
Skill: An Elusive and Ambiguous Concept in Labour Market Studies

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Abstract

*The concept of skill and its measurement has been central in contemporary discussions of labour market issues. Such issues as the rise in earnings inequality and changes to the skill composition of employment have served to highlight the limitations of definitions of skill and the problems that these pose for analysis of labour market changes. This paper argues that current measures of skill contain numerous limitations and ambiguities. Part of the reason is that the concept is complex and ill defined. This paper suggests that a more robust and detailed definition of skill is imperative. Furthermore, definitions and measures of skill used in the Occupational Information Network (O*NET) provide an advanced and more useful background for skill measurement and analysis than current measures. Such an approach would be beneficial to adopt in Australia, as it would provide a broader, more accurate and detailed understanding of the nature of occupations, issues related to skill and skill shortages, and labour market change.*

1. The Problem of Defining and Measuring Skill

1.1 Theoretical Frameworks

The definition and measurement of skill has come to assume central importance in discussions of labour market change. Despite the efforts that have gone into defining the concepts of skill in labour economics, an appropriate and robust definition or measure has proven elusive. It seems that skill is a more complex

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and abstract concept or idea than current approaches have been able to capture.

A close look at a number of dictionary definitions reveals the complexity of the concept. For example, the Macquarie Dictionary defines skill as 'the ability that comes from knowledge, practice, aptitude, etc., to do something well'. The basis of the definition appears to have embedded in it the idea of competence, proficiency – to basically do something well and effectively. The definition also contains a dimension of learning by doing or of incremental ability. In the social sciences, and in particular in the fields of industrial sociology and labour economics, most of the controversy and confusion in defining and measuring skill arises out of a number of theories of skill that hold different notions and 'are blind to their preconceptions regarding skill' (Attewell 1990, p. 422). Attewell, for example, traces and categorises these notions of skill and organises them into four schools of thought: positivist, ethnomethodological, Weberian and Marxist.

The positivist school sees skill as measurable, possessing an objective character which is independent of the observer. It then becomes relatively simple to create a common yardstick which assists the researcher in the relative comparison of skills and their measurement. Unfortunately, the creation of such a yardstick becomes a drawback in positivist thought. Definitions and measures are seen to be too reductive and narrow, and thus fail to capture the complexity of the attributes of skill. Sociologists and economists who follow a positivist approach have tended to treat skill as an attribute of jobs rather than persons and, in particular, are unable to deal adequately with the subjective dimensions that affect assumptions, definitions and measures of skill. The Occupational Information Network (O*NET) and its predecessor, the Dictionary of Occupational Titles (DOT), designed and applied by the US Department of Labor, are the best representative examples in this area. The DOT is based on the judgements of inspectors who observe workers at their jobs. While useful, this approach suffers from subjectivity because perceptions and interpretations of skill can vary quite significantly from inspector to inspector. At the same time, the positivist approach seeks quantitative skill measures that conform to rigorous methodological norms related to statistical reliability and validity (Attewell 1990, p. 423). This approach is often too rigid and abstracted to be able to deal with the many qualitative dimensions of skills. For these measures to be meaningful, they must represent and capture the diversity of skills that are embodied in different occupations, so that the attributes of each can be comparable and measurable. To measure and capture this diversity of qualitatively different skills, appropriate methodologies need to be developed to deal with the subjective dimensions that inevitably enter into definitions of skills. This complexity and ambiguity in defining and measuring skill is often found in positivist studies of skill.

In contrast to the positivist approach, the ethno-methodological school of thought defines skill in larger and more dynamic terms. At its centre is the view that all human activity, even the most mundane, is quite complex. The things that everyone does on a daily basis are amazing accomplishments requiring a complex coordination of perception, movement and decision, a myriad of choices and a multitude of skills. Adoption of the ethno-methodological perspective makes it easy for the researcher to become sceptical of the validity of current positivist approaches. Nevertheless, a drawback of this position is that the skills required to perform mundane tasks such as walking, sleeping, talking and so forth are extremely multifaceted and difficult to catalogue or enumerate, thus becoming undetectable, buried within layers of complexity which makes them difficult to pin down and apply in labour economic analysis. As a result, individuals become conscious of this myriad of knowledge and skills when their own capacities are interrupted. This creates difficulties and complexities for those who would measure skill in an objective, positivist manner.

The Weberian or social constructionist school tries to understand the conditions under which occupations are socially demarcated as skilled, and the processes by which some come to command higher standing than others. The most direct method of enhancing an occupation's power is to remove itself or its members from market competition. For example, barriers to entry into many occupations can be created by stipulating lengthy periods of training, by associations or by creating different forms of credentialism. Hence, by adopting this approach

the important question that emerges is whether the elevated status and claims to skill of some occupations are purely a matter of social construction and supply and demand or whether they rest on a real technical skills or task complexity (which are then exaggerated for purpose of occupational self-aggrandisement) (Attewell 1990, p. 437).

The Marxist school of thought brings in another dimension to skill. According to Attewell (1990), skills enter Marxist theory in three areas: in the labour theory of value, in debates concerning the 'labour aristocracy' and in the theory of alienation and technological change. The problem here, Attewell argues, is that many contemporary Marxists treat skill as a 'common sense' category which does not require explanation, while other neo-Marxists treatments of skill frequently shade into either positivist or social constructionist thought.

As stated at the outset, skill is a concept enveloped in complexity, ambiguity and fluidity. Given that, in most labour economics research, skill is required to be measured at an aggregate level, it becomes increasingly difficult to utilise

measurement approaches that are ambiguous. There is therefore, an urgent need for a more concrete, integrated approach that can be applied in economic analysis. The reason for adopting such an approach, in my view, is a logistical one.

1.2 Approaches to Measuring Skill in Labour Economics

At a time when the labour markets of most industrialised countries are experiencing rapid change, and increasing inequality of earnings has become a central issue of investigation, many economists have treated the concept of skill as a given, without carefully considering its meaning and the different approaches used to measure it. But as discussed above, it is important to pose the question: What is skill, especially in the current context? Similarly, we could ask: Do economists know enough about what skill is to be able to use it as an explanatory variable in empirical work or as an important feature of policy development? Do they know enough about the proxies of skill to know what they actually capture in econometric analysis? In labour economics, the concept of skill has been difficult to define and measure directly. Certainly the proxies for skill used in most econometric work leave much to be desired. Many studies proxy skill by educational attainment, but it is clear that the two notions are very different. People in some specialised occupations may be highly skilled but without high formal educational qualifications.

The aggregate occupational classifications of official statistics (managers, professionals, tradesmen, etc.) have only modest relevance to changing trends. Many studies in manufacturing use the ratio of non-production to production personnel as a measure of skill, but replacing skilled tradesmen with salesmen or account clerks may reduce rather than increase the overall level of skill in a firm. Other studies proxy skill by earnings but, while this has some real advantages, it does little to throw light on the role of skill changes in the changing pattern of earnings or on our understanding of the changing nature of skill.

For example, Colecchia and Papaconstantinou (1996) conclude that upskilling has occurred in most OECD countries, but nowhere do they provide an explicit definition or discussion of the concept of skill. Many such examples abound, where studies of skill-biased technological change (SBTC) or skill bias have been conducted without there being a considered explanation or discussion of what is meant by skill.

As an initial working definition, I take skills to be those generalisable attributes of individuals that confer advantage in the labour market. Thus they are a central form of human capital, and their existence needs to be

demonstrated both as characteristics of individuals and as having the central feature of capital, namely, the potential to provide a return. From this it follows that skills may change over time, as the nature of the economy and its requirements change, and are likely to be diverse, appearing in different forms in different sectors of the economy.

While needing further refinement, this definition does serve to highlight the fact that the nature of commercially relevant skills may be changing very rapidly. We are not yet well placed to understand those changes. Studies which, while often using sophisticated theoretical and econometric frameworks, rely on a few simple proxies for skill may well give very misleading results. Tables 1 and 2 detail the different approaches used in the international and Australian literature.

Table 1: Recent Studies of SBTC Change and Skill-bias Outside of Australia

Author	Year	Sector covered	Measure of skill
Krueger	1993	Open	Computer usage
Berman, Bound and Griliches	1994	Manufacturing	Production/non-production workers
OECD	1996	Manufacturing	Standard Classification of Occupations
Colecchia and Papaconstantino	1996	Manufacturing	Standard Classification of Occupations
Kremer and Machin	1996	Manufacturing	Production/non-production workers
DiNardo and Pischke	1997	Open	Calculators, pens, sitting down etc.
Autor, Katz and Krueger	1998	Whole economy	Educational attainment
Berman, Bound and Machin	1998	Manufacturing	Production/non-production workers
Gregory and Machin	1998	Whole economy	Classification of Standard Occupations
Haskel and Slaughter	1998	Manufacturing	Production/non-production workers
Kahn and Lim	1998	Manufacturing	Production/non-production workers
Machin and Van Reenan	1998	Whole economy	Production/non-production workers; educational attainment
Murphy, Riddell and Romer	1998	Whole economy	Educational attainment
Bruinshoofd and ter Weel	1998	Whole economy	Educational attainment and occupation classification
Howell and Wolff	1992	Whole economy	DOT
Gittleman and Howell	1995	Whole economy	DOT
Wolff	1996	Whole economy	DOT
Pryor and Schaffer	2000	Whole economy	NALS and education

