact person:

Prof Sonali Das
Tel: +27 012 841 3713
Email: sdas@csir.co.za

CSIR document reference number:

Groupwise 260018-1

Date:

March 2016

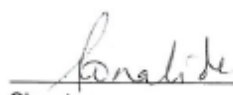
Document to be referenced as:

LG SETA (2015) Local Government Skills Forecasting model: Skills demand and supply forecasting –International best practise with focus on water.

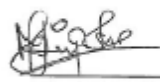
Date: March 2016

Contract: LG SETA
Workpackage: WP-MDS-1

MDS lead by: Sonali Das
MDS Principal Researcher


Signature Date 24/05/2016

Reviewed by: Dr. Njabulo Siyakatshana
MDS AMM RGL


Signature Date 24/05/2016

Approved by: Dr. Onno Ubbink
MDS AMM CAM


Signature Date 24/5/16

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1 INTRODUCTION

1.1 Background

The Council for Scientific and Industrial Research (CSIR) has been appointed by the Local Government Sector Education and Training Authority (LG SETA) to develop an empirical model to forecast the demand and supply of skills in the local government water sector in South Africa. For details of the background of the overall project the reader is referred to the document titled *LG SETA (2015) Local Government Skills Forecasting model: Desktop study of skills demand and supply at Local government in the Water Sector* (Appendix A).

1.2 Purpose of this report

The purpose of this report is to highlight some of the readily available literature that deals with skills forecasting exercise done internationally.

1.3 Scope of this report

The scope of this report is limited to publicly available information readily available online.

2 SKILLS DEMAND AND SUPPLY FORECASTING

2.1 Why it is important?

The answer to this is very aptly captured in the foreword of the CEDEFOP (2009) report, and we quote, -- *“Economic crisis, climate and structural change, and demographic developments, including ageing and migration, are posing huge challenges for economies and labour markets in Europe and across the world. Driving economic recovery through skills enhancement is crucial because skills are, and will be, needed to respond to the new economic structures that will emerge and to fill the new jobs that will be created.”*

The National Skills Development Strategy (NSDS) III espouses that there is a need to develop a projection mechanism for skills demand and skills supply in all sectors in South Africa, including the water sector, at the local government level to ensure that the services that the water sector provides meets the needs in the future. In this context, the LGSETA Strategic Plan 2011-2016 document emphasizes the need for a coordinated strategy between training centers and those that will use the skills that are being trained to ensure that each of the sectors under the LGs can effectively perform their roles. The Strategic Plan 2011-2016 also highlights that in order for that to be achieved, there needs to be skills plans for each sector, the Sector Skills Plan (SSP), aligned to the NSDS III, and the need to have a model for skills demand and skills supply in the future. The plan envisions that any such model should ideally be a combination of quantitative (data driven) as well as qualitative (incorporating expert knowledge) analyses.

Thus, this report is a first stage of the endeavour to understand some of the approaches in skills forecasting, in an effort to understand what the components of the water delivery system at the local government level, which includes the skills component are, in order to make useful projections that are informative enough for effective planning for availability of skills for LG SETA. In this report, we summarise some of the forecasting methods adopted internationally in order to help us identify the forecasting framework that will be of use for the purpose of this project.

2.2 Regional studies

Before we discuss some of the regional forecasting approaches for our purpose, we present the perspective of general hiring process at an organisations level from the human resources perspective which primarily relates to three important features of the job – namely,

- the description of the job,
- the skills required for achieving that job, and
- the corresponding qualification expected.

Human resource in any sector or organization primarily focuses on hiring for job openings based on the goals the organization wants to achieve, adjusting for attrition. It thus requires thorough evaluation of the aims and scopes of the organization as well as the competition in the sector with regards retention (Tarraco and Swanson, 1995). A further step is when such human resource planning is done taking into account potential unseen demand in the future, and not just related to the status quo. In either case, the focus is primarily on the skills demand side issues.

However, when skills planning goes beyond the purpose of a particular organization, it is important to have an understanding of what other drivers that may be exogenous to the system may influence the forecast – and what are the specific aspects of the drivers that affect skills demand, and what are those that affect skills supply. Without informed planning, any investment to ensure that those demands are satisfied by the supply, will be futile. Below we summarize some skills forecasting exercise in different regions.

2.2.1 European studies

Founded in 1995, the European Centre for the Development of Vocational Training (CEDEFOP) was set up to draft policies for vocational education and training (VET) in Europe. The CEDEFPR (2009) report was developed to help envision how skills demand and supply will change in Europe taking into account anticipated changes in terms of migrations, changes in the demographic composition of the population, economic changes as well as technological changes. The purpose of the report was to be able to provide an initial forecast of skills supply in Europe until 2020. However, since the initial forecasts are at a high aggregate level, it has been pointed out that with availability of additional and

complementary data, that can further help the VETs to plan their management of such forecasts, particularly in terms of investments into training.

CEDEFOP (2009) also mentions that regional and sectoral forecasts for sector specific skills can substantially be improved by undertaking surveys with employers to gain in-depth insights into jobs and qualification needs, as well as what on-the-job training may be needed. Further, for the EU, the challenge remains that each of the member countries have their specific local characteristics, and hence a skills forecast for the whole of EU will not necessarily help individual countries to plan for their sector specific skills needs. And as such, within the EU, country specific skills forecasts based on regional data is important.

CEDEFOP (2009) puts forth serious caveats in the form of relying solely on macroeconomic drivers for skills forecasting ignoring other complementary drivers, as well as being too ambitious in providing long-term forecasts. These caveats are in agreement when a statistical forecasting model is used for any kind of forecasting.

On the methodology aspect, CEDEFOP (2009) reports the development of a basic database to enable the projection of skills for all the countries in the EU. Thereafter, the methodology had a modular approach in order to improve any one module as required, and to produce regular skills forecasts for both demand and supply. For the demand side, Module 1 – they focus is the E3ME European macroeconomic model that incorporates demographic and labour supply modules, and using historical data projects labour supply by age and gender. Module 2 that focuses on sector specific demands; Module 3 that

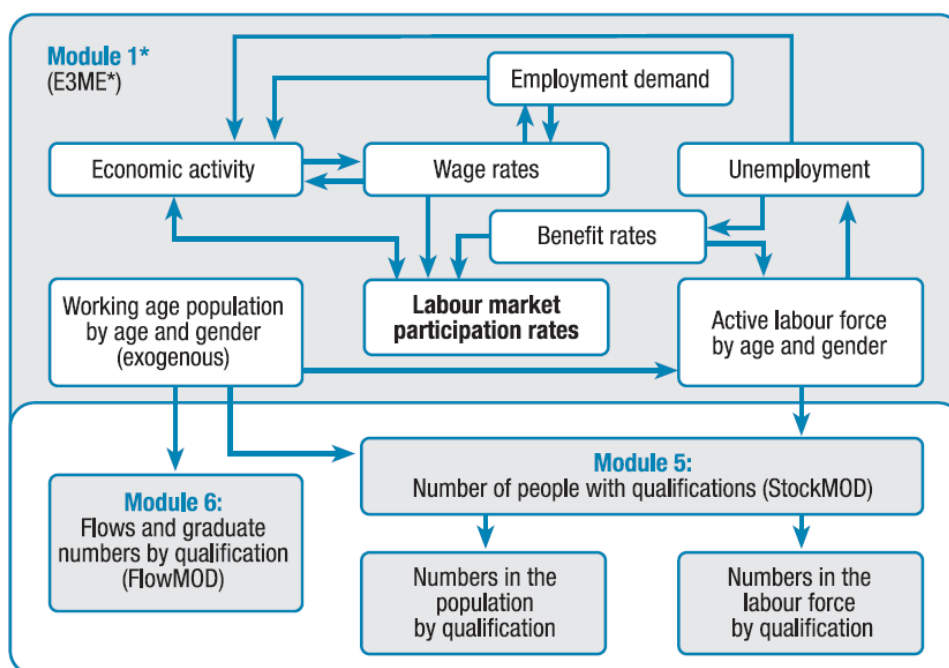


Figure 1: Modelling the supply of skills (framework)

Source: CEDEFOP (2009) pp 20.

focuses on qualifications; Module 4 that focuses on the replacement demand that entails incorporation of changes in occupation levels as well general attrition. Other modules include analysis of the probabilities of the labour force achieving different qualifications by age groups. CEDEFOP (2009) mentions that the modular approach to the forecasting process enables the further development of the model as a whole, as well as the modules individually. For the supply side, in Module 1 continue with the E3ME macroeconomic model; along with modules that focus on qualifications – whether already acquired or those qualifications that will be attained, which is presented in Figure 1: Modelling the supply of skills (framework).

The E3ME model is a multi-sectoral macroeconomic model (E3ME) (Pollitt et al., 2010) which has been developed by the *Cambridge Econometrics* group with the foundation of their models based on the understanding of how the economy grows. ‘E3’ refers to its inclusion of Energy-Environment-Economy aspects in the model. A schema of their modelling framework is depicted below in Figure 2: E3ME framework.

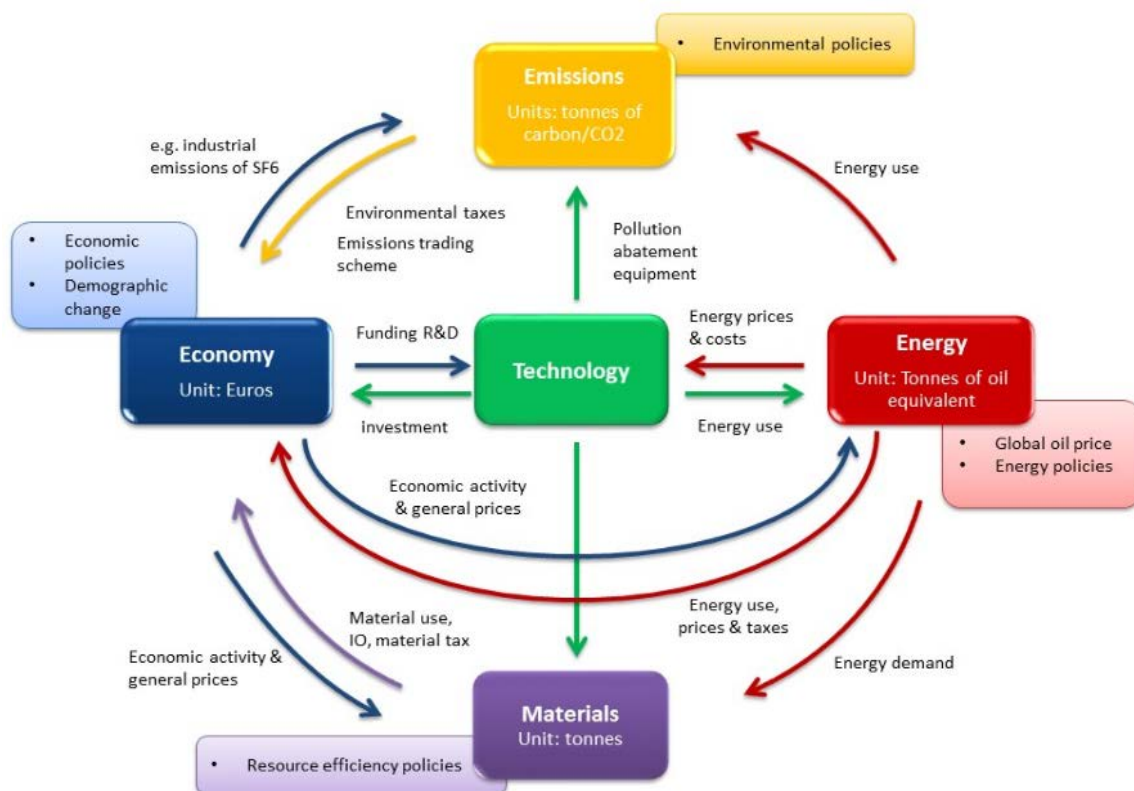


Figure 2: E3ME framework.

Their models allow for disaggregating the forecasts by regions (sub-national) as well as by employing activity (sector) on the basis of available data. Both models use detailed understanding of the economy and interrelationships thereof, which are then quantified (estimated) using robust time-series econometric techniques, taking into account exogenous variables such as those that occur outside the country (such as world GDP, exchange rate, etc). It has been stressed that the reliability of the forecasts depends on the reliability of the data used as inputs to the models. Also, it has been stressed that the fact that national level data are often more reliably available than those available at the sub-regional spatial level, that techniques should be designed to enable estimation using higher spatial resolution of the data accordingly. It has been emphasized that the E3ME model is not based on a computational general equilibrium (CGE) approach.

The E3ME model links labour supply to independent drivers such as economic activity, wage rates, unemployment, education level, among other drivers. The model allows for the analysis of scenarios such as a optimistic scenario in which the assumption is that the World Trade Organisation (WTO) reduces trade barriers, and ease of skilled labour to migrate across Europe; a pessimistic scenario in which there is increased energy prices and low global economic growth.

On the data aspect, CEDEFOP (2009) mentions that such were sourced from Eurostat data (for demographic information), Eurostat/Labour Force Survey (for qualifications), UNESCO-OECD-Eurostat data (for education statistics), from each of the 27 member countries. On the issue of data quality, quoting from the report, there exists “*data-comparability and quality issues that have emerged during the project*”. Recommendations that individual countries can customise the results from the European model by incorporating any alternate relevant data (information) as well as by including any specific assumptions. The report also discussed the multinomial logit regression approach in which the response of interest is counts of the qualification. The overall conclusion of the report is that while there were challenges, the trends that were projected were robust for all the countries, qualifications would rise, especially for women.

In the context of this project, it appears that the CEDEFOP approach is at a very aggregate level and based on assumptions based on the data and assumptions relevant to the European labour market scenarios. Further, they conclude that obtaining detailed information on demographics along with qualifications can help refine the forecasts. None-the-less, as far as the objective of the report is, which is to help policy decisions to be made better for the European VETs, it ties with the objective of the LG SETA which is to be better prepared by getting better understanding of the skills demand scenario for the water sector to enable that the requisite skills are available and adequately trained.

2.2.2 UK studies

The CEDEFOP (2009) report includes projections for the UK. Besides that, the Warwick Institute for Employment Research (WIER) has undertaken a number of projects that include the Working Futures project that projects for up to 2017. The Skills in England 2007 project of WIER was focused on summarising the 'research evidence on the supply of, and demand for, skills'. Further, the Local Economy Forecasting Model (LEFM) was a software development project for labour market forecasting and enables users to make economic projections by local areas within the UK.

Wilson et al (2014) report by the UK Commission for Employment and Skills was the result of inputs from various small and large employers within the UK to enable them to be better informed about how investment should be planned for developing the skills in order to secure employment together with growth. The study focused on answering three major questions namely: 'where will the jobs of the future be concentrated in the UK?'; 'what are the implications of this for skills demand, as measured by occupation and qualification?'; and 'How does this compare with development of the supply side?'. Wilson et al (2014) claims that their labour market model is the 'most detailed and comprehensive of its kind for the UK'.

Wilson et al (2014) present a detailed section comprising macroeconomic component of their model that includes assumptions as well as uncertainties of the exogenous factors, a section on sectors and employment prospects within the sectors, a section on occupations structures and replacement, a section on qualifications both at the time of employment and those obtained during the employment phase. Wilson et al (2014) assesses both the demand and supply of employment prospect over a ten-year horizon. It provides such by performing a detailed analysis by sector, as well as accounting for future changes. It's projections "... are based on the use of a multi-sectoral, regional macroeconomic model, combined with occupational, replacement demand and qualification modules."

Wilson et al (2014) improved on models such as the E3ME, and developed the Multisectoral Dynamic Model (MDM-E3) with the inclusion of detailed analysis by sector and region provision. Quoting from the Cambridge Econometrics website¹: 'In summary MDM-E3 provides:

- annual comprehensive forecasts to the year 2030:
 - for industry output, prices, exports, imports and employment at a 86-industry level; for household expenditure by 51 categories; for investment by 27 investing sectors

¹ <http://www.camecon.com/MacroSectoral/MacroSectoraluk/ModellingCapability/MDM-E3UKMultisectoralDynamicModel.aspx>

- for the nine former Government Office Regions, Wales, Scotland and Northern Ireland, projections of value added output and employment by 46 industries, plus aggregate household income and expenditure
- full macro top-down and industrial bottom-up simulation analysis of the economy, allowing industrial factors to influence the macro picture
- an in-depth treatment of changes in the input-output structure of the economy over the forecast period to incorporate the effects of technological change, relative price movements and changes in the composition of each industry's output
- scenario analysis, to inform the investigation of alternative economic futures and the analysis of policy'. 'The schema of their approach is given in figure 3

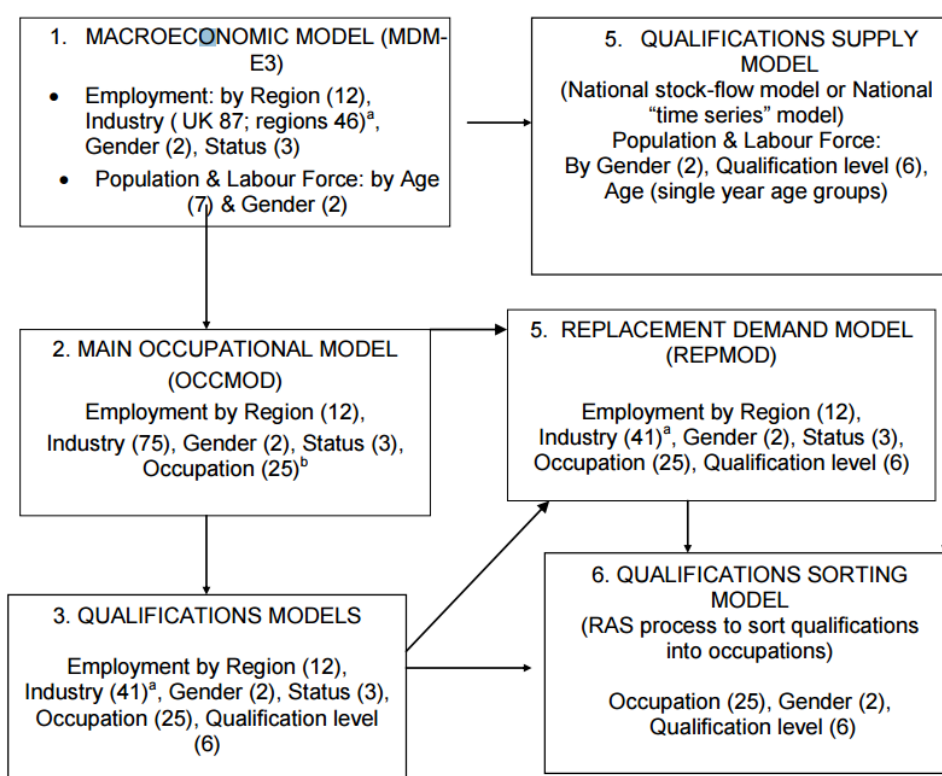


Figure 3 The schema of Wilson et al (2014) approach.

As also mentioned in the CEDEFOP (2009) report, here too it has been highlighted that as *'with all projections and forecasts, the analysis presented in Working Futures should be regarded as being indicative of likely trends and orders of magnitude, given a continuation of past patterns of behaviour and performance, rather than precise forecasts of the future. The results should not be seen as definitive and should be used in conjunction with other sources of intelligence about the labour market.'*

2.2.3 United States of America

The Bureau of Labour Statistics of the US Department of Labour in 2015 released its employment projections for the period 2014-24. The release is not detailed in the methodological side, but only on the findings, and mentions that the projections are based on long-term economic trends and do not include any anticipated change in the future. Other than that, limited information was available during online searches on skills forecasting studies for the US.

2.2.4 Australian studies

2.2.4.1 NATIONAL INSTITUTE OF LABOUR STUDIES

The Richardson and Tan (2007) report was conducted by the National Institute of Labour Studies at Flinders University with the aim of informing the Australian vocational education and training (VET) centres regarding changing skills and related aspects in the future. For projecting skills demand in the future, they use the Monash Model, which is the most popular skills forecasting model in Australia. However, Richardson and Tan (2007) highlight that models that rely on the complexity of the economy can rarely produce accurate future skills demand estimates, as well will fall short of long term forecasts, especially if they are also disaggregated by sector and/or regions. They also point out that due to the uncertainty associated with future technologies and innovations, it is not easy to foresee how demands for skills can evolve. From their experience they mention that skills forecasts can be off by as much as 20% within a few years of their initial estimate, which also is indicative of how challenging an exercise skills forecasting can be. As such, skills projections should be taken as an overall indication of where skills demands will be to help with planning towards meeting those trends.

Richardson and Tan (2007) also make it explicit that there is no direct skills demand data that is available, rather occupation types and numbers are considered as proxy for skills demand. It is also an assumption that the number of people employed equate to the number of skills demanded. On the aspect of the uncertainties associated with forecasting skills demand, they highlight that a number of externalities can influence it, such as, the advent of new technologies and innovations, domestic macroeconomic conditions as well as macroeconomic condition of other countries, governments available capital investment; policy decisions of the government, and the interactions of among them.

On the modelling aspect they mention that these are based on economic theory, simulations studies as well as on large historical data, and are focused more towards labour demand rather than on labour supply. They discuss that a bottom-up approach to such modelling is more useful for sector specific skills which can include the undertaking of sector specific skills profile of demand and supply needs survey – that include both the qualitative and quantitative aspects.

Richardson and Tan (2007) then devote substantial effort to compare the outcome of the Monash Model of the Centre of Policy Studies at Monash University. The Monash model has been developed to help project labour demand by region, sector as well as by skills type. However, as expected, the accuracy of the model was best when projections were not disaggregate, and when the forecast horizon was short.

Richardson and Tan (2007) mention that both employers and potential employees have different expectations from the labour market at different times. Also, it is not uncommon that people with specific qualifications are doing jobs that they did not have a qualification for. As such, to best serve the purpose of forecasting for a sector, one needs to have intensive survey of that sector to understand sector specific concerns, challenges and expectations, as well as what on-the-job training are required for serving the specific needs of the sector, that may not be necessarily readily obtained from a tertiary education degree.

Finally they conclude by saying that they refrain from advising numbers of future enrolments by skills/ sectors/ region to the vocational education and training centres based on the projections of the models for two reasons: one that such projections are only indicative; and two that the labour market is very dynamic. Quoting from the Richardson and Tan (2007) on the recommendation that they make, they suggest undertaking of *“separate, bottom-up, high-quality studies of expected skills demands for those major skills that take a long time to learn and gear up to teach—it is for these that the ability to make accurate projections is of most importance.”* This is the approach that is in fact needed for the purpose of our project.

2.2.4.2 NSW Strategic Skills Plan 2011 -2015

The Watson (2011) report focuses on skills modelling for the specific region of New South Wales (NSW) in Australia, and compares the methodologies in two reports related to Centre for the Economics of Education and Training (CEET) Model and the Access Economics Macro (AEM) Model for modelling of future skills demand. Watson (2011) states that there are a number of other reports also available which discuss skills modelling; however the two reports chosen for their study presented their findings in a way that was directly comparable.

Watson (2011) looks at forecasts for 2025 comparing employment and qualification holding and different economic modelling assumptions and scenarios. The author further investigates the skills planning for NSW using the results of the two different models (presented in the respective reports) and the work done by the UK Commission for Employment Skills.

Finally, Watson (2011) highlights the inconsistencies that arose from the examined economic models and how these could affect policy makers. The author suggests that the focus should be on medium term planning and making use of the two methodologies presented to create a balanced strategy. This was proposed to be done in two steps:

- I. Extrapolate from current trends to plan for 4-5 years.
- II. Supplement with in-depth interviews with key stakeholders and people directly involved in the labour market with perceptive insights.

The goal of the models discussed is to estimate the number of employed persons that have qualifications and also the demand for any additional qualifications. Without providing the finer detail and differences between the two models a flow chart is shown in Figure 1 to illustrate the underlying strategy of the models. It should be noted that each model used a different macroeconomic model.

Both the CEET and AEM models allow for skills deepening (growth in qualifications occurs at a greater rate than in employment and also multiple qualification holding). In addition as workers retire, the models take it into account by forecasting additional qualifications needed in future using labour force growth rates, retirement rates and student qualification demands. For clarity workforce refers to employed persons, whereas labour force/market also includes the unemployed.

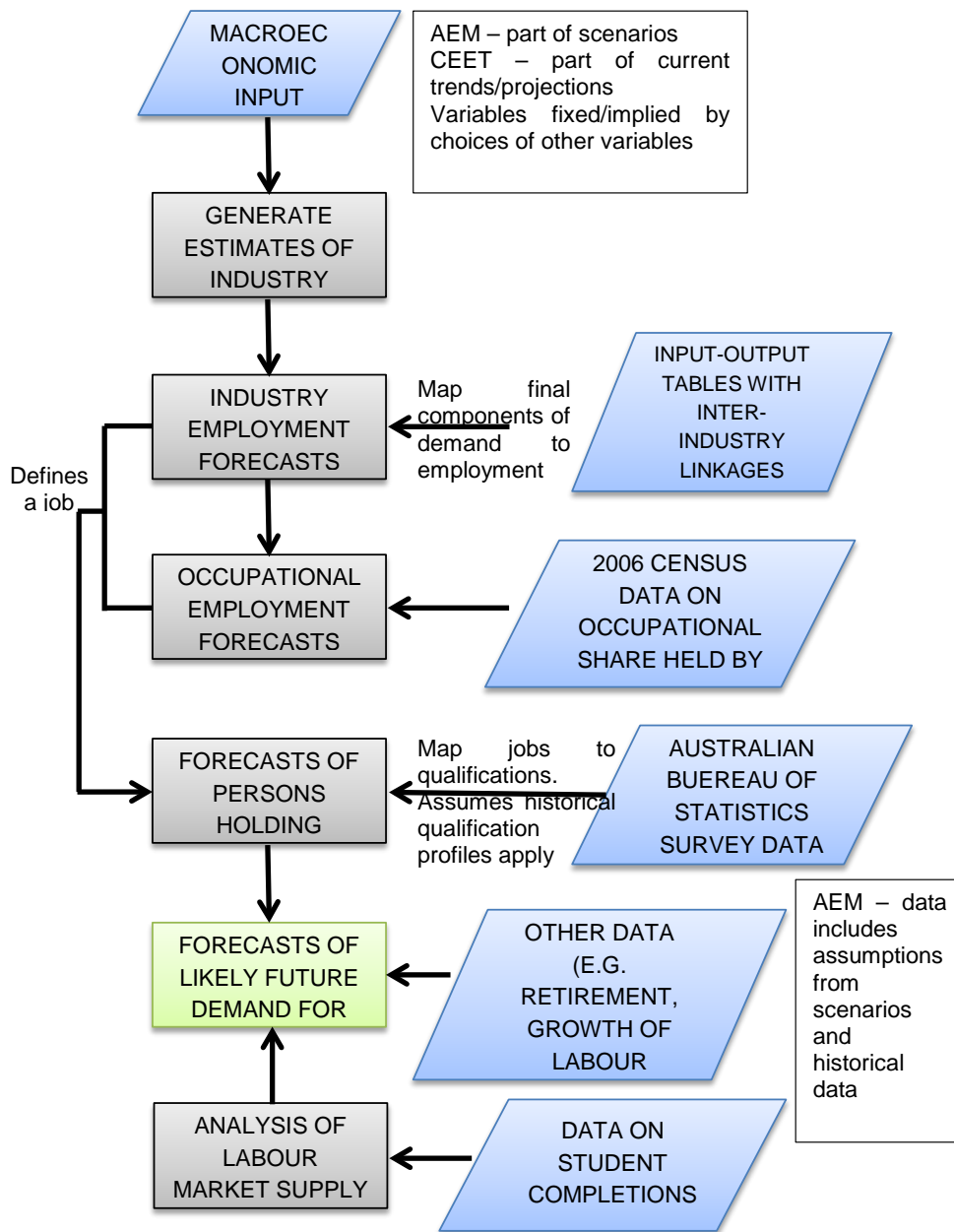


Figure 4: Flowchart illustrating the underlying strategy of the AEM and CEET skills forecasting methodologies.

Watson (2011) also compares the forecasts made for 2025 using the two methodologies, CEET and AEM, which is tabulated below for easy comparison.

	Centre for the Economics of Education and Training (CEET) Model	Access Economics Macro (AEM) Model
Initial Report Title	Demand for qualifications and the future labour market in Australia – Chandra Shah from CEET, 2010	Economic Modelling of Skills Demand – Access Economics, 2009
Model Information		
Macroeconomic Model	MONASH Employment Forecasting Model (incorporates AEM 5 year macro forecasts)	Not mentioned
Relevant Population	Employed and non-employed persons	Employed persons only
Macroeconomic Input Variables	Based on assumptions of current trends or forecasts provided by others	Based on three scenarios: Open Doors, Low-trust Globalisation and Flags

Description of scenarios		Open Doors	Low-trust Globalisation	Flags
		National growth paths follow long-term trends. Globalisation continues with improved market structures.	Increased competition and trade barriers, expansion of natural resource industries, growth in role of multinational corporations, focus on bilateral trade	Global depression and expansion of bilateral and regional agreements, increased trade barriers and more nationalistic political culture
Macro model Parameters		Global Growth Rate		
Macro Model Assumptions	Australian Growth Rate, Annual net immigration	Australian Growth Rate, Annual net immigration, Labour Productivity Growth, Exports and Capital/Labour Ratio		
Macro Model Implied Results	Participation Rate	Population, Workforce and Employment Growth; Unemployment and Participation Rate; Exports and Business Investment to GDP		
Methodological Limitations	Assumes that qualifications equal skills	Little scope for qualitative changes, however policy does influence input-output table adjustments. Assumes that qualifications equal skills.		

The outcomes from the modelling, measured as stocks, are presented in levels based on actual counts found in the two reports (CEET and AEM) reviewed. Both methodologies accommodate the 2008 global financial crisis and long term labour market changes. It should be noted that both methodologies omit climate change, peak oil (models do accommodate change in oil prices) and prolonged economic malaise. Both methodologies accommodate scenario analysis.

Neither of the CEET or the AEM report clearly defines their methodology regarding how qualifications are forecasted AEM assumes a different replacement rate for each scenario calculated from census data, whereas CEET data was tabulated differently and thus is not comparable. It appears that a category 'new entrants' is used to indicate the growth and replacement of labour. On the supply aspect the author notes that the assumption that the qualifications forecasted represent the true demand is misleading as it probably ignores underutilised skills in the workplace and equates qualifications with skills. CEET does not provide information on course completions, AEM does. Data in this section was only provided for AEM. The supply of qualifications doesn't vary much between the three scenarios. The author makes an assumption regarding what CEET would do, based on the results from the educational and additional qualification. He assumes that CEETs forecasts would be much higher than AEM.

General conclusion of the Watson (2011) report is that there is a need for more hybrid scenarios as it will more closely resemble the current economic state. The author believes that forecasts of current situations will be between the open doors (expansionist) and flags (least growth) scenarios described by the AEM model. Both models perform similarly with CEET forecasts similar to those for the open door and low-trust globalisation of the AEM model. The author highlighted a number of shortcomings in modelling educational qualifications in Australia as follows:

- Different economic models produce different policy-relevant outcomes. It was noted that at each link in the modelling process (see Figure 4) the divergence between the two models increases.
- Outcomes are assumption-driven. For example, different assumptions regarding skills deepening and multiple qualification holding resulted in divergence between the modelling outcomes.

The author also suggests that one consider simply extrapolating from current trends (Census or workforce profile), rather than use a skills forecasting model approach, for medium term planning (4-5 years). To augment this quantitative data one can obtain qualitative data from key informants regarding their experiences.

2.2.5 Others studies

Youdi and Hinchliffe (1985) edited UNESCO: International Institute for Educational Planning report is a rather old report that deals with analyzing the future skills needs for eleven countries. The overall criticism of the edited report was that, one, the data and techniques

have been very rudimentary, and second, beyond just economic factors, one needs to include other aspects such as political environment, and do the projections by different economic types.

3 CONCLUDING REMARKS

The purpose of this report was to consolidate readily available information related to skills forecasting in other countries, and if possible for water. While no specific site was found dealing with skills forecasting for the water sector, a number of international studies were found dealing aspects of such forecasting. From the discussion presented here, skills forecasting approaches in various countries, it is evident that there are a number of challenges in trying to do so even in developed countries where data quality and availability is much better than in developing countries such as in South Africa. Further, caveats were repeatedly drawn that irrespective of the methods used to do the forecast, such should be taken as indicative trends under the assumptions made, rather than as final numbers around which skills planning should be done. Additionally, like in any forecasting exercise, the longer the forecast horizon, the more unreliable the forecast becomes. Most of the studies indicated that for effective planning for skills, it is better if sector specific models were developed. So while it is challenging to do skills forecasting, none-the-less one needs some objective ways to help with the planning for future skills demand and supply. From the discussion above it has emerged that a realistic forecast horizon is about for 10 years, with the first 5 years being extrapolation of the existing trend, and the following 5 years that allows for the incorporation of expert intelligence in the form of qualitative inputs. Further, for sector specific investments for skills development, it is important to get insight into the sector specific skills requirements rather than skills projections only based on national level macroeconomic inputs, which is bottoms-up approach to skills forecasting.

In the next workpackage, our focus will be on skills forecasting studies that have been conducted for South Africa, and to understand how they are relevant to the purpose of planning for future skills demand and supply for the LGSETA in the water sector.

4 REFERENCES

European Centre for the Development of Vocational Training (CEDEFOP). 2009. *Future Skill Supply in Europe: Medium-term forecast up to 2020 Synthesis Report*, Office for Official Publications of the European Communities, Luxembourg

Pollitt, H. et al. 2010. *Projections of labour supply and demand from the E3ME model. Cedefop project on forecasting skill supply and demand in Europe*. Technical report 001. Warwick: IER, Institute of employment research.

Richardson, S. and Tan, Y. 2007. *Forecasting future demands: What we can and cannot know*, National Institute of Labour Studies, Flinders University. Published by NCVET.

Watson, I. 2011. *Modelling of future skills demand: the implications for skills planning in NSW, Background Research for the NSW Strategic Skills Plan 2011-2015, Board of Vocational and Education and Training (BVET)*, NSW Department of Education and Training.

Wilson, R, May-Gillings, M, and Beaven, R. 2014. *Working Futures 2012-2022: Technical report on sources and methods*. <https://www.gov.uk/.../working-futures-2012-2022-technical-report.pdf>

Youdi, V. and Hinchliffe, H.K. 1985. *Forecasting skilled-manpower needs: the experience of eleven countries* Edited. the United Nations Educational, Scientific and Cultural Organization. Printed in Belgium by Comedi, Brussels. ISBN 92-803-1122-3