ASCO

STATISTICAL CLASSIFICATION

PART 1

THE CONCEPTUAL BASIS OF ASCO

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Introduction

ASCO is a skill-based classification of occupations developed in Australia as a national standard for the production and analysis of labour force statistics, human resources management, education planning, the listing of job applicants and vacancies, the provision of occupational information and for vocational guidance.

The development of ASCO was a response to a strong user demand for a skill- based classification suitable for adoption as an Australian standard. This demand presented a significant challenge in so far as the term 'skill' is a concept capable of being interpreted in a wide variety of ways.

The starting point for developing the concept of skill in relation to an occupation was to examine the intended applications of the classification and then to develop a conceptual approach which would result in a structure suitable for these applications. This led to a dialogue with potential users of ASCO and to the publication of alternative structures, as the basis for further discussion. The discussions culminated in a second user requirements survey in 1983-84. The information from this survey played a significant role in the development of the final structure.

The concept of skill is represented in ASCO by two distinct criteria: skill level and skill specialisation. The skill level of an occupation is a function of the amount of formal education, on-the-job training and previous experience usually necessary before an individual can satisfactorily perform the set of tasks involved. The skill specialisation of an occupation is a function of the field of knowledge required, tools or equipment used, materials worked on and goods and services produced in relation to the tasks performed. Further discussion of these concepts will be found later in this introduction.

Both of these criteria are defined in terms of necessary requirements for the performance of a set of tasks for a given occupation.

ASCO has four distinct levels of aggregation: at the base level, there are 1079 distinct occupations covering all jobs in the Australian labour force; at the next level of aggregation there are 282 unit groups each containing a number of occupations; at the third level of aggregation there are 52 minor groups each containing a number of unit groups; and at the fourth level there are eight major groups.

At one stage in the development of ASCO it was planned to produce, as a final classification, two distinct structures. Both were to be based on a common set of building blocks at the Unit Group level (the level at which statistical collections such as the Population Census were coded). However, one would be designated as the 'skill structure' and the other the 'type of work' structure. This decision was made, partly because of initial doubts about the feasibility of developing a skill-based classification and partly because of concern that a significantly different occupation classification might not find ready acceptance from many users.

The definition of type of work originally adopted for the development of ASCO defined the concept as being concerned with what a person did in a job, how he or she did it and, in some cases, why it was being done. It was stated that type of work may involve the identification of materials worked on (if any), products or services produced, and machines, tools or work aids used.

The difficulties with this approach were ultimately traced to the absence of a suitable operational definition of type of work. Further research enabled a definition to be developed but it then became clear that to discuss type of work as a classification criterion distinct from any skill criterion was misconceived.(An account of this research was presented as a paper to the Sociology Section, Conference of the Australian and New Zealand Association for the Advancement of Science, Perth 1983. The paper was entitled 'The Classification of Occupations According to their Intrinsic Properties'.)

In ASCO, the concept of 'type of work performed' is now interpreted in terms of the set of tasks that workers in an occupation are required to perform. As explained above, these sets of tasks are in turn classified in terms of the variables skill level and skill specialisation. ASCO groups occupations into successively broader groups on the basis of their similarity in terms of these criteria. Moreover the two criteria are correlated and the application of either of these criteria at any given level of the classification usually constrains the range of variation in the other.

In summary, the structure developed for the first edition of ASCO is based on a conceptual model which is a significant departure from previous approaches to the classification of occupations. The model incorporates operationally feasible criteria which have been applied as consistently as possible throughout the classification. What follows is a detailed description of this conceptual model.

Definition of a Classification

A classification defines a particular relation of similarity between all members of a class of objects.

The principal purpose of classification is to simplify the real world and enhance the understanding of it. The desire for understanding is usually directed towards some particular purpose and this purpose guides the choice of what attributes of the objects to abstract and what to discard as irrelevant. The complexity of the real world is reduced by studying only a relatively small number of selected attributes of the objects concerned and grouping those objects into categories that are useful in furthering analysis and understanding.

To develop a classification it is necessary first to identify the objects to be classified; then to select those attributes of the objects which are relevant; to define the objects precisely in terms of those attributes; and to define a relation of similarity between the objects in terms of those attributes. This relation must then be used to group the objects into successively broader categories.

The purpose of ASCO is to identify a set of occupations covering all jobs in the Australian economy; to define those occupations in terms of a number of selected attributes; and to group those occupations on the basis of their similarity into successively broader categories for purposes of statistical description and analysis. The individual objects to be classified are jobs and to begin the construction of the conceptual model it is necessary to define the concept of job in terms of the attributes of interest. An occupation is then defined as a set of jobs which are identical in terms of those attributes. A relation of similarity between any pair of occupations is defined in terms of these attributes so as to enable them to be grouped into successively broader categories.

The Concept of Job

A job in any given establishment is a set of tasks designed to be performed by one individual.

Any particular job will typically involve a particular individual working for a particular employer at a particular location and undertaking a particular set of tasks in return for a wage or salary. Of course, some people may work for themselves but they are still regarded as having a job and belonging to the labour force. The description of the particular tasks will usually involve the identification of any tools or equipment used, materials worked on and goods or services produced.

The Concept of Occupation

An occupation is a set of jobs with identical sets of tasks.

Of course, every job is a little different. In practice, an occupation is a collection of

jobs sufficiently similar in their main tasks to be grouped together for classification purposes. The ASCO occupation definitions list the set of tasks which are common to all jobs in any given occupation. These tasks are referred to as the primary tasks of the particular occupation. The occupation definitions also list any more specific tasks which are attributes of the specialisation titles identified for that occupation.

The above definitions of the concepts of job and occupation are consistent with those adopted either implicitly or explicitly by other national and international occupation classifications e.g.

- International Standard Classification of Occupations (ISCO), published by the International Labour Office, Geneva
- Classification of Occupations and Directory of Occupational Titles (CODOT), published by the Department of Employment, United Kingdom
- Canadian Classification and Dictionary of Occupations (CCDO), published by Department of Employment and Immigration, Canada
- Dictionary of Occupation Titles (DOT), published by Department of Labor, United States of America.

The point of departure of ASCO from international practice begins with the interpretation of the concept of type of work in terms of the set of tasks involved and continues with the definition of the degree of similarity between two occupations on the basis of the degree of similarity between the sets of tasks involved.

The Concept of Similarity in Type of Work

The commonly accepted definitions of the terms 'job' and 'occupation' and the generally accepted procedure for moving from the concept of job to the concept of occupation provide the intuitive basis for a definition of the degree of similarity in type of work between any pair of occupations.

The degree of similarity in type of work between two occupations varies directly as the degree of similarity between the sets of tasks involved in each occupation.

In comparing two occupations with very similar sets of tasks the degree of similarity can be assessed simply by a direct comparison of the tasks involved. If the two occupations have few or no tasks in common there is then a need for some criteria for assessing the similarity of sets of tasks.

The following criteria have been adopted for assessing the similarity of disjoint sets of tasks:

- range and complexity
- field of knowledge required
- tools and equipment used
- materials worked on
- goods and services produced

These criteria have been combined into the two broader concepts of skill level and skill specialisation (defined below). Hence, by definition, the degree of similarity between two occupations is a function of the values of the skill level and skill specialisation variables associated with the sets of tasks involved in each occupation.

The Concept of Skill Level

The skill level of an occupation is a function of the range and complexity of the set of

tasks involved. The greater the range and complexity of the set of tasks the greater the skill level of the occupation.

An occupation that involves more complex tasks than another will have a greater skill level than the other. Further, an occupation which requires the performance of a wide range of tasks has a higher skill level than an occupation which requires the performance of a subset of those same tasks.

The above definition of skill level captures an intuitive understanding of the concept. However, it is difficult to use it to compare any pair of occupations in the labour force. A more operational definition is required.

In general, the greater the range and complexity of the set of tasks involved, the greater will be the amount of formal education, on-the-job training and experience required before an individual can perform that set of tasks satisfactorily. For example, the occupation of engineer typically requires an individual to undertake 12 years of primary and secondary education, and a 4 year degree or diploma combined with significant practical experience before he or she is able to perform the set of tasks involved satisfactorily. Similarly, the occupation of fitter and turner typically requires an individual to undertake 10 years of primary and secondary education and a 4 year apprenticeship before he or she is able to perform the tasks satisfactorily. On this basis, it could be concluded that the occupation of engineer has a higher skill level than that of fitter and turner.

Hence, the following operational measure of this important concept has been adopted:

The skill level of an occupation is a function of the amount of formal education, on-the-job training and previous experience usually necessary before an individual can perform the set of tasks involved satisfactorily.

A number of aspects of this definition require comment. Skill level is an attribute of occupations and not an attribute of particular individuals in the labour force. For example, to classify the occupation of motor mechanic to a major group in the ASCO structure it is necessary to examine the amount of formal education, on-the-job training and previous experience that an individual usually requires in order to perform the set of tasks involved satisfactorily. The relevant values of these variables are given in all ASCO occupation and group definitions.

In coding jobs to the ASCO structure, it is not relevant whether any particular individual working as a motor mechanic has this amount of training. It is not relevant whether any particular individual is an extremely competent, an average or an extremely poor motor mechanic. The individual's job would be classified to the occupation of motor mechanic and the job would be assigned an ASCO code based on the location of that occupation in the structure.

The three variables used in the measurement of skill level - formal education, on-the-job training and previous experience - require definition themselves. They are defined with specific reference to the Australian institutional structure.

Formal education consists of three types: primary, secondary and tertiary education. Primary and secondary education are measured in years of schooling. The number of years of secondary education is expressed as the total number of years of primary and secondary schooling e.g. in most Australian States, year 12 represents 6 years of primary education plus 6 years of secondary education. Tertiary education is divided into categories consistent with those recognized by the Australian Council of Awards in Advanced Education (ACAAE) and the Technical and Further Education Advisory Council (TAFEAC). When practical training is incorporated as a necessary component of formal education it is not separately identified.

On-the-job training is defined as training given to a worker after he or she has been employed in the job in question. It is usually not supervised by recognized educational institutions. It is measured in weeks, months or years as appropriate.

Previous experience for a given occupation is defined as the number of years of experience required in other occupations before an individual can satisfactorily perform the tasks of the occupation in question.

Obviously, the determination of the skill level of each occupation in the classification involves some subjective judgement. This is particularly so with respect to judgements about the amount of on-the-job training and previous experience necessary for an individual to perform the tasks satisfactorily. In practice, current labour market requirements for entry into a job in a given occupation were often used as an indicator.

The relevant data was sought from employer groups, trade unions, educational institutions and well informed individuals. There was some variation in the relevant data supplied from the various sources particularly across industries and across States. Often there are a number of possible routes of entry to any given occupation. Only the most common routes of entry are listed in the occupation and group definitions and only the most common formal route of entry is used for classification purposes. The data given in the occupation and group definitions represents the best judgement of the ASCO Project Team but should not be interpreted as authoritative.

The principal use of the skill level criterion in ASCO is for the purpose of defining the major groups. Table 1 lists the eight major groups in the classification and their appropriate values on each of the variables which collectively define skill level.

Table 1: The Skill Level of ASCO Major Groups

MAJOR GROUP	SECONDARY EDUCATION	TERTIARY EDUCATION	ON-THE-JOB TRAINING	RELEVANT EXPERIENCE
Managers and Administrators	12	degree/diploma	-----	7 years
Professionals	12	degree/diploma	-----	-------
Para-professionals	12	associate diploma	6 months	-------
Tradespersons	10	apprenticeship	------	-------
Clerks	11	-----	6 months	-------
Salespersons and Personal Service Workers	10	-----	3 months	-------
Plant and Machine Operators, and Drivers	--	-----	1 year	-------
Labourers and Related Workers	--	-----	3 months	-------

Individual occupations in each of these groups may vary significantly from the typical pattern. This occurs in those segments of the classification where the correlation between skill level and skill specialisation is less marked than elsewhere.

An example will illustrate the point. Managers of small establishments are classified in the major group Managers and Administrators but those occupations do not require a degree or diploma for satisfactory performance of the set of tasks involved. They were included in that major group on the basis of the skill specialisation criterion. Conversely, a few occupations classified in the major group Salespersons and Personal Service Workers typically require a degree or diploma for satisfactory performance. Again, these occupations were included in that major group on the basis of the skill specialisation criterion.

There are other instances of lack of skill level homogeneity at major group level. Some general explanations for these variations will be given in the section entitled

Application of the Criteria and more specific explanations are given in the relevant group definitions. However, most of these problems disappear at the minor group level as a result of the stronger correlation between the skill level criterion and the skill specialisation criterion at that level of disaggregation.

Although the principal application of the skill level criterion is at the major group level of the classification, it is used at the occupation level to distinguish trainee occupations (e.g. apprentices) from those occupations which require training as a prerequisite. Skill level is also used at the occupation level to distinguish supervisory occupations from the occupations supervised. As explained in the section entitled Design Constraints, these distinctions are made at occupation level for reasons of statistical feasibility.

The Concept of Skill Specialisation

The skill specialisation of an occupation is a function of the field of knowledge required, tools and equipment used, materials worked on, and goods and services produced in relation to the tasks performed.

These terms are defined below:

> Field of knowledge required: This variable indicates the subject matter which is essential to the tasks performed.
>
> Tools or equipment used: This variable indicates the plant, machinery or hand tools used in the performance of the tasks.
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> The term plant is used to describe mobile or stationary equipment which is large in size, performs several related functions, and is usually controlled by an internally located operator. The term machinery is used to describe stationary equipment which is not as large as plant, performs one processing function and is usually controlled by an externally located operator. The term hand tools is used to describe equipment which is small enough to be moved and operated by one person.
>
> Materials worked on: This variable indicates the materials which are extracted, processed, refined or fabricated as an essential part of the tasks performed.
>
> Goods or services produced: This variable indicates the goods or services produced as a result of the performance of the tasks.

The skill specialisations identified within each of a set of broad skill levels have been determined by an examination of the primary tasks of all occupations within each skill level. This procedure has led to the empirical determination of unique clusters of primary tasks and the resultant grouping of the relevant occupations into appropriate cells. This approach was assisted by the existence of widely recognised categories of occupations such as machine operators, plant operators, trades assistants, natural scientists, teachers, sales representatives, technicians, etc.

The procedure has been supplemented by an examination of the frequency distribution of occupation responses obtained in censuses and surveys. A keyword search of these responses yielded large clusters of occupation titles such as plant operator, machine operator, factory hand, labourer, trades assistant, salesman, clerk, manager, etc. The lists of tasks given as the main tasks of these occupations were analysed in conjunction with the relevant titles. It was then found that the most frequently occurring clusters of tasks corresponded well with the clusters of primary tasks obtained as a result of the content analysis of the ASCO occupation descriptions.

Hence the specific variables used to measure skill specialisation are similar to those traditionally used in the development of occupation classifications. The approach used in ASCO is essentially to extract the skill level dimension first and then to classify occupations within skill levels on the basis of skill specialisation interpreted in an

appropriate manner for each particular skill level. An examination of the ASCO structure will reveal the obvious correlation between skill level and the particular interpretation of skill specialisation.

For example, occupations in Major Group 2, Professionals, are classified into minor groups on the basis of field of knowledge required for the performance of the tasks: Natural Scientists, Building Professionals and Engineers, Health Diagnosis and Treatment Practitioners, etc. Occupations in Minor Group 21, Natural Scientists, are classified into unit groups on the basis of more specific categories of field of knowledge: Chemists, Geologists and Geophysicists, Physicists, Life Scientists, Medical Testing Professionals, and Other Natural Scientists.

On the other hand, occupations in Major Group 7, Plant and Machine Operators and Drivers, are classified into minor groups on the basis of the tools or equipment used or operated in the performance of the tasks: Road and Rail Transport Drivers, Mobile Plant Operators (except Transport), Stationary Plant Operators, and Machine Operators. Occupations in Minor Group 71, Road and Rail Transport Drivers, are classified into unit groups on the basis of more specific categories of tools or equipment used or operated: Bus and Tram Drivers, Automobile Drivers, Truck Drivers, and Locomotive Drivers.

The Application of the Criteria

Although the selection and operational definition of the classification criteria provides the basis for the construction of the classification there is considerable scope for debate on the relative emphasis to be given to skill level and skill specialisation at each level of the classification.

To solve this problem, two quantitative measures were developed that can be used to assess the degree to which a particular structure achieves the basic objective.

The two measures are defined as properties of the cells of the classification so that they can be applied at unit, minor and major group levels. They are defined as follows:

> A task is primary to a cell if it is listed in the cell description.
>
> Cell homogeneity is the ratio of the number of occupations in a given cell whose primary tasks are primary to the cell to the total number of occupations in the cell.
>
> Cell coverage is the ratio of the number of occupations in a given cell whose primary tasks are primary to the cell to the total number of occupations having the same primary tasks.

The following example will illustrate the simplicity of the above concepts. Suppose there exist a number of occupations whose primary tasks involve selling and suppose there exists a major group entitled Salespersons. To maximise cell homogeneity would require that the majority of occupations classified to the major group Salespersons would list selling as their primary task. Similarly, to maximise cell coverage, would require that the majority of occupations whose primary tasks are selling should be classified in the Sales major group.

The quantitative evaluation of the classification in terms of these concepts has had to await the development of the occupation and group definitions to a sufficient standard of completeness and consistency. To date, this form of evaluation has only been undertaken in an intuitive way but it will provide a framework for future review and possible revision.

The major groups of the classification are distinguished principally on the basis of the skill level criterion. However, at this very broad level of aggregation, it is difficult to design groups which are as homogeneous as some users might wish. The minor groups are distinguished from each other principally on the basis of a broad band of values of the skill specialisation criterion; the unit groups and occupations are

distinguished principally on the basis of a progressively narrower range of values of the same criterion.

Design Constraints

ASCO was developed for the specific practical applications outlined in the opening paragraph. Although the structure is based on the conceptual model described above, it was constrained by practical considerations such as the framework of Australian economic and social institutions, the relative significance of particular occupations in the Australian labour force, data collection possibilities in statistical censuses and surveys, and user demand for statistics on particular categories of occupations. It was also constrained by the need for the structure to have sufficient intuitive appeal to provide the basis for its acceptance as a national standard classification.

The structure of some major groups in the classification has been constrained by the Australian institutional framework. The most notable example is Major Group 4, Tradespersons. ASCO has closely followed an existing and widely accepted classification of tradespersons used by all State Apprenticeship Committees. While it may have been possible to develop a conceptually superior classification of occupations in this major group, it was decided that the advantages of incorporating an existing standard were more important. Further, during the design of the structure, specific reference was made to the existence of trades courses in the majority of the States before it was decided to classify occupations to this major group rather than another. There are some exceptions to this rule where occupations have been classified as trades although no trades courses yet exist, e.g. sheep shearers.

Another factor which influenced the final structure of the classification was the design objective of producing a structure which is statistically balanced. For example, since there are eight major groups in the classification, the average size of a major group is 12.5% of the labour force. A group which is smaller than 5% of the labour force is not by definition a 'major' group. In practice, the approximate size of the major groups ranges from 5.5% to 18%. A similar design constraint was imposed at all levels of the classification.

Hence, the occupations defined in the classification have been identified on the basis of their significance in the Australian labour force. A somewhat arbitrary limit of 300 was set as the minimum number of jobs in a group before it was given the status of a principal occupation in ASCO. Groups of jobs smaller than this are given the status of specialisations of the principal occupations.

The nicety of the classification has also been compromised by limitations imposed by data collection possibilities in statistical censuses and surveys. An extensive program of operational testing was conducted by the ABS to ensure the statistical feasibility of categories defined at all levels of the structure. When prototype structures for the classification were first developed, they were extensively tested on data obtained in regular ABS collections such as the Labour Force Survey and the Employer Survey. They were also tested in the extensive development program for the 1986 Census of Population and Housing.

At the same time, a very significant research program was conducted to improve the quality of data obtained in all major ABS collections. Significant improvements in data quality were achieved in all these collections and this reduced the need to compromise the structure of the classification. However, when particular segments of the structure still posed problems in a number of different collections there was no choice but to modify the classification. In general, distinctions between categories which proved difficult to draw on the basis of available data were relegated to the lower levels of the classification.

A number of examples will illustrate the significant effect which this has had on the structure of ASCO. Operational testing revealed that it was not possible to distinguish reliably between apprentices and tradespersons without asking a number of additional questions just on this issue. Similarly, it was found that it was not possible to distinguish between supervisors and the workers they supervise without asking a number of additional questions on the specific issue of supervision.

In order to minimize the imposition on respondents, the ABS limits the number of questions which can be devoted to any one topic in any given collection. Since the classification was designed so that the unit group level would be the principal statistical collection level, both of these distinctions are now made only at the occupation level of the structure.

Another constraint on the nicety of the classification has been imposed by the requirements of significant users for a particular set of occupations to be grouped together (or otherwise) for statistical purposes. For example, there was a strong user demand for all tertiary teachers to be classified together as teachers rather than as economists, political scientists, engineers, carpenters, welders, plumbers etc. This demand was reinforced by the results of feasibility testing which revealed that, when tertiary teachers were asked about their occupation, most of them did not state their field of specialisation. In short, the only feasible solution was to classify them simply as tertiary teachers.

Lastly, the structure has been constrained by the design objective of producing major and minor groups which have some intuitive appeal and some minimum level of comparability with other major national and international occupation classifications. A number of prototype structures were developed on the basis of a more strict application of the ASCO criteria but these were not intuitively appealing. They were discarded as unlikely to provide the basis for a widely accepted national standard classification.

Thus, although the structure is based on the conceptual model outlined in this section, the reader will note some instances where the classification criteria have been applied with less precision. Most of these instances can be explained by the operation of some of the constraints mentioned above.