Source: Author's investigation

Table 2: Measures of Skill Used in Recent Australian Studies

Author	Year	Sector covered	Measure of skill
Miller and Mulvey	1997	Open	Computer usage
Borland, Hirschberg and Lye	1997	Open	Computer usage
Borland	1996	Whole economy	Educational attainment
Maglen	1993	Whole economy	Educational attainment
Aungles, Dearde, Karmel and Ryan	1993	Whole economy	Standard Classification of Occupations
Cully	1999	Whole economy	Standard Classification of Occupations
Wooden	2000	Whole economy	Standard Classification of Occupations
Gregory	1995	Whole economy	Educational attainment
Pappas	1998	Whole economy	DOT
Dunlop and Sheehan	1998	Whole economy	Standard Classification of Occupations

To take an example, a common proxy for computer skills is computer usage. Krueger (1993) examined the impact of computers on the US wage structure. Computer usage at work was defined as programming, word processing, e-mail and computer aided design. A similar approach was adopted in two Australian studies conducted by Miller and Mulvey (1997) and Borland, Hirschberg and Lye (1997), which concluded that workers using computers in the workplace were able to obtain a wage premium similar to that found by Krueger.

DiNardo and Pischke (1997) and Haisken-DeNew and Schmidt (1999) dispute these findings, arguing that computer usage is not a true indicator of returns to computer skill. Borghans and ter Weel (2003) provide further evidence that computer usage is not an adequate proxy for computer skills. They argue that measures related to computer usage do not accurately provide information about how well and how effectively a worker uses a computer. For example, Borghans and ter Weel, drawing on the work of Bell (1996), DiNardo and Pischke (1997) and Hamilton (1997), who employ computer usage as an indirect measure of computer ability or skill, question whether the measures of computer usage are actual measures of computer skill or ability in general. Moreover, they argue that these measures, broadly, fail to capture how well or effectively a worker conducts different complex activities using a computer. In their own study they use information that is used as a proxy for skill, which is directly related to

the computer tasks that a worker is required to perform: 'information on the effectiveness of computer use from data analysed in this paper is directly related to computerised tasks a worker has to perform' (Borghans and ter Weel 2003, p. 6). They conclude that skill differences between workers do not necessarily explain why users of computers earn a premium. Returns to computer skills are only detected when workers use a computer in an advanced manner. Moreover, they argue that the tasks required to operate the computer are not of central importance in terms of gaining employment:

In most instances operating a computer is a routine job activity, which is not particularly the employer's motivation for hiring a worker and, as a result, the worker is not paid for the performance of these activities (p. 16).

Another approach found in the literature is the use of earnings as a proxy for skill, and to examine the changing structure of employment by earnings (Haskel and Slaughter 1998; Berman, Bound and Machin 1998). Haskel and Slaughter show that the sector bias of SBTC can help explain changing skill differentials. They found that these fell when SBTC was generally concentrated in unskilled labour-intensive sectors. A clear limitation of this approach is the extent to which changes in the earnings composition of employment actually reflect changes in the skill composition of employment and changes in the reward for skill or other factors.

For studies of the manufacturing industry, the split between non-production and production workers has been widely used as a proxy for skill (e.g. Machin and Van Reenan 1998; Kahn and Lim 1998). The authors classify employees as production and non-production workers in relative terms, the former being skilled workers and the latter unskilled or less skilled workers. This dichotomy has also been described as white-collar versus blue-collar and is found in research by Kremer and Maskin (1996) and Berman, Bound and Griliches (1994).

This production/non-production dichotomy is also used by Haskel and Slaughter (1998). They use sector-level data on capital stocks, output, computer use and employment and wages for both skilled and unskilled workers. Unfortunately, only manufacturing data were available and used in their study. This poses a major problem in that they draw conclusions about economy-wide effects based on the manufacturing sector, when changes in earnings that may have occurred in the services sector or other sectors of the economy are not necessarily able to be accounted for. Another criticism made of the production/non-production

proxy of skill is that the distinction is blurred and imprecise, suggesting a far too broad and arbitrary category. For example, occupations such as line-supervisor, product development and record keeping have been classified as production work, while jobs categorised as delivery, clerical, cafeteria and construction have been classified as non-production.

Most human capital is acquired through formal education at school and through formal and informal training programs conducted in workplaces. Education plays an important role in improving the labour market outcomes of men and women and in ethnic or racial groups (Borjas 2000, p. 228). In a number of studies of earnings inequality, it has been assumed that years of education are rewarded in the labour market by a wage premium. Murphy, Riddell and Romer (1998), for example, examine trends in relative wages in the US and Canada by using educational attainment measures as proxies for skill. This approach has also been widely used in Australian studies (Maglen 1993; Gregory 1995; Borland 1996). Borland (1996) studied the evolution of earnings of workers with different levels of education between 1968 and 1969 and between 1989 and 1990, finding a relative increase in the demand for more highly educated workers.

The above approaches have been the subject of criticism. Taking years of education and educational attainment as proxies has been criticised for their being only rough measures. This is mainly because secondary and post-secondary educational institutions differ in the level and content and, hence, the abilities they impart, while degrees can differ between universities in terms of the skill levels attained by their graduates. As a result, it can be said that years of education or educational attainment are far too broad, disparate and hence inadequate proxies for skill.

A similar approach can be found in a study by Dougherty (2000) who uses numeracy and literacy levels, obtained from a US data set known as the National Longitudinal Survey of Youth (NLSY), as a proxy for skill. Similarly, Pryor and Schaffer (2000) use both years of education and the National Adult Literacy Survey (NALS) data. A variation on this approach which is widely used in the literature combines both education and training measures (e.g. Bartel and Sicherman 1999; Autor, Katz and Krueger 1998). These proxies of skill used in combination tend to suffer from similar limitations to those found in educational attainment proxies for skill, which mirror years of education.

A more direct approach to identifying changes in skills is the use of the Dictionary of Occupational Titles (DOT). Drawing on a detailed skill profile of highly specific occupation categories, this provides an empirically-based analysis of the skills

and abilities required by occupations at the micro level, with 21 task and skill descriptors for almost 12,000 occupational titles. In principle, such information allows for a more detailed analysis of the changing demands of the workplace, compared to some of the earlier approaches. The use of the DOT approach in labour economics, pioneered by Howell and Wolff (1992), has given rise to a number of studies using their technique. For example, they use the DOT to analyse technological changes in the economy and changes in the demand for skills in US industries. Gittleman and Howell (1995), using the US Current Population Survey and the DOT, undertook an analysis of the changes in the structure and quality of occupations for the 1974-1990 period. Wolff (1996) used skill indices derived from the DOT to show that cognitive and interactive skills in the workplace grew in the US, while motor skills declined. A more recent study using the DOT conducted by Autor, Levy and Murnane (2000) investigated an occupation's requirements for routine and non-routine cognitive and manual skills.

Adapting the DOT to Australian labour market conditions and using a similar approach to Wolff (1996), Pappas (1998) found that inter-industry effects have been important in explaining changes in relative demands for cognitive, interactive and motor skills.

Another approach commonly used by economists, which is designed to provide a way of assessing skill, analyses occupational profiles in terms of the implicit skill content, and ranks occupations in broad categories. This approach has been used by the OECD (1996), as well as by Colecchia and Papaconstantinou (1996) and Dunlop and Sheehan (1998). In these studies, occupations were aggregated at different levels, making up a total of four 'skill' groups: white-collar high-skilled (WCHS), white-collar low-skilled (WCLS), blue-collar high-skilled (BCHS) and blue-collar low-skilled (BCLS) (OECD 1996, p. 82; Colecchia and Papaconstantinou 1996, p. 8; Dunlop and Sheehan 1998, p. 238). The shortcomings of this method are that it operates at quite a high level of aggregation, the skill structure is created on an a priori basis and the aggregated categories are framed in general terms.

In the Australian context, a number of studies have used the occupational data contained in the 1st and 2nd editions of the ASCO. In their analysis of occupational change, Aungles, Dearde, Karmel and Ryan (1993) devise an index using ASCO 1st edition data to show upskilling of the workforce between 1971 and 1986. Similarly, Cully (1999) and Wooden (2000) analyse upskilling of the labour force using ASCO 2nd edition to cluster occupations into five skill categories/levels as recommended by the Australian Bureau of Statistics.

Table 3: Australian and New Zealand Standard Classification of Occupations (ANZSCO), Major Occupational Groups and Skill Levels

Major groups	Predominant Skill level	Brief description
1. Managers	1, 2	Skill Level 1: Level of skill commensurate with a bachelor degree or higher qualification. At least five years experience may substitute for the formal qualification. In some instances relevant experience and/or on-the-job training may be required in addition to the formal qualification.
2. Professionals	1	Skill Level 2: Level of skill commensurate with one of the following: Register Diploma; or AQF Associate Degree, Advanced Diploma or Diploma. At least three years of relevant experience may substitute for the formal qualifications listed above. In some instances relevant experience and/or on-the-job training may be required in addition to the formal qualification.
3. Technicians and Trade Workers	2, 3	Skill Level 3: Level of skill commensurate with one of the following: NZ Register Level 4 qualification; AQF Certificate IV or AQF Certificate III including at least two years of on-the-job training. At least three years of relevant experience may substitute for the formal qualifications listed above. In some instances relevant experience and/or on-the-job training may be required in addition to the formal qualification.
4. Community and Personal Service Workers	2, 3, 4, 5	Skill Level 4: A level of skill commensurate with one of the following NZ Register Level 2 or 3 qualification or AQF Certificate II or III. At least one year relevant experience may substitute for the formal qualifications listed above. In some instances no formal qualifications or on-the-job training may be required.
5. Clerical and Administrative Workers	2, 3, 4, 5	Skill Level 5: A level of skill commensurate with one of the following: NZ Register Level 1 qualification; AQF Certificate I; or Compulsory secondary education. For some occupations a short period of on-the-job training may be required in addition to or instead of the formal qualification.
6. Sales Workers	2, 3, 4, 5	
7. Machinery Operators and Drivers	4	
8. Labourers	4, 5	

Source: ABS (2006, pp. 7-8, 21).

The 2nd edition was revised and replaced by the Australian and New Zealand Standard Classification of Occupations in August 2006. Like the 2nd edition, the new occupational classification (ANZSCO) is skill-based and aims to cover all the occupations in the Australian workforce. It considers the skill level of an occupation as measured in terms of three factors, namely, formal education and training, previous experience in a related occupation, and the quantity of on-the-job training required to be able to perform competently a particular set of tasks in a job (ABS 2006, p. 6). Thus ANZSCO's skill measure is highly reliant on three factors: education, training and years of experience. One clear limitation of this approach and previous approaches aimed at capturing the concept of skill in Australian occupations is that these measures are too broad to be able to be used in the study and analysis of the skill composition of Australian jobs.

In broad terms, these approaches are limited, especially when the skill composition of the workforce is changing rapidly and, indeed, when the very meaning of 'skill' may be undergoing change, for example, as a result of technological advances or market (de)regulation policies.

Thus present approaches may not generate clarity based on an agreed definition of the term 'skill' and what it encapsulates. The measures of skill in current studies may be capturing a particular dimension or a small cluster of dimensions of skill. A further feature of the current lack of clarity is reflected in the fact that economists are unsure whether skills are features of jobs or occupations or properties of individuals, being made up of various combinations of education, training, experience and competence (human capital). One example of the occupation based approach is found in the ANZSCO definition of skill level

as a function of the range and complexity of the set of tasks performed in a particular occupation. The greater the range and complexity of the set of tasks, the greater the skill level of the occupation (ABS 2006, p. 6).

The task of developing a clear and agreed definition of skill is also made more urgent as well as more complex by the changing nature of the modern economy, which makes it difficult to measure relevant skills uniformly over extended periods of time. Economists are unlikely to succeed in assessing and identifying occupational skills without developing an agreed and scientifically based definition of skill.

It is for these reasons that I have sought more robust and detailed definitions of skill. The development of the Occupational Information Network (O*NET)

allows for a more detailed data analysis.

2. The O*NET: A Suggested Approach to Defining and Measuring Skill in Labour Economics

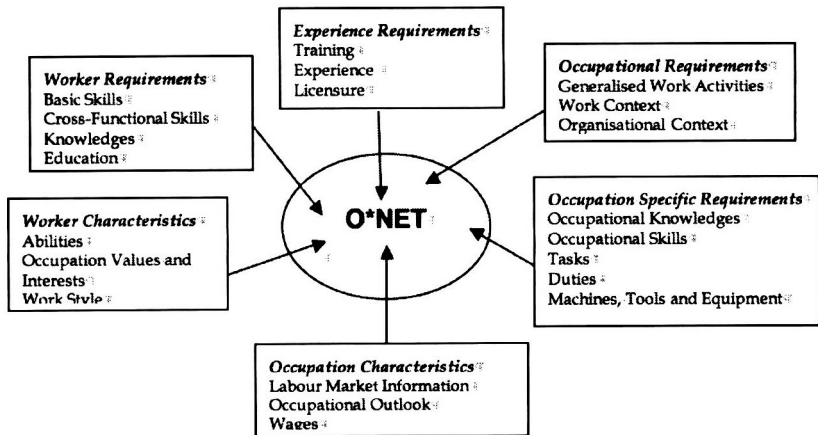
The O*NET is an extensive and comprehensive database that describes the attributes and characteristics of occupations and workers and can be applied in the study of labour market change. Developed by the Department of Labor in the US, its primary function was to replace the Dictionary of Occupational Titles (DOT) which was conceived in the 1930s.

The occupational information in the O*NET is organised in a relational database which identifies, defines and describes the comprehensive elements of job performance. A special feature of the O*NET is that it is closely linked to labour market data which are updated on a continual basis, containing cross-occupation descriptive information that includes the kind of work, conditions under which it is done and the requirements imposed on the people doing the work. Finally, the O*NET takes into account the variety of applications of the information that is collected. All the occupations in the database are related to a common framework that describes job requirements and worker attributes, as well as the content and context of work, using nearly 300 descriptors for 812 occupations. This is a very rich source of data that can be applied in labour market studies.

2.1 The O*NET Content Model

The Content Model is the conceptual foundation of the O*NET. It was developed by Mumford and Peterson (1995), using research on job and organisational analysis, and embodies a framework that reflects the character of occupations (using job-oriented descriptors) and people (using worker-oriented descriptors).

The Content Model classifies data into six domains that provide detailed information related to the attributes of occupations and to the characteristics required of people who actually do the job. It includes the specific domains and elements in the O*NET database that might be used to describe jobs. The domains are Worker Characteristics, Worker Requirements, Experience Requirements, Occupational Requirements, Occupation Characteristics and Occupation Specific Requirements. Figure 1 summarises each of these domains and their components. The organisation of the Content Model allows the user to concentrate on relevant information that details the attributes and characteristics of jobs and workers.

Figure 1: Six domains of the O*NET Content Model

Source: Mumford and Peterson (1999, p. 25, Figure 3.2).

2.1 Skills in the O*NET

An important contribution of the skill definition of the O*NET (Skill O*NET) is that it goes beyond the traditional means of capturing skills in terms of educational attainment, years of experience, occupational classification and the other proxy measures discussed earlier.

Mumford and Peterson define skill as a set of general procedures that underlie the effective acquisition and application of knowledge in different areas of endeavour (chap. 3, p. 4). The implication of this definition is threefold. Firstly, skills are innately linked to knowledge, learning, practice, education and experience. For example, a person cannot acquire or apply skills without learning, practising, being exposed to education or acquiring experience. Secondly, skills can be seen as general procedures that are necessary for the performance of multiple tasks. These tasks must form part of a given domain of skills such as social skills, basic skills or problem solving skills. Finally, skills are not constant attributes of individuals that remain unchanged over time. These attributes can be acquired (sometimes they can be lost) and developed as a result of new learning or experience.

Given the above, Mumford and Peterson (1995) argue that skills are not one-dimensional and require a variety of taxonomies.¹ They divide the taxonomy of skill into two broad categories. The first is basic skills, defined as the developed

capacities that facilitate the attainment of new knowledge. Basic skills are subdivided into two further categories: content and process skills. These are made up of six and four skill variables respectively, out of a total of 46 skills that comprise the complete O*NET taxonomy. Content skills can be broadly defined in terms of those capabilities that allow people to acquire information and convey it to others. They represent the structures required to work with and acquire other skills. This category includes skills such as reading, writing, listening, sound educational system.

Process skills, on the other hand, are those skills that facilitate the acquisition of content across domains. The ability to think critically is thus part and parcel of process skills. This skill is closely related to a second kind of general learning skill, referred to as active learning. Another process-oriented skill takes the form of learning strategy. This uses a variety of approaches when learning new things. Finally, monitoring represents an ongoing appraisal of the success of an individual's efforts because it assists them in assessing how well they are learning something or doing a particular task.

The second classification of skills is defined in the O*NET as the capacities that enable individuals to perform effectively in a variety of job settings. This definition is also known as cross-functional skills, and in the O*NET Content Model is based on the notion of socio-technical systems theory.

This definition of skill is indeed far richer than anything that is currently used for the purpose of analysing labour market change. It can be argued that the Mumford and Peterson (1995) definition of skill is the most complete and practicable currently available for labour market analysis, while the O*NET has the potential of providing a standardised approach to skill and human capital analysis that has not been available previously.

3. The O*NET and ANZSCO: A Brief Comparison

Although the current ANZSCO and previous ASCO versions have proven useful for labour market analysis, a number of shortcomings are quite evident. One limitation is found in the ANZSCO definition of skill, which is concerned about the range of tasks involved in a job, but does not in any way list, identify or assess the tasks that are required to perform it. The way that ANZSCO handles skill level is by using education, training and years of experience as an indicator, which in effect is another proxy for skill. As argued earlier, years of education as a proxy for skill is both too broad and inadequate.

A second limitation is that ANSZCO (and ASCO 1st and 2nd editions) updates are

quite infrequent and are conducted on a 10-year turnaround basis. For example, the 1st edition of ASCO was released in 1986, the 2nd in 1996, and the latest upgrade (ANSZCO) in 2006. Because of this slow upgrade process, information becomes dated very quickly, particularly at a time when the world of work is changing rapidly and continuously. To overcome this deficiency, the O*NET database is being updated regularly on a scheduled basis through the Data Collection Program (Occupational Information Network 2006).

Thirdly, the list of tasks included in ANZSCO and ASCO is descriptive and lacks any information or measures on the level or the intensity required to perform a given task as is the case in the O*NET. As a result, it is difficult to compare the importance of similar tasks performed in different jobs. The O*NET, as seen in the Content Model, provides specific information about occupational requirements (e.g. generalised work activities, work context and organisational context). ANZSCO has no such capability. Another weakness is that the information available is occupation-specific and provides little information about the setting or the environment in which the job is to be performed.

A fourth advantage of the O*NET over ANZSCO is that it is an extensive and comprehensive database that describes the attributes and characteristics of occupations and workers. Unlike ANZSCO, the O*NET provides detailed information and measures about the tasks involved in occupations. It identifies, defines and describes the comprehensive elements of occupations and contains hundreds of information items on worker attributes and job requirements, capturing what people do in their day-to-day activities and providing valuable information about the work environment.

A final limitation of ASCO and ANZSCO is that they, like the O*NET, neglect the human capital factor currently being developed as non-cognitive skills.² The way that tasks are described in ANZSCO and the O*NET does not recognise values and attitudes on the job and does not have a capability to measure or describe personal attributes such as perseverance and tenacity. A reason for this is the lack of any reliable measures for non-cognitive skills (Heckman and Rubinstein 2001, p. 145).

One limitation of using O*NET measures to analyse skill, and changes in skill, over an extended period of time is that the O*NET does not take account of skill changes within detailed occupations, but measures only changes in the skill composition of employment as a result of changes in the distribution of employment across occupations. While recognising this limitation, it is important to make two points. Firstly, the other measures commonly used (other than years of education)

have similar problems at a much more aggregate level. For example, when the one-digit (major group level) occupation scale is used in ANZSCO, there is no way of assessing whether the skill level of, say, 'managers' has changed over time. Nor is it possible to assess changes in skills over time within and between skill levels 1 to 5. This limitation must be kept in mind in interpreting the results. Secondly, on the other hand, one strength of the O*NET approach is that the measures enable a numerical ranking to be made of all occupations in terms of scores, thus facilitating various forms of analysis.

4. O*NET Applications in Labour Market Research

A number of studies have used the O*NET database to analyse labour market change, to identify occupational skill requirements and to provide forecasts of the demand for skills. One of the first was conducted by the Minnesota Department of Economic Security (MDES). Titled *Minnesota's Most Marketable Skills* (1999), this identified the occupational skill requirements considered to be most marketable. These were defined as those occupational requirements that are meant to be associated with high wages and/or employment growth. The report found that out of 57 occupational skill requirements that measure the knowledge, ability and skill dimensions of an occupation, 18 were extremely marketable. The findings of this study were used by the state of Minnesota both for labour market policy and to align the skill requirement of occupations to educational curricula. In 2002, the MDES forecast the demand for skills in the short term, using 46 skills, 52 abilities, 33 knowledge and 38 generalised work activity measures found in the O*NET database. The report summarised research into the feasibility and appropriate methodology for developing short-term, skill-based forecasts in order to direct public resources more effectively. The report concluded that the O*NET was an effective data system that could be applied for the analysis of forecasts of short-term demand for skills.

Esposito (2005) applied the O*NET database to study labour market change in Australia. Drawing on earlier work by Sheehan and Esposito (2001), he investigated labour market change using the O*NET. The study focused, first, on how skill should be measured in addressing the issue of skill-bias in the demand for labour; secondly, it showed that the Australian labour market had experienced a long-term process of skill-bias in the demand for labour; and, thirdly, having confirmed skill-bias, the study showed (using O*NET measures of skill and knowledge) that this increasing relative demand for higher skill labour is an important explanatory factor in the rise in earnings inequality in Australia.

More recently, Esposito and Meagher (2006) estimated the demand for skills using

46 skills, 33 knowledge and 42 generalised work activity O*NET measures. The results indicated that the O*NET measures are quite useful in providing a detailed picture of the future demand for employability skills. Another application of the O*NET measures was used in a study designed to identify occupations that are comparable in earnings to primary and post-primary teachers in the US. Using the generalised work activities, basic and cross-functional skills and educational level scales embodied in the O*NET, Milanowski (2003) performed a variety of cluster analysis methods, and was able to identify comparable work activity and skills for US occupations. Finally, Rotundo and Sackett (2004), using the O*NET database, conducted a job-level evaluation of whether specific skills or abilities were most strongly linked to wages or broad skill/ability factors accounted for a majority of wage variance. They found that a majority of the wage variance explainable by skills/abilities could be attributed to a general cognition factor.

5. Adopting the O*NET in Australia

The O*NET program has been the primary source of occupational data information in the US for nearly ten years and its application and modification to suit the Australian context would, in my view, be extremely useful in obtaining a broader and more accurate understanding of both labour market change and labour market policy development. The adoption of the O*NET in Australia is likely to provide much finer-detailed data on occupational categories. Clearly, the US and Australian labour markets have much in common, but there are also differences. These differences would necessitate the adaptation of the O*NET to an Australian labour market context. My argument is that the O*NET is a better tool than ANZSCO and its predecessor ASCO because of its capacity to provide better and more detailed analytical data that would allow closer monitoring of labour market change. Should this proposal be taken up, ANSZCO can readily be included and subsumed into an Australian O*NET (see for example Esposto (2005)).

6. Conclusion

The preceding discussion draws attention to the problematic nature of current definitions and measures of skill, particularly in the way that they are applied in labour market analysis. Current labour market analysis suffers from a lack of a standard definition and measures of skill, particularly in the context of a rapidly changing labour market. It is imperative that there be a standard, more robust and more sophisticated definition of skill, as well as measures which would more closely reflect the diverse and complex nature of skill. The rationale for this approach is that it has the potential to provide a more appropriate means for identifying and measuring skill changes within a dynamic and changing

labour market. This paper also argues that the O*NET represents an advance on current definitions and measures of skill, and provides a richer set of variables for understanding human capital and the changes occurring in the labour force over time. By implication, it is suggested that this approach (the O*NET) be adopted as a standard tool or instrument and possibly become a replacement for ANZSCO, for such reasons as its greater breadth of design and ability to describe occupations in more detail and its capacity for collecting up-to-date complex data. In addition, the O*NET approach of studying and analysing occupations, such as using industrial psychologists to study the nature of work, is a good way to gain further understanding of how occupations and workplaces are changing in Australia. This approach has applications that go well beyond labour market research, which include identifying what are the essential skills for the new economy and, potentially, finding alternative ways to foster these in education and training systems and in the workplace by having them reflected in policy development of lifelong learning.

Appendix I: Skills Taxonomy

Basic Skills

Content Skills: Background structures needed to work with and acquire more specific skills in a variety of different domains.

B01	B01IM00M	B01LV00M	Reading and comprehension
B02	B02IM00M	B02LV00M	Active listening
B03	B03IM00M	B03LV00M	Writing
B04	B04IM00M	B04LV00M	Speaking
B05	B05IM00M	B05LV00M	Mathematics
B06	B06IM00M	B06LV00M	Science

Process Skills: Procedures that contribute to the more rapid acquisition of knowledge and skills across a variety of domains.

B07	B07IM00M	B07LV00M	Critical thinking
B08	B08IM00M	B08LV00M	Active learning
B09	B09IM00M	B09LV00M	Learning strategies
B10	B10IM00M	B10LV00M	Monitoring

Cross-Functional Skills

Social Skills: Developed capacities used to work with people to achieve goals

C01	C01IM00M	C01LV00M	Social perceptiveness
C02	C02IM00M	C02LV00M	Coordination
C03	C03IM00M	C03LV00M	Persuasion
C04	C04IM00M	C04LV00M	Negotiation
C05	C05IM00M	C05LV00M	Instructing
C06	C06IM00M	C06LV00M	Service orientation

Complex Problem Solving Skills: Developed capacities used to solve novel, ill-defined problems in complex, real-world settings.

C07	C07IM00M	C07LV00M	Problem identification
C08	C08IM00M	C08LV00M	Information gathering
C09	C09IM00M	C09LV00M	Information organisation
C10	C10IM00M	C10LV00M	Synthesis/Reorganisation
C11	C11IM00M	C11LV00M	Idea generation
C12	C12IM00M	C12LV00M	Idea evaluation
C13	C13IM00M	C13LV00M	Implementation planning
C14	C14IM00M	C14LV00M	Solution appraisal

Technical Skills: Developed capacities used to design, set up, operate, and correct malfunctions involving application of machines or technological systems.

C15	C15IM00M	C15LV00M	Operations analysis
C16	C16IM00M	C16LV00M	Technology design
C17	C17IM00M	C17LV00M	Equipment selection
C18	C18IM00M	C18LV00M	Installation
C19	C19IM00M	C19LV00M	Programming
C20	C20IM00M	C20LV00M	Testing
C21	C21IM00M	C21LV00M	Operation monitoring

C22	C22IM00M	C22LV00M	Operation and control
C23	IM00M	C23LV00M	Product inspection
C24	IM00M	C24LV00M	Equipment maintenance
C25	C25IM00M	C25LV00M	Troubleshooting
C26	C26IM00M	C26LV00M	Repairing

Systems Skills: Developed capacities used to understand, monitor, and improve socio-technical systems.

C27	C27IM00M	C27LV00M	Visioning
C28	C28IM00M	C28LV00M	Systems perception
C29	C29IM00M	C29LV00M	Identifying downstream consequences
C30	C30IM00M	C30LV00M	Identification of key causes
C31	C31IM00M	C31LV00M	Judgement and decision making
C32	C32IM00M	C32LV00M	Systems evaluation

Resource Management Skills: Developed capacities used to allocate resources efficiently.

C33	C33IM00M	C33LV00M	Time management
C34	C34IM00M	C34LV00M	Management of financial resources
C35	C35IM00M	C35LV00M	Management of material resources
C36	C36IM00M	C36LV00M	Management of personnel resources

Explanatory Notes

1. 'I' in IMO0M refers to the skill importance indicator. For a particular skill descriptor this denotes how important this particular area of skill is to the performance of the job in question.
2. 'L' in LVO0M refers to the level indicator. For a skill descriptor this refers to the degree or quality of skill required to perform that specific job.

Source: Department of Labor (1998).

Endnotes

- ¹ The full skills taxonomy of the O*NET is detailed in Appendix I.
- ² For discussions and studies on non-cognitive skills, see for example Heckman and Rubinstein (2001) and Heckman, Stixrud and Urzua (2006).

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