ABILITY ASSESSMENT AND JOB STRUCTURE MEASURES IN OCCUPATIONAL MOBILITY

JOHN ANTHONY SPARROW

Ph.D

THE UNIVERSITY OF ASTON IN BIRMINGHAM

AUGUST 1984

THE UNIVERSITY OF ASTON IN BIRMINGHAM

ABILITY ASSESSMENT AND JOB STRUCTURE MEASURES IN OCCUPATIONAL MOBILITY

JOHN ANTHONY SPARROW Ph.D AUGUST 1984

SUMMARY

Recent and potential changes in technology have resulted in the anticipation of increases in the frequency of job changes. This has led manpower policy makers to investigate the feasibility of incorporating the employment skills of job groups in the general prediction of future job learning and performance with a view to the establishment of "job families" within which transfer might be considered reciprocally high.

A structured job analysis instrument (the Position Analysis Questionnaire) is evaluated in terms of two distinct sets of scores; job dimensions and synthetically established attribute/trait profiles.

Studies demonstrate that estimates of a job's structure/dimensions and requisite human attributes can be reliably established. Three alternative techniques of statistically assembling profiles of the requisite human attributes for jobs are found to have differential levels of reliability and differential degrees of validity in their estimation of the "actual" ability requirements of jobs.

The utility of these two sets of job descriptors to serve as representations of the cognitive structure similarity of job groups is investigated in a study which simulates a job transfer situation. The central role of the index of similarity used to assess the relationship between "target" and "present" job is demonstrated. The relative extents to which job structure similarity and job attribute similarity are associated with positive transfer are investigated.

The studies demonstrate that the dimensions of jobs, and more fruitfully their requisite human attributes can serve as bases to predict job transfer learning and performance. The nature of the index of similarity used to optimally formulate predictions of transfer is such that networks of jobs might be establishable to which current job incumbents could be expected to transfer positively. The derivation of "job families" with anticipated reciprocal transfer consequences is considered to be less appropriate.

Key Words :- Transfer
Ability
Skill

ACKNOWLEDGEMENTS

Grateful thanks are expressed to Dr. P. Spurgeon and Dr. J. Patrick for providing the opportunity for my doing the research and their consistent support in its evolution.

Thanks are also due to all of the working people who gave their time and co-operation in the collection of job description data, and to the associated personnel and training officers for their scheduling and internal administration of job analyses.

Finally, thanks to Mrs. Beryl Herbert for typing the thesis with such care and consideration.

LIST OF CONTENTS

Page

LIST OF TABLES

LIST OF FIGURES

SECTION 1

INTRODUCTION

1.1 BACKGROUND TO THE PRESENT RESEARCH

A defining feature of applied psychology is that the problems to be tackled come directly from real-life situations. As Warr (1973) has noted, "the applied nature of an investigation derives from the fact that its proximal origin is in a sense external to the discipline (in this case, psychology)." Occupational psychology as an applied discipline, attempts to study and contribute to problems facing society, organisations and individuals in the realm of work. One does not have to look far to identify issues and decisions associated with work which can benefit from research from an occupational psychology perspective. The design of jobs, individual choices of work, selection and training for task performance are all decisions which have involved the attention of occupational psychology.

The concept of "change" is often the catalyst in applied research. When technical innovations, alterations in personal circumstances, or changes in the demands of jobs occur, for example, the need for research effort increases. When the concept of change is associated with words such as "revolution", in the terms industrial revolution or micro-electronics revolution, then changes are implied which are so profound that they significantly disturb the whole socio-industrial order. Technological changes are made upon business and production systems. Man has to react to and cope with the changes in these systems. Business and production systems have undergone changes in the past which have led to changes in job demands. The implications of mass production technology and more recently, process-control technology, have been the focus of occupational psychologists' attention with regard to job satisfaction and ergonomics for example. These technological advances were, however, of a more evolutionary nature and affected only particular production systems. The recent technological innovations have such widespread applications as to affect the allocation of function within virtually all business and production systems. The world-wide consequences of the changes in technology, associated with the microelectronics revolution, include three major changes in actual employment patterns which have clear research implications for occupational psychology.

Firstly, there is a high degree of unpredictability in the employment world. Many jobs face obsolescence when automation is increased, but it is difficult to predict accurately when which jobs will be affected. Automation, however, does not simply mean the total elimination of some jobs. The vast majority of jobs will be affected in some way, but it can be difficult to predict accurately when and the ways in which the content of particular jobs will be affected.

Secondly, there will be an increase in the frequency of job changes. Job changes can be of three main types. The traditional form of job change is where a person moves from one example of a job to another example of the same job. The economics associated with rapid technological change are likely to lead to an increase in the liquidation of organisations and hence an increase in this type of job change. In the past, changes in jobs where a person moved from one job to another very different job with a different job title and function were quite limited. The structural changes associated with automation are likely to lead to an increase in this form of job change. Where technological changes affect a particular job's content then this is another form of job change. The incumbent of the job will have to be re-trained to deal with the new requirements of the job. This type of job change will become more commonplace.

The third and final major change in employment patterns concerns the training consequences of technological change. In the past, the majority of people could leave school, be trained by an employer for as little as a week, and then learn on-the-job skills required by a particular job. Very limited change in job content would occur in their working lifetime and relatively few people changed jobs in the sense of entering a different type of work. To a large extent therefore, society could rely upon the unco-ordinated efforts of employers to train people (primarily young people) in the skills each particular job required. The anticipated changes in employment patterns discussed above could radically alter this picture (Trist, 1972). The demands of jobs may become more complex. Less emphasis will be placed upon training simple repetitive psycho-motor skills (Stonier, 1983). Jobs will require longer periods of training and there will be more re-training of adults (Bell, 1974). In essence, employers will not need employees with only a basic education who can be briefly trained, but will seek employees with the knowledge of related systems, appropriate occupational skills and the ability to learn throughout their careers. Therefore, people will have to have certain minimum competencies, occupational skills and the learning skills required to cope with frequent job changes. Overall it will be less appropriate for employers to train solely young people and further to only train specific skills. Rather, a more co-ordinated training strategy in industry is required which can take advantage of adults' existing work skills and train both young and adult workers in comprehensive terms.

The changes in employment patterns will in essence, therefore, require people to continuously apply their education and skills to frequent changes in the physical and mental requirements of jobs, ie. to be re-trained. An appreciation of these issues has led manpower policy-makers to focus attention upon the determinants of job learning and performance.

The Training Services Agency (now subsumed generally within the Manpower Services Commission) noted that "existing methods of selection are frequently based on far too narrow a view of individual experience and potential" and that there was a need to "identify and understand better the underlying skills needed to perform jobs so that they can be grouped to throw light on manpower mobility and training problems" (Dunn, 1977). Similarly, Freshwater & Townsend (1977) noted that "a better understanding of both the underlying skills needed for jobs and also the job "families" which are formed when skill similarity is considered, will facilitate the manpower transfer and retraining processes".

The fundamental observation in employment research that all individuals do not learn all new job skills equally easily, together with the pressing nature of job changes led the policy makers towards two broad postulations:-

A. Perhaps workers in need of re-training (whilst not necessarily being able to learn all new jobs) could more readily learn a job "similar" to the one they have been doing.

B. If this were true, then perhaps there are "families" of jobs within which people can readily move and learn the specific demands of constituent jobs.

The "real-life" problem put to occupational psychology is, in simple terms therefore, "Are these postulations true?" More specifically, the objective is to examine the psychological issues which are raised by the postulations and through research and study provide a contribution to the knowledge concerning their tenability.

1.2 THE DETERMINANTS OF JOB LEARNING/PERFORMANCE

A major objective in occupational psychology is to understand the relationships between experience and performance contexts such that prior experiences can be utilised to make predictions concerning future performance. Traditionally, occupational psychologists have attempted to define/identify representations of consistencies in behaviour (and by implication, cognitive structure) which are predictive of performance contexts in general. In particular, attention has been focussed upon the measurement of abilities/traits and achievement/attainment. Anastasi (1976) in reviewing the functions and origins of psychological testing, notes that the difference between these two types of tests is chiefly one of degree of specificity of content and the extent to which a test presupposes a designated course of prior instruction. In other words the concept of abilities/traits is a representation of relatively homogeneous and clearly defined segments of potential to learn, whilst achievements are measures of the attainment of broad educational goals. For the last 60 years psychologists have empirically established relationships between such measures and learning/performance in particular job contexts. Two inter-related theoretical and applied problems have been highlighted by these studies:

A. The measures by design do not incorporate attainments in the sense of prior work experience.

B. The approach utilises an empirical paradigm which results in context specificity.

The inter-relationship between the problems lies in the failure of the research to yield a science of human behaviour which can systematically relate what Dunnette (1976) refers to as the "world of work" and the "world of human attributes", and what Singleton (1974) refers to as the "systems-oriented concept of a task" and the "person-oriented concept of a job". The establishment of person-task relationships in terms which do not include a representation of prior work experiences ignores the concept of skill as a factor in human performance. The establishment of person-task relationships in a statistical summary of the association between molar job performance levels and psychometric measures only provides information which is specific to the context of application. Why and how such associations operate is not revealed with such an approach. As such the prediction of how particular groups of individuals would fare in a series of new jobs would require the empirical identification of associations within each separate context. Job changes of any form would similarly require the re-identification of associations. For occupational psychology to make a contribution to the knowledge concerning the tenability of the postulation of improved learning/performance between "similar" jobs (and thence within families of "similar" jobs) therefore requires two features:

1. An understanding of the psychological factors which determine the circumstances in which prior experience (of all forms) affects future learning/performance.

2. The reliable and valid assessment of these factors in terms which can be systematically related to employment contexts in the absence of specific empirical examination.

It is clearly appropriate to detail the psychological literature which relates to these two features. The concept which is fundamental to this review is that of the "transfer of training".

1.2.1 THE TRANSFER OF TRAINING

The Glossary of Training Terms distributed by the Department of Employment (HMSO, 1971) lists the following definition of the transfer of training:

> "Occurs whenever the existence of a previously established habit or skill has an influence upon the acquisition, performance or relearning of another habit or skill. "Positive transfer" occurs when the existence of the previous habit or skill facilitates learning the new one; "negative transfer" refers to the interference by a previously learned habit or skill on new learning."
>
> Glossary of Training Terms (HMSO, 1971, p.32).

The existence of such a term as transfer of training reflects the fact that learning is a cumulative process. The more knowledge and skills an individual acquires the more likely it becomes that his new learning will be shaped by his past experiences and activities. The circumstances and process of this shaping have been studied by psychologists for the last 100 years. The findings of this research have been both driven by and incorporated in several basic models of psychological transfer.

1.2.1.1 Theories of Transfer

Current models of transfer have evolved from three broad "theories" of the transfer process which have been held over the last 100 years. These approaches may be referred to as the theory of formal discipline, the theory of identical elements and cognitive theories.

The doctrine of formal discipline was prevalent in the 19th century, and maintained that particular branches of study gave a mental discipline of training which was quite general in that it affected ability in other subjects. The doctrine however rested merely upon anecdotal evidence and was in general restricted to a posteriori 'explanations' of transfer effects. The doctrine was brought under experimental control as interest centred on the question of whether there was transfer of training between tasks that apparently engaged the same mental function. Postman (1971) reviews several of the early classical experiments with their accompanying evolution and refinement of experimental design.

The empirical work of Volkmann (1888), James (1890), Ebert and Meumann (1905) and Winch (1908, 1910) for example, reflected and prepared the ground for the postulation of the first empirical theory of transfer. Thorndike & Woodworth (1901) suggested that transfer from one task to another would only occur when both tasks shared identical elements. Elements were defined as features of the number of shared elements the greater the amount of transfer from one task to the other. McGeoch and his associates (McGeoch & McDonald, 1931; Johnson, 1933; McGeoch & McGeoch, 1937) showed, however, that where tasks shared a high number of stimulus features, interference could occur among the task performances, ie. negative transfer. In other words, the greater the similarity the greater the interference. It was known however that where stimulus situations are maximally similar, the greatest facilitation is obtained, ie. ordinary learning.

Robinson (1927) attempted to resolve this paradox by hypothesising that facilitation is greatest when successively practiced materials are identical; facilitation is least (and hence interference maximal) with some moderate degree of similarity; and facilitation increases again as one moves toward neutrality but never attains the original level. Several experiments (eg. Cheng, 1929; Harden, 1929; Dreiss, 1933; Kennelly, 1941) found evidence of validity for this hypothesis but could not clarify the dual function of facilitation in relation to similarity by specifying at what degree of similarity the shift occurs.

Osgood's(1949) rapprochement of empirical findings broadened the concept of identical elements from shared stimulus features, to include features of the response environment. This stimulus/response transfer and retroaction surface went beyond existing empirical evidence and made several hypotheses of transfer effects which had not been studied. Holding (1976) summarises the empirical evidence pertaining to Osgood'stransfer surface and other supplements (eg. Houston, 1964; Dallett, 1965; Martin, 1965). He notes that all of the major attempts to confirm its accuracy have wholly or partially failed. Whilst acknowledging the limitations of a three dimensional surface, Holding presents a surface which is consistent with the general principles of transfer. The surface is summarised as follows:-

> "The combination of same stimuli with same responses yields maximum positive transfer, with decreasing stimulus similarity giving somewhat less positive transfer; different stimuli with different responses yield zero transfer; different stimuli for the same response give large positive transfer; and identical stimuli with different but similar responses produce negative transfer."
>
> Holding (1976, p.8)

The concept of identical elements as it has evolved has incorporated the behaviourist approach to human learning and carries the assumption that the human mind encodes task performances primarily in terms of their stimulus and response characteristics. Little explicit reference is made to the structure of human memory in the theory of identical elements, but recent work in cognitive psychology has shed light upon the structure and strategies of human learning and memory, and constitutes the basis for a more embrasive theory of transfer.

There is nothing radically new about recent cognitive explanations of learning and behaviour, even within experimental psychology. Tolman (1932, 1959)cited experiments designed to demonstrate that the result of learning is not so much a fixed, new behaviour pattern as a 'model' of some part of the environment, available when the need arises. Bartlett (1932) drew attention to the active nature of the encoding process and the reconstructive element in recall but did not provide a testable model of the process of memorising. More recently, attempts have been made to describe specific models which might produce testable predictions. There are several specific theories of knowledge structures (eg. Anderson & Bower, 1973; Bransford & McCarrell, 1974; Collins & Loftus, 1975; Anderson, 1976; Mackay, 1982) but each shares some common basic assumptions.

The models are based on the assumption that human memory is a highly structured storage system in which information is both encoded and retrieved in a systematic manner. Further they maintain that the 'richness' (Royer, 1979) of knowledge structure is not uniformly constant. Richness is here referring to the number of interconnections between the units (nodes, propositions) in the structure. Thussome parts of knowledge structure can be richly elaborated with a very large number of interconnections between the units and some can be relatively impoverished with few interconnections between the units. One possibility is that concepts are connected hierarchically in a way which corresponds to their level of inclusiveness, so that the properties of concepts are stored at the most general level to which they apply.

From these models of knowledge structure, the process of recall entails a search of the network of particular nodes, and activation spreads from those nodes to connecting nodes until the search process is discontinued. From the perspective of these models, transfer does not revolve around shared features in the stimulus or response environment but is determined by the probability of retrieving the relevant prior learning during the search process. This probability will depend only in part upon shared stimulus and response features in the original and transfer situations.

A series of refinements to the cognitive models outlined above have been invoked by schema theories of transfer. Schemata serve as structures for representing information and as sources of hypotheses about what kinds of information to expect. Schemata may be conceptualised as hierarchical in nature with more specific schemata embedded in a general schema. They may be abstract structures consisting of generic entries for frequently experienced events or concepts, or procedural strategies which activate subschemata concerned with particular strategies.

The essence of the refinements afforded by schema theories to broader cognitive conceptualisations, is that new information is encoded in terms of existing schemata. If incoming information matches a schema expectation, learning proceeds smoothly and easily. If information does not relate to a particular schema then learning becomes difficult and arduous (Anderson, 1978). Studies by Spiro (1977), Pichert & Anderson (1977) and Anderson & Pichert (1978) have attempted to show that the recall of previously-stored information can be altered depending on the nature of the schema in use at the time of recall.

When viewed from the perspective of schema theory, transfer of learning involves the activation of a previously acquired schema upon encountering a new learning situation. Given that the activated schema is appropriate for the task, learning could occur much more rapidly than where a less appropriate schema was available.

The cognitive models of knowledge representation described above have been developed primarily by psycholinguists and computer scientists working upon artificial intelligence, and the example material they utilise is mainly sentence comprehension and problem solving tasks. Behaviour classified as substantially psycho-motor has also recently been studied by experimental and cognitive psychologists from the cognitive perspective. Harvey & Greer (1980) provide a comprehensive presentation of theories and studies of motor control.

A pioneering approach to the study of transfer of psycho-motor behaviour was outlined by Miller, Galanter & Pribram (1960). They conceived the development of skills as involving the construction of a hierarchy of behavioural units, each unit guided by its own plan. Skills are conceived as plans which were originally voluntary but have become relatively inflexible, involuntary and automatic through overlearning. Other hierarchical/heterarchical models of motor control have been formulated by Fitts (1964) and Turvey Shaw and Mace (1978).

Cognitive theorists' rejection of the behaviourists' cued-movement theories in favour of advanced planning stress the active nature of the individual. The hierarchic/heterarchic nature of knowledge/skill is emphasised in psycho-motor research by the suggestion that such a structure represents the resulting plan in different levels of the nervous system. The use of rules or schemata has been found to be a satisfactory way of coping with the problems of accounting for the flexibility of action. Schmidt (1975, 1976) has proposed a model of motor control wherein learning produces rules not associations. Response specifications are related to required outcomes and initial conditions by a single rule, the recall schema. Sensory consequences are related to required outcomes and initial conditions by another single rule, the recognition schema. Once acquired these rules allow the individual to use past experiences to produce response specifications and the expected feedback appropriate for initial conditions and desired outcomes which he has never encountered before.

MacKay (1982) has presented a model which attempts to integrate studies of cognitive and psycho-motor performance. A hierarchical node structure is postulated. Activating a node at any level in the system primes or partially activates its connected nodes. Practice or repeated activation increases the rate of priming per unit time, thereby allowing a faster rate of output at the lowest, muscle-movement level (Fluency). Because behaviour results from the sequential activation of a hierarchy of nodes, different behaviours at the muscle movement level can share some of the same nodes at higher levels in their hierarchies. These shared nodes provide the basis for transfer of skill from one behaviour to another.

According to MacKay (1982) the degree of positive transfer between two performances depends on the existence of shared nodes and the current level of practice of the remaining unshared (divergent) nodes for realising the transfer performance. Negative transfer or interference occurs when the higher level nodes controlling an action sequence strongly prime one or more extraneous nodes within an 'intended-to-be-activated domain'. This extraneous priming is the result of prior connections either learned or built in.

An additional facet of cognitive approaches to transfer is provided through approaches commonly referred to as trait or ability models. Measures of ability have been developed which assess human performance. Scores on such measures appear to stabilise and remain fairly constant over individual lifetimes from the mid-teens onwards. In addition to the single measure of intelligence, research on the structure of intellect has systematically identified clusters of cognitive abilities such as verbal reasoning, numerical reasoning, abstract reasoning and spatial reasoning. Whilst scores on such measures are regarded solely as statistical representations of cognitive structure, their validity has been consistently established in transfer, eg. predictive validity of training time and subsequent performance in employment (see Ghiselli, 1973).

A similar statistical approach to the study of psycho-motor performance has been pioneered by Fleishman (eg. Fleishman, 1967a; 1967b; 1975). Although the resultant factors have less consistently been isolated, certain abilities have regularly been identified and validated in transfer situations. Trait approaches have similarly been developed to represent personality structure (eg. Cattell et al., 1956). The construct and content validity of trait models rests primarily upon the observation that performance of certain behaviours is systematically correlated with other behaviours of a similar 'class'. Ferguson (1954, 1956) maintained that these classes of behaviour are attributes of behaviour which through overlearning have attained a stability of invariance. Further he argues that abilities "emerge through a process of differential transfer and exert their effects differentially in learning situations". i.e. Those abilities that transfer and produce their effects at one stage of learning may differ from those at another (eg. Fleishman & Hempel, 1954; 1955).

The essence of the trait model in terms of transfer, is the concept of noegenesis as originally formulated by Spearman. Noegenesis is the "production of new or novel content, based on the relations observed between the elements of a given problem" (Eysenck, 1981). Educing relationships between elements and then educing correlates of this relationship is the basis of transfer. Samples of events which are novel (and not dependent upon particular prior knowledge) are the basis of measures of cognitive ability structure. The facility of subjects to educe relationships or correlates from this novel material is predictive of overall learning potential.

The alternative models of the process of transfer outlined above may usefully be synthesised. This eclectic view of cognitive structure can provide an interpretative basis for the literature on experimental studies of transfer and applied research into the relationships between tasks and job behaviours.

In the course of learning, the individual may be formally presented with (ie. informed of) relationships between entities (knowledge) and/or his actions and those entities (skills). The presentation of these relationships may highlight the hierarchical nature of the relations such that the properties of concepts are encoded in a way which corresponds to their level of inclusiveness.

In addition to this relatively passive mode of encoding (guided), it is clear that there is an element of active encoding (eg. Paivio, 1960; Auble & Franks, 1978). Here the form of encoding will be determined by pre-existing schemata. The way in which encoding is conducted may be a function of the degree of overlearning of specific abilities such that a spatially-based strategy is adopted by some individuals, and a verbally-based strategy is adopted by others. These schemata will determine what is 'seen' in the learning situation, the form and number of elaborations of the relation, and thereby the 'richness' of the inter-connections in the cognitive structure.

The stimulus and response elements of entities may well be one elaboration of the relation but the schemata brought to bear on the learning may, in addition to linearly encoding this relation, formulate rules of association which are embedded in a hierarchical cognitive structure.

Transfer can thus be hypothesised to occur through the process of the development of schemata, amended to include several of the novel task's properties as exemplary material of a cognitive class. Where a novel task's properties are readily incorporated into an existing schemata then the transfer may be referred to as generalisation. Where a novel task's properties require the establishment of new schemata then the transfer may be referred to as linear or vertical transfer. The distinction between horizontal (linear) and vertical transfer lies in the notion of hierarchy. Where transfer involves the establishment of a higher-order plan which draws upon lower-order existing knowledge and skills then transfer is defined as vertical. Where transfer involves the establishment of schemata or plans at broadly the same level then transfer is defined as linear or horizontal.

1.3 APPROACHES TO THE ESTABLISHMENT OF PERSON-TASK RELATIONSHIPS

We have noted that an individual may encode a novel experience in a variety of ways. These encodings may include stimulus or response similarity to known actions and knowledge but may also relate in other ways (and at different levels) to prior knowledge and skills. An understanding of the stimulus/response similarities between tasks is not therefore a sufficient basis to predict transfer between task performances.

Relationships between tasks can be established in innumerable terms. Some of these relationships may have transfer consequences to the extent that they can serve as representations of cognitive structure similarity of sets of job incumbents. Person-task relationships are the essence of occupational psychology but it is important to note that many of the approaches to this issue were not developed with transfer in mind. The objective here is to evaluate alternative approaches in terms of their potential as generators of descriptors in predicting transfer. In this respect the empirical paradigm of science seems to offer an appropriate evaluative approach. Alternative techniques to the establishment of person-task relation-ships can be evaluated in terms of several empirical criteria.

The first criterion is that the terms used to establish relationships between tasks have "construct validity" ie. there are adequate a priori grounds to constitute an explanation of the transfer process in the terms of the description/representation. Relating tasks solely in terms of their requisite energy expenditure for example, may not be the most appropriate aspect of task relationship to predict transfer.

The second criterion is that the measures used to establish similarity have "content validity", ie. that the measurements taken are representative (not contaminated) assessments of the construct of relationship. For example, assessing energy expenditure in terms of the temperature of individuals whilst performing the task is a contaminated measure since temperature may reflect factors other than energy expenditure.

The third criterion is that the measures used to establish task similarity are "reliable", ie. that repeated measurements over time (test-retest) or by other raters (inter-rater) would yield similar results.

The fourth criterion is that the measures used to relate tasks are capable of "discriminating" between different tasks. One may be able to reliably establish for example, that certain tasks involve breathing. This is not a very discriminative factor however. The discriminating power of measures is a function of the context of application. For example, a series of assessments may be able to differentiate between all jobs in broad terms, but not within sub-sets of jobs, eg. clerical jobs. Conversely, assessments which can differentiate between clerical jobs may not be able adequately to differentiate between a broader sample of jobs (since all non-clerical jobs may score identically on the measure).

The fifth and final criterion is that the measures used to relate tasks have "predictive validity" in the transfer context, ie. that the performance of individuals upon the transfer task is significantly associated with the a priori prediction of performance based upon the measures of task similarity.

Taken together, these 5 criteria enable us to evaluate laboratory and applied approaches to the prediction of transfer.

1.3.1 LABORATORY STUDIES

The study of transfer under strict controlled conditions has evolved over the last 70 years. Postman (1971) gives a good acccount of the experimental designs associated with laboratory studies of transfer. The use of random allocation to experimental and control groups are attempts to confine effects to the experimntal manipulations being studied. Under these conditions, material to be initially learned, and transfer tasks may be related to each other and 'savings' in acquisition times attributed to the relationship between tasks. The use of nonsense syllables in paired-associate learning is one which is felt unlikely to be subject to encodings other than in terms of the paired associations themselves. Stimulus item and response item similarity may be measured, and predictions of transfer made in terms of these assessments of similarity. Stolurow (1966) summarises the findings of many of these early studies. A similar experimental regime has been adopted for studies of psycho-motor tasks. It can be concluded from both the verbal and motor studies that where task relationships are manipulated such that 'similarity' only exists in terms of stimulus environments or response environments, then transfer is a function of these relationships. As noted, the construct validity of these studies was rooted in the concept of identical elements. The problem with these studies is that they demonstrate that in certain circumstances transfer can be a function of stimulus/response similarity, not that this is the only factor involved in transfer.

That there were other factors in the psychology of transfer became apparent in early experimental studies. It was noted that there was a pronounced (though temporary) facilitating effect of practice in some activity prior to learning the transfer tasks (Ellis, 1965). Further, the rate of learning seemed to be related to the number of warm-up trials (eg. Mandler, 1956). Warm-up gain has been shown to be relatively independent of and consistently larger than the general practice effect (eg. Thune, 1951). Stolurow (1966) summarises the findings concerning warm-up and notes that on both recall and learning, performance on a similar, but not identical warm-up task, facilitates performance. A second factor observed in experimental studies is learning to learn. Practice on successive samples of the same kind of material is accompanied by an increase in the rate of learning (eg. Bunch, 1941; Duncan, 1960; Postman, 1964). In many areas of learning, practice on a series of learning tasks leads to an improvement of the subject's ability to deal with the particular learning situations involved (eg. Kimble, 1961). These learning sets direct the subject toward an attack upon a rational problem and determine to a considerable extent what prior knowledge he shall bring to bear upon it (eg. McGeoch and Irion, 1952). This insight appears to develop as a result of extensive practice in solving similar or related classes of problems (eg. Harlow, 1949). The more variable the behaviour, the more likely it is that an adequate response will be discovered (Osgood, 1953). Transfer to a new task may be better if in learning, the learner can discover relationships for himself (Hilgard, 1956).

In summary, laboratory approaches to the study of task similarity have not generated a comprehensive set of reliably assessable descriptors which can discriminate between tasks and hence jobs and formulate predictions of the transfer process outcome.

1.3.2 APPLIED STUDIES

The prediction of performance in training/performance is implicitly a study of transfer in that task demands are related to the knowledge/attributes of the individual, with measures of association used to predict post transfer performance. This is one form of applied study which has relevance in the present review. Several applied studies have attempted to "group" jobs according to various person or task criteria. These studies could carry transfer implications if the constructs used to "group" jobs have psychological meaning, ie. they can serve as representations of cognitive structure similarity of the incumbents of respective jobs.

The applied studies with potential transfer relevance can be classified as general person-oriented approaches which include trait approaches and basic skills approaches; and job approaches which include task-oriented approaches and worker-oriented approaches. Figure 1 is a reproduction of the category system used in the current review.

1.3.2.1 General Person-Oriented Approaches

The behavioural description/requirements of jobs can be expressed in person-oriented terms. The objective here is to categorise work behaviours in terms which require less inference in relating similarities to human attributes. There are a large number of studies which have presented molecular breakdowns of work behaviours in person-oriented terms.

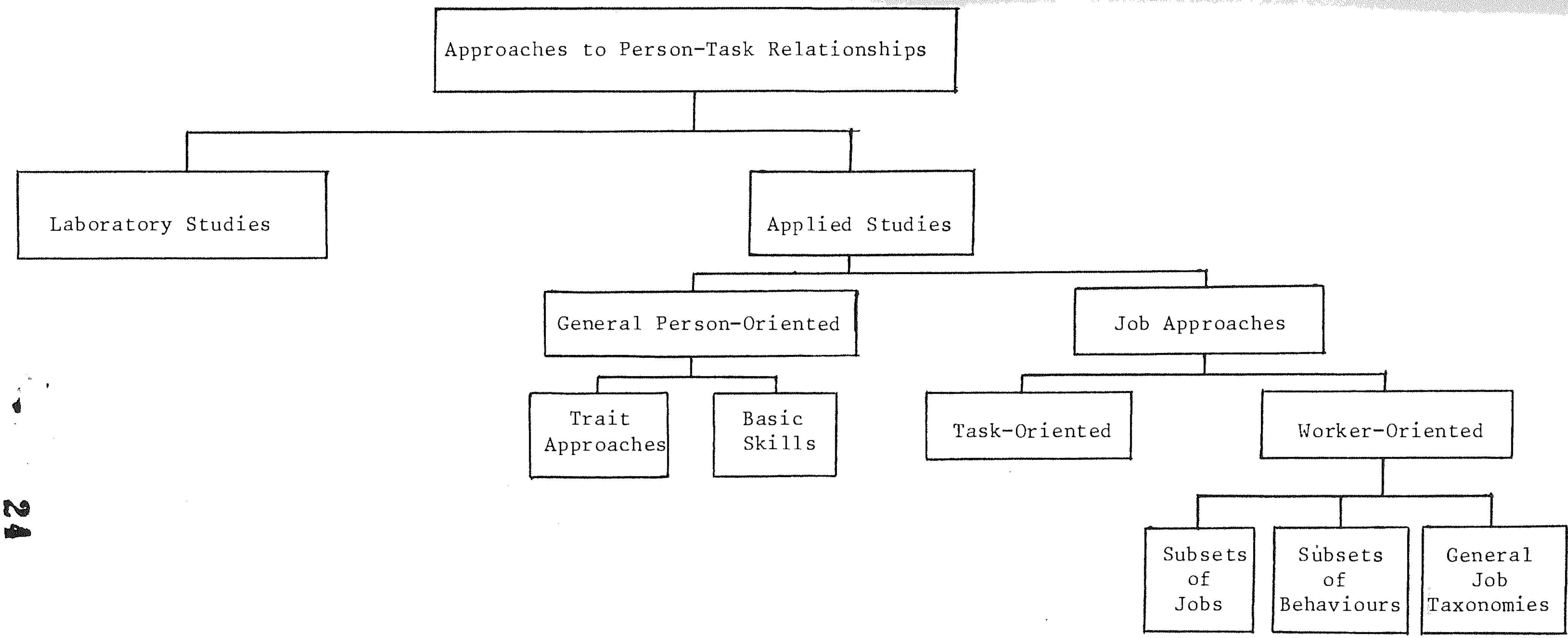


FIGURE 1 A CLASSIFICATION OF STUDIES WITH POTENTIAL TRANSFER RELEVANCE

24.

Two major approaches which classify work behaviours in terms of groups of skills, interests and personality are those of Holland & Roe. These approaches assert that throughout working life people develop approaches and preferences for particular types of work and that they stabilise into a particular category and transfer most effectively within that category in later working life and less so between categories. Holland classifies these work/people types as Realistic, Investigative, Artistic, Social, Enterprising and Conventional. Roe classifies people/jobs as Service, Business, Organisation, Technology, Outdoor, Science, General cultural and Arts/entertainment. There is a large body of research concerning the two classifications. Studies on Holland's taxonomy include those listed below.

Holland & Whitney (1969) reviewed the general literature on personality and interests and Holland et al (1969) grouped jobs in terms of their 'psychological relatedness'. Viernstein (1971) contrasted this taxonomy to the functional classification DOT. Johnson & Moore (1973) and Holland et al (1973) examined work histories to establish that homogeneity of types develops. Nafziger & Helms (1974) demonstrated that clusters from the Strong Vocational Interest Blank, Kuder Preference Record and Minnesota Interests Inventory were consistent with the taxonomy. Studies of the classification's consistency with sub-populations include Crabtree & Hales (1974) on rural youth, McLaughlin & Tiedman (1974) on project TALENT students, Wakefield (1975) with black undergraduates, and Salomone & Slaney (1978) on non-professional workers. Taylor et al (1979) have examined work and leisure relationships in terms of the taxonomy. General career stability has been confirmed by Gottfredson & Daiger (1977), Gottfredson (1977, 1978, 1980). Eberholt & Muchinsky (1982) have demonstrated that particular people classified according to the taxonomy have significantly different personal history experiences.

Anne Roe's classification of psychological relatedness has been studied extensively and references include Lunneborg & Lunneborg (1968) using the classification to predict academic success; Hutchinson & Roe (1968) demonstrating that career movements are congruent with the classification; Roe & Kloss (1969) presenting the taxonomy; and Siess & Rogers (1974) examining whether university students perceive occupational similarity in terms of Roe's classification.

A similar approach to the psychological relatedness of people and work is proposed in life history/biodata studies. Baehr & Williams (1967) identified 15 factors which interacted with occupational groups. Schoenfeldt (1974) used life history data to predict grade point averages and career paths. Morrison (1977) demonstrated that occupational groups have significantly different life histories. Brush & Owens (1979) found significant relationships for biodata subgroups and education, termination rate, job classification and performance rating. Eberhardt & Muchinsky (1982) found significant interactions between biodata and Holland's taxonomy categories.

All of these approaches are using a wide range of constrcuts to cluster people and jobs. The inventories have been shown to have transfer consequences. Career movement is congruent with the various expressions of psychological relatedness, and performance a function of relatedness of types. Specific transfer predictions could be postulated and tested on the basis of such measures of psychological relatedness.

A further body of research to be summarised in this section is a series of studies by the National Centre of Research in Vocational Education at Ohio State University. Pratzner (1978) has summarised all of the research conducted at Ohio State. The majority of the work has been discussion and clarification of the various terms associated with transferability. Altman (1976) has addressed the issue of transferability from the basis of the psychological literature. Altman regards transferability as a function of the motivational, contextual and behavioural domains. He reviews the psychological literature on motivation, mediation, saliency, contingency and probability. The behavioural domain is reviewed in terms of perception, memorisation, intellectual processing, response and integration. The reviews are intended to serve as syntheses of the validated psychological areas with transfer consequences which could be used to create blocks of items which on strong a priori grounds might affect transfer. Such a taxonomy has not however been attempted and so there is no information concerning issues such as reliability, discriminability and predictive validity. Wiant (1977) developed a taxonomy of transferable skills from brainstorming sessions with groups of employers. Categories include Intellectual/Aptitudinal factors including communicating, basic computation, foresight, typing, goal-setting, etc. Interpersonal factors including motivating, selling, delegating, team building; and Attitudinal factors including diligence, determination, pride, honesty, loyalty, kindness, etc. McKinlay (1976), Sjogren (1977) and Ashley (1977) present reviews of approaches to classifying and clustering jobs, transferable skills, and current data bases.

The major problem associated with these general person-oriented approaches is that they lack focus and therefore have difficulty in ensuring comprehensive coverage of the human factors associated with employment. Further, they have not been empirically evaluated in psychometric terms such that they can be reliably applied, scale responses and discriminate between jobs. Each of these techniques would require considerable inference on behalf of respondents to interpret and scale their job in these terms. Two more-focussed person-oriented approaches towards occupational classification are based specifically upon traits and basic skills.

1.3.2.1.1 Trait Approaches

It was noted in the criteria of evaluation that the constructs chosen to relate contexts, should have reliability. In the science of prediction, it is important that the property being assessed is relatively stable. The measurement of a quality which is transient would not meet the criterion of reliability. With this in mind, psychologists sought to establish measures of human attributes which were relatively stable over time, ie. traits. From this work a general consensus on the structure of intellect has emerged. In addition to a single measure of intelligence, several lower order factors have consistently been identified (eg. verbal reasoning, numerical reasoning, abstract reasoning, spatial reasoning). The selection paradigm described by Freyd (1923) of identifying the abilities implicit in a job and using correlations of these abilities with job performance is still prevalent today (Brotherton, 1981). Ghiselli (1973) summarises the results of these studies, and shows that significant relationships are consistently found in both learning (training) performance and subsequent employment performance. There are however, difficulties in identifying the potentially requisite abilities for jobs, since this is essentially an inferential process. Particular job analysis techniques have been developed which can reduce the role of inference by yielding molecular breakdowns of job duties rather than global accounts of roles. Dunnette (1976) reviews many of the alternative approaches to aid the empirical validation of ability measures. Similar findings to those associated with ability have been identified with trait measures of personality (eg. Cattell's 16PF), interests, (eg. Kuder Preference Record) and motivation (eg. McClelland's T.A.T.).

The empirical selection paradigm by definition establishes the relationship between measures of ability and a specific context-bound employment situation. For the results of such studies to be generalised requires particular contexts to be grouped such that the observed validity of measures in one context are demonstrably valid in related contexts. There has been considerable research on the establishment of such groupings.

One of the major approaches to this generalisation has attempted to group jobs in terms of similar ability/personality/interest requirements. Groupings of jobs with similar general intelligence levels are described by Stewart (1947); similar aptitude scores by Dodge (1935), Barnette (1950); similar personality profiles by Cattell et al (1956), Holland et al. (1972), Seymour et al (1973), Thumin (1965); similar interests by Thurstone (1931), Strong (1943), Kuder (1946), Guilford et al (1954), Jackson & Williams (1975), Creaser (1976).

A parallel approach has been adopted by Fleishman and his associates in the realm of psycho-motor abilities (eg. Fleishman, 1967; 1975). Here large scale correlational studies have identified a series of factors which underpin performance on wide varieties of psycho-motor tasks. These ability factors are therefore differentially required by jobs and jobs can be grouped in terms of their similar psycho-motor abilities. The model underpinning the trait approaches to intellect and personality assessment regards these factors as either primarily genetically determined (eg. Eysenck, 1981) or as over-learned associations which stabilise in maturation by the mid-teens (eg. Ferguson, 1954, 1956). In all events they are felt to be generally intransient and unlikely to alter in the absence of major interference (eg. trauma, physical injury, brainwashing). Psycho-motor factors and interest factors are felt to be less stable and more amenable to later learning (training) through attitude change (eg. Tannenbaum, 1956) and specific practice (eg. Levine et al, 1982). Nevertheless, the observed stability of these factors is such that in everyday circumstances they can serve as reliable and valid predictors of performance.

The differential validity of aptitude measures (where particular sub-tests appear more valid in one context than another) may well be less problematic than earlier studies suggested. Work by Schmidt and his associates (eg. Schmidt & Hunter, 1977, 1978, 1980; Schmidt et al, 1981a, 1981b) on the issue of validity generalisation, has demonstrated that minor task differences in jobs (which seemed to be reflected in the differential validity of ability measures) are in fact rarely a limitation to extending the validity of tests. Most of the studies which previously appeared to identify differential validity lacked the statistical power to validly draw such conclusions. Schmidt's studies have consistently demonstrated that validity is far more robust and flexible than previously thought and that validity coefficients for broad groupings of jobs are potentially establishable.

In terms of the criteria of evaluation therefore, trait approaches to the prediction of transfer can be summarised as follows:-

In terms of construct validity, work requirements are related to the individual in terms of traits. These traits are by definition stable statistical representations of basic potential to transfer.

In terms of content validity, test item development is a well established procedure. Ensuring that item content is free from later learning and cultural factors is however a difficult task.

The test-retest reliability of trait measures is generally very high. The reliability of assessments of the potential appropriateness of particular measures is more problematic. Minimum criteria for the reliability of such assessments have to be adopted in applied studies.

Trait measures are designed to maximise discrimination between the general adult population (or even, in some instances, within particular subsets of populations). Discriminating between jobs in terms of their different ability requirements may (as noted above) be less difficult than previously thought.

Trait measures have consistently been shown to have validity in predicting individual post-transfer performance. Relating jobs in terms of their ability requirements and establishing that transfer is greater within groupings than between groupings needs to be demonstrated.

There is support for this hypothesis in the observation that there is a notable homogeneity of ability/personality scores of incumbents within particular jobs. The techniques of factor analysis adopted by Fleishman are based upon the correlations of individuals' performance on varieties of tasks. These correlations may be interpreted as confirming that there is transfer between certain tasks and less so between others. Further that statistical factor representations of these patterns are valid representations of generally observed psychomotor transfer capabilities.

Predictive validity is traditionally established at the individual level. If, however, tasks (and jobs) are relatable in terms of common ability requirements, and there is demonstrable gravitation/homogeneity of individual scores, it may be possible to identify the transfer potential of particular job groups and make predictions of their potential performances on other jobs on the basis of trait similarity. Such an approach could go some way towards confirming the postulations of manpower policy-makers discussed in Section 1.1. If reliable and valid techniques could be established to indicate the requisite abilities for traits from job analysis (without the need for empirical validation procedures) then the postulations could be readily adopted in manpower practices. This direct linking of job behaviours and ability requirements is a blossoming area of research in occupational psychology and is referred to as synthetic validity. This issue is studied and discussed in detail throughout the current research.

1.3.2.1.2 Basic Skills Approaches

Western culture and the educational system aim to equip young people with a set of basic competencies. The terms used to describe these attainments include, "basic skills", "generic skills", "minimum competencies", "attainment batteries" and "achievement batteries". There is some consensus upon the aspects of knowledge and skill incorporated in these labels. Generally included are aspects such as mathematics, reading, language and listening. In some approaches the label also includes manipulative skills and reasoning. Buros (1978) lists 37 different batteries of achievement tests.

The vast majority of these batteries have been developed to serve as predictors or criteria in educational settings. The two most well-researched batteries are the Comprehensive Tests of Basic Skills and the Iowa Tests of Basic Skills. A wide range of factors have been examined to identify the potential determinants of scores on these measures. Studies include Gose et al (1980) on intelligence and self-concept; Plake et al (1980) on sex differences; Zimmerman & Sassenrath (1978) on discovery learning/teaching; May et al (1978) on socio-economic factors; Lehrer & Hieronymus (1977) on achievement motivation; Bernstein (1976) on the effects of father absence on girl's scores; Crano et al (1972) on intelligence as a determining factor; Chittendon et al (1968) on the performances of first-born children; and Buckley (1968) on parental occupation and children's performance on attainment measures.

Achievement batteries are developed along traditional psychometric lines and have been found to have acceptable levels of reliability (Cureton et al, 1973), test-retest stability over time (Linn, 1969) and to relate highly to other measures of attainments (Modjeski & Michael, 1978; Wakefield et al, 1975).

There are many studies of the predictive validity of basic skills in educational settings. Studies here include Sabers & Feldt (1968) on subsequent modern maths and algebra performance; Smead & Chase (1981) on student expectations; Cooper et al (1982) on teacher expectations; and Gross (1982) on subsequent academic performance.

Establishing the relationship between basic skills and work performance requires the analysis of jobs in terms which identify the basic skills implicit in the performance of job tasks. There are three major techniques associated with this approach.

Smith and his co-workers have developed a taxonomy of Generic Skills which covers mathematics skills, communication skills, reasoning skills, interpersonal skills and manipulative skills (see Smith, 1974, 1975; Kawula & Smith, 1975). Jobs may thus be analysed and related in these terms. If related measures of pre-employment generic skills performance could be established then perhaps transfer on entry to employment could also be assessed.

A similar approach has been developed by Freshwater (Freshwater, 1980, 1981, 1982) called Basic Skills Analysis assessing basic calculations, measurement and drawing, listening and talking, reading and writing, planning and problem solving and practical skills. A team of researchers at the Social and Applied Psychology Unit (Banks et al, 1983) have developed the Job Components Inventory assessing the use of tools and equipment, perceptual and physical requirements, mathematics requirements, communication requirements and decision-making requirements.

The principle underlying all three of these techniques is that transfer potential will be increased where an individual has a greater range of competencies. It is hypothesised that transfer to a job is a function in part of the individual's basic competencies and the requirement of these competencies in the job. Further it is argued that where education, training and job design are synchronised around basic skills, that broad-based training can be developed which will facilitate job mobility, employment opportunities and transferability in general.

The techniques have developed in content terms from progressive studies of frequency of usage and discriminability, and have attempted to maximise reliability of ratings through item and scale development. In view of the recency of the development of these techniques there is little empirical evidence of their validity in terms of transfer. Randhawa (1978) has utilised cluster analysis to group jobs in terms of their similarity in generic skills. Studies are required however to establish:

(a) whether transfer potential is enhanced from broad-based training of minimum competencies, and

(b) whether transfer between jobs is a function of these minimum competencies.

It would be interesting to determine whether transfer between jobs with 'similar' profiles is greater than that to jobs with less similar profiles; or indeed, within and between groups of jobs established in minimum competency terms.

In terms of the criteria of evaluation therefore, basic skills approaches to the prediction of transfer can be summarised as follows:-

In terms of construct validity, the educational system provides knowledge in the form of minimum competencies. The competencies are in turn applied in employment. Selection and/or training in terms of these competencies may have transfer consequences.

In terms of content validity, the achievement batteries developed in educational settings are derived from the curriculum and endeavour to provide comprehensive representation of basic skills. Statistical analysis of the inter correlations between competencies have shown however that a single composite factor reflects such a substantial amount of variance that there is no statistical evidence to support the separation of achievement areas generally suggested by the techniques (see eg. Klein, 1980; Gustafson, 1970; Klein, 1981).

The taxonomies developed in occupational settings are derived in part from achievement batteries but also from job analyses for areas such as practical skills and the use of tools and equipment. The rationale for item inclusion is a criterion of frequency vs. discrimination.

Standard psychometric approaches to the study of reliability have been generally adopted. The techniques have acceptable levels of test-retest, split-halve and inter-rater reliability, although clearly the rating task implicit in the occupational taxonomies yields generally lower inter-rater reliability figures. It is suggested that the number of raters is increased so as to maximise reliability utilising for example the Spearman-Brown equation (Guildford, 1954).

Achievement batteries have been shown to discriminate well between children in school. With occupational taxonomies it is difficult to know whether occupations "actually" differ since similarity is assessed in terms of the items themselves (which make assumptions in their own right concerning the "similarity" of behaviours in attempting to make items relatively context-free).

In terms of predictive validity, the role of minimum competencies in subsequent learning and performance is conceptually an identical elements theory of transfer. Where such competencies are either directly reproduced or extended in other performances then one can postulate positive transfer. The studies on achievement batteries noted earlier have demonstrated validity in educational performance. There are also large observable differences in the attainment levels of different job groups. Whether occupational taxonomies and job groupings based upon them would have predictive validity in terms of transfer has not however been established.

1.3.2.2 Job Approaches

It has been noted that trait and basic skill approaches to transfer were based on psychological models which regard traits and minimum competencies as relatively stable in the absence of active intervention. The short-coming of these approaches however, is that they largely disregard the learning and experience which occurs from the mid-teens onwards. Job approaches to the study of transfer are based on the premise that the experiences of work affect the individual, and further that the development of these skills has transfer consequences. The fact that individuals can learn these skills potentially limits the validity of predictions based on these terms. They are by definition more transient than aptitudes and basic skills which are "trained" almost exclusively in childhood.

In relating tasks and individuals in behavioural terms, we are faced with apparently innumerable constructs of similarity. The psychological literature on these approaches can however be evaluated in terms of the criteria detailed earlier. It should be borne in mind that although these approaches implicitly model the process of transfer, very few have explicitly attempted validation in transfer terms.

1.3.2.2.1 Task-Oriented Approaches

Task-oriented approaches are describing behaviour in what Singleton (1974) refers to as "systems" terms. Such descriptions are effectively statements of the functions or operations required to perform specific tasks. Such objective functional descriptions are largely 'psychologically celebate' (Duncan, 1972) or certainly require a high degree of inference to relate to the individual. For example describing an operation in terms such as:- "Warm-up Lepol grate", "Check calcining chamber temperature", "Check drying chamber temperature", "Check under-grate temperatures 1 and 2" are detailed functional descriptions of requirements to achieve the objective of warming-up a cement kiln and associated plan. To assert that tasks related in such terms have transfer consequences is to assume for example that the functional relationship "warming-up" in cement manufacture psychologically relates to "warming-up" a coal-fired boiler.

There are a large number of classification systems for particular job types which are based upon task characteristics. Techniques of analysis which attempt to yield systematic molecular breakdowns of jobs include Hierarchical Task Analysis (Annett & Duncan, 1967), Critical Incidents Technique (Flanagan, 1954) and work behaviour categories (Outerbridge, 1981). Specific job taxonomies include those for managerial jobs (Brumbach & Vincent, 1970) and technical jobs (Youngman et al, 1979). Mills & Rahmlow,(1967), Ramsey-Klee, (1979), Harding & Downey, (1964), and Wiley et al, (1966) analyse electronic technicians, enlisted technical jobs, electronic engineers and communications officers in task characteristics terms. A task characteristics approach to describe all systems maintenance personnel including electricians, fitters and instrumentation personnel has been developed by Spurgeon, Patrick and Sparrow (1982). Skilled level manual and non-manual jobs have been studied by Bakamis & Kuhl (1967) (building trades), Perkins & Byrd (1967) (office employees), Rahmlow & Cavanagh (1966) (food service work), Dunnette & England (1957) (engineering work), Dunnette & Kirchner (1959) (sales jobs), Bingham (1935) (clerical jobs), Kesselman & Lopez (1979) (accounting personnel). Studies with jobs at the semi and unskilled level include Ertel (1967) (retail) and Long (1968) (agriculture).

The development of these task taxonomies requires the detailed study of those jobs regarded as members of a particular class. Tasks (functions) frequently conducted may then be summarised. The similarity of jobs within such classes can be assessed (Youngman, 1979) and predictions made concerning the transfer potential of incumbents within such jobs to other 'similar' jobs. Occupational Training Families are effectively classes of jobs where it is assumed that the execution of similar key purposes within particular classes will have transfer consequences. Administrative, clerical and office services are regarded as having the key purpose of "information processing" which requires for example "following procedures to collect data together", "record data", "transform data from one format to another", "produce and send response", "produce copies of data or information" (Hayes et al, 1983). The transfer hypothesis here is that young people will transfer more readily to jobs within the same class (fulfilling the same key purpose) because of training in different "work stations" which require the listed competencies. The particular classes are not formed however on the basis of established competence homogeneity but on a subjective basis. The competencies are an expression of that which is common to jobs within the postulated class. There are no studies or even tangential evidence which demonstrate the validity of this approach to transfer. There is no evidence of the reliability with which trainers assign work behaviours to particular competencies in the work learning guides. It is doubtful whether fulfilling the task requirements as stated in O.T.F.'s bear any psychological similarity necessarily from one context to another.

Task taxonomies are potentially the most appropriate techniques for yielding specific job training requirements. Their context-specificity enables them to describe the functions/operations implicit in jobs at a level of detail which can fruitfully guide trainers. Generalisation of such descriptors is however an essentially intuitive process. There may be transfer consequences between tasks in terms of particular descriptors. This is as a by-product result of the psychological skill/knowledge similarities between the contexts and is not necessarily due to the execution of similar functions/operations per se.

1.3.2.2.2 Worker-Oriented Approaches

Worker-oriented approaches are describing behaviour in human terms. Such approaches are attempting to identify a level of description of human performance which minimises the context specificity implicit in task-oriented approaches. Worker-oriented approaches have been adopted in three basic forms. Firstly, taxonomies of human work behaviour have been developed which can describe particular types of jobs (ie. subsets of jobs). Secondly, taxonomies have been developed concerning particular sub-sets of work behaviours. Finally some attempts have been made to develop taxonomies which are applicable to all jobs. These may be referred to as general job taxonomies.

A large number of researchers have attempted to invoke person-oriented (psychologically-based) descriptors in their taxonomies of work behaviours for particular jobs. Managerial jobs have been studied by Tornow & Pinto (1976), Dulewicz & Keenay (1979), Morsh (1969), Hemphill

(1960), Wexley & Silverman (1978) and Shapiro & Dunbar (1980). Technical jobs have been studied by Prien (1963), Cornelius et al (1979), Szilagyi & Sims (1974), Meyer et al (1975) and Baukus (1973). Skilled level occupations have been studied by Prien (1965), Thomas (1952), Cardall (1942), Ronan et al. (1977) and Van Rijn (1978).

Each of these studies has attempted to derive items which reflect particular "skills" within the occupation under study. The approaches may have transfer consequences in two ways. Firstly to examine whether 'similar' jobs within the occupational groups have greater transfer reciprocity. And secondly, to examine whether broad-based training addressing the items in the taxonomy would lead to greater transfer within the occupational group. Neither of these forms of evaluation have been conducted with the person-oriented approaches to job analysis associated with subsets of jobs.

The second person-oriented approach to transfer is one which does not attempt to relate complete job analyses and relationships. Rather they are hypotheses concerning particular sub-sets of work behaviours. These sub-sets of behaviours are regarded as particular "skills" in themselves and are sometimes referred to as process skills. The hypothesis underlying these approaches is that training (utilising example materials) of these skills will transfer to situations where these skills are applicable. Examples of these approaches include Bramer & Arbrago (1981) on coping skills, Henrickson (1980) and Reddin (1977) on leader skills, Akridge (1979) on life skills, Arroba (1977) on decision-making styles and Steffen (1974) on friendship building. Such approaches try to make trainees encode particular situations in terms of the construct being trained and provide them with procedures which are felt to be generally effective. Where a particular construct represents a major part of an occupation there may be broad transfer consequences, eg. leadership skills in management training. There is a great deal of non-psychological but practical work conducted on such approaches particularly focussing on social-psychological constructs such as leadership, communications, team-building, interpersonal relations, etc. Evaluation is however generally made only in terms of self-reported improvements in performance in situe.

Two areas particularly worthy of attention, since they have been postulated as psychological processes, are problem-solving/fault diagnosis skills and learning skills. Both of these areas are being actively researched within the UK.

Fault-diagnosis strategies and procedures have been formulated in terms of logic and attempts have been made to demonstrate that the construction of situations in these terms facilitates performance. Category systems of problem-solving tasks have been formulated (eg. Speedie et al, 1976). Detailed studies of the nature of strategems have been conducted by Brooke, Duncan & Cooper (1980) and Hunt & Rouse (1981). Studies generally conclude that it is possible to train context-free diagnostic skills which can show transfer benefits to context-specific problems.

Learning strategies and skills have been formulated upon the basis of 'good practice' and the psychological literature. Singer et al. (1979), Mayer (1980), and Wang (1983) have examined the use of elaboration techniques in learning, retention and transfer. Learning styles have been categorised by Bransford (1982), Freedman & Stumpf (1978), Honey & Mumford (1982) and Marton & Saljo (1976). Training suggestions for learning to learn have been presented by Saljo (1976), Hoonsell (1979) and Downs & Perry (1982). Sylvia Downs has focussed on skills associated with memorising understanding and doing. The hypothesis is that approaching learning situations with particular procedural skills and strategies will facilitate learning.

Person-oriented taxonomies of work behaviour which have been designed to be applicable to and capable of discriminating between all jobs have been proposed by Reed (1967), Cunningham and his associates (Pass & Cunningham, 1975, 1978) and McCormick and his co-workers (McCormick, 1959, 1967; McCormick, Jeanneret & Mecham, 1969; McCormick, 1974; McCormick, Denisi & Shaw, 1979). These approaches may be referred to as general job taxonomies. Reed (1967) utilises a series of verbs to represent behaviours in a checklist, and it would be possible to postulate transfer in terms of job similarity in verb terms. It is difficult to determine the comprehensiveness of the listing of verbs since there is no paradigm around which they are structured. Further, the simple checklist nature of such a "job analysis" does not include scaling of relative involvement and could lack discriminating power. Cunningham's work is essentially an application of McCormick's approach to the field of occupational guidance. It is appropriate therefore to discuss this research alongside the review of McCormick's approach.

McCormick has spent over thirty years attempting to refine a taxonomy of general job behaviours. The current version of the taxonomy is called the Position Analysis Questionnaire (PAQ). The taxonomy uses a bank of 190 person-oriented terms based on the Stimulus-Organism-Response paradigm, and has been applied to a large stratified sample of jobs. Classical psychometric approaches to item development have been utilised and aided through principal component and factor analyses of inter-item correlations to identify "job dimensions". These are representations which reflect the extent to which job behaviours tend to occur in combination within jobs. These job dimensions have been used to "predict" rates of pay (job evaluation), stress indices and job satisfaction. In addition, each of the items within PAQ have been related to a comprehensive range of traits (aptitudes, psycho-motor factors and personality factors) in an attempt to constitute a technology of synthetic validity. It is this dual context aspect which singles out the PAQ from the work of Cunningham who has restricted his attention to job behaviour description per se. PAQ, in structuring item content around the S-O-R paradigm has gone some way towards attempting to provide a comprehensive description of job content. The ability of the technique to be applied to all jobs would therefore be of great value in attempting to determine whether job content similarity is associated with transfer performance.

In terms of the criteria of evaluation, job approaches to the prediction of transfer can be summarised as follows:-

Human beings learn from experience. An understanding of occupational experiences may enable us to predict future work learning. Non-work experiences are assumed to be irrelevant in approaches which relate work contexts only. Task characteristics approaches make no attempt to describe jobs in human terms. It is doubtful whether similarities between jobs in functional/systems terms will per se have transfer consequences. Many taxonomies have been developed which attempt to reflect the psychological relatedness of occupations in skill terms. PAQ attempts to reflect the job behaviours across all jobs.

In terms of content validity the taxonomies developed are based on large samples of members of particular job sets (groups) or all jobs. The items used to reflect the behaviours being undertaken are observational and/or inferential in nature. There is a trade-off between level of description and a manageable number of items.

The reliabilities of those techniques which present figures for the reliability with which raters assess jobs seem adequate. Many of the techniques do not however present this information. There is a well-established methodology for obtaining reliable mean estimates of job content.

In terms of discrimination, those techniques which aimed to assess all jobs have been able to discriminate between jobs. Techniques which address particular subsets of jobs can discriminate within the sub-sets.

Validity in transfer terms has been defined by Holland, Roe & Schoenfeldt as evidence of homo-geneous mobility of adult workers, both in intentional and actual transitions. Both of these measures may reflect "acceptable" or "realistic" movements in society's terms, ie. they may not represent transfer potential per se. None of the task characteristics approaches have been validated in transfer terms.

Worker-oriented approaches at the occupational group level have not been validated. PAO has demonstrated validity in several occupational terms. The technique has demonstrated potential in the establishment of synthetic validity.

1.3.3 CONCLUSIONS CONCERNING THE UTILITY OF APPROACHES TO PERSON-TASK RELATIONSHIPS AS CONTENT BASES TO PREDICT TRANSFER.

In order to discuss the alternative approaches to establishing person-task relationships, it is appropriate to summarise the arguments so far. It has been noted that anticipated major structural changes in the socio-industrial order are likely to lead to increases in job changes. A broad hypothesis has been made by manpower policy-makers that incumbents of particular jobs may be more able to learn and perform jobs which are "similar" to their current job and that families of "similar" jobs are formulable. A review of the psychological literature on the process of transfer of training has revealed that the unique cognitive structure of individuals determines transfer performance. Representations of the cognitive structure similarity of incumbents of respective jobs may however be inferable from descriptions of job duties. In attempting to define "similarity" between jobs, occupational psychology has yielded many terms in which to express similarity. These studies have been classified (Figure 1) along a fundamental dimension of the orientation of descriptors. Jobs may be described in either terms of fundamental personal (psychological) characteristics, such as abilities/traits or basic skills; or in terms of their implicit objectives or duties in the hope that these terms can serve as representations of the skills of respective job incumbents.

Whilst the use of fundamental psychological characteristics to assess transfer potential has a high level of construct validity, two potential problems have been identified. Firstly, the identification of the abilities associated with particular job performance is traditionally conducted empirically. For such constructs to serve as a content base to formulate transfer predictions between jobs, a systematic (non-empirical) technique is required to validly indicate the ability/trait "requirements" of jobs. This general issue has become a central element in occupational psychology and techniques which provide molecular breakdowns of job content to indicate ability requirements have been researched under the label of synthetic validity. Further development of these techniques may enable trait information to offer great potential in formulating predictions of transfer performance. The second potential problem associated with formulating job "similarity" in terms of common ability requirements, is that later learning associated with work experience is not being addressed. This omission may mean that the assessment of job similarities in trait terms alone would not be the optimal strategy.

The description (and classification) of jobs in terms of their implicit objectives or duties has been categorised (Figure 1) along a dimension which ranges from a specification of the tasks to the description of the worker behaviours of jobs. The context specificity of task-oriented approaches leads one to reject such approaches for the universal comparison of job similarity. The context specificity associated with such approaches would necessitate very high degrees of inference to determine whether or not task/systems objectives carried any degree of "psychological" similarity in their constituent demands.

Descriptions of worker "behaviours" can be made at a series of "levels". The specificity of descriptors depends ultimately upon the application one has in mind. Detailed descriptions of the behaviours involved in particular jobs (subsets of jobs) have been identified. Similarly detailed descriptions of particular work behaviours (subsets of behaviour) have been reviewed. The level of description of job behaviours in terms of a general taxonomy which can be applied to all jobs has been found to be of a generally higher order. The particular technique associated with this approach (PAO), has been researched for many years in other contexts, but can be considered to have construct validity in the current context in that it is a representation of job behaviours which is generally applicable, and has demonstrated acceptable degrees of content validity, reliability and discriminability.

Hanon (1977) in a review of taxonomies of work behaviours identified 14 areas of description and concluded that PAQ "includes descriptors in all the identified areas whilst coverage by other developments is less uniform". Similarly, Freshwater and Townsend (1977) concluded that PAO "seemed the most useful and comprehensive instrument available".

A feature of the technique is its potential dual role. PAO, in addition to yielding descriptors of job content which have potential transfer implications, has developed a content base of "links" between job behaviours and human attributes/traits (Mecham, 1969; Marquardt, 1972). This data base and other derived scores from the instrument have been used to formulate profiles of the ability/trait requirements of jobs synthetically. A detailed examination of the ability of the technique to synthetically derive attribute "profiles" which might then be used to express job "similarity" (and hence predict transfer) is a clear research need.

Whilst the transience of work behaviours as they are represented by PAQ (or by any general worker-oriented taxonomy), is the major potential limitation to the use of such features as a content base to assess job "similarity", an examination of the meaning of job similarities and differences and study of the utility of the descriptors in predicting transfer performance is also clearly a major research need.

In summary, the applied employment problem is likely to benefit from research and study from an occupational psychology perspective. The fundamental issue concerns the transfer of training, and PAQ as a technique offers potential as a generator of two complimentary sets of descriptors. These descriptors may constitute adequate representations of the cognitive structure similarity of incumbents of respective jobs and hence serve as bases to formulate transfer predictions on the basis of job "similarity".

The current research is a subset of studies which utilised PAQ in a related series of investigations into the selection and training implications of "upgrading" (transferring) workers. This latter research was otherwise conducted by a team of researchers, headed by Dr. P. Spurgeon and Dr. J. Patrick at the University of Aston in Birmingham on behalf of the Manpower Services Commission. The Position Analysis Questionnaire was selected as a technique which could, in addition to being systematically evaluated in the transfer context, highlight the general issues associated with the prediction of transfer performance on the basis of job similarity.

1.4 THE DEVELOPMENT AND BACKGROUND OF THE POSITION ANALYSIS QUESTIONNAIRE

It has been noted that the basic approach adopted by McCormick has been the development of a standardised system of job analysis which can be used across industries and across jobs within a given industry. According to Gordon & McCormick (1962), "in order to study the interrelationships of jobs across occupations and firms, one would need a system of analysis which would yield information along a common base, applicable to a great number, if not at all, job situations". McCormick further suggests that a system based on the description of "worker oriented elements" may well fit this requirement. This orientation, as contrasted with a "task oriented" approach, has the advantages of being independent of the product produced, or the specific situation in which the job is performed. In this context, Gordon (1963) defines a worker-oriented element as "one which describes an activity in terms of what actions the worker is performing without reference to the job or product involved".

The early predecessor of the present PAQ was a Checklist of Worker Activities developed by McCormick & Palmer (Palmer, 1958). It consisted of 178 elements organised into sections corresponding somewhat with those of the PAQ. Various rating scales and special codes were used with the individual elements. It was used as the basis for the analysis of 250 jobs in the American steel industry. A principal components analysis of the resulting data was carried out and resulted in the identification of 14 factors. These 14 factors, in turn, were subjected to a higher order principal components analysis, resulting in 4 more-general factors (Palmer & McCormick, 1961). Even at the time of its development, however, the check-list was viewed as only an approximation toward the development of a more refined device for job analysis in worker-oriented terms (Gordon, 1963).

The next approximation to a more refined system of job analysis was the development of the Worker Activity Profile (WAP) by McCormick, Gordon, Cunningham & Peters (1962). The development phase of this instrument consisted primarily of two parts, namely the development of a classification system of worker-oriented variables, and the construction of elements to measure these variables. The initial classification system of worker-oriented variables consisted of the following 7 categories.

1. Environmental Effects
2. Physical Activities
3. Mental Activities
4. Activities involving special talents and abilities
5. Communication Activities
6. Supervisory Activities
7. "Personal" Requirements

Each of these categories was progressively broken down into lists of more specific variables which could later be developed into items. The next phase of the research was the development of individual items, and the main objective was the conversion of the concepts implied by the variables into statements which would be descriptive of human behaviour in a job. The resulting product, the Worker Activity Profile, consisted of 163 job elements re-grouped into the following nine categories (Gordon, 1963).

1. Discrimination Activities
2. Mental Activities
3. Body and Limb Activities
4. Supervisory Activities
5. Communications and Interpersonal Relations
6. Rhythm of Work Activities
7. General Characteristics of the Job Activities
8. Physical Environment
9. Psychological and Social Aspects of the Job

It is notable that some of these variables and constituent items are not "behavioural" in nature, eg. those characterising physical aspects of the environment. McCormick, Jeanneret & Mecham (1969) note that the variables so listed generally were those which if incorporated in a job "would have some implications in terms of the human characteristics that an incumbent should possess".

In contrast to its predecessor (Checklist of Worker Activities), the Worker Activity Profile introduced scaling. Some of the items were of a checklist nature (ie. used to indicate the presence or absence of the elements in a job), whilst for other elements, scales were provided, these being either general scales or scales constructed for the individual item. Whilst some limited information is available concerning the general reliabilities of the alternative response scales used by McCormick throughout his research and development work, much of the critical decision-making concerning the choice of particular scales for particular items is not presented. In general, it would seem that ratings concerning the "presence/absence" of particular behaviours, the "time spent" in such behaviours, the "part of position" and the "importance" of the behaviour to successful completion of tasks are generally rated reliably, whilst assessments of the "difficulty" of the behaviour/task have notably lower levels of reliability. McCormick (1979) summarises the average reliabilities obtained on test-retest across items for different scales in three studies. Table 1 details this summary of findings.

TABLE 1 THE AVERAGE RELIABILITIES ASSOCIATED WITH ALTERNATIVE RESPONSE SCALES FOR JOB ANALYSIS

RESPONSE SCALE	(a)	(b)	(c)
Task Occurrence	.70-.73	.87	.63-.65
Time spent on task	.61	.83	.62
Part-of-Position (of task)		.83	.63
Importance (of task)			.56
Difficulty (of task)	.47		.35

Key: (a) McCormick & Ammerman (1960)
(b) Birt (1968)
(c) Cragun & McCormick (1967)

It is clear from Table 1 that the analysis of the differential reliabilities of response scales is not complete. McCormick and his co-workers have not used a task "difficulty" response scale in any of the evolving forms of structured job analysis instruments, (the scale with notably lower reliability), but further work is required to distinguish between the acceptability of the other alternative scales.

The Worker Activity Profile was factor analysed in a similar manner to that used on the Checklist of Worker Activities and used in the context of job evaluation by Champagne and McCormick (1964).

Successive applications of the WAP highlighted deficiencies in the instrument and the next phase of research developed the Position Analysis Questionnaire (Form A). This taxonomy consisted of 189 items plus certain optional items reflecting salary rates for the job being analysed. It was organised into the following 6 divisions (McCormick, Jeanneret & Mecham, 1969).

1.	Information Input	(35 elements)
2.	Mediation Processes	(14 elements)
3.	Work Output	(50 elements)
4.	Interpersonal Activities	(36 elements)
5.	Work Situation and Job Context	(18 elements)
6.	Miscellaneous Aspects	(36 elements)

Each of the 189 job elements was rated by job analysts or others using one of the following six scales:

U	Extent of Use
T	Amount of Time
I	Importance to the Job
P	Possibility of Occurrence
A	Applicability
S	Special Code (different scale content for each appropriate item)

McCormick, Jeanneret & Mecham (1969) report an average inter-rater reliability for the PAQ (Form A) items of 0.80.

Form B of the Position Analysis Questionnaire, the present edition, is similar to Form A, but contains 13 job elements which were not present in Form A, and a further 9 job elements which were substantially modified from Form A,. The Position Analysis Questionnaire (Form B) is divided into the following 6 divisions.

1.	Information Input	(35 elements)
2.	Mental Processes	(14 elements)
3.	Work Output	(49 elements)
4.	Relationships with other Workers	(36 elements)
5.	Job Context	(19 elements)
6.	Other Job Characteristics	(34 elements)

In addition to these 187 items there are a further 7 optional items which refer to remuneration. These items are not included in the calculation of reliability figures by McCormick nor any investigator. They are included specifically for applications of the technique in predicting job evaluation "points" for jobs as support data. Applications of the technique in the present research did not gather information in terms of these 7 items. It is clear from the summary of the evolution of PAQ that the approach adopted by McCormick has been to progressively refine his job analysis technique around a behaviural paradigm. This is particularly notable in Form B of the questionnaire where Divisions 1, 2 and 3 are equatable with the Stimulus-Organism-Response Paradigm. Division 4 of the questionnaire is a structured analysis of interpersonal skills as inferred from social setting and the "players" involved. For example, items will ask if any "inter-viewing" is done in the job (Item 103, see Appendix 1) and further whether one has dealings in the job with "Clerical Personnel" (Item 118). Division 5 of PAQ adopts a classical ergonomic perspective enquiring as to whether the job involves excessive heat, vibration, noise, light, etc. Division 6 of the questionnaire focusses on the demands of jobs in terms of psycho-social aspects such as hours of work, mode of dress, coping with repetition, frustration, etc. In total, McCormick has attempted to develop a comprehensive taxonomy of work demands which are relatable to human behaviour and minimise task/context specificity. The experiences of the investigator in administering the technique over a hundred times would support the view that it is a comprehensive job analysis instrument, but clearly one must always question its exhaustiveness. This taxonomic criterion is the most elusive of all and requires constant re-assertion if a technique is to keep abreast of developments within psychology. If, for example, major new evidence indicated the need to further categorise "vibration" into distinct (but context free) forms then this distinction should be included in a future version of the technique. This is the process which characterises the evolution of PAQ to date, and whilst it will always remain partially subjective as to whether particular developments are required, the technique as it stands seems to offer a sufficiently current coverage of issues as to stand application.

Cronbach (1970) notes the considerable problems faced by researchers in content validation and suggests that in many instances it can only be a matter of "judging whether each item, and the distribution of items as a whole, covers what the tester wants to measure". Prien (1977) in summarising the validity studies performed upon PAQ concludes that "it measures what it is supposed to measure", and ignores the distinction between construct and content validity, regarding it as "nebulous and at the moment somewhat arbitrary".

The distinguishing feature of PAQ from many worker-oriented taxonomies of subsets of jobs or subsets of behaviour is that whilst by definition its initial item inclusions are somewhat subjectively decided, psychometric criteria of reliability, discriminability and inter-correlation are used to develop the technique. This is in sharp contrast to many "taxonomies" which fail to incorporate any rigorous assessment of content. It is appropriate therefore to briefly present the findings of McCormick and other researchers with PAQ in psychometric terms.

1.4.1 RELIABILITY

Detailed accounts of the inter-rater reliability issue and findings with PAQ are given in Section 2.1 of this report. It is useful nevertheless to summarise the main form and results of these studies here.

The main objective in using the Position Analysis Questionnaire is to obtain a reliable estimate of a job's demands in the terms which the instrument assesses. To this end the technique can be completed by either "internal" or "external" respondents. Internal respondents would include job incumbents, supervisors, personnel officers, training officers and any other company personnel who could be considered to be "highly familiar" with the demands of the job. "External" respondents are primarily job analysts who have no initial familiarity with the job, but who attempt, through discussion, observation and documentation, to become familiar with the job and thence rate the job in PAO terms. There are clear difficulties in ensuring the familiarity of "external" respondents and the relative reliabilities of various sources of "internal" and "external" respondents have been studied by McCormick, Jeanneret & Mecham (1972); Arvey, Passino & Lounsberg (1977); Taylor & Colbert (1978) and Smith & Hakel (1979). In general the levels of reliability associated with "external" respondents are lower than those associated with "internal" respondents, whilst there seems to be little difference between alternative sources of "internal" respondent. The average inter-rater reliabilities found in studies with PAQ for internal respondents range between 0.59 and 0.89 whilst external respondents' inter-rater reliabilities range between 0.63 and 0.74. There are, however, potential problems associated with self-completion of PAQ by internal respondents in terms of the readability and comprehensibility of the directions and content of the technique (eg. Ash & Edgell, 1975; Smith & Hakel, 1979; Salisbury, 1982). These problems may be moderated with the use of an alternative administration format of PAQ. The technique can be administered in a highly structured interview format to internal respondents in an endeavour to maximise reliability. This form of administration has been utilised in the present research programme and the issues and findings surrounding its efficacy are discussed in Section 2.

1.4.2 JOB DIMENSIONS

An integral component of job analysis with PAQ is the identification of "job dimensions" by the technique. These factor structures of jobs have been extracted by McCormick and his co-workers throughout the evolution of the technique (Palmer & McCormick, 1961; McCormick, Cunningham & Gordon, 1967; Jeanneret & McCormick, 1969; Marquardt & McCormick, 1974). The major hypothesis that has guided this research is that there is an identifiable structure to the world of work, and that this structure can be of utility for various personnel functions.

In essence the factor structure scores derivable from PAQ data are representations of the underlying structure of jobs, and in general reflect "the extent to which the job elements tend to occur in combination as they actually exist in jobs" (McCormick, 1974, p.7). Marquardt & McCormick (1974) conducted the appropriate analyses on data collected for PAQ (Form B) and it is appropriate to summarise the procedures they adopted. A sample of 3700 PAQ (Form B) analyses, stratified to approximate the occupational composition of the USA labour force as expressed by the Dictionary of Occupational Titles and the 1970 Census of Population, was extracted from the data pool of 8,000 PAQ analyses which McCormick had gathered between 1970 and 1974. This sample of PAQ data was subjected to alternative forms of statistical analysis.

As indicated earlier, PAQ (Form B) consists of 6 separate divisions dealing with various aspects of jobs. These divisions are of an a priori nature, in that the various job elements which comprise the questionnaire were originally divided into these divisions to reflect the fact that jobs consist of various phases and take place in various environments. In cognisance of this structure, separate analyses were performed for the job elements within each of the PAO divisions, ie. the job elements (items) used in any particular analysis were those found in only one of the PAQ divisions.

The first five component analyses were performed independently upon the job elements in the first respective five divisions of PAQ. Two separate analyses were performed for the job elements within Division 6 (Other Job Characteristics), since this division contained a group of job elements which were dichotomous rather than interval in nature. Separate analyses were performed therefore on the dichotomous and non-dichotomous job elements.

A further component analysis was performed with all of the PAQ job elements taken together ie. regardless of division. Marquardt & McCormick (1974) term the first 7 component analyses described above as "divisional" analyses. The latter analysis is termed "overall" or "general" analysis. Job elements 188-194 which deal with pay/income and job elements 44, 60, 127 and 181 which are open ended in nature were not included in any of the analyses.

All of the eight analyses performed employed principal components solutions followed by Varimax rotations. The diagonal elements (cells) in the correlation matrices were set at 1.0, and a restriction was imposed that the extraction of components terminate when the eigenvalue became less than 1.0. In summary the analyses performed were traditional factor analyses as outlined by Child (1970).

Table 2 details the percentages of variance within each Division accounted for by the principle components for each division. A total of 30 divisional job dimensions were extracted.

TABLE 2 A Summary of the Divisional Principal Components of PAQ (Form B)

PAQ Division Title	No. of Factors	% of Variance Accounted
Information Input	5	52%
Mental Processes	2	61%
Work Output	7	55%
Relationships with other Persons	6	57%
Job Context	3	54%
Other Job Characteristics (non-dichotomous)	3	51%
Other Job Characteristics (dichotomous)	4	53%

Source: Marquardt & McCormick (1974, p.7-25)

The principal components analysis of the 168 job element correlation matrix computed using all of the job elements except the dichotomous ones yielded a total of 14 general job dimensions which accounted for 54% of the variance. Appendix 2 details the titles of the 30 divisional job dimensions of PAQ (Form B). Appendix 3 details the titles of the 14 general job dimensions of PAQ (Form B). The composite factor loadings for each job element for each dimension are detailed in Marquardt & McCormick (1974).

The labelling of statistical factors is a difficult task but Marquardt & McCormick (1974) felt that "the job dimensions which resulted from the study seemed, for the most part, to be logical, in that the job elements which loaded substantially on any given job dimension seemed to form recognisable combinations of work characteristics". As such the authors concluded that these 2 sets of job dimensions "characterise or tap the structure underlying the domain of work."

If job dimensions are to have generality beyond the specific data from which they are derived, they should represent the groupings of job characteristics of jobs in general. The effects of minor deviations in the stratification of jobs across industralised Western countries upon item intercorrelations and thence resultant factor structures is not quantifiable. Whilst in the long term, the desirability of British workforce job dimensions is not questioned, it is the view of the investigator that the factor structures derived from the large sample of jobs analysed by Marquardt & McCormick (1974) are representative of the structure underlying the domain of work in Britain.

Predictive validity studies of PAQ job dimensions have been conducted over many years across a wide variety of criteria. McCormick (1974) summarises the applications of PAQ conducted up to that time. Section 4.1 of this report discusses in detail the "meaning" of job dimensions established through predictive validity studies. Section 3.1 of this report focusses upon a particular subset of studies using PAQ job dimensions to estimate (predict) the aptitude "requirements" of jobs. It is appropriate, nevertheless, to briefly outline the range of studies which have utilised PAQ job dimensions.

McCormick, Denisi & Marquardt (1974) conducted a study to predict job compensation rates from PAQ (Form B) job dimensions and identified cross-validated multiple coefficients of between +0.64 and +0.68. These figures were somewhat lower than those obtained by Mecham & McCormick (1969) with Form A primarily because the latter study used data collected over four years (necessitating adjustment) and the "peculiarly volatile nature of the economy of that time may have resulted in substantial mis-alignment of some of the jobs in terms of relative position along a compensation scale". A similar study was conducted concerning Naval Compensation Rates by Harris & McCormick (1973) with a resultant shrunken multiple regression of +0.89. A study by Taylor (1978) predicting job evaluations within a single large organisation found a shrunken multiple r of +0.93. A paper by Calitz, Hilaael, McCormick & Peters (1974) adds another facet to the predictive validity of PAQ. Work satisfaction was predicted in a multiple regression format with r = +0.70. The association of PAQ job dimension scores with occupational stress has been studied by Shaw & Riskind (1983).

As noted in the introduction to this review, the grouping of jobs into "families" with reasonably common characteristics has been postulated to serve various purposes including personnel selection, vocational counselling and manpower planning. Denisi & McCormick (1974) conducted two job-clustering studies with a view to developing job families. One study, using the stratified occupational sample drawn by Marquardt & McCormick (1973) used the clustering procedure developed by Tryon & Bailey (1970) upon scores on the 14 general job dimensions of PAQ. The analysis resulted in 33 clusters. The second study used a sub-sample of 800 jobs from the above and used a hierarchical grouping procedure upon 21 of the 30 divisional job dimensions to yield 42 clusters. McCormick (1974) notes however that in the light of the conflicting statistical evidence with regard to the respective merits of the alternative procedures that "further experimentation in the formation of job clusters would be in order before it might be possible to identify a "master" set of job clusters that might have widespread utility".

A series of studies conducted by Taylor (1978), Taylor & Colbert (1978) and Colbert & Taylor (1978) constitute a useful subset of studies concerning job grouping. Taylor (1978) examined the construction of job families within a large insurance company based upon the divisional and general job dimensions of PAQ. The author used Form B of the questionnaire. It seems surprising and not clarified that he should use the factor loadings developed by Jeannearet & McCormick (1969) for Form A of the questionnaire, rather than those derived from a much larger stratified sample of the American work force specifically for Form B by Marquardt & McCormick (1974). The legitimacy of the resultant dimensions is therefore questionable. The author then used Cronbach & Glaser's (1953) distance measure D^2 to determine inter-job dimension profile similarity and subjected the data to Ward & Hook's (1963) hierarchical grouping analysis. Only 17 out of the 27 divisional dimensions were used, 10 were omitted due to either having fewer than 5 items or having a combined rating reliability of less than 0.75. All of the general dimensions were included.

Six "groups" were identified from both the analysis of the component dimension and the analysis of the overall dimensions. Only 4 of the 76 jobs were found to belong to no job family. A subjective examination of the data suggested that the empirically established job subgroups had meaning on two principal constructs, job content and job level. It was concluded that "job groups formed on the basis of PAQ scores were organisationally meaningful".

Taylor & Colbert (1978) upon the basis of the first study collected data upon 325 jobs from the companies' regional offices. Given the increased sample size, it became feasible to derive job dimensions based specifically on the jobs of interest. It was believed that job families formed on the basis of company-specific job dimensions would be even more homogeneous than the job families formed in Taylor's study. Thirteen interpretable dimensions were identified. The same procedure detailed above was used to form job families, and identified 13 "families" among the jobs. The authors concluded that the formation of families of jobs appeared to have achieved the desired results, ie. more homogeneous clusters of jobs than those of Taylor's (1978) study using divisional and general dimensions of PAQ.

The final study in the series was conducted by Colbert & Taylor (1978) to determine the generalisation of selection test validity. Three of the thirteen job families were used for the research. It was hypothesised that:-

"1. Different predictors would be found valid for different job families.

2. Prediction equations developed on one job within a job family would be found to cross-validate at a statistically significant level when applied to other jobs within the same job family.

3. Prediction equations would be found to yield greater amounts of prediction error when applied to a cross-validation sample drawn from a different job family than would be yielded if the cross-validation sample were drawn from the same job family."

Colbert & Taylor (1978, p.356)

A battery of three commercially available aptitude tests were administered for a period of 18 months to applicants for clerical positions within the company's regional offices. They were the Verbal Comprehension, Numerical Speed and Accuracy, and Visual Speed and Accuracy tests from Ruch & Ruch's (1963) Employee Aptitude Survey. The tests were not made available to employment personnel for use in selection decision-making. Performance data was acquired for all new clerical staff after three months, and for a subsample, after nine months on the job. Because requirements for acceptable job performance varied somewhat among the three job families, the criterion items were analysed to determine their applicability to the various families. As a result, the final criterion differed somewhat in composition between families. Predictive validity was determined by developing regression equations for two-thirds of the observation within each job family and cross validating these equations on the remaining one-third of the observations. Different predictors were found valid for the different job families. Further it was demonstrated that regression coefficients developed on one job within each family could be successfully applied to other jobs within the same family. Analysis of variance of the absolute values of prediction errors resulting from each validation operation revealed that prediction error was greater for equations applied across job families than for equations applied within job families. The authors concluded that the studies had "demonstrated that job analysis information derived from PAQ can be used to form homogeneous job families within which selection test validity can be generalised". Some of the issues concerning the meaning and assessment of job similarity and differences in PAQ terms are discussed in Section 4.1 and 4.2 and an empirical investigation of the transfer implications of PAQ job similarity is reported in Section 4.3.

A major subset of predictive validity studies of PAQ job dimensions have addressed the issue of synthetic validation. It has been noted that the reliance upon empirical validation to establish the ability requirements of jobs constitutes a major barrier to the formulation of transfer hypotheses between jobs in ability/trait terms. Although the studies utilising PAQ to synthetically derive attribute profiles do not have this ultimate objective in mind, they clearly have a bearing in the present context. These studies are discussed in detail in Section 3.1.1.3. Marquardt & McCormick (1974) utilised PAQ job dimensions in multiple regression format to "predict" General Aptitude Test Battery scores of samples of job incumbents. Median multiple correlations for predictions of mean test scores and potential cut-off scores (one standard deviation below the mean of the incumbents of the job in question) were +0.73 and +0.73 respectively for divisional job dimensions. The authors concluded that the results were comparable with those previously reported by McCormick, Jeanneret & Mecham (1972) using Form A of the question-naire. Marquardt & McCormick (1974) concluded that the use of such structured types of job analysis procedures would "seem to provide the basis for establishing personnel requirements for individual jobs directly from job data, thereby eliminating the need for conventional test validation procedures". A similar study by Mecham (1977) utilised PAQ divisional job dimensions to estimate GATB mean test scores and identified a median multiple regression of +0.73. McCormick, Denisi & Shaw (1979) extended the approach to 5 commercially available aptitude tests for General Intelligence, Verbal Aptitude, Numerical Aptitude, Spatial Aptitude and Clerical Perception and obtained correlations of 0.75, 0.71, 0.67, 0.70 and 0.52 respectively between PAQ predictions of mean GATB test scores and the "equivalent" mean test scores. Whilst the validity co-efficients obtained in these studies are on the whole quite respectable, the "shot gun" approach with its lack of construct validity to explain the findings beyond the observation that there is some mechanism of association between job behaviours and scores on cognitive ability tests, is questionable. This issue is further discussed therefore in Section 3.1.1.3.

The studies of the predictive validity of PAQ job dimensions detailed above have demonstrated that the dimensions have some psychological correlates. The approach seems able to differentiate between jobs in terms which have meaning. A series of papers have specifically addressed the issue of assessing similarity and differences (ie. discriminating) between jobs in PAQ terms. Much of McCormick's work, like the vast majority of psychometric research, utilises correlation as an overall index of relationship. There are many instances however where more detailed discriminations may be sought between jobs and the need for a statistical technique to identify " differences" between jobs (or "indices" of similarities between jobs) has become the subject of statistical study. The observation that jobs in general as described by

PAQ are associated with certain qualities/constructs is a different issue from determining the specific meaning of differences between particular jobs. This latter issue is more appropriately studied with the use of an analysis of variance design. Since several ratings of each job are obtained (in order to obtain a reliable estimate of the "true" scores for the job), it is possible to contrast different jobs using a two-way repeated measures analysis of variance design. In such a design within group variance is provided by alternative raters and the design is repeated across job dimensions (or items, or any set of derived scores from PAQ). This design was first utilised by Arvey & Mossholder (1977) with PAQ. The authors note that the power of the technique to identify "differences" between jobs is a function of the respective reliabilities of job ratings (within group variance). In an endeavour to maximise the power of the technique in applications, the authors suggest the adoption of a minimum inter-rater reliability criterion. In such a context, inter-rater reliability is most appropriately calculated by the intra-class correlation coefficient (Winer, 1971), and the authors suggest a minimum criterion co-efficient of 0.7. The issue of inter-rater reliability (and the use of the intra-class correlation coefficient) is discussed more fully in Section 2.1 of this report. The application of this approach (and the general adoption of analysis of variance to contrast jobs) sheds light on the discriminability and face validity of PAQ assessments. A range of such applications of PAQ were conducted as part of the Grouping of Skills research programme by the investigator, and are reported more fully in Section 4.1 of this report. In general it may be concluded that this form of analysis yields a great deal of complimentary information to that obtained through the correlation of job scores with other constructs.

1.4.3 ATTRIBUTE-ITEM LINKAGE

McCormick and his co-workers have invested a large research effort into the establishment of "links" between PAQ item content and information of a trait nature. (eg. Mecham, 1969; Marquardt, 1972; Shaw & McCormick, 1976). These studies constitute an alternative basis for the establishment of the ability requirements of jobs using "synthetic validation", to that outlined earlier using PAQ job dimensions (eg. McCormick, Jeanneret & Mecham, 1972; Marquardt & McCormick, 1974). Ratings of the "relevance" of various attributes (traits) to each PAQ item were obtained by Mecham (1969) for Form A of PAQ, and extended by Marquardt (1972) for Form B of the questionnaire. There are a wide variety of alternative techniques for "assembling" attribute profiles to represent the ability requirements across complete jobs from this data base (Shaw & McCormick, 1976). This whole issue is of extreme importance to the current research. If reliable and valid estimates of the abilities of job incumbents can be established synthetically using PAQ, then job "similarity" can be expressed in ability terms without the need for empirically establishing the ability requirements for each job. Three alternative "assembly" techniques are examined in the current research and are evaluated in terms of their reliability in Section 3.2, and in terms of validity in Sections 3.3 and 4.3 of this report.

The three techniques of assembling attribute profiles are referred to as "additive", "cross-product" and "critical behaviour" approaches and the procedures associated with their calculation are summarised in Appendix 4.

1.4.4 ANGLICISATION

The Position Analysis Questionnaire (Form B) was developed in the United States. Whilst the technique is readily applicable within industrialised Western countries, certain minor alterations were required before using the technique in the current research programme. The spelling of certain words was altered from the American spelling to the English. For example the following anglicisations of spelling were made:- tire - tyre; behavior - behaviour; color - colour; theater - theatre. A second form of anglicisation concerned job titles. For example, the term "janitor" was changed to "caretaker", "corporate president" was changed to "managing director". Two items in the questionnaire with special codes, ie. with unique response scales, required the anglicisation of the scales. Item 46 concerning education, required alterations to the British equivalents, eg. "Less than high school diploma" to "No examinations taken" and "High school diploma" to "CSE or 'O' levels". Item 184, concerning Responsibility for Material Assets required alterations from American to British currency. None of the alterations were considered contentious or likely to distort the job dimension or attribute loadings associated with the original item forms. The anglicised form of the questionnaire is reproduced in Appendix 1.

1.4.5 A SUMMARY OF THE SCORES DERIVABLE FROM PAQ (FORM B)

The anglicised form of PAQ (Form B) has been used throughout the current research programme. It is apparent from the brief outline of the development and background of the Position Analysis Questionnaire that there is a wide variety of terms associated with the technique. It is appropriate therefore to re-cap briefly the form and functions of these terms.

PAQ (Form B) has 187 "items" (sometimes referred to as "job elements"). These items are assessed by various "response scales". The majority of items are assessed by the scales "extent of use" or "importance". There are 6 point rating scales from '0' to '5'. Where there is a unique rating scale associated with a particular item, this scale is referred to as a "special code". Two forms of factor analyses have been performed on PAQ. Where factor analyses were performed separately upon each of the 6 sections ("divisions") of PAQ, the resultant 30 factors are referred to as "divisional job dimensions". The factor analysis of all the items in PAQ yielded 14 factors which are referred to as "general job dimensions" or "overall job dimensions". The dimension scores for each job analysed are calculable by multiplying the appropriate rating scale by the corresponding factor loading and summing across the constituent items of each dimension. The final score is expressed as a percentage of the total possible score for that dimension. Ratings of the relevance of 76 traits were obtained for each PAQ item. These traits are referred to generally as "attributes", and include attributes of an "aptitude" nature (which include cognitive and psycho-motor abilities), and attributes of a "personality or temperament" nature. There are three main approaches for the "assembly" of the total "attribute profile" or "ability requirements" of each job. These three approaches are referred to as "additive", "cross product", and "critical behaviour" techniques. The calculations implicit in the scoring of attribute profiles by these three techniques are summarised in Appendix 4.

The scoring of each rating of a job obtained with PAQ clearly takes a considerable time and some skills of interpretation. The reader is urged to study the Questionnaire as listed in Appendix 1; the Divisional and General Job Dimension Titles in Appendices 2 and 3; and the list of 76 attributes associated with the technique in Appendix 5.

1.5 THE RESEARCH STRATEGY AND STRUCTURE OF THIS REPORT

The review of theories of the process of transfer has revealed that since the cognitive structures of individuals are ultimately unique; at best, some form of "representation" of the common qualities of the cognitive structures of sets of job incumbents could be assessed to formulate transfer predictions. Assessing the "similarity" between jobs should be made in terms which make psychological sense (ie. have construct validity), are appropriately assessed (ie. have content validity), are reliable and capable of discriminating between jobs, and ultimately have been shown to be predictive of transfer effects.

Transfer predictions in occupational psychology have traditionally been made using statistical representations of cognitive structure which are relatively stable over time, ie. abilities/traits. Whilst these representations meet many of the criteria detailed above, they are conventionally related to the transfer task criterion in an empirical paradigm. In other words, the "ability requirements" of jobs are established through the context-specific validation of particular measures with job performance criteria. If it were possible to non-empirically establish the ability requirements of jobs, then jobs with "similar" so-established ability requirements might be compared and postulated to have transfer reciprocity.

An alternative content base upon which to formulate transfer predictions might usefully address the behavioural aspects of jobs, and generate representations of the "skill" aspects of cognitive structure. Task-oriented descriptions of jobs are not readily comparable, and it has been suggested that a worker-oriented approach might be more appropriate.

A technique which has evolved in America over the last 25 years appears to offer potential in generating both the "ability require ments" of jobs and representations of the "structure" of jobs in behavioural terms. This technique is the Position Analysis Question naire. Whilst the technique has not been previously applied specifically in terms of the present issue, it has demonstrated utility in related occupational psychology areas and has a data base which could not otherwise be attained without many years of work. This technique has been chosen for study therefore in the present context. Whilst the investigations have used PAQ, it is anticipated that many of the considerations highlighted in the studies will have more general relevance to the issue of using current-job descriptions to formulate transfer predictions.

A schematic representation of the studies conducted in the present research programme is reproduced in Figure 2.

It can be seen in Figure 2 that there are two broad applied problems; the context-specificity of the empirical validation of traits, and the non-incorporation of attainments/skills. The current approach treats as a starting point therefore, the analysis of job behaviours. Whilst PAQ has been extensively psychometrically evaluated, there is a potential limitation of inter-rater reliability associated with the self-completion of the questionnaire. This issue is discussed, and a study conducted to contrast the inter-rater reliabilities associated with a self-completed and structured-interview presentation of information (see Sections 2.1 and 2.2). The interview presentation format was subsequently adopted throughout the research, and since many administrations of the technique were conducted, summaries of the inter-rater reliabilities associated with this approach for items, dimensions, and attribute profiles are presented and discussed in Section 2.3.

In order to synthetically (non-empirically) establish the attributes associated with particular job performances, three steps are required. Firstly, associations must be established between each item of PAQ and a range of attributes. This data base has been developed by Mecham (1969) and Marquardt (1972). Secondly, techniques of "assembling" overall attribute profiles must be developed. Section 3.1 discusses three alternative approaches to this issue. Section 3.2 contrasts the resultant reliabilities of the overall profiles associated with these three approaches. Section 3.3 contrasts the extent to which these three techniques can "predict" the mean test scores of job incumbents of various jobs. Thirdly, it is necessary to determine whether a profile of attributes generated by PAQ represents the "actual" ability requirements of a job. This issue is discussed and studied in Section 3.4. In total, these three steps are an evaluation of the issues associated with synthetic validation, and a determination of whether PAQ can generate representations of the abilities required by jobs (and hence held by incumbents).

Figure 2 A Schematic Representation of the Steps required to Overcome the Applied Problems of Validity Context Specificity and Non-Incorporation of Attainments/Skills

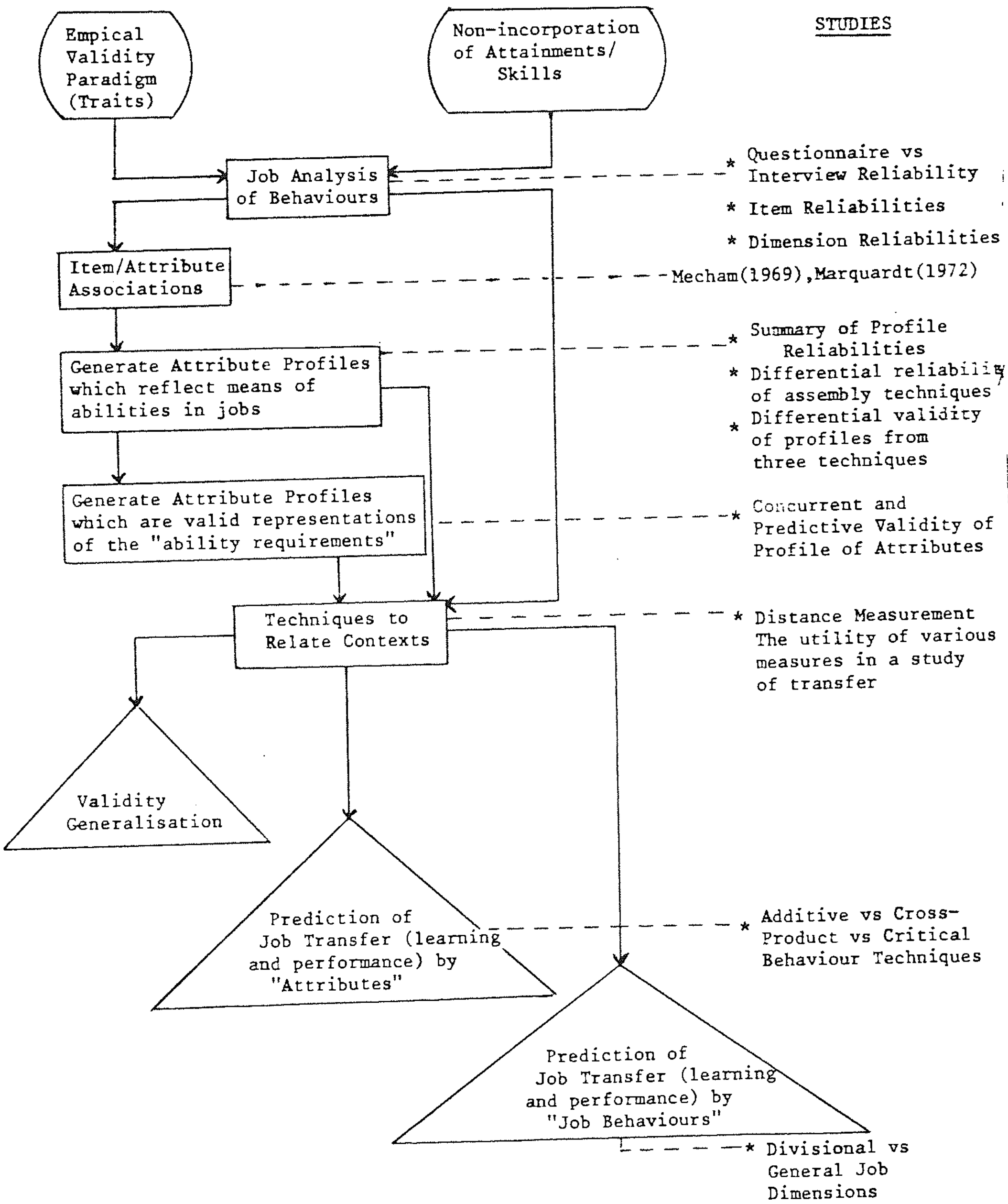


Figure 2 further demonstrates that the generation of the two alternative content bases to formulate transfer predictions (ie. ability descriptors and behaviour descriptors), subsequently requires the measurement of "similarity" between jobs in these terms. Section 4.2 discusses the psychological assumptions implicit within alternative profile-similarity measures. A by-product of the studies concerns the concept of validity generalisation, ie. the generalisation of the validities empirically established for a particular job to other "similar" jobs. This issue has become the focus of recent study in occupational psychology, and although not of direct relevance to the present research programme, is a clear output from the studies. The two major outputs from the research are information on the utility of predictions of the performances of a range of job groups on novel tasks, based on the "similarity" between the task demands and each job's current demands in "attribute" terms and "job behaviour" terms, ie. the "prediction" of transfer effects. This study is discussed and described in Section 4.3. Section 5 of the report discusses the extent to which PAQ can generally constitute a "technology" of synthetic validity, ie. non-empirically establish the ability demands of jobs. Further, a discussion is held concerning the extent to which such descriptors and those associated with job behaviours themselves can constitute bases to generally predict transfer effects. The implications of the results for the establishment of "families" of jobs in PAQ terms are also discussed.

SECTION 2

THE ADMINISTRATION AND RELIABILITY OF PAQ

2.1 THE RELIABILITY OF JOB ANALYSIS

The starting point in a research programme aimed at overcoming the context-specificity of trait-job relationships and incorporating 'job skills' has been highlighted as Job Analysis (see Figure 2). Whilst the current research programme has adopted an "off-the-shelf" technique as a vehicle for study (with a comprehensive item development history), the issue of the reliability of job analysis is of such general importance, that it must serve as the first area of evaluation.

Item development can be regarded as having two interacting considerations. Firstly, the item content itself, (determined through construct and content validity), and secondly the reliability of items. The interaction is apparent where the construct under scrutiny is, for example, so vague and nebulous that it is difficult to obtain an adequate estimate of the 'true' score for the item. Assessments made by the same respondents over time may lack agreement since they may have "interpreted" the construct differently over the two applications. In psychometric measures of the individual this aspect of reliability (ie. test-re-test) is the form of reliability study of paramount importance. The same problem (lack of agreement over applications), may be apparent in the administration of psychometric measures of constructs when assessed by several respondents. If the item content is vague and nebulous then assessments by different respondents may lack agreement since they may each have "interpreted" the construct differently. This aspect of reliability (ie. inter-rater) is the form of reliability study of paramount importance in the assessment of job behaviours. Reliability in the absence of validity is only an assessment of "agreement" of opinion. It is theoretically possible for raters to concur on an assessment but for them to be 'wrong'. Where reliability studies are conducted in conjunction with validity studies, then ratings are regarded as assessments of the 'true' score of the construct.

The research conducted by McCormick and his co-workers, and several other investigators, on the inter-rater reliability of PAQ, is seeking to establish the ability of the technique to estimate the "true" scores of jobs in PAQ terms. It is appropriate therefore to summarise the psychometric model of inter-rater reliability and review the reliability findings for PAQ.

2.1.1 INTER RATER RELIABILITY

The objective in using a structured job analysis procedure (such as PAQ) is to obtain the 'true' scores of each job analysed. There is statistically, however, a universe of possible observations "of the same kind" that can be made to determine the true/universe score. In the present context, there are a universe of raters who can be considered highly familiar with the demands of a particular job. If a single observation were to be regarded as representing the universe score then one would be generalising. The degree to which one would be generalising depends upon the error of measurement, ie. the difference between the true/universe score and a single observation. It is not possible to know a true/universe score and so it is not possible to determine the error of any particular observed score. It is possible however, to estimate how large such errors tend to be. To investigate the magnitude of errors there must be 2 or more observations. The mean of this distribution of scores can constitute an estimate of the true universe score.

Lord & Novick (1968), Cronbach (1970), Cronbach et al (1970) and Stanley (1970) have written extensively on the mathematics of current theory concerning the statistical relationship between the 'true' score and the score that can be obtained through measurement. In brief, the "components of variance" can be estimated. An observed score is made up of components. The following analysis of the variance components of ratings with PAQ follows Cronbach's (1970) analysis (p. 158-160). Where X_{ir} is the observed score for item i under condition r (the conditions here are alternative ratings), M_i is the universe score for i (ie. the average of X_{ir} over all conditions). M_r is the mean score for condition r, the average of scores in condition r for all items in the questionnaire. Where M is the mean score for all observations (ie. the average score over all items and ratings), then the observed score X_{ir} is the sum of several components or effects.

$$X_{ir} = M + (M_i - M) + (M_r - M) + (\text{residual})$$

The first term (M) is the general average of PAQ scores, a baseline against which other effects are judged. The "item effect" $(M_i - M)$ describes the difference between i and the average item. If i is rated more highly than average then $M_i - M$ will be positive. The "rater effect" $M_r - M$ indicates whether rater r tends to produce high or low scores. The "residual" includes any influence that makes a particular observed score higher or lower than would be predicted from knowledge of the corresponding M_i and M_r.

It is clear from the above breakdown of variance components that a two way repeated measures analysis of variance procedure yields the appropriate scores. Arvey & Mossholder (1977) specifically advocate this approach in calculating the reliability of PAQ ratings for particular jobs. Winer (1971) utilises a similar worked example to demonstrate computational procedures.

Table 3 illustrates the form of analysis of variance summary table yielded by analysing ratings of n items (aspects) of the question-naire.

Table 3 Analysis of Variance Summary Table Format for calculating Reliability

Source of Variation	SS	d.f.	MS
Between items	SSb.items	n-1	MSb.items
Within items	SSw.items	n(k-1)	MSw.items
Between judges	SSb.judges	k-1	MSb.judges
Residual	SSres.	(n-1)(k-1)	MSres.
Total	SSb.items + SSw.items	(n-1)+(n(k-1))	

Coefficient "alpha" (Cronbach, 1970) which is also referred to as the reliability of the mean of k measurements (Winer, 1971) indicates how well scores obtained by testing under k conditions (here, utilising k raters) represent universe scores.

i.e. $\alpha_k = \hat{p}k = \dfrac{k\hat{\bar{\Theta}}}{1 + k\hat{\bar{\Theta}}}$

where $\hat{\bar{\Theta}}$ is the unbiased estimate of Θ and

$$\hat{\bar{\Theta}} = \frac{\text{M.S.b. items} - \text{mMSw. items}}{\text{kmM.S.w.items}} \quad \text{where } m = \frac{n(k-1)}{n(k-1) - 2}$$

(after Winer (1971, pgs. 283-289)

This estimate indicates how well the mean of the current sample of k ratings can be expected to correlate with the mean of another sample of k ratings "of the same kind". It is the best estimate of the true/universe score. As k increases the coefficient asymptotically approaches 1.00.

The intraclass correlation (r_1) indicates how well a score obtained by testing under 1 condition (here, utilising only one rater) represents the universe scores. It is the reliability of a single measurement. It is given by:-

$$r_1 = \frac{\hat{\bar{\Theta}}}{1 + \hat{\bar{\Theta}}} \qquad \text{(after Winer (1971, pg. 287))}$$

The intra class correlation is an index of reliability which can be compared with other coefficients of reliability since it is independent of k (the number of ratings). There is however no cut-off point which can allocate coefficients as "acceptable" or "un-acceptable". Arvey & Mossholder (1977) regard a value of 0.7 as a minimum criterion when attempting to scale the 'similarity' of jobs with subsequent analysis of variance and strengths of effects analyses. This value may be loosely regarded therefore as the minimum acceptable level of reliability. In practice, where measuring instruments have intraclass correlations below this level, increases in the number of conditions (k) can generate acceptable reliabilities for the mean of k ratings. In many contexts it is the ultimate reliability of the mean estimate which is of importance rather than the reduction in statistical power which would be apparent in subsequent analysis of variance applications.

Anastasi (1976), Cronbach (1970) and Nunnally (1978) note that these formulae constitute a more generalisable approach to the study of reliability than the computation of product moment correlation coefficients between ratings, because the procedure gives more information (with a complete breakdown of variance components), and can be applied when there are more than two observations. The procedure has now gained prominence in psychometric research.

All sets of ratings for each job analysed with PAQ in the course of the present research have been evaluated with the above procedures. A summary of the overall reliability findings of the current research in these terms is presented in Section 2.3. Several specific aspects of reliability have also been investigated. The procedure has been employed to determine whether there is differential reliability for alternative presentation formats of the questionnaire (Section 2.2), and differences in the reliability of alternative derivation methods for establishing attribute profiles from the questionnaire (Section 3.2).

In discussing the reliability of PAQ, it has to be borne in mind that the present research was adopting the instrument (item content and directions) as a research tool in its own right. Alterations to item comprehensibility and readability are utilised by psychometricians in the development of a psychometric instrument in order to maximise reliability. The current research could not influence the reliability of results through item analysis and development, since this would necessitate the abandonment of the job dimensions/factor structure and attribute data base established for PAQ and the focus of the current research. Several aspects of reliability are however rooted in decisions concerning the sources of respondent, the presentation format of the questionnaire, and the assessments made upon items and derived scores from the questionnaire. Each of these aspects was examined in the current research.

2.1.1.1 Sources of Respondents for PAQ Ratings

It has been noted that ratings of job content can be obtained from respondents considered to be "highly familiar" with the demands of the job in question. Whilst familiarity might be considered optimal with "internal" respondents such as job incumbents, supervisors and other in-company personnel, it is also possible to employ "external" job analysts to evaluate a job through initial observation and discussion and thence complete the questionnaire. This latter form of analysis does however invoke several reliability considerations. The dynamics of person perception, observer characteristics and interviewee characteristics are additional sources of bias in this form of data gathering (Randell, 1978).

Arvey, Passino & Lounsbury (1977) studied the issue of bias in PAQ ratings as influenced by sex of external analyst and sex of incumbent. Twenty two males and thirty five females were given training in the use of PAQ and subsequently analysed the job of administrative assistant presented through a verbal narrative and colour slide stimulus format. Male and female 'incumbents' (matched on attractiveness and voice quality) were used in the study. Analyses of variance results indicated that although sex of the job incumbent did not influence the PAQ scores, sex of the analyst showed a marginal, but consistent, effect. Female analysts gave relatively lower PAQ scores to the job than male analysts (regardless of the sex of incumbent) on 22 PAQ job dimensions. The authors conclude that both male and female job analysts might be necessary when carrying out job analysis. Two aspects of the study are worthy of comment. Firstly, in examining response bias in terms of job dimensions rather than PAQ items the study was a less powerful test of potential bias than could have usefully been conducted. The reason for this is that the reliability of job dimension scores is generally higher than that for item scores since the former are composites of items which average across error. It is probable therefore that a higher degree of response bias at the item level could have been identified. Secondly, the analysis was conducted across "32 job dimensions". These dimensions are, however, two complementary sets of data. Jeanneret & McCormick (1969) conducted two sets of principal component analyses upon PAQ questionnaire results. 5 general/overall job dimensions resulted from principal components analyses across the 6 divisions of PAQ. A further total of 27 divisional job dimensions were yielded by principal component analyses within each of the 6 divisions. These two sets of data have differential reliabilities due to the number of composite items within them and the differential reliabilities of items which load upon them. The failure to discriminate between these higher and lower order factor structures make discussion of their results difficult. Again a more powerful test of the potential response bias would have been possible if the analyses of variance had been conducted across the 27 divisional job dimensions and 5 general/ overall job dimensions separately. The study does at least demonstrate that response bias is likely at the divisional job dimension level (since significant findings were obtained for 22 "dimensions", which must by definition include divisional job dimensions though not necessarily general job dimensions). In summary it would seem appropriate to hypothesise that the use of external analysts could lead to generally lower levels of reliability in the analysis of jobs. McCormick, Jeanneret & Mecham (1972) present reliability findings for PAQ (Form A) which are broken down in terms of analyst. These data are reproduced in Table 4.

It can be seen from Table 4 that the average reliabilities (product-moment correlations between pairs of raters) associated with two analysts, one analyst and one supervisor, and one analyst and one incumbent are lower than that found for jobs analysed by one supervisor and an incumbent. In general therefore it would seem that there might be potential problems in ensuring the "familiarity" of external analysts with the job, and additional problems of interviewer bias in relying upon their perceptions and evaluations of particular incum-bents and their duties. The administration format utilised in the present research <u>does not</u> adopt external analysts as sources of information.

Table 4 Averages of Coefficients of Reliability for Individual Jobs analysed with PAQ by Pairs of Analysts (from McCormick, Jeanneret & Mecham, 1969)

Pairs of Individuals Analysing Same Job	Number of Pairs	Average Reliability Coefficient
Two job analysts	44	.74
One-job analyst-one supervisor	4	.83
One-job analyst-one incumbent	4	.84
One supervisor-one incumbent	10	.89
All pairs combined	62	.79

It is possible, however, that differential reliability may result from the utilisation of alternative "internal" respondents, eg. job incumbents as opposed to supervisors. A study by Smith & Hakel (1979) examined the issue of differential reliability associated with data sources using the conventional questionnaire administration format of PAQ (Form B). 25 jobs in the State of Ohio Government were analysed by pairs of incumbents, pairs of supervisors, pairs of external job analysts, and pairs of students (working solely from job titles or written job specifications). The product moment correlation between ratings was used as the measure of reliability. The results of their study are presented in Table 5.

There were no significant differences between the correlations obtained for alternative pairs of raters and the authors conclude that "there seems to be little difference between job incumbents, job supervisors and job analysts in terms of their ability to reliably analyse a job using the PAQ".

Table 5 The reliabilities of alternative data sources for 25 jobs analysed with PAQ (Form B)
(From Smith & Hakel, 1979)

Judge Category	No. of Pairs	Mean Reliability Coefficient	Range
Job Incumbents	42	.59	.28 to .83
Job Supervisors	45	.63	-.07 to .84
Job Analysts	33	.63	.47 to .86
Students (titles only)	72	.51	.17 to .79
Students (job specification)	72	.49	.10 to .76

A study by Taylor & Colbert (1978) using 427 pairs of "raters" to assess 325 jobs on State Farm Insurance Companies with PAQ (Form B) utilised any combination of job incumbents and supervisors and established a mean product-moment correlation of 0.68 between "internal" raters in general.

In the present research, ratings have similarly been obtained utilising supervisors and incumbents. The only restriction adopted in this research has been that the respondent could be considered to have been "highly familiar" with the job's demands for a period of more than one year. These are several areas which warrant additional investigation. Research addressing the problem of assessing internal respondents' "familiarity" with a job's demands and related subject variables is advocated. The restrictions implicit in applied research have led to the adoption of "internal" respondents whose only qualification is a high degree of familiarity with a job's demands assessed solely through the length of time that they have had a "working knowledge" of the job.

2.1.1.2 The Presentation of Information to Respondents

The utilisation of "internal" respondents for the analysis of jobs places an increased emphasis upon the comprehensibility of item content and directions. External analysts can be comprehensively briefed on the meaning and examples of each questionnaire item, and have a thorough grasp of the questionnaire directions. In the majority of conventional applications of PAQ, the questionnaire is being completed by respondents without prior training/familiarisation. The item content and directions are therefore the only information available to such respondents, and whilst McCormick and his co-workers have devoted considerable research effort towards item/scale analysis and development (eg. McCormick & Ammerman, 1960; Cragun & McCormick, 1967; Birt, 1968), there are potential limitations to inter-rater reliability implicit in the self-completed questionnaire format of administration. Specifically two issues are of relevance: readability and comprehensibility.

A study by Ash & Edgell (1975) for example, examined the readability of PAQ directions and questions. Readability measures assess factors such as the commonness of words, or whether words used in the text appear on a list of familiar words; word length, or the number of letters or syllables; and sentence length. Ash & Edgell (1975) evaluated PAQ in terms of four different readability indices which placed their relative emphases upon the above factors in different ways. The findings uniformly demonstrated that the readability level of both PAQ directions and question content was equivalent to American college students or college graduates. The authors conclude that respondents could therefore suffer from errors of interpretation unless they have the appropriate level of reading ability.

A similar study was conducted by Salisbury (1982) upon one of the six divisions of the Job Structure Profile. The J.S.P. is a modified and enlarged anglicised version of PAQ being developed by the University of Aston. The second division of the JSP addresses the decision making and information processing activities in jobs and was analysed by Salisbury in terms of readability. Four indices of readability were calculated and the results are summarised in Table 6.

Table 6 Reading Age Levels for Division Two of the J.S.P. from four readability indices (from Salisbury, 1982)

Readability Index	Reading Level (in years)
Flesch	19
Dale-Chall	College (19-21)
SMOG	19
FOG	22

It can be seen from Table 6 that the reading level associated with the item content and directions of the questionnaire are equivalent to those found for university undergraduates and are con-siderably higher than the reading ability of the average adult. Indeed one may reasonably postulate that the levels of readability of incumbents of jobs with varying levels of skill demands will relate to the distribution of reading ability of the adult population. In other words, in instances where PAQ or JSP is administered in a self-completed format to incumbents of unskilled jobs, the reading ability potentially associated with such incumbents would create major problems in completion.

A study by Smith & Hakel (1979) examined the reliabilities of ratings obtained from alternative sets of respondents across a sample of 25 government jobs. Job level was crudely equated with salary and this measure used to determine whether mean reliabilities were correlated with salary grade for pairs of incumbents, pairs of supervisors, pairs of external analysts. Correlations, significant at the 0.05 level were found for ratings by incumbents (r = 0.58) and supervisors (r = 0.63). The correlation between salary grade and mean reliability was not significant. The authors conclude that "as job level increases so does the ability of the judges to reliably analyse the job. This is especially true for job incumbents and supervisors" (Smith & Hakel, 1979). There are problems with this study in that item reliabilities probably interact with job level, ie. Higher level jobs might not involve the same job content as lower level jobs. It may be that the reliabilities associated with the items for differential job levels have differential reliabilities. The fact that the correlation for external analysts just failed to reach significance ($r = 0.38$, $p < 0.051$) may however be interpreted as lending some support to the authors' conclusion.

They postulate that language/readability levels vary across job levels is tenable and there are strong a priori grounds to question the efficacy of presenting information and obtaining responses in the questionnaire format, particularly for lower level jobs.

Readability as a term is usually taken as referring to those aspects of text which make it easier to understand (eg. legibility, organisation, syntax, vocabulary and conceptual difficulty) (Harrison, 1980).

Comprehension may be viewed as a two-stage process (Carroll, 1972). It involves the apprehension of linguistic information and relating that information to the wider context. Understanding language therefore not only involves comprehending the words and grammatical structures of a message as linguistic symbols, but also taking account of knowledge, facts or ideas that underlie the message but are not explicitly built into it (Freedle & Carroll, 1972). Comprehension of each item in PAQ is determined in part therefore by the examples/instances cited alongside the construct. These "probes" highlight the unifying principle or dimension being presented. There is a need for research in this area to examine the adequacy of the exemplars/probes for each PAQ item in terms of maximising comprehensibility. The study by Salisbury (op.cit.) on the readability and comprehensibility of JSP made a preliminary examination of this issue. A 'probe-matching' task was devised, so that 30 University undergraduates were presented with one item at a time, and four sets of probes/exemplars (one of which was the "actual" set). Their task was to select what they felt was the most appropriate set for that item. Where more errors occurred for some items than others it was taken as a lack of comprehensibility for those items. A "probe generation" task was also formulated. Items were presented to a further 8 undergraduates, without the probes/ exemplars which normally accompany them. Their task was to generate their own probes for each item, the appropriateness of which was assessed subjectively. The assessment was taken as an indication of the comprehensibility of each item per se. Such studies of readability and comprehensibility are ultimately of concern in questionnaire item and content development. Whilst the current research does not address questionnaire development, it is clear that readability and comprehensibility may be influenced by the format of information presentation used by the experimenter. The static presentation of fixed written items and probe sets may exacerbate problems of readability and comprehension for certain respondents.

An alternative administration format can be proposed. If interviewers (with the appropriate reading abilities) can be trained to become highly familiar with the layout and constructs implicit in the questionnaire, they could be employed to dynamically present the information and record the responses of raters. The issues surrounding the advocacy of such an approach are discussed in Section 2.2.

2.1.1.3 <u>The Inter-Rater Reliabilities of Alternative Derived Scores</u>

It was noted in Section 1.4.5 that in addition to obtaining data upon the scales for items within PAQ, that there are several scores which can be derived from these ratings. The principal component analyses conducted by Marquardt & McCormick (1974) yielded two sets of factor structures. 30 divisional job dimensions and 14 general job dimensions were identified (see Appendices 2 and 3). Profiles of 76 "attribute scores" can also be derived from the item scores in at least three different ways. These alternative assembly techniques are referred to as "additive", "cross-product" and "critical behaviour" attribute profiles (see Appendix 4). Whilst an estimate of the reliability of ratings across PAQ items is of importance, it is also appropriate to assess the reliabilities of resultant derived scores. The overwhelming majority of studies with PAQ have conducted research utilising these derived scores and yet seldom refer to the specific reliabilities of these factors. No studies have been found which report the specific reliabilities of these derived scores for a range of jobs.

Insofar as divisional and general dimensional scores are concerned their composite nature (averaging across item error) may have been regarded as a sufficient rationale for acceping McÇormick, Jeaneret and Mecham's (1972) "intermediate" item reliability data as the potential minimum level of reliability. Since composite scores draw upon item data in alternative ways, however, it is statistically possible for their reliability to be lower than that obtained for overall item reliability. It is possible for example, for the reliability levels of those items which load upon PAQ dimensions to be lower in general than those for items which do not figure in dimension scoring and thus reduce reliability.

Similarly, the reliability with which raters assign scores of "5" to particular items (a feature in the derivation of critical behaviour attribute profiles) is not necessarily that which obtains for overall item reliability. It is possible therefore for the reliabilities of profiles of attribute scores to have unique levels of reliability. In the present research, reliability is calculated for each specific derived score from PAQ. Although this policy appears to be an obvious requirement for the thorough analysis of any predictive context, it is remarkable that virtually all previous research conducted with PAQ has assessed the inter-rater agreement across the questionnaire items and treated this observed value as the appropriate index of reliability for job dimensions or attribute profiles.

2.2 A STUDY OF THE INTER-RATER RELIABILITIES ASSOCIATED WITH INTERVIEW AND QUESTIONNAIRE ADMINISTRATION FORMATS OF AN ANGLICISED VERSION OF THE POSITION ANALYSIS QUESTIONNAIRE

2.2.1 INTRODUCTION

The issue of comprehensibility and readability of PAQ item content and directions has been highlighted. Concern has been expressed about the efficacy of administering PAQ in a self-completed presentation format to respondents with no previous training/familiarisation, and particularly to job groups with potentially low levels of readability.

A decision was taken early on within the Grouping of Skills research programme to administer the questionnaire in a survey interviewing format (Patrick & Spurgeon, 1978). There were three broad advantages hypothesised for administering the questionnaire in an interview format:-

- the experimenter could establish whether the responses were adequate since it would be possible to determine whether the respondent had comprehended the PAQ items. It would thus be possible to decide whether additional respondents were required for the accurate establishment of job content.

- the experimenter could exert control over the context in which the questionnaire was completed. An informal threat-free atmosphere could be established rather than that of a "test" session through controlled administration of the self-completed questionnaire.

- some improvement of comprehension and thence reliability might be effected through person-to-person contact and the provision of feedback to respondents.

It is appropriate to examine the distinction between administering the questionnaire in these alternative formats and some of the psychological and practical issues associated with each format.

The essence of the distinction between administering a questionnaire in a self-completed format and in an interview format lies in the distinction between open and closed loop information presentation and response. The differences between these two modes of presentation are illustrated in Figs. 3 and 4. In the open-loop (questionnaire) situation (Fig 3), each question is simply displayed (Qx), and responded to by the subject (S). However, the question may be less than adequate, and there is the possibility that the subject may not absorb the information or interpret the question correctly. In contrast a closed-loop (interview) system of presentation (Fig. 4) puts the data collection under greater control. By requesting the subject to offer an example/instance (E) of each question (Ox), in addition to responding with the quantitative assessment (S), it is possible to determine whether or not the subject has correctly interpreted the question. The interviewer is performing an evaluating/controlling function. If the instances/examples of a particular class of events (eg. the uses of pictorial displays as a source of job information) detailed by the subject are not members of that class, then the question can be re-stated to the subject (Qx) with the additional information that the question does not refer to the behavioural instance (E) included by the subject in his prior response because that behaviour is an instance of another class of events (Y). On many occasions it was observed that the problem lay in the fact that the behavioural instance given by the subject was referred to by a subsequent PAQ question. The subject

Fig. 3 An open-loop system of information presentation and response

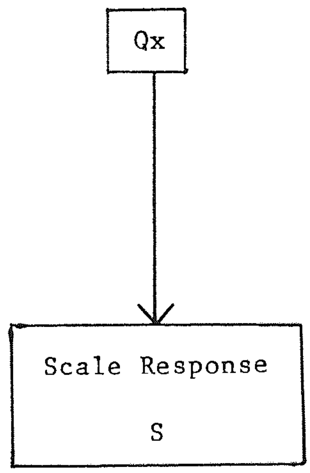
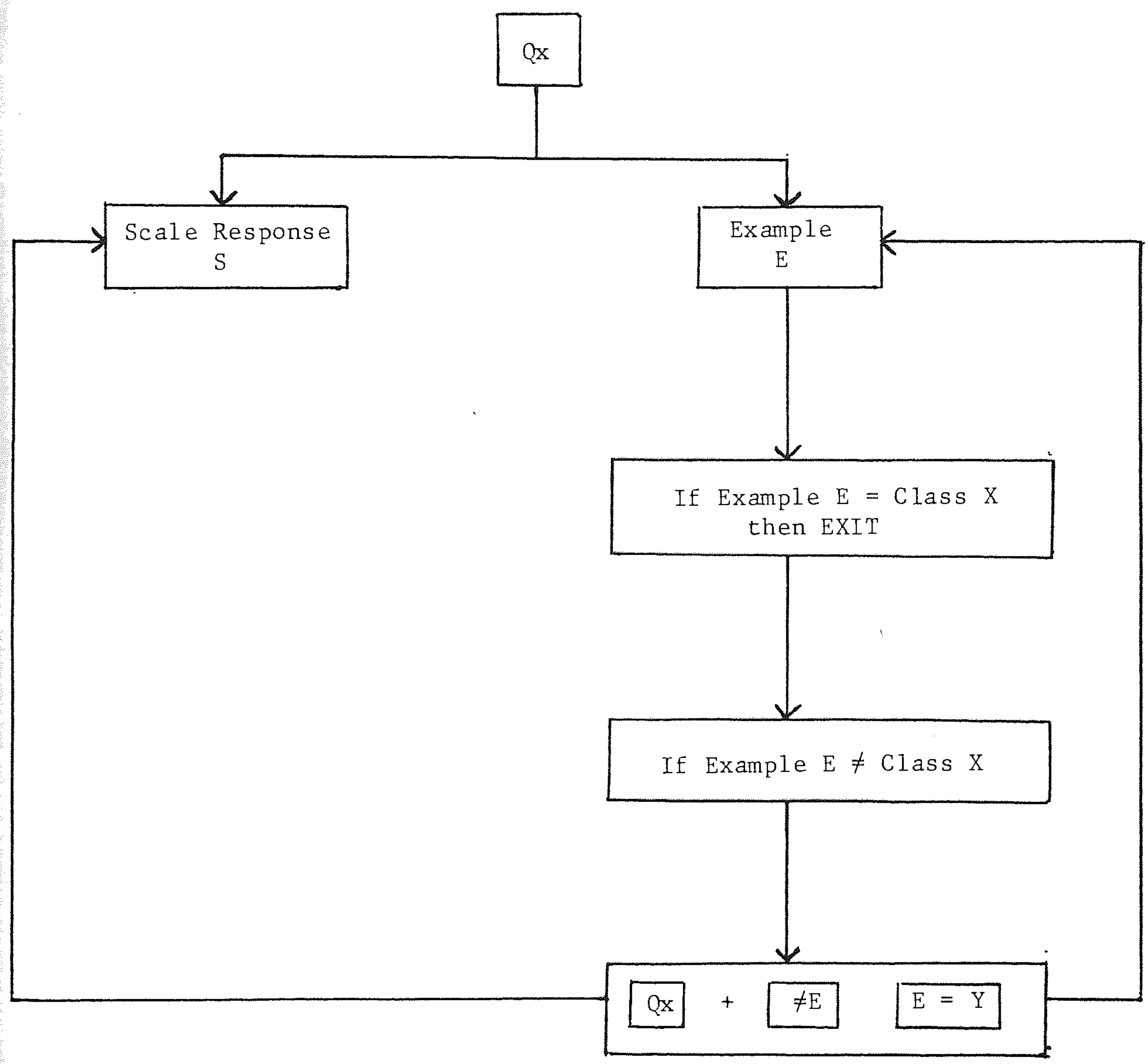


Fig. 4 A closed-loop system of information presentation and response



could not be expected to anticipate the distinctions which PAQ would make between classes of behaviours. It was also fairly common to note that apparent lack of understanding was often a matter of attention flunctuation rather than an inability to grasp the question meaning. Cannell & Kahn (1953) have noted that simply repeating a question can overcome this problem in the interview. The situation in question-naire self-completion is not detectable or controllable and it is likely that the stimulation implicit in an interpersonal setting will if anything have moderated these attentional effects. This aspect and other forms of psychological fatigue are therefore potentially more problematic in self-completion than in interviewing.

It has been noted that the comprehensibility of items in PAQ rests with the facility of "probes" (exemplars) to exemplify the construct under discussion (Salisbury, 1982). The provision of feedback to respondents even in the simple sense of accepting/not accepting the exemplars they additionally generate in the interview setting could be expected to facilitate comprehension.

The advocacy of an interview format in systems terms does not include any potential loss of empirical control through the introduction of an additional variable, the interviewer. Research on the interview as a process is plagued with problems of definition and context. The term interview can be applied to verbatim presentation of written material and to an unstructured, non-directive informal counselling session. General principles cannot be drawn from such diverse structures. There is a general consensus among researchers in survey methods that interviews can however usefully be classified along the dimension of "structure" (Moser & Kalton, 1979). The pertinent literature in the present context is that which refers to highly structured inter-viewing.

There is a large body of research which addresses the reliability and validity of unstructured interviews where inferences and assessments/ judgements are required of the interviewer. For example, Randell (1978) has reviewed interviewing at work and highlighted the problems of subjectivity in person perception, observer characteristics, interviewee characteristics and interview dynamics. Problems of reliability and validity associated with the interview in personnel selection have been reviewed by Mayfield (1964); Ulrich & Trumbo (1965); Wright (1969); Carlson, Thayer, Mayfield & Peterson (1971); Guion (1976) and Schmidt (1976). The data they quote have been drawn from a heterogeneous range of situations. Length of interview, degree of structure, the availability of prior information and laboratory/ field encounters all contributed to the difficulties in drawing in-variate conclusions about the interview. Carlson et al (1971) note inter-interviewer reliability coefficients on ratings of 31 personal attributes ranging from 0.07 to 0.82 with a median of 0.62. It is this large range of reliabilities which has legitimately cast doubt upon the unstructured interview as a viable tool in data gathering (Eysenck, 1953).

The present context does not require the subjective assessment of person variables, and the more appropriate research findings are those which pertain to highly structured survey interviewing.

2.2.1.1 The Role-Independent Characteristics of the Interviewer in Structured Survey Interviewing

The first area of investigation to be reviewed addresses the role-independent characteristics of the interviewer. A considerable number of studies have examined the form and extent of response bias in the survey interview. Hagenaars & Heinen (1982) discuss the findings with regard to interviewer characteristics and note that in general "there are no response effects of the interviewer's role-independent characteristics; only under rather specific circumstances are they to be expected". In situations where variations in the characteristics of interviewers are highly pertinent to the area under investigation there is evidence of response bias. For example, in examining feminist attitudes, Landis et al (1973) found response differences across male and female interviewers. Cosper (1972) found response differences in reported drinking practices associated with the social status of interviewers. In a period of racial tension, Schuman & Converse (1971) identified significantly different response behaviour from black subjects when interviewed by black vs. white interviewers. Sudman & Bradburn (1974) in reviewing response effects in surveys report no consistent findings with regard to interviewer, age, personality, attitudes or expectations. In summary, in the present context the social desirability of responses is considered unlikely to be influenced by role independent interviewer character-istics. When the efficacy of company personnel conducting job analysis interviews is considered however, the role conflict implicit in the context is potentially biasing. The extent and form of this influence has not been studied with PAQ (since it has not been administered by company personnel) but it is felt to be worthy of attention before one could advocate the implementation of the technique in such contexts.

2.2.1.2 The Skills Required of the Interviewer

A second dimension along which interview contexts might be placed is that of the selection/training requirements of interviewers. The skills required of interviewers are likely to co-vary with the degree of structure within the interview. Counselling skills are of a higher order of complexity than those implicit in structured interviewing. Moser & Kalton (1979) note that more than a careful following of instructions is involved and that intelligence, understanding, tact and a deeper understanding of subject matter are required in informal interviewing. Whilst the skills required to conduct a PAQ interview are limited, the investigator is a trained interviewer and had experience of several hundred prior interviews. Before advocating the universal utilisation of PAQ in the interview format, this aspect of variance although potentially small, needs to be investigated.

2.2.1.3 The Social and Environmental Features of the Interview

The final body of research which is pertinent to the present context, concerns the social and environmental features of the interview setting. Cronbach (1970) provides an excellent review of findings and guidelines for test administration which are of direct relevance to the interview administration of PAQ. In the course of the current research, an interviewer's handbook was developed which established guidelines concerning the privacy, confidentiality, ergonomic and rapport features desirable in test administration. These procedures were rigidly adhered to throughout the investigations. The Interview Presentation Format is presented in Appendix 6.

In summary, an interview presentation format was proposed because it is felt on a priori grounds that its interactive nature is capable of yielding a more accurate form of comprehension and response to the questionnaire items.

In order to shed light upon the validity of this hypothesis, a study was conducted which examined the reliabilities of sets of ratings associated with an interview presentation format as opposed to a self completed questionnaire presentation format.

2.2.1.4 The Differences Between Questionnaire and Interview Administration Formats of PAQ

The anglicised version of the Position Analysis Questionnaire can be administered in a questionnaire format or in an interview format. In both formats, the job analysis is conducted by persons considered to be "highly familiar" with the demands of the job in question. Appendix 1 lists the questionnaire version of the PAQ. It can be seen from Appendix 1 that the scaled responses requested by the questionnaire are entered by the rater in a separate answer booklet. This booklet was developed with ease of completion by raters in mind. In contrast the answer sheet for the interview presentation format was developed with direct computer entry in mind and was only considered appropriate in trained hands (see Appendix 6). Aside from these response entry differences, the question content of these two versions of PAQ is identical. In the interview format, the job analysis is also con-ducted by persons considered to be "highly familiar" with the demands of the job, but the scaled responses he selected are told to the interviewer alongside example instances of the type of behaviour being questioned. In the vast majority of instances the example cited by respondents conveyed comprehension of the question and the scale response given to the interviewer was entered by the interviewer in the response booklet. In some instances however, it was apparent that the respondent had not comprehended the question since the example cited was not applicable to the question in hand. In these instances the respondent was politely informed that that form of behaviour was not what the interviewer had in mind (since it was an example of another type of behaviour) and was asked to reconsider the question. The new cited example was evaluated and if appropriate, the new scaled responses generated by the rater were entered in the response booklet.

2.2.2 THE RESEARCH METHODOLOGY

The data collected in this aspect of study was part of a more extensive sponsored research programme. The investigator was fortunate therefore to have access and a high degree of co-operation from case study companies in the rubber, plastics, cement manufacture, and cement products industries. Additionally, personal contacts of the team of researchers working on the more extensive contract research were able to elicit the co-operation of job groups from other industries.

Six different jobs were selected for study in this aspect of the research. The alternative forms of the questionnaire were completed by separate but matched groups of persons considered highly familiar with the demands of the pertinent job. It was considered necessary to restrict ratings to respondents who had familiarity with the job's demands over at least a one year period. Beyond this, it is difficult to match respondents in terms of "familiarity" with a job's demands. In one instance, however (the job of Setter/Operator in the Plastics

Industry) in addition to two appropriate incumbents who completed the alternate forms, two supervisors who were considered highly familiar with the demands of the job were also allocated to alternate conditions. Table 7 details the jobs analysed for the study together with the number of raters used for each assessment. Each interview lasted approximately one-and-a-half hours and questionnaire completions were reported as requiring approximately one-and-a-quarter hours.

Table 7 The jobs analysed by Interview and Questionnaire Presentation Formats

Job Title	Industry	Number of Respondents Interview	Questionnaire	Total
Setter/Operator	Plastics	2	2	4
Electrician	Cement Manufacture	3	2	5
Instrument Mechanic	Cement Products	5	4	9
Careers Officer	Education	5	2	7
Mechanical Workshop Technician	Physics Laboratory	5	2	7
Fitter	Cement Manufacture	2	4	6
TOTAL		22	16	38

2.2.3 ANALYSIS AND RESULTS

Each of the 38 ratings was scored in terms of the six derived scores of PAQ detailed in Section 1.4.5 (ie. PAQ items; Divisional Job Dimensions; General Job Dimensions; Additive Attribute Profiles; Cross Product Attribute Profiles; and Critical Behaviour Attribute Profiles) (see Appendix 4). The psychological interpretations of each of these scores are different and these alternative sets of scores are used by researchers in accordance with the objectives of particular investigations.

The measure selected to assess inter-rater reliability was the intra-class correlation coefficient (Winer, 1971) (see also Section 2.1.1). The coefficient was calculated for each of the six derived scores for each job. Table 8 summarises the results of the analyses.

It is possible to determine whether the reliabilities of questionnaire and interview presentation formats significantly differ for each of the 6 derived scores. Each intraclass correlation was transformed by squaring and correlated t-tests used to contrast presentation formats. The results of these analyses are also listed in Table 8.

It can be seen from Table 8 that the intraclass correlation co-efficients associated with interview administration are significantly higher than questionnaire reliabilities for the analysis across PAQ items ($t = 7.283$, $df(5)$, $p < 0.001$). There are no significant differences in the resultant reliabilities across divisional job dimensions, general job dimensions, or alternative attribute profiles. The latter group of scores are ones which are derived from item scores in combination. As such they are not uniformly affected by rater differences on particular items.

TABLE 8 The intraclass reliabilities for 6 scores of PAQ utilising interview and questionnaire presentation formats

Job Title	Presentation Format	Number of Ratings	All 187 Items	30 Divisional Job Dimensions	14 General Job Dimensions	76 Additive Profile Attributes	76 Cross Product Profile Attributes	76 Critical Behaviour Profile Attributes
			INTRACLASS COEFFICIENT					
Setter/ Operator	Interview	2	.612	.834	.909	.992	.359	.288
	Questionnaire	2	.433	.381	.556	.984	.728	.596
Electrician	Interview	3	.841	.940	.974	.996	.652	.347
	Questionnaire	2	.634	.940	.944	.973	.010	.000
Instrument Mechanic	Interview	5	.725	.947	.966	.993	.880	.430
	Questionnaire	4	.616	.872	.945	.994	.706	.375
Careers Officer	Interview	5	.719	.913	.838	.978	.972	.683
	Questionnaire	2	.616	.934	.854	.997	.976	.614
Workshop Technician	Interview	5	.731	.922	.955	.992	.778	.513
	Questionnaire	2	.520	.809	.877	.954	.000	.000
Fitter	Interview	2	.799	.950	.988	.993	.886	.782
	Questionnaire	4	.684	.887	.943	.996	.922	.607
t-test results comparing squared intraclass correlation coefficients for interview vs. questionnaire presentation (two-tailed test)		t	7.283	1.861	1.714	0.904	0.927	1.032
		df	5	5	5	5	5	5
		P	< 0.001	NS	NS	NS	NS	NS

2.2.4 CONCLUSIONS

The analysis of differential reliability associated with interview and questionnaire presentation formats has shown that the interview technique can yield significantly higher levels of reliability. In applications of PAQ data where item scores are to be directly applied or considered it seems that these data may be more appropriately gathered in an interview setting. Where attention is focussed upon other derived scores of the questionnaire, it seems that the choice of administration format is of less relevance. In practice, the higher item reliabilities associated with interviewing might indicate the general preference for administering the questionnaire in this format.

It is appropriate to reiterate the provisional status of these results however. It was noted in the introduction to this study, that although the appropriate research evidence concerning any response bias associated with role-independent interviewer characteristics indicates little potential contamination of results through the use of alternative interviewers, the present study utilised only one interviewer and may therefore present a more favourable interpretation. Multi-interviewer studies and subsequent analyses of findings were not feasible in the context of the present research but are advocated. Secondly, the investigator is a trained interviewer and whilst the skills demanded of administering PAQ in an interview format are not overly complex, research is warranted into the requisite selection and training features required to maximise inter-interviewer reliability. Finally, the present study was conducted by an investigator who had no formal role within the organisations to which the selected jobs belonged. There are strong a priori grounds to suggest that role-conflict might influence the results of respondents and the technique could not therefore be advocated for administration by an interviewer where his formal role might influence results.

The interview presentation format was adopted throughout the grouping of skills research and hence all of the subsequent studies to be reported in this thesis utilise this approach.

2.3 A SUMMARY OF THE INTER-RATER RELIABILITY FINDINGS WITH AN INTERVIEW PRESENTATION FORMAT OF AN ANGLICISED VERSION OF PAQ

2.3.1 INTRODUCTION

The present research represents a subset of studies conducted within the "Grouping of Skills" research programme undertaken by the University of Aston.

The general aims and findings of this overall research programme are discussed in Section 4.1. The programme's applications of PAQ were invariably conducted by the present investigator as a series of pilot investigations. A larger-budget research programme may have been able to address a wide range of issues utilising teams of interviewers to amass samples of many thousands of job analyses. Such a volume of studies have been monitored by McCormick in the United States and this clearly facilitates generalisation of results. The current research programme in contrast, primarily adopted case-study approaches. The need to demonstrate tangible benefits to co-operating companies in order to obtain job analysis data restricted the volume of data amassed in the course of the research. Written reports upon the meaning and interpretation of PAQ analyses (and associated Hierarchical Task Analyses) were frequently prepared for co-operating companies. This is a characteristic of applied research, and whilst such exigencies restrict the volume of data, there are many advantages to such an approach. The techniques have been administered in "real" applications and have shed light upon many of the practical administration issues associated with the use of the technique "in-the-field". For example, although the administration time associated with PAQ is approximately 1.5-2 hours, the practical difficulties associated with maintaining production meant that it was generally only possible to conduct at best 2 interviews per day. In essence a two-day period was required to obtain 3 ratings of any job under analysis. Whilst this is a long period for a single data-point in the experimental sense, it was regarded as an acceptable "disruption" in the eyes of companies to obtain detailed analyses of job duties and personnel requirements. The post-administration scoring, analysis, interpretation and preparation of a summary for each job can take several days, but this can be conducted "off-site" and therefore present no further difficulties to the co-operating company. Many forms of job analysis are more disruptive in-the-field than PAQ. The establishment of "critical-incidents" for example, can take many weeks of prime production time. It is worthy of note therefore that PAQ as a technique offers a fast and minimally disruptive approach to the structured analysis of jobs.

2.3.2 THE SAMPLE OF JOBS ANALYSED WITH PAQ IN AN INTERVIEW FORMAT

In the course of the applied studies with PAQ, 19 jobs were analysed with the interview format of presentation. The jobs were drawn from a variety of industries, and can be classified in terms of socio-economic and educational level. Table 9 lists the sample of jobs in terms of job level. The categorisation used is the Office of Population Censuses and Surveys Classification of Occupations (1980).

Although it was not practical to achieve an exhaustive sample of jobs, it is felt that a sufficient range of jobs has been analysed to justify some useful comments from the applications of the technique in Britain.

Table 9 The sample of jobs analysed with the anglicised version of PAQ in an interview presentation format

Job Level	Number of Jobs Analysed	Number of Jobs with Additional Attribute Analyses
Professional	2	2
Intermediate	2	1
Skilled	11	8
Semi-Skilled	3	0
Unskilled	1	1
TOTAL	19	12

Appendix 7 lists the job titles used in the present analyses together with the number of raters used to assess job content. The inter-rater reliabilities of ratings of items, divisional job dimensions and general job dimensions are based upon studies of these 19 jobs utilising a total of 70 respondents. The additional inter-rater reliabilities of the alternative attribute profiles (additive, cross product and critical behaviour) were based on a smaller sample of jobs. Twelve of the 19 jobs, utilising a total of 52 respondents have additionally been analysed in these terms. The reason underlying the disparity in sample sizes was the focus of case-study application at the time of administration. Many companies were not concerned with the "ability requirements" of jobs and hence such analyses were not conducted. The sample of jobs with additional attribute analyses are also summarised in Table 9.

The two sets of data constitute the largest reported sample of data with PAQ in Britain, and can usefully serve as a sample to draw general conclusions concerning the inter-rater reliabilities of the scores derivable from PAQ when administered in an interview format.

2.3.3 THE INTER RATER RELIABILITY FINDINGS

The intra class correlation coefficient and mean estimate of reliability were calculated for each of the sample of jobs in terms of the 6 scores derived from PAQ. Appendix 9 presents the reliability scores for each job in terms of the six sets of scores which include all items, divisional job dimensions, general job dimensions, additive attribute scores, cross product attribute scores and critical behaviour attribute scores. The mean intra-class correlation coefficient can be calculated for each of the sets of derived scores. The intra-class correlation co-efficient were squared and averaged and retransformed to provide estimates of the average reliability across the sample of jobs.

$$\text{Since } r_1 = \frac{\hat{\bar{\Theta}}}{1 + \hat{\bar{\Theta}}} \quad \text{and } \hat{p}k = \frac{k\hat{\bar{\Theta}}}{1 + k\hat{\bar{\Theta}}}$$

(Winer, 1971, p.289) where r_1 is the intra-class correlation coefficient, k is the number of raters and pk is the mean reliability of k ratings, it is possible to calculate the number of raters required in order to obtain mean estimates of reliability of various criterion levels. In other words, it is possible to determine the number of raters required (given the "average" level of reliability) to obtain on average a mean rating for a job with a reliability of, for example, 0.90. This degree of reliability is generally accepted in psychometrics as a high level, and constitutes an accurate estimate of the 'true' score for a job. Table 10 presents the average intra-class correlations found across the sample of jobs together with the indicated number of raters required to yield this mean estimate reliability of +0.90.

A one-sample X^2 test across the number of raters required for 'reliable' assessments (Siegel, 1956, p.42) was calculated and found to be statistically significant ($X^2 = 13.273$, df(5), $p < 0.05$). Significantly different numbers of raters are required to yield scores reliable at the 0.90 level for alternative derived scores of PAQ.

It can be seen from Table 10 that the average reliability of PAQ at the item level is such that on average 4 raters are required to obtain an overall profile of a job with a mean reliability of +0.90. When information is sought solely in terms of the items of PAQ therefore on average one can expect to require 4 ratings to provide an acceptably reliable assessment of a job. In utilising job dimension information, 3 ratings will generally be required for assessments in terms of divisional job dimensions, and 2 for general job dimensions. The number of raters required on average to obtain reliable profiles of the attribute requirements of a job are on average 1, 3 or 10 depending upon the assembly technique selected. (This aspect is further examined and discussed in Section 3.2).

In practice it would seem that 4 ratings of a job would generally enable profiles of job demands to be established in terms of job element (item) content, divisional and general job dimension content, and additive or crossproduct representations of attribute content.

TABLE 10 The average intra-class correlation coefficients for PAQ in an interview format with an estimate of the number of raters required on average to yield mean reliability of +0.90.

	PAQ DERIVED SCORE					
	All Items	Divisional Dimensions	General Dimensions	Additive Profiles	Crossproduct Profiles	Critical Behaviour Profiles
Average Intraclass (R_1)	.689	.749	.815	.985	.766	.466
N of Jobs in Sample	19	19	19	12	12	12
Required n of rates for criterion reliability	4	3	2	1	3	10

2.3.4 CONCLUSIONS

In general the interview presentation format of the anglicised version of PAQ has acceptable levels of job element (item) inter-rater reliability. McCormick et al. (1972) report an average inter-rater product-moment correlation for PAQ (Form A) items of +0.79, and Frieling et al. (1974) report on average inter-rater product moment correlation of +0.79 for the items of a German version of PAQ. Smith and Hakel (1979) report mean inter-rater product moment correlation coefficients for pairs of job in-cumbents of +0.59 and +0.63 for pairs of job supervisors with Form B of the questionnaire. Taylor & Colbert (1978) report an average inter-rater product moment correlation coefficient of +0.68 for "internal" ratings by job incumbents and/or supervisors.

Comparisons with these studies would suggest that broadly comparable inter-rater reliability findings are associated with Forms A and B of the questionnaire independent of national alterations, sources of respondents, the samples of jobs and the statistical measure of association used in studies. The mean intra-class correlation for ratings of PAQ items in the present study was 0.69. This level is in line with previously reported findings with questionnaire administrations of PAQ and in general constitutes an acceptable level of agreement.

The findings in the present study concerning the reliabilities associated with job dimensions and attribute profiles are worthy of comment. The levels of reliability for divisional job dimensions and general job dimensions are higher than those for PAQ items. Intra-class correlation coefficients (and product moment correlation coefficients) are influenced by the number of items included in the measurement.

Correlations across larger numbers of items will in general be higher than those obtained for fewer items. It would seem therefore that the composite nature of job dimensions is such that despite yielding a smaller number of factors, error is "averaged" across constituent items to produce more reliable assessments. The mean intra-class correlation across raters for divisional job dimensions was 0.749. The mean co-efficient for general job dimensions was 0.815. Reliable assessments of jobs in dimensional terms can in general therefore be obtained utilising only 3 raters.

The findings for the reliabilities of profiles of 76 attribute scores generated by PAQ are based upon the sample of 12 jobs detailed in Appendix 7. It can be seen from Table 10 that the associated reliabilities are not uniformly higher than those for PAQ items. The study to be reported in Section 3.2 examines the differential reliabilities of the three alternative assembly techniques used to generate attribute profiles. The study to be reported in Section 3.3 investigates the differential validity associated with these alternative assembly techniques.

The major conclusion to be drawn from this study is that the "intermediate" reliability of PAQ questionnaire items is not directly equatable with the alternative scores which are derivable from PAQ. In studies which utilise the subsequent derived scores as predictors or correlates, it is the latter set of reliabilities which are of relevance, and not the intermediate overall reliability of raters across PAQ items.

The studies to be reported in the current research programme calculate and report the reliabilities of the scores actually used in the statistical calculation of correlations between PAQ "predictors" and criterion validity constructs.

2.4 DISCUSSION AND CONCLUSIONS OF PAQ RELIABILITY

The practical ability of a technique to yield accurate analyses of job behaviours is of prime importance. Psychometric instrument development is a perpetual refinement of item content to maximise accuracy. The directions, item content and rating scales of the Position Analysis Questionnaire have evolved from studies of test re-test and inter-rater reliability, and in general have been found to have acceptable levels of consistency. Several moderating factors have however been highlighted in reviewing and researching PAQ reliability. These factors can appropriately be summarised under two broad headings: source of respondent and presentation format.

The use of a descriptive rating device rather than an objective technique of establishing job demands requires that assessments are made by persons who "know" the demands of the job. The question of how to identify who "knows" a job is not answered conventionally through study. There are no objective tests of job "knowledge" which can serve as general purpose screening devices for the selection of respondents. The practical approach is to pre-define groups of persons that could be considered to be "highly familiar" with the demands of a job, and thence to establish their ability to achieve consistency in their respective assessments.

In general subject variables such as age, sex or race do not constitute useful categorisations of incumbents. This is because the age, sex or race of respondents frequently interact with employment. There are, for example, many jobs which are predominantly (if not exclusively) conducted by persons of particular ages, sex or race either by definition or tradition, eg. apprentice, secretary, halal butcher. The selection of such subsets of job incumbents generally would run the risk of involving a poor general sample of the job duties. Similarly a measure such as intelligence or verbal reasoning might be hypothesised to correlate with accuracy of response, but the 'more intelligent' members of a job group may perform in effect a "different" job from the conventional respondent. On the other hand, to place no restrictions on the choice of incumbents as respondents may not maximise representative reliability. Where a person is new to a job it seems reasonable to assume that he may not "know" the job adequately. Whilst there is clearly no true dichotomy in knowing a job, a minimum period of one year's employment in a job has been adopted as a criterion for the preselection of incumbents as respondents. There are of course additional issues concerning the willingness/ability of job incumbents to respond accurately. The social desirability of factors such as 'status' and 'decision making' may lead incumbents to inflate the importance of their job's role within the organisation. If such biases are uniformly present then the index of inter-rater reliability cannot yield the 'true' score for a job, but only the agreement between the stated opinions of incumbents.

Such arguments may lead one to reject incumbents as sources of respondentsfor job analysis. The criteria of "familiarity" with other respondents such as 'supervisors' is however no more easy to maximise. Similarly, biases may exist on their behalf in terms of minimising the importance of their subordinates' role to informally inflate their own 'status'. Supervisors may be regarded as potentially less familiar with the demands of a job than incumbents since they do not have the everyday "hands on" experience of the latter group. Studies contrasting the inter-rater reliabilities of supervisors as opposed to incumbents would be using an inadequate index of "truth" and would have to assess familiarity to impractical degrees. In general, therefore, the collection of job analysis information utilises both incumbents and others highly familiar with the demands of the job in as much of a 'threat-free' environment as possible. Whilst the associated levels of identified inter-rater reliability are in general respectable there clearly remains the doubt concerning the 'truth' of the resultant mean estimate.

The employment of 'external' job analysts as respondents to PAQ does appear in general to be less desirable. The inherent problems of ensuring comprehensive interchange between the analyst and sources of job information are such that this form of analysis is not to be generally recommended. Studies contrasting the inter-rater reliabilities associated with 'external' analysts as opposed to "internal" respondents (eg. McCormick, Jeanneret & Mecham, 1969) have identified lower levels of reliability with the former group of respondents.

Whilst the importance of obtaining accurate assessments of job duties is clear, the solution adopted in practice is to obtain ratings and ultimately determine their validity. Whilst theoretically this validity may be the validity of opinion (bias) rather than truth it is currently a necessity.

A second moderating factor in reliability concerns the readability and comprehensibility of the item content directions and scales. The identified problems in this realm (eg. Ash & Edgell, 1975; Salisbury, 1982) potentially affecting respondents with low levels of reading ability have been hypothesised to be remedied through the use of a structured interview presentation format. The strength of this reasoning led the research team at Aston University to adopt this latter approach. The study of respective inter-rater reliabilities, whilst only using a single interviewer would seem to confirm the preferability of this form of administration. The major objective of the current research programme is to establish the validity of PAQ in a transfer context and these studies have been conducted by the present investigator. Before the technique could be advocated for general adoption larger scale multi-interviewer evaluations would be clearly required. Such studies are being conducted on the British successor to PAQ (ie. the Job Structure Profile) in the light of the pilot investigation findings detailed in this report.

Whilst some emphasis has been placed upon the provisional status of the results of the reliability studies described above, it is important to re-state the role of the studies and the status of PAQ in a transfer context.

PAQ has been found capable of describing a comprehensive range of jobs utilising 'internal' respondents in an interview setting with adequate levels of inter-rater reliability. This faculty is a pre-requisite of the validities of various derived scores of the questionnaire to serve as content bases for the prediction of transfer effects. The reliability of ratings across PAQ items (job elements) is a pre-requisite of their subsequent use in developing a picture of the demands of jobs in ability/trait terms. The reliability of ratings across PAQ job dimensions is a pre-requisite of their use as a content base to 'predict' transfer effects. The meaning and utility of PAQ job dimensions in the transfer context is discussed in Section 4 of this report. Before PAQ indications of the abilities/traits associated with current job performance can be used as a content basis to predict transfer effects, several intermediate aspects of reliability and validity need to be examined. These issues are discussed in Section 3 of this thesis.

SECTION 3

RELATING JOB BEHAVIOURS TO TRAITS

3.1 INTRODUCTION

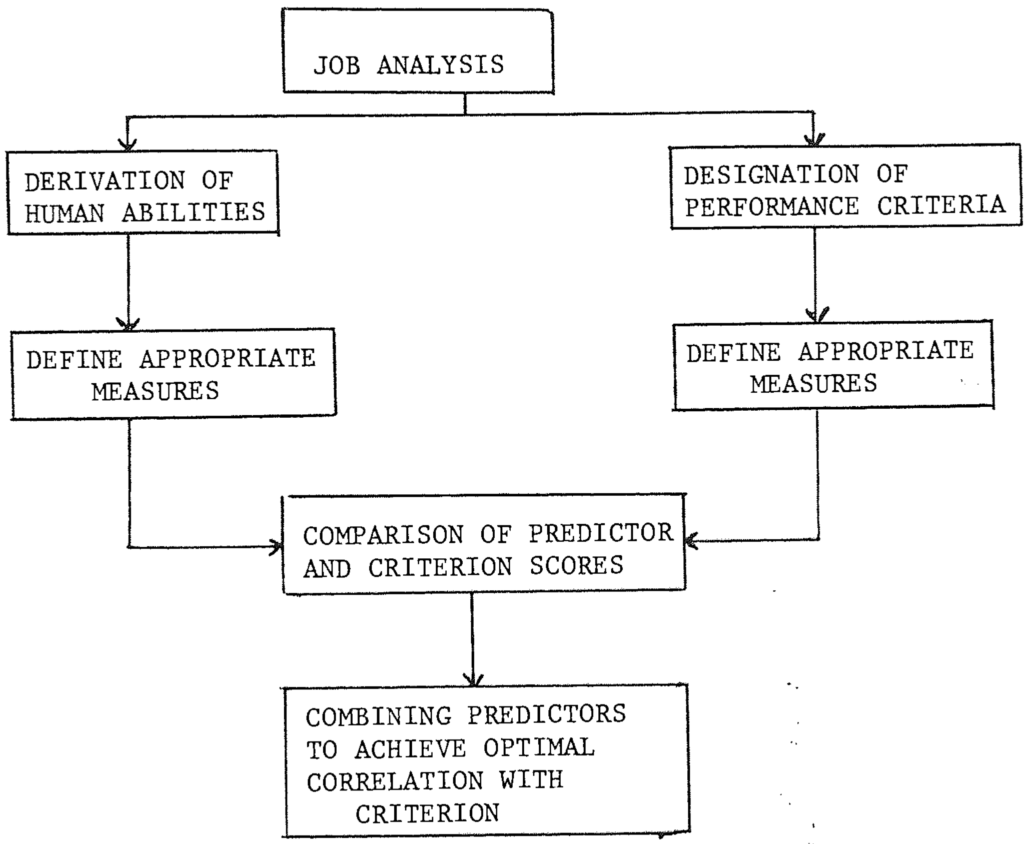
The potential of individuals to deal with novel instances of particular classes of events is the basis of psychometric models of ability. It is also a statement with clear transfer implications. The hypothesis that an individual's cognitive structure can be statistically represented by measures of ability which are predictive of future learning within such classes of events is a model of transfer. Such a hypothesis is based upon the premise that novel tasks/behaviours which "require" abilities that individuals have differentially acquired, will be learned to an extent associated with the relative competence of individuals in terms of those abilities. In other words tasks might usefully be contrasted not in stimulus or response element terms but in terms of their ability requirements.

The conception of task learning/performance being "underpinned" by abilities has been the cornerstone of the personnel selection paradigm. Freyd (1923) outlined a paradigm which is still prevalent today. The paradigm is presented in Figure 5.

Links between behaviour and human attributes/traits have consistently been demonstrated with the empirical selection paradigm. Ghiselli (1973) has reviewed the empirical studies associating human attributes with training and work proficiency criteria, and concludes that "quite respectable" validity coefficients are generally obtained.

There are, however, a range of practical problems associated with the empirical selection paradigm. These issues and suggested remedies

Figure 5 A Schematic Representation of the Empirical Personnel Selection Paradigm
(after Freyd, 1923)



have been examined by occupational psychologists in the investigation of synthetic validity.

3.1.1 SYNTHETIC VALIDATION

3.1.1.1 The Objectives of Synthetic Validation

It can be seen from Figure 5 that the personnel selection process stems from an initial job analysis. Job analysis techniques generally elicit the performance requirements of jobs, and one is always faced with the task of translating these into the human attributes required to attain the appropriate levels of performance. This linking of what Dunnette (1976) calls the "taxonomic worlds" of "work" and "human attributes", and what Singleton (1974) refers to as the "systems-oriented concept of a task" and the "person-oriented concept of a job" is predominantly conducted inferentially. Aside from the problems inherent in legitimately deriving lists of requisite abilities for jobs there is a further problem with this selection paradigm. It is an empirical technique. It can be utilised either concurrently (ie. examining the current attributes of job holders and correlating these scores with their job performance) or predictively (ie. examining the attributes of those applicants recruited to the job and correlating these scores with their job performance after a period of time). Though empirical criterion-related validation procedures might be the most desirable approach for evaluating personnel selection instruments, Balma (1959) notes that such traditional validation poses a number of practical problems for the industrial psychologist. Among these are:

1. too few people on a particular job to carry out an empirical validation,

2. insufficient time for use of the "follow-up" method of validation and at the same time resistance of employees and trade unions to the "employee method" of validation,
3. great variability of job content of jobs with the same title,
4. a rapid rate of change in job content within a given job,
5. an increased number of jobs necessitated by automation and computerisation,
6. a shortage of professional personnel to carry out an empirical study, and
7. the time and cost involved in a traditional validation study.

Sparrow, Spurgeon & Patrick (1982) additionally note that the paradigm requires people to be performing the job and the establishment and use of an adequate performance criterion. It is not possible to use this paradigm therefore for the selection of appropriate personnel for a new job.

As a result of these difficulties, a number of authors have suggested that an alternative approach to validation based systematically upon the use of job analysis data is utilised. Lawshe (1952) introduced this alternative into the psychological literature under the name of "synthetic validity". Lawshe used the term to denote the "inferring of validity in a specific situation". Balma (1959) expanded Lawshe's definition somewhat by stating that synthetic validity refers to an "inferring of validity in one situation from a logical analysis of jobs into their elements, a determination of test validities for these elements, and combination of element validities into a logical whole". McCormick (1959), referring to the concept as "indirect validity", notes that such a process requires the validation of tests or other predictors of jobs which have certain characteristics in common, and the extension of these validities to similar jobs. McCormick has subsequently renamed the concept "job component validity" (eg. McCormick, 1979) in the hope that this alleviates any confusion caused by the term "synthetic validity". Shaw & McCormick (1976) note that "it is, after all, not the validity which is synthesised, but is, instead, the test battery which is established by synthetic means."

In the general current conception, "synthetic validity" (or job-component validity) is a technology for systematically establishing the overall attribute requirements of jobs.

Before discussing techniques for determining the relevance of traits to human behaviour, it is appropriate to briefly outline the nature and number of traits currently established.

3.1.1.2 <u>The Nature and Number of Traits</u>

The search by psychologists for assessments of individual characteristics in thought, feeling or act has been conducted for over eighty years. The quest has been to classify situationally specific behaviours into descriptive classes which "explain" human behaviour. Differences in the relative frequencies of behaviours among human beings have thus been categorised as individual differences. Many of these categories (descriptive classes) have been reified as mental faculties, or interpreted as psychological processes in their own right and adopted in everyday language. These identifications of relative consistencies within samples of human behaviour are commonly referred to as traits. The philosophical debate concerning the validity of reification continues, and the arguments concerning the validity of cognitive modelling are hotly contended. It is not surprising therefore that there is some lack of consensus upon the total number of traits which characterise human behaviour. The evolution of agreed statistical procedures for the identification of associations between behaviours has however gone some way towards achieving this consensus.

Factor analytic procedures have been employed to identify statistical structures of intellect, psycho-motor behaviour and personality. The nature of the statistical procedures is to "identify" a hierarchical structure of factors ultimately being reduced to a single embrasive factor. Thurstone's (1947) conception of simple structure has been generally adopted as a criterion for determining the number of independent/orthogonal factors which maximise the explanation of variance (Child, 1970).

The structure of human cognitive/intellectual behaviours has been extensively studied by Vernon (1950). Cattell (1965) has similarly analysed the structure of human personality, and Fleishman (1966) has studied psycho-motor behaviour to identify motor ability factors. These factor analyses of human psychological behaviours have generally revealed categories of factors which are relatively independent of each other and which can be labelled, on examination of their most salient features, as aptitudes (cognitive and motor ability factors) or temperamental traits. Their importance lies not solely in the parsimony of descriptive classes but in the claims of the psychometric model (Kline, 1980) that any given behaviour is a function of these factors and their interaction with the relevant stimulus situation. Such a model is readily testable, and from an occupational psychology perspective its prediction of criterion measures of job performance or training time/performance sufficiently precise to have warranted general adoption (Ghiselli, 1973). The factors most frequently corroborated include twenty four cognitive abilities (Dunnette, 1976), sixteen personality traits (Kline, 1983) and 20 psychomotor abilities (Kleinman, 1977). These are the approximate numbers of factors relatively consistently identified by experimenters and not the number of "actual" abilities. Indeed in reviewing the findings for trait approaches in personnel selection, Ghiselli (1973) classified test materials into only 14 categories which accounted for the vast majority of applied studies.

The above discussion can be summarised by saying that a large (but manageable) number of statistical factors have been identified which are in general predictive of human performance.

An extensive body of data has accumulated showing that intelligence test performance is quite stable (eg. Anastasi, 1958; McCall, Appelbaum & Hogarty, 1973). Similarly, Cattell (1946, 1957, 1971, 1973) has examined the factor structure of personality and concluded that such traits are relatively stable over time. In the area of psycho-motor behaviour, little attention has been paid to longitudinal or cross-sectional studies of motor ability factors over lifetimes. The statistical nature of the resultant factors would suggest nevertheless that in the absence of rigorous intervention, stability would be expected. This argument is the central principle in all trait approaches. The suggestion here is that human cognitive structures progressively develop consistencies and that major interventions or total restructuring occur rarely in Western society in the post-education years. The over-learned nature of schemata results in a crude stability which is statistically represented in psychometric samples of behaviour. Since the human behaviours of large samples of adults of all ages are the basis of the correlation matrices subjected to factor analyses, the resultant factors are by definition a reflection of that which generally remains stable over lifetimes.

This relative stability is readily capitalised upon by psychometricians. Transient qualities would lack the stability necessary for reliability and thence validity. The establishment of representations of human behaviours which are not transient has enabled psychology to become an applied predictive science. The procedures associated with empirical and synthetic paradigms of relating traits to human behaviour are clearly central to the practices of applied psychology.

3.1.1.3 Determining the Relevance of Traits to Human Behaviour

It has been noted that there are many practical difficulties associated with the empirical establishment of relationships between predictors and occupational criteria. The concept of synthetic(job component) validity has been briefly outlined. The objective of systematically establishing the range of traits associated with job performance through synthetic validation requires three things (Wherry, 1955).

1. A list of elements (behaviour units) assumed to be adequate to cover the behaviours of job performance.
2. Judgements by persons acquainted with the job demands as to the degree to which each element is necessary for job success.
3. Judgements by persons acquainted with tests and statistical test theory as to the degree of association between each element and each test.

The meeting of these three requirements enables profiles of the attribute requirements for particular jobs to be assembled. A review of the literature concerning the development of systems of job analysis identifies several attempts to analyse jobs in terms of the human traits required to perform them.

One of the earliest attempts was made by Viteles (1922, 1932) in his development of the Job Psychograph. Viteles selected a list of 32 mental traits which were rated by job analysts in terms of their importance to the job on a 5-point scale ranging from "negligible" to "of utmost importance". The job analysis instrument was not rated in component terms and profiles were established for the job as a whole. Similarly, Stead & Shartle (1940) rated 9,000 occupations in terms of 45 human attributes in "molar" terms but the instrument was never validated (Shartle, 1959). A component ("molecular") approach was adopted by Wherry (1955). The list of behaviour units consisted of 62 job elements, and each of these was rated on a 3 point scale. Using these data, the "J-coefficient" was computed by obtaining job attribute weights (from the ratings) and test values supplied by the Civil Service Commission, and combining these to give estimates of the correlation between test scores and a job performance criterion. It was this estimate which was termed the J-coefficient. Wherry (1955) reported rank correlations between the J-coefficient and actual test validities ranging between .51 to .90.

Fleishman and his associates have attempted to demonstrate the usefulness of the synthetic validity model in the area of motor skills. (Theologus & Fleishman, 1971; Levine, Romashko & Fleishman, 1973; Fleishman & Hogan, 1978; Mallamad, Levine & Fleishman, 1980). Fleishman's first step was the development of 37 rating scales (Task Assessment Scales) which reflected psycho-motor abilities. Judges rated 38 tasks used in previous research by Fleishman (1954) along 7-point scales to assess "the lowest level of the ability which a person would need to possess in order to produce errorless performance on the task." Of the 37 ability scales, 8 were felt to correspond closely with statistical factors obtained by Fleishman (1954) when he factored the matrix of correlations based on performance scores across the 38 tasks. The correlations between the mean ability scale ratings for each of the 38 tasks and the factor loadings on each of the corresponding factors ranged between 0.22 and 0.77. In addition to demonstrating that ratings of required abilities reflect the factor structure underlying the tasks, Fleishman sought to establish the correlation with performance on the tasks. A corrected multiple regression coefficient of 0.64 was obtained with three of the ability scales. (Gross body co-ordination, Manual dexterity and Arm-Hand Steadiness) (Theologus & Fleishman, 1971). Fleishman's "ability requirements approach" has been extended from task assessment scales to a technique to describe jobs in terms of the abilities required to perform them. The inter-rater reliabilities of behaviourally anchored ratings of ability requirements (Theologus & Fleishman, 1973; Theologus, Romashko and Fleishman, 1973) and decision flow diagrams (Mallamad, Levine & Fleishman, 1980) are discussed in Section.3.2. It should be noted that the technique rates the ability requirements across a whole job, ie. it is a molar approach. The reliability studies are based upon ratings obtained from written job descriptions. Guidelines for the language, level of description and comprehensiveness of such molecular job descriptions need to be established. Whilst earlier studies with the Task Assessment Scales reported validity findings, the technique has not been validated in job terms.

The Position Analysis Questionnaire does provide molecular breakdowns of job performance. McCormick and his co-workers have additionally developed a list of human attributes which can be related to jobs, and have obtained ratings of the relevance of each of these attributes to each of the job elements of the questionnaire. Mecham (1969) and Mecham & McCormick (1969) developed a list of 68 attributes from an evaluation of current psychometric research, with the intention being the development of a list which was reasonably complete, and whose definitions were sufficiently clear and not overlapping. The list consisted of 41 attributes of an "aptitude" nature (cognitive and psycho-motor abilities) and 27 attributes of an "interest or temperament" nature (personality traits and interest factors). Each of these attributes was rated by psychologists to determine its relevance to each of the job elements in PAQ (Form A). The work was extended by Marquardt (1972) to incorporate additional attributes and changes in PAQ (Form B). Marquardt (1972) extended the list of attributes to 44 aptitudinal factors and 32 temperamental factors. This listing together with the definitions associated with each of the 76 attributes is given in Appendix 5. It can be seen from Appendix 5 that the list provides a comprehensive range of factors embracing the kit of 24 Cognitive Factors (French, Ekstrom & Price, 1963), personality/interest factors and Fleishman's 20 psychomotor ability factors. The taxonomic criteria of exhaustiveness and mutual exclusivity are however, not proven to be fulfilled. Profiles of such attributes would nevertheless constitute a relatively comprehensive specification of ability requirements which can be related to jobs. Each of the 76 attributes were rated by psychologists in terms of their relevance to each job element (item) in PAQ (Form B). The raters in both Mecham's (1969) and Marquardt's (1972) studies were drawn from occupational psychology division members of the American Psychology Association. As such it was felt that "this population of raters would most easily and accurately understand what was desired of them, and make their ratings accordingly." (Marquardt, 1972). Between the two studies ratings were obtained for each item in PAQ (Form B) and 76 human attributes in terms of "the degree of relevance of attributes to job elements." A six-point scale was used for assessments. The scale used is reproduced in Table 11.

Table 11 <u>The rating scale used by Mecham (1969) and Marquardt (1972) to relate attributes to PAQ job elements</u>

Code	Degree of relevance of attribute to job element of PAQ
0	Attribute is of <u>no</u> relevance to job element
1	<u>Very limited</u> or <u>nominal</u> relevance
2	<u>Limited</u> relevance
3	<u>Moderate</u> relevance
4	<u>Substantial</u> or <u>considerable</u> relevance
5	<u>Extreme</u> or <u>extensive</u> relevance

Eight to eleven ratings were obtained for each attribute across PAQ items and a measure of inter-rater reliability calculated. The reliability co-efficients were computed using the ANOVA approach suggested by Winer (1971). The intraclass correlations ranged between .005 and .729 yielding reliabilities of mean estimates ranging between .043 and .964. 73 of the 76 attributes had reliabilities of mean estimates greater than 0.70. Three attributes accounted for the lower end of the range figures quoted. The attribute "Working alone" had the lowest level of reliability (.005), "Measurable/verifiable criteria" (.204), "Variety of duties" (.211). The authors conclude that the resultant attribute weightings for each PAQ element "were rather respectable, generally ranging from .80 to the upper .90s."

Studies utilising PAQ in the synthetic validity paradigm have adopted two broad approaches. The first of these approaches does not utilise the attribute information detailed above and will be briefly discussed first. In this approach, the job dimensions derived from principal component and factor analyses of PAQ items (Marquardt &

McCormick, 1974) are used in multiple regression solutions to "predict" mean test scores on psychometric measures, ie. the mean aptitude score of samples of incumbents on particular jobs. The resultant multiple shrunken correlation coefficients are presented in Tables 12 and 13. Table 12 shows the validities obtained for PAQ divisional job dimensions for the nine tests of the General Aptitude Test Battery (Mecham, 1977). Table 13 shows the validities obtained with PAQ divisional job dimensions for 5 commercially available tests (McCormick, Denisi & Shaw, 1979).

Whilst the validity coefficients listed in Tables 12 and 13 are on the whole quite respectable, one point in the approach requires comment. Dunnette (1976) notes that in using the factored job dimension scores McCormick was including "much attribute information that is not conceptually relevant" to scores on the tests. Because of this the results are difficult to interpret - particularly in Dunnette's term of "linkages" between job behaviour taxonomies and human attributes. The use of such a "shot-gun" approach is not to be advocated. It is not possible to formulate construct validity for the findings, beyond the observation that there is some "mechanism" of association between job behaviours as statistically combined, and scores on a limited range of cognitive ability tests. The approach cannot be generalised to other countries or standardisations of tests since it is ultimately a context-bound statistical procedure for "optimising" prediction.

Table 12 Shrunken Multiple Correlations of combinations of PAQ Divisional Job Dimension Scores as predictors of GATB Mean Test Scores. Source: Mecham (1977)

GATB Test	Multiple R
General Intelligence	.79
Verbal Aptitude	.83
Numerical Aptitude	.77
Spatial Aptitude	.69
Form Perception	.61
Clerical Perception	.78
Motor Co-ordination	.73
Finger Dexterity	.41
Manual Dexterity	.30
Median	.73

Table 13 Correlations between predicted and actual mean-test scores for five constructs. Source: McCormick, Denisi & Shaw (1979)

Construct	r
General Intelligence	.75
Verbal Aptitude	.71
Numerical Aptitude	.67
Spatial Aptitude	.70
Clerical Perception	.52

The second approach adopted by McCormick and his co-workers to synthetic validation utilises the job-component approach evolved by occupational psychologists. The attribute/job element linkages reliably established by Mecham (1969) and Marquardt (1972) can be used to formulate predictions of job ability requirements. The specification of the attribute "relevances" for PAQ items leaves many avenues open to express the total attribute requirements of jobs. Shaw & McCormick (1976) describe the validity of a range of approaches to utilising such information. The authors categorise methods of estimation as representing three different "models" for estimating total job ability requirements. These models are detailed in Figure 6.

Figure 6 <u>The three models of ability requirement estimation used by Shaw & McCormick (1976)</u>

Approach	Macro	Micro	
Model	Macro Model 1	Cumulative Model 2	Critical Behaviour Model 3

It can be seen from Figure 6 that the authors distinguish between micro and macro approaches to estimation. Micro approaches refer to the data for the individual job element ratings and the individual attributes as related to these job elements. Macro approaches utilise attribute dimension scores which assess more general classes of work activities. There is only one "model" associated with the "macro" approach. A further distinction is made between forms of micro approach. "Cumulative" models conceptualise ability requirements as being determined by the degree to which a particular ability is required for each of the various work behaviours represented on PAQ. "Critical Behaviour" models suggest that ability requirements depend upon the level of a particular attribute which is necessary for only those work behaviours which have been judged most crucial to the job.

The authors subdivide these three models into 17 methods and further into 21 techniques. Whilst the statistical assembly rules for each technique generate different scores, the techniques can usefully be summarised. The 5 techniques of macro models of estimation are essentially scores which resulted from the use of previously established Q-type principal component factors (attribute dimensions). These attribute dimensions are combinations and weightings of PAQ items which reflect similar attributes. Marquardt & McCormick (1974) note that the similarity of this factor structure with that of the structure of job dimensions is confirmation of fundamental similarities between taxonomies based on the estimated importance of task elements and getting jobs done and the aptitudinal and adaptive attributes judged to be important in each of those task elements. The problem in using such data to "predict" mean test scores is however subject to the same limitations detailed earlier concerning job dimensions, ie. that a great deal of attribute information that is not "conceptually relevant" to the criterion tests is being included in correlations between attribute or job dimensions and ability test scores.

The authors utilise 14 techniques based upon cumulative micro models. Essentially these techniques utilise a cross-product approach. The assumption here is that the degree to which an attribute is involved in a job is the cumulative effect of the degree to which an activity is involved in a job multiplied by the 'relevance' of the attribute to each item. These cross-products are computed for all item scores or other criteria for inclusion. For example, one method was to calculate the sum of these products for those instances where the score for a job element was above the mean job analysis rating for that element as computed across all 659 jobs in the sample. The assumption underlying all of these techniques is that attributes are involved in a job to the degree that activities are performed. For example, the suggestion is that an aptitude is needed more in a job where a particular activity is performed to a greater extent than in another job. The assumption that the amount by which an attribute is required for a job element is monotonically associated with its rated involvement in the job is questionable.

Finally, the authors utilise 2 techniques based upon the critical behaviour micro model. Here the attribute scores are the sum of the attribute weightings for only those items which have been given the maximum rating of involvement, ie. "critical" job elements. The assumption underlying these techniques is that job elements which are not highly involved in the job do not require their corresponding attribute. It could be argued that the involvement at any degree of a particular job element necessitates the inclusion of the corresponding attributes.

In summary it can be seen that accepting the reliability and validity of the attribute weightings assigned to PAQ items in the studies by Mecham (1969) and Marquardt (1972) leaves a plethora of alternative approaches open to express the total attribute requirements of jobs. It seems clear however that the statistical alternatives can be derived ad infinitum and can lose sight of the psychological sense of the resultant scores. Shaw & McCormick (1976) make little reference to the psychological implications of these statistical machinations throughout their 70 page technical report. The present research has adopted three alternative approaches with simple yet contrasting psychological interpretations for study. It is accepted that varieties of techniques for assembling attribute profiles from the raw data of PAQ job analyses need to be evaluated, but some form of parsimony must be employed.

The inattention to psychological relevance is further emphasised in Shaw & McCormick's study in that the validation procedure is not as straightforward as it might be. Relationships between "indicated" and "actual" test scores are not established for corresponding attributes. Instead multiple regressions across sets of "indicated" attribute scores are used to predict "actual" test scores. For the sample of 659 jobs, the average multiple correlation for the cumulative (cross product) model methods was 0.36, while the average multiple correlation for the critical behaviour model of estimation was 0.30. The mean multiple regression for the macro model of estimation was 0.61. None of the techniques appear to offer sufficient predictive power to warrant the general adoption of a synthetic validity technology in their terms. The methodology of the study makes further meaningful discussion difficult. Shaw & McCormick's (1976) study does however highlight the issue of differing psychological interpretations and assumptions being associated with alternative mathematical assembly formulations of the overall ability requirements of jobs.

In view of the inadequacies of the Shaw & McCormick (1976) study, three major aspects of research are warranted:

1. A study of the reliabilities with which profiles of 76 human attributes can be derived from PAQ using alternative assembly techniques.
2. A study to determine whether the abilities indicated by PAQ for jobs are corroborated to the extent that incumbents on such jobs have differing mean scores on specific corresponding psychometric measures.
3. A study to determine whether the abilities indicated by PAQ are the actual "ability requirements" of that job.

Acceptable levels of reliability for yielded attribute profiles are a pre-requisite of validity. A study is conducted therefore to determine whether there are differential levels of reliability associated with three alternative techniques of assembling attribute profiles. A second study is conducted to examine the validities of these three assembly techniques to the extent that they reflect the mean levels of specific corresponding psychometric measures for samples of job incumbents for several jobs. Finally, a case study job is examined, and the aptitudes indicated as being required are concurrently and predictively validated against actual job performance.

In total, the studies are an examination of the utility of PAQ in constituting a "technology" of synthetic validity. A general discussion of the findings and limitations of the studies is conducted in Section 3.5.

3.2 A STUDY OF THE INTER-RATER RELIABILITIES ASSOCIATED WITH ADDITIVE, CROSS-PRODUCT AND CRITICAL BEHAVIOUR TECHNIQUES FOR ASSEMBLING ATTRIBUTE PROFILES

3.2.1 INTRODUCTION

The concern in the present study is to examine the reliability with which profiles of abilities can be systematically established. Brief reference to the rationales and validity findings of current approaches are given, but the focus of the review is upon the reliabilities of techniques for yielding ability profiles. As noted above, two broad approaches have been adopted in the study of synthetic validity. The approaches are associated with two major figures in the area, Fleishman and McCormick.

Fleishman and his associates have attempted to demonstrate the usefulness of the synthetic validity model in the area of motor skills/abilities. (Theologus & Fleishman, 1971; Levine, Romashko & Fleishman, 1973; Fleishman & Hogan, 1978; Mallamad, Levine & Fleishman, 1980).

Fleishman's 'ability requirements approach' is rooted in his experimental studies of psycho-motor abilities. Studies of the inter-correlations between task performances have led to the postulation of a range of ability factors which account for a considerable proportion of the variance in psycho-motor task performances. Theologus & Fleishman (1971) proposed behaviourally anchored rating scales to assess the lowest level of an ability which a person would need to possess in order to produce errorless performance on particular tasks. The task assessment scales have been amended to facilitate descriptions of jobs in terms of the abilities required to perform them. The concern in the present context is not so much a discussion of the comprehensiveness or validity of the ability factors utilised in Fleishman's approach, but rather an examination of the reliability with which raters can assess the "ability requirements" of tasks and jobs.

The index of inter-rater reliability used by Theologus, Romashko & Fleishman (1973) in a study using the behaviourally anchored rating scale approach was the intraclass correlation. The mean estimate of reliability for 5 raters was also established. The average intraclass identified was 0.33 yielding a mean estimate of reliability for 5 raters of 0.65. These low levels of inter-rater reliability led Mallamad et al. (1980) to evaluate the effectiveness of decision algorithms in aiding raters in their assessments. The authors demonstrated a significant increase in inter-rater reliabilities. The average intraclass correlation was 0.46 yielding a mean estimate of reliability for 5 raters of 0.81. These analyses were conducted upon sets of ratings based upon written job/task descriptions, and guidelines for deriving such descriptions remain to be formulated.

The rating of single tasks would appear to be conceptually less complex than ratings across an entire job. The use of external "expert" raters for the abilities approach in analysing jobs additionally requires the establishment of job/task analysis techniques which can comprehensively present the task requirements or duties of a job before ratings can be made. Alternatively the technique must be evaluated using "internal" job incumbents or supervisors (ie. persons who could be considered to be highly familiar with the job's complete demands) to assess ability requirements. No studies have evaluated the reliabilities of "actual job" ratings made in these ways.

Intra-class correlations of 0.33 and 0.46 for assessments based on common source material do not augur well for acceptable reliability levels in the practical study of jobs.

McCormick and his co-workers have devoted considerable effort towards a technology of synthetic validity utilising PAQ. It has been noted that McCormick has adopted two broad approaches to synthetic validity, job dimensional, and attribute-linked.

McCormick does not quote the reliability figures for the job dimensions used in the regression equations (Mecham, 1977; McCormick, Denisi & Shaw, 1979) to predict ability scores, nor those for the reliability of the resultant "profiles" of aptitude test score predictions.

The authors appear to have accepted the overall reliability findings across PAQ question items as indicative of the reliability of resultant "profiles" of aptitude test score predictions. The evidence presented in Section 2 of the present research has demonstrated that the statistical loadings of items in computing job dimension scores effectively transform and combine items, and that the reliabilities of resultant job dimension scores are not directly equatable with intermediate overall PAQ item reliabilities.

In the second of McCormick's approaches to synthetic validation using PAQ, the linkage between job elements (items) of PAQ and human attributes established by Mecham (1969) and Marquardt (1972) has been incorporated in the work by Shaw & McCormick (1976). The authors used what they termed "critical behaviour" and "cross product" methods to assemble overall attribute profiles for jobs. Since these alternative assembly techniques are a central feature in PAQ's approach to synthetic validity their mathematical derivations are worthy of re-capping.

In the "critical behaviour" method, the job elements used to generate the attribute profile are only those which have been given the maximum rating of involvement in the job (ie. a rating of "5" on the appropriate scale). The resultant attribute profile is the sum of attribute weightings for those "critical" job elements.

In the "cross product" method, the score on each job element of PAQ is multiplied by the weighting of the corresponding attribute to produce the profile. The resultant profile is the sum of these "cross products" across all items for each of the 76 attributes.

Shaw & McCormick (1976) do not report reliabilities for the resultant "critical behaviour" or "cross product" profiles used in their study of synthetic validity. The profiles in their study were derived on the basis of the mean estimates of PAQ item ratings. Single cross-product and critical behaviour profiles were therefore only produced for each job. It is clear however, that in using these profiles in "predicting" mean test scores that the authors were equating the overall item reliability of PAQ with the reliability/acceptability of the resultant profiles. The metric of overall item reliability is not however an assessment of the reliability with which raters assign ratings of particular values to items as they are combined in the cross-product methodology. Nor is the overall item reliability of PAQ equatable with the reliability of resultant critical behaviour attribute profiles. The latter reflect the reliability with which raters assign values of "5" to PAQ items.

In view of these shortcomings, the present study aims to investigate the reliabilities associated with the "cross product" and "critical behaviour" techniques of assembling overall attribute profiles for jobs.

A further approach to assembling attribute profiles is also evaluated. In this "additive" method, the attribute weightings for each job element involved (in any degree) in the job are summed. The resultant attribute profile is the sum of the attribute weightings for those items in PAQ which are performed on the job. A verbal account of the "additive", "cross product", and "critical behaviour" techniques of assembling overall attribute profiles is given in Appendix 4.

3.2.2 THE RESEARCH METHODOLOGY AND RESULTS

Analyses of particular jobs throughout the present research have been made by raters considered to be "highly familiar" with the demands of the job. Two or more raters have been employed to provide an assessment of each job. The alternative scores which are derivable from PAQ have differing psychological meanings and are used variably in studies which utilise PAQ as a source of predictors. The inter-rater reliabilities of each of the alternative derived sets of scores can be established utilising an analysis of variance approach such as the intraclass coefficient or coefficient alpha. Due to the nature of the transformations and constitutions implicit in alternative derived scores, the resultant reliabilities of these scores have been shown not to be directly equatable with the intermediate reliability across PAQ items (Section 2.3).

The objective throughout the present research has been to establish the reliabilities of the scores specifically used as predictors. The reliabilities of job dimensions and attribute profiles need to be established in situations where these scores are used as prediction data for particular criteria.

In order to compute and contrast intra-class correlation coefficients, certain statistical criteria have to be met. The first of these criteria is that of commensurate measurement. The computational procedures detailed by Shaw & McCormick (1976) for the establishment of critical behaviour and cross product attribute profiles would not be commensurate. The standardisation of these scores and those for additive attribute profiles was achieved by expressing each resultant summed attribute score as a percentage of the total possible score for that attribute. This has the additional benefit of creating a metric which is common to divisional job dimension scores and general job dimension scores. All the derived scores for PAQ have been made expressable as percentage scores.

Whilst the intraclass correlation coefficient is independent of the number of raters used to obtain assessments, it is influenced by the number of aspects across which assessments are made. The attribute profiles generated by the alternative assembly techniques each contain 76 "percentage of maximum" scores for attributes, and the resultant intraclass correlation coefficients are therefore directly comparable.

Three forms of profile are thus computable for each rating of each job under analysis. A sample of 12 jobs was used to investigate the differential reliability of the three profile forms. Each job was analysed in an interview setting utilising two or more independent "internal" respondents. The intra class correlation coefficient of reliability was calculated for the ratings of attribute profiles for each job. The sample of jobs was largely dictated by applied psychology constraints and the co-operation of companies and incumbents. The jobs nevertheless represent a wide range of industries and job behaviours however, and constitute an adequate basis to generalise results.

Table 14 details the calculated intra class reliabilities for each of the sets of profiles for each job. An inspection of Table 14 indicates that the reliabilities associated with the three forms of attribute profile differ. Correlated t-tests were used to compare the squared reliabilities of the profiles across the 12 jobs in the sample. The results indicated that the Additive Attribute Profiles

TABLE 14 The reliabilities of additive, cross-product and critical behaviour attribute profiles derived from PAQ.

		Intraclass Correlation Coefficients		
Job Title	Number of Raters	Additive Attribute Profile	Cross Product Attribute Profile	Critical Behaviour Attribute Profile
Setter	5	.992	.703	.257
Setter/Operator	2	.992	.359	.288
Electrician	3	.996	.652	.347
Instrument Mechanic	5	.993	.880	.430
Maintenance Fitter	2	.993	.886	.780
Careers Officer	5	.978	.972	.683
Motor Vehicle Fitter	5	.991	.617	.270
Secretary	5	.973	.789	.070
Teacher	5	.967	.942	.692
Library Assistant	5	.964	.659	.180
Mechanical Technician	5	.992	.778	.513
Labourer	5	.988	.749	.466
MEAN		.985	.766	.466

were significantly more reliable than Cross Product Attribute Profiles ($t = 5.479$, df (11) $p < 0.001$). The Additive Attribute Profiles were significantly more reliable than Critical Behaviour Attribute Profiles ($t = 12.933$, df (11), $p < 0.001$). The Crossproduct Attribute Profiles were significantly more reliable than the Critical Behaviour Attribute Profiles ($t = 8.033$, df (11), $p < 0.001$). It was concluded that the profiles generated by alternative assembly techniques have differential reliability.

3.2.3 CONCLUSIONS

In studies which utilise attribute profiles derived from PAQ as data, attention should be paid to the reliabilities of the attribute profiles. The computational procedures associated with the derivation of each of these forms of profile yield differentially reliable profiles. The significantly lower reliability associated with the critical behaviour method of assembly stem from a poor operational definition of critical behaviours in a job. The reliability with which raters assign values of "5" to PAQ items would appear to be too low to justify this criterion. This form of attribute profile is clearly subject to a high degree of distortion when items rated just below the criterion level of "5" are completely disregarded in computation. The cross product technique of assembling attribute profiles is based upon a multiplicative rule which effectively "weights" item reliabilities. If particular items have higher standard deviations within a particular set of ratings, then the consequences are not "averaged", as they effectively are in computing reliability across items. The relevance weights attached to particular items for particular attributes create a cumulative distortion of the resultant attribute profile.

The additive technique attaches zero-weightings to items and is based upon a conceptually more simple rating task. Raters are likely to be more able to reliably determine whether an activity "is" or "is not" performed in a job, than they are to make assessments of degrees of involvement. As such, the resultant additive attribute profiles have extremely high levels of inter-rater reliability within a set of job ratings.

In comparison to the reliability figure quoted by Mallamad et al (1980) of a mean intra-class correlation of 0.46, the reliability figures for the PAQ approaches are very encouraging. Several points must be borne in mind when discussing the results of the present study. Reliability can be obtained at the expense of discriminability and thence validity. In other words, whilst ratings can create profiles of abilities which are highly consistent, the profiles may not differentiate between jobs. This issue is discussed and examined in Section 3.3 of this report.

The validity of these profiles of attributes can be established in several ways. The ultimate form of validity sought in the present context is to establish whether the indicated abilities for a particular job can represent the transfer potentials of individuals within that job. If this were to be demonstrated, then the synthetic validity concept could be adopted as a replacement for the empirical paradigm. Intermediate aspects of validity may establish the accuracy with which indicated attribute profiles reflect actual mean attribute scores for jobs, and whether these indicated scores can be operationalised validly to 'predict' job performance. Each of these aspects is examined in subsequent sections of this report. The utility of the alternative derived profiles of attributes is clearly dependent upon the results of such studies. The findings of the current study would suggest that an additive attribute profile technique can generate profiles of attributes for jobs which are sufficiently reliable to offer promise in the subsequent prediction of job transfer performance.

3.3 A STUDY OF THE USE OF PAQ ATTRIBUTE DATA FOR ESTABLISHING THE JOB COMPONENT VALIDITY OF TESTS, WITH ADDITIVE, CROSSPRODUCT AND CRITICAL BEHAVIOUR ATTRIBUTE PROFILES

3.3.1 INTRODUCTION

Three techniques for assembling the overall attribute profiles for jobs have been found to be differentially reliable. The present study addresses the validities of these three techniques to the extent that they reflect the 'actual' abilities associated with job behaviours.

3.3.1.1 Criterion Measurement

It has been observed that incumbents of particular jobs constitute an homogeneous set of individuals. It was noted in Section 1.3.2.1.1 that different jobs have each been shown to have homogeneous incumbents, which in general manifest differences in trait terms. Stewart (1947) demonstrated differences between jobs in terms of general intelligence scores. Dodge (1935) and Barnette (1950) demonstrated differences between jobs in aptitude terms. Similarly personality differences have been demonstrated by Cattell et al

(1956), Holland et al. (1972) and Seymour et al (1973). Differences between interests have been demonstrated by Thurstone (1931), Strong (1943), Kuder (1946), and Creaser (1976). The consistent identification of such homogeneities in trait terms has led to the establishment of Occupational Ability Patterns for large numbers of jobs (Dunnette, 1976). The significant differences between the mean scores of groups of job incumbents are accounted for by the concept of "gravitation". The gravitation hypothesis is that these observed homogeneities of test scores reflect the attribute "requirements" of the job. The assumption underlying this hypothesis is that people tend to gravitate towards and remain in jobs that they are able to perform and that are reasonably compatible with their personal characteristics. Survival in a given job might be regarded as implying that the incumbents have performed at a reasonably satisfactory level and have found the job to be reasonably acceptable. Following this rationale, it is logical to consider significant mean differences in test scores of incumbents in various jobs as reflecting differences in the nature and level of the human characteristics or constructs that contribute to success on the jobs in question.

There are arguments against the acceptance of such homogeneities as proof of their constituting the valid "ability requirements" of jobs. In the absence of proven statistical association between performance (success) and attribute scores, the criterion is only a corollary of the ability requirements of jobs.

The criterion is however commonly employed in occupational psychology studies, (McCormick, Denisi & Shaw, 1979) and is adopted in the present study. The need to demonstrate the validity of "indicated" attribute scores in performance terms is, however, important, and the study reported in Section 3.4 utilises this approach. In the present study, the mean test scores on psychometric measures are treated as the criterion measurement.

3.3.1.2 Trait Measurement

The present study investigates whether differences in "ability requirements" as expressed by alternative attribute profiles are associated with "actual" differences in mean test scores. The attribute profiles generated by PAQ consist of 76 attributes. It was clearly not practicable to comprehensively test samples of job incumbents on each of these measures. The approach adopted in the present study was to utilise a battery of tests for which there were established high levels of reliability and validity and comprehensive normative data. Whilst this approach does not sample the 76 human attributes randomly, it does provide an indication of the validity of the corresponding attributes in the profile.

One of the most thoroughly researched aptitude test batteries is the Differential Aptitude Test Battery (DAT). First published in 1947 by Bennett, Seashore & Wesman, the test battery has been used extensively in occupational psychology and undergone several revisions to ensure relevance of items. Forms S and T of the current battery cover the eight abilities listed in Table 15.

Table 15 The Eight Aptitudes covered by the Differential Aptitude Tests (Forms S and T) (1973)

1. Verbal Reasoning
2. Numerical Ability
3. Abstract Reasoning
4. Clerical Speed and Accuracy
5. Mechanical Reasoning
6. Space Relations
7. Spelling
8. Language Usage

It can be seen from Table 15 that the battery provides assessments of a wide range of abilities, each of which is clearly defined. The battery had recently undergone an anglicisation and standardisation upon a representative sample of school children in the UK (Hodgkiss, 1979), and in view of this relevance and currency of norms together with its breadth of coverage, the battery was adopted for this study. Form S of the battery was used, and all scores were standardised to the British norms for 5th year boys and girls (Hodgkiss, 1979, p.31).

3.3.1.3 The Correspondence between Psychometric Assessments and PAQ Attributes

The studies of Shaw & McCormick (1976), Mecham (1977) and McCormick, Denisi & Shaw (1979) did not attempt to identify correspondence between their predictor and criterion measures, ie. PAQ human attributes and G.A.T.B. scores. As noted, their studies thereby included much information which was not conceptually relevant in formulating predictions. The present study has attempted to validate the attribute indications of PAQ. A careful study of the 76 attributes yielded by PAQ (See Appendix 5) found that 5 PAQ factors could be considered to be conceptually equivalent to DAT factors. Whilst the comparison of labels and verbal descriptions of statistical factors is potentially problematic, the consistency of identification by psychometricians of certain cognitive factors made the task less contentious.

Table 16 details the DAT factor title and definition alongside the "corresponding" PAQ attribute title and definition. Whilst the task of identifying correspondence is of necessity subjective, an examination of Table 16 confirms the general feasibility of forming such associations.

The identification of correspondence was in the minds of Mecham (1969) and Marquardt (1972) in their constituting lists of human attributes, since they included factors being "relatable to work" as a criterion for inclusion. In fact, the attributes very clearly reflect a comprehensive range of established psychometric measures. It is notable however, that only 5 out of the 8 DAT factors were identified within the list of PAQ attributes. This raises the issue of the comprehensiveness of the PAQ profiles of attributes. The DAT factors of Abstract Reasoning, Clerical Speed and Accuracy, and Spelling were not felt to equate with any PAQ attribute. Whilst it might be argued that this is deficiency on the part of the PAQ attribute listing, it is of course possible that certain PAQ attributes are more specific factors, and do not singly comprehensively embrace a DAT factor. For example, "perceptual speed" (Factor 13 in Appendix 5) might be interpreted as a component feature of Clerical Speed and Accuracy (DAT Factor 4). This lower order aptitide is not however in itself conceptually identical to Clerical Speed and Accuracy.

Table 16 The definitions of 5 DAT factors with definitions of "corresponding" PAQ Attributes

Sources: D.A.T. (1973)
Mecham (1969), (Marquardt (1972)

DAT Factor Title and Definition	PAQ Attribute Title and Definition
Verbal Reasoning: Ability to reason with words, to understand and use concepts expressed in words.	Verbal Comprehension: Ability to understand the the meaning of words and the ideas associated with them.
Numerical Ability: Ability to reason with numbers, to deal intelligently with quantