Developing a National Skills Forecasting Tool for South Africa

Annex A: Rationale for Conducting National Occupational Projections and how they are Typically Undertaken

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1. WHY FORECAST?

Before embarking on a major investment in data collection and model building it is useful to rehearse the reasons why so many countries have chose to go down the route of undertaking regular large scale employment projections.

This can be discussed under a series of headings:

- Why Forecast? - The distinction between Projections and Forecasts;
- Aims & objectives of typical projections - Audiences and their different interests;
- Practical limitations - What is actually projected?
- Method - How skill needs are projected?

Based on the dictionary definition, to Forecast is defined as: *To predict, estimate or calculate beforehand; calculation or estimation of something future*.

Further related definitions are:

- To guess, defined as: *To estimate without calculation or estimation;*
- To predict*: To foretell an event*;
- To foretell: *To tell of an event before it takes place.*

In contrast,

- To project is defined as: *To plan or extrapolate to a future time (forecast),* which brings us full circle.

Most of those involved in Forecasting and Projection work emphasise that they do not possess a crystal ball, in which they can see the future precisely laid out. Rather, they stress that what is typically done is to map out the implications of certain assumptions (about patterns of behaviour and other factors) from which some inferences about possible futures can be made.

A distinction is often made between Forecasts, Projection and Scenarios. The former is a very precise prediction about certain events. A projection is a quantitative assessment of what might occur, given certain conditions, while scenarios are more qualitative assessments of what the future might look like. However, the boundary between these elements is often blurred.

Various analogies have been used to describe the process of conducting forecasts or projections. These include:

The idea of *Clearing mists*, in which the analyst's aim is to disperse the mists and reveal the future. However, this is in many ways rather passive and it implicitly assumes that the future is in some sense predetermined and fixed.

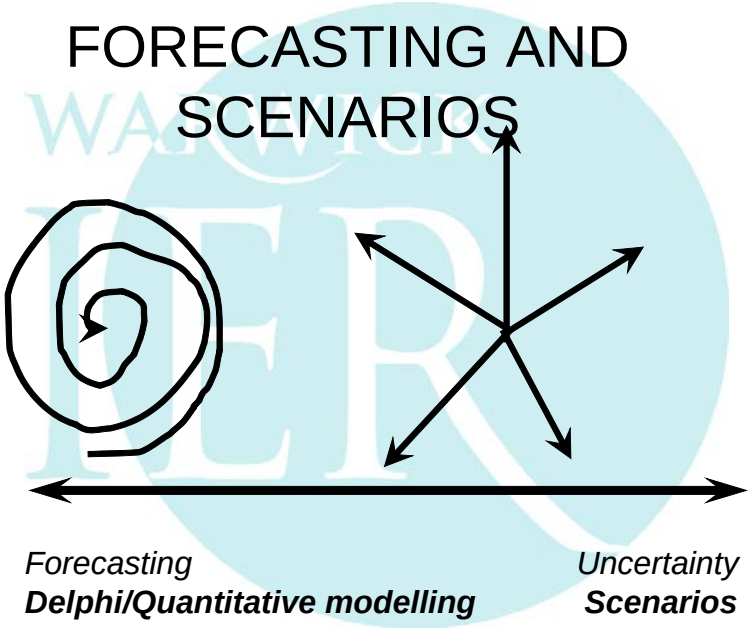
A more useful analogy is the idea of *Avoidance of problems.* Thus if the analysis does reveal that, for example, the Titanic is heading for an iceberg ahead, it is not inevitable that ship and obstacle must collide. The information from the projection can be used to change behaviour (i.e. alter the course of the vessel, in order to avoid a collision).

This emphasises that societies and economies face *multiple paths,* with alternatives and choices to be made. It also highlights a key problem in evaluating such projections, in that they may result in changes of behaviour that are explicitly aimed at avoiding the prediction coming to pass.

Even this view may be too mechanistic; the *Growing tree* analogy can be helpful. What forecasting and projection work can help to illustrate is that from little acorns great oak trees can grow, with very complex branches, and that economies and societies are in many respects more akin to organic beings than to engineering structures.

Figure 1 illustrates the key distinction between some types of forecasting, which tend to be closed, and scenario development which is more open-ended. However, much scenario development now involves a quantitative forecasting element, while few "forecasters" believe that they are producing a precise and unique prediction of the future.

Figure 1: Forecasts and Scenarios



The reasons typically given for undertaking some kind of forecasting or projection work are numerous. They include:

- Uncertainty - the world is a rapidly changing & uncertain place;
- There are long lead times on many investment decisions, and this is especially true for many education, training and skill development choices;
- Anticipation: everyone has to plan to avoid problems & optimise outcomes –this includes government, educational institutions, employers and individuals;
- Often there is also a need for a counterfactual to assess the impact of policy interventions – what would have happened in the absence of the policy change.

The only real issue is ***How*** this should be done - there is a need for a cool, logical and systematic assessment of future prospects.

Various people have argued that forecasting is not necessary. It is helpful to consider the reasons that they have advanced for this view and why those conducting projections believe that they are mistaken. The main reasons advanced fall under three headings:

- Forecasting is impossible;
- Forecasting is unnecessary;
- Forecasts are inaccurate and based on invalid assumptions.

Why forecasting is possible

Forecasting in the social sciences is, in a literal sense, clearly impossible. Nobody can **predict** the future with certainty. However, everybody can prepare or **plan** for the future. To do this involves some element of forecasting or projection, either **implicitly** or **explicitly.** In this sense not only is forecasting possible it is also **inevitable**. The only meaningful questions are **how**, by **whom** and with **what end** in mind?

Why forecasting is necessary

Many have argued that forecasting or projection work is unnecessary in a market economy, since market forces can be relied upon to generate optimal outcomes. Even if labour and product markets did operate in the manner assumed in classical economic textbooks, this would not remove the need to anticipate future change, threats and opportunities. Many organisations in the private sector spend considerable resources on systematically trying to anticipate the future.

Moreover, there is considerable evidence that, left to their own devices, market forces will not necessarily provide optimal outcomes. Market prices (wages in the case of labour markets) may not provide adequate or useful signals in a complex and uncertain world, with long lead times on investment in education and training. There is also much evidence of market failure.

In addition, in a policy evaluation context, some kind of projection is often essential to provide a counterfactual (i.e. what would have happened had the policy change NOT been introduced). In the absence of such an assessment it is difficult, if not impossible to gauge the impact of any policy intervention, since observed changes

may have happened anyway. A “forecast” based on what might have occurred had the policy not been introduced can help to fill that gap.

Accuracy and validity

Some have argued that forecasting in the social sciences is both inaccurate and invalid for a number of reasons. This raises a whole host of issues (not all of which will be pursued in depth here). For example, should we expect accuracy in social science forecasting? This raises the question of what precisely is the purpose of such forecasts or projections. Those involved in such activities have typically responded with the following aims and objectives:

- Setting out options to policy makers;
- To influence and change behaviour generally, including the actions of policy makers;
- Providing key actors such as education and training providers with relevant information to help them make rational choices;
- Guiding individual career decisions and highlighting alternatives;
- Making technical information digestible for a lay audience.

From the first two of these at least, it is clear that outcomes are often expected to be different from the forecasts or projections. In such circumstances asking about **accuracy** is rather pointless. The crucial question is whether or not the projection is **useful** and **informative**. Nevertheless, most employment forecasting is concerned with projecting general trends in employment structure. In these circumstances the question of accuracy is more pertinent, although even then there is some element of wishing to prevent major surpluses or shortages by influencing behaviour, so measuring accuracy is far from straightforward. Reviewing the work that has been undertaken in many countries over the past 30 years, it is clear that methods are improving but margins of error remain uncertain. They are probably quite large but no more so than in other types of forecasting. The key point is that such projections do not necessarily have to be precise and accurate in order to be *useful*.

2. BRIEF HISTORY OF LABOUR MARKET PROJECTIONS

2.1 Introduction

Labour market projections have been carried out on a systematic basis for over 50 years. The Bureau of Labor Statistics, in the USA was a pioneer, developing projections of changing employment structure as part of a programme to find employment for GIs returning from war.

The OECD Mediterranean Project also experimented with such projections as part of post-war redevelopment in Southern Europe.

In other countries, such as France, there is long a history of Indicative Planning by the State. Initially this attempted to establish formal links between education and training and the economy, although this has been replaced more recently with less mechanistic methods. In the UK, the Government has adopted a more arms length approach, commissioning others since the mid 1970s to undertake regular but more general labour market assessments.

Most of the other developed economies of the world have followed a similar course although the degree of direct involvement of the State has varied considerably. In the past decade many countries have introduced innovative new approaches, but these often involve considerable investment in data collection and monitoring. In all cases such work has been primarily State funded. In recent years a number of developing countries have also begun to engage in such activity, including China, South Korea and Singapore. Not much of this work has been published in English, but personal correspondence with the author suggests that such work has followed a similar approach to that already outlined for other countries. Their experience in terms of the use of such results ranges from command economy, indicative type manpower planning, to more general labour market assessments, characteristic of market economies.

The review of this now very large body of work, across such a wide range of countries, has highlighted the benefits of using a formal model (as set out in more detail in the next section) and the value of developing benchmark projections.

2.2 Aims & objectives

The aims and objectives of this work have been manifold:

- Understanding past trends;
- Provision of useful LMI on future occupational employment prospects;
    - numbers employed;
    - job openings;
    - qualifications needed.

A number of caveats have been expressed by those carrying out such work, although these are frequently ignored. These warnings include:

- Details about the implicit assumptions about the labour market;
- That such projections should not be regarded as mechanistic manpower planning;
- That the role of such projections should be seen as part of an ongoing ***iterative process.***

2.3 The audience

It is important to recognise that there are many different audiences for such information generally and that their specific and detailed needs for labour market information (LMI) may be very different.

The main audiences include:

- Government at National and Regional level;
- Local Bodies;
- Industry Training Organizations and Employers;
- Education and Training Institutions;
- Careers Guidance and Individuals making occupational choices.

The interests of the different audiences include:

- Occupational demand - future employment levels by occupation/skill;
- Replacement demands - job openings (recognising the need to replace those leaving);
- Education and training requirements - qualifications typically needed;
- Supply/demand balances;
- Terms and conditions of employment (pay).

2.4 What is usually projected

There is usually a gap between the ideal LMI requirements and what is actually produced. This reflects data limitations as well as technical and conceptual difficulties in modelling and projecting everything audiences would like. The typical set of employment projections includes:

- "Outcomes" - employment levels by occupation (usually interpreted as demand);
- "Outcomes" - employment levels by qualification;
- Total requirements (replacement demand).

The key dimensions cover:

- Sectors;
- Occupations;
- Qualifications;
- Regions.

Only rarely do such projections cover balances/imbalances, earnings or other aspects of skill. This reflects lack of data as well as conceptual and technical difficulties in modelling aspects of supply.

There are various constraints on what can be projected. These include data constraints such as:

- Suitability for purpose;
- Availability of key indicators;
- Reliability.

Other constraints relate to the current state of knowledge (or lack or it). This includes:

- Areas of dispute in the literature (social scientists' understanding of the way that labour markets work remains imperfect);
- Acts of God – things that social scientist just cannot hope to predict, such as earthquakes and other natural disasters or wars.

3. HOW TO MAKE PROJECTIONS

3.1 Approaches and methods

The methods used to undertake labour market projections are numerous and varied. They differ significantly according to the purpose, the audience and the data available.

Such work has become progressively more scientific and quantitative as methods, tools and data have improved (not least as a consequence of the benefits of Information Technology).

General approaches

The different approaches can be grouped under 4 main headings:

- Ask employers (employer skill surveys);
- Sectoral studies;
- Qualitative (non-quantitative) methods;
- Quantitative methods and formal models;

Ask Employers

In many ways, it seems that the most natural approach to finding out about future skill needs is to ***ask employers***. This can involve questions about:

- Current skill deficiencies;
- Anticipated future change.

At one time, this approach was a popular technique. However, it soon became apparent that employers are often not very well placed to provide robust answers to such questions. Their responses are more often than not inconsistent and misleading, especially when concerned with the future. More recently, greater emphasis has been placed on using employer surveys to assess current skill problems rather than anticipated future requirements.

Sectoral studies

Such information has often formed the cornerstone of *sectoral assessments*. These involve a range of different methodologies and actors, in order to "triangulate" a view of the key problems and likely future developments from various different perspectives. Such assessments have in recent years often also had a strong

geographical focus, with the setting up in many countries of *regional observatories* and the like to monitor changing skill needs at a more local level.

Qualitative methods

This type of approach often also involves a range of *non-quantitative* methods. Such qualitative techniques include the use of in depth interviews with key stakeholders including employers, in-depth case studies (especially of particular sectors). These are often combined with focus groups, round table discussions and similar mechanisms, to enable "soft" qualitative data to be incorporated into thinking about such issues alongside the "harder" statistical information upon which most quantitative analysis is based.

Quantitative modelling

The basic methods adopted for quantitative modelling can be classified under the following headings:

- Extrapolation of past trends;
- More complex time series methods;
- Introducing behavioural content.

Extrapolative techniques are often used, especially where only very limited time series information is available. In many cases, only one or two observations are available on occupational structure and this clearly limits the sophistication of what can be done. Where more time series observations are available, much more sophisticated analysis is possible, which attempts to find replicable patterns in a time series that can be used to predict its future path. Such approaches are widely used in the business and financial world, although they are much better at predicting short-term change than longer-term patterns. Unfortunately, history suggests that most linear (or more complex) trend patterns eventually come to an end and that they should therefore not be relied upon for medium to long-term forecasting. Behavioural analysis is an attempt to move beyond patterns in observed time series data and to provide some understanding of how it is that these patterns have arisen and more importantly, why they may change in the future. Such behavioural analysis draws upon disciplines such as economics and sociology for an understanding of what influences the behaviour of the key actors in the economy and how this is reflected in the key economic and social indicators that can be measured.

Such understanding finds representation in so-called computerised “models”, which take the form of algebraic equations linking key variables. A model is an attempt to provide a simplified representation of reality that can help understanding of the phenomenon of interest (in this case changing patterns of the demand for skills in the labour market). Most are familiar with the idea of engineers building models in order to test out their ideas. For example, testing model aircraft in wind tunnels. Models in the social sciences are rather more like a biological analogy than an engineering one, where for example, scientists have built models of dinosaurs in order to try to understand how they could fly. Social systems are much more akin to the biological than the engineering model. Social scientists attempting to understand how societies and economies work face problems such as:

- Lack of fixed laboratory conditions;
- Lack of good experimental data (they can only observe outcomes).

Social science models are typically built, using quite sophisticated statistical and econometric techniques and using data drawn from largely official, sources, including National Accounts and related estimates of employment based on surveys of employers and of households.

3.2 What projections can and cannot do

Having built such models and used them to make projections, it is important to recognise what they can and cannot do. On the positive side, projections can:

- Help to Make Assumptions about the Future **Explicit** and **Transparent;**
- Help to Enforce **Systematic** and **Logical** Thinking;
- Act as a **Focus** for intelligent **Debate;**
- Provide a useful **counterfactual** to assess policy impacts (i.e. what would have happened in the absence of the policy intervention).

But they cannot provide:

- Mechanistic manpower planning;
- Precise indications of education and training requirements.

3.3 The use of multi-sectoral macro-models

The review in Annex B suggests that the most common approach to assessing future skill needs in most developed economies is to use a multi-sectoral macroeconomic model. This is a formal, quantitative methodology, which adopts an essentially behavioural approach (although typically some elements rely upon more simple minded extrapolative methods).

The advantages of such an approach include:

- The sectoral and other detail it provides;
- The fact that it is typically comprehensive, covering the whole economy;
- Logical consistency;
- Imposition of accounting constraints;
- Recognition of economic constraints and influences;
- Explicit assumptions;
- Consistent scenarios.

Such methods do, of course have some disadvantages and problems. These relate to:

- Data limitations (often data were not collected with modelling in mind);
- Technical limitations within fixed resource limits;
- Resource costs of development and maintenance;
- Limits to current understanding of the way labour markets work;
- The possibly limited relevance of the past (such models being based on an assumption of a continued of past patterns of behaviour).

There are various elements in a typical set of employment projections. These include:

- Behavioural Models (Econometrics);
- Exogenous factors, which typically include:
  - Demographics;
  - Government policy;
  - What is happening in the rest of the world;
- Judgement.

The behavioural content is encapsulated in the multi-sectoral macroeconomic model. It is helpful to describe a typical example. The following is a description of the Multi-sectoral Dynamic macroeconomic Model (MDM) developed by Cambridge Econometrics, which has been used by the Warwick Institute for Employment Research to produce the main national and regional level employment projections for the UK Government over the past 25 years.

MDM can be briefly described as follows:

- It is a computerised macroeconomic model, in the Keynesian/Leontief tradition;
- It is multi-sectoral, providing a detailed analysis by sector (& occupation);
- It is dynamic, providing a full time series profile, including adjustment lags;
- It has a transparent, well documented methodology;
- It is consistency with official UK statistics;
- It adopts up to date data & classifications;
- It has a regular 6-monthly cycle of updates.

Figure 2 provides a diagrammatic overview. The outer rectangle (shaded in blue) represents the world. Within that, the next rectangle (purple) represents the home (UK) economy. The small (yellow) boxes represent blocks of key economic or labour market variables or indicators. The darker shaded boxes are variables that the model does not attempt to explain. These are termed *exogenous*. Values of the variables within them are set by assumption. The other variables are all *endogenous*, that is they are explained within the model by the various behavioural and technical relationships embedded within it. These relationships are represented by the arrows joining the boxes.

The key function of the typical macroeconomic model in the present context is to deliver a prediction of output and employment by industry and to a lesser extent to say something about labour supply and unemployment.

At the centre of the diagram is the box labelled the ***Total demand for UK goods and services***. This is at the heart of the model. It contains estimates of the demand for a vast range of goods and services ranging from agricultural produce, minerals, manufactured goods of all kinds, business and consumer services and public services including heath and education.

Demand for these goods and services depends upon various factors as represented by the other boxes and the arrows linking them to the ***Total demand for UK goods and services*** box. For example, a key component of demand is ***Consumers expenditure***. Consumers demand food, clothing, cars, haircuts, holidays, schooling, public services, etc. This is not the sole source of demand. Various consumption functions in the model represent these behavioural links.

Other producers also demand goods and services as part of their investment, in building plant and machinery, or as intermediate inputs in producing their own goods and services. This is represented by the box labelled ***GDFCF, Intermediate Inputs***.[1] In the model such demands are based around a Leontief input-output table and various behavioural equations, which model investment demand.

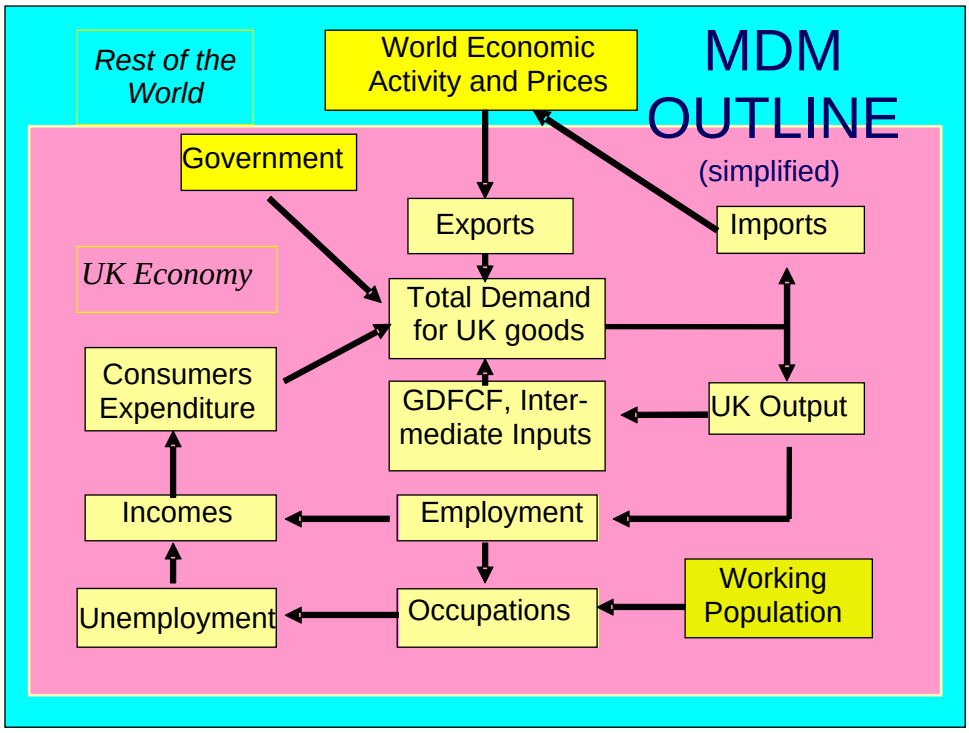
Other demands come from Government (both in the form of current consumption and investment spending) and from the rest of the world. The former is dealt with in the box labelled ***Government***, the latter by that labelled ***Exports***. The latter is in turn driven by what is happening to ***World Economic Activity and Prices.*** Of course, not all UK demand is met by domestic producers. This is reflected in the box labelled ***Imports*** that is also linked to ***World Economic Activity and Prices.***

Together these elements determine the total level of ***UK output***, (essentially, UK demand less imports). This is broken down into around to different sectoral categories. Output in each of these sectors is the prime driver of ***Employment*** levels in the sector.[2] Employment is one of the key factors influencing ***Incomes***. This in turn is the key driver of ***Consumers expenditure*** thus completing one of the main feedback loops in the model. Another important loop relates to the link from employment though labour supply (***Occupations***) to ***Unemployment*** and ***Incomes***. Labour supply is driven by demography (the ***Working Population***).

Government spending, ***World Economic Activity and Prices,*** and demography ***(Working Population)*** are regarded as *exogenous* in the model. All the other variables are determined within the model itself (i.e. *endogenous*). There are many other feedback loops and behavioural relationships not represented explicitly in this diagram. Nevertheless, it provides a bird's eye view of a typical model of this kind.

[1] GDFCF is Gross Domestic Fixed Capital Formation or investment.
[2] The behavioural equations also allow for sensitivity to factor prices, technological developments (affecting labour productivity, and adjustment lags).

Figure 2: Typical Multi-sectoral macroeconomic model MDM

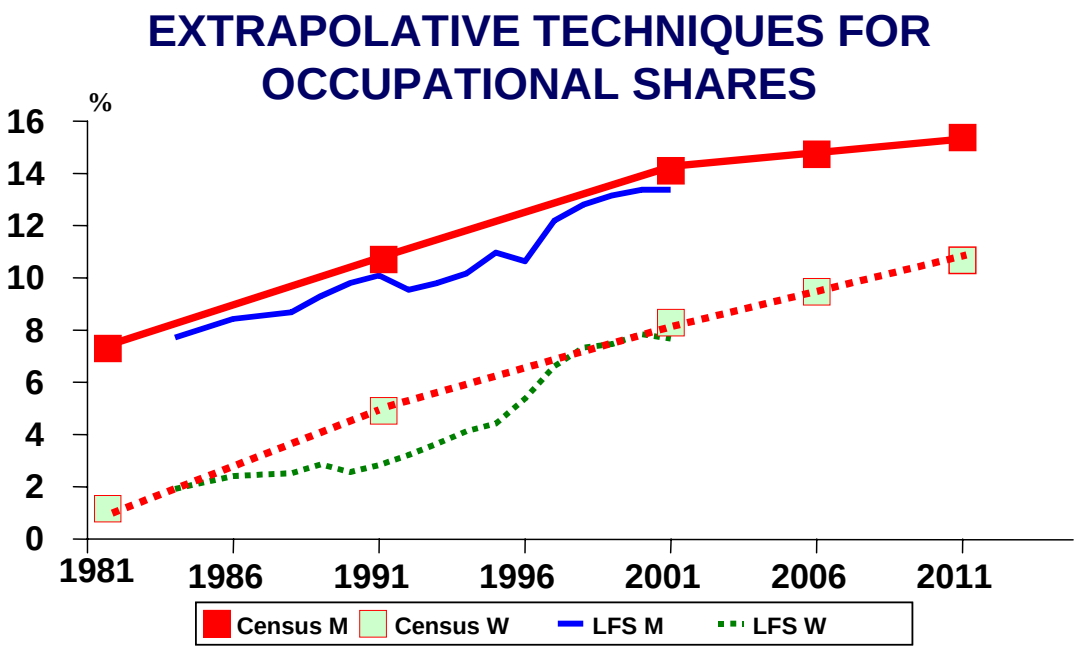


The quantitative, econometric models, are usually moderated by qualitative evidence. The sectoral analysis involves quite sophisticated econometric analysis including error-correction type methods based annual time series data. The occupational aspect of the analysis is generally more basic. Simple extrapolative methods are normally used where data are weak (i.e. often only 2 or 3 time series observations available, precluding anything more sophisticated). Further details of sources and methods can be found in the discussion of UK models in Annex B

Sub-models for employment structure by gender, status, occupations and qualification, therefore typically use methods as summarised in Figure 3.

This shows a typical procedure for projecting the occupational employment share within a sector. Data from the Census of Population (CoP) are plotted for the years available possible complemented by data from less reliable sources such as a Labour Force Survey (LFS). The latter may be used to moderate an extrapolated trend from the limited Census (CoP) historical observations as shown.

Figure 3: Methods used for projection of occupational structure



In recent years the boosting of the sample sizes of the LFS have enabled more sophisticated time series analysis more analogous to the treatment of other equations in macroeconomic model. Briscoe and Wilson (2003) provide an example of how the methodology can be extended and refined. However, the reliability of data means that this is still not feasible at the same level of sectoral detail as the main projection is conducted.

3.4 Replacement demands

A key limitation of early projections was their emphasis on employment levels and changes by occupation rather than replacement demands. Such projections tend to focus upon the *expansion (or contraction) demand* arising from growth or decline in occupational employment. This is only part of the demand that needs to be met if employers are to maintain their operations. In order to do this they need to replace those members of their staff who leave.

In principle, four components of replacement demands can be separately identified:

- Losses due to retirement from the workforce, which require positive replacement;[3]
- Losses due to mortality (including AIDS);
- Net occupational mobility, which, when outward, positively adds to replacement demand; if inward, it reduces such replacement demand;
- Geographical mobility, which, when outward, adds to replacement demand;

Total replacement demand is the sum of these four elements. When this total replacement demand is added to *expansion demand,* an estimate of expected **net requirements** for each occupation is obtained. This measure provides an indication of the number of newly qualified entrants likely to be required in each occupational group over a period of time.

The data used to estimate both the age structure of the workforce and the various flows are usually based upon very limited information, typically from Labour Force Surveys. The estimates of replacement demands should therefore, be regarded as indicative rather than precise. Detailed data on net migration are also usually not readily available, so this is often set equal to zero by assumption. Similarly, net occupational mobility measures based on turnover of those who change occupations within a 12-month period is often ignored.

3 These include losses at all ages, such as women leaving work during family formations, not just retirement for reasons of old age.

4. CONCLUSIONS: BENEFITS AND LIMITATIONS OF FORECASTING

A number of important conclusions can be drawn from this brief review.

The first is that forecasting is not a crystal ball. There is no technique that can predict precisely what shape the future labour market will take, what skills will be required and the scale of investment in different kinds of education and training that will be needed. Mechanistic manpower planning is not a practical possibility.

Labour market forecasting remains an art as much as a science, with a considerable element involved of judgement.

It should not therefore be seen as an end in itself, rather as part of an ongoing process of trying to articulate to key actors in the labour market what is going on, how this might affect them and what action they might need to take. In this respect, it can provide very valuable information for both policy makers and individual actors in the labour market.

It should not be a one-way path. It is very important that the views of these key actors find their way back to those undertaking the projections so that the projections can gradually be refined and improved in the light of outcomes. Such quantitative projections can therefore act as a focal point for debate, which can help to form a foundation and framework within which softer more qualitative information can be incorporated and exploited.

Quantitative projections are one important element in such a systematic approach to trying to anticipate future skill needs. In combination with other methods, such as employer surveys and more qualitative techniques, they can help to establish a virtuous circle between intervention and outcomes.

Regarding methods, a number of techniques have been adopted in various countries throughout the world. These tend to be shaped by the data available more than any other factor.

Wherever the data permit, detailed quantitative projections of occupational employment are produced on a regular basis, usually based around forecasts from a multi-sectoral macro economic model.

As well as projecting numbers employed in various occupations another key element in most forecasts is to assess the implications of replacement needs to fill the gaps left by those leaving the current work force because of retirement or other reasons.

Various other methods are also used to anticipate changing skill needs. These include regular employer surveys as well as more qualitative techniques. While these tend to be most prominently used in those countries where quantitative employment projections are not feasible, they also form an important part of the armoury of those countries that do undertake such projections. These methods and approaches should be seen as complementary rather than substitutes, enabling a richer and subtler picture of changing employment patterns to be produced.

REFERENCE

Briscoe, G, and R.A. Wilson, R. A. (2003). “Modelling UK Occupational Employment”, *International Journal of Manpower.* 24, 5, 568-589.

Separate annexes and reports connected to the present document

Main Report:

Wilson, R. A, I. Woolard and D. Lee (2004). *Developing a National Skills Forecasting Tool for South Africa.* IER/HSRC/Department of Labour.

Separate Annexes:

A: The Rationale for Conducting National Occupational Projections and how they are Typically Undertaken.

B: Labour Market Projections: A Review of International Best Practice

C: A Critical Review of Previous Work on Employment Projections in South Africa.

D: Data Sources for National Skills Forecasting in South Africa: Strengths and Weaknesses - A Critical Assessment of Data Availability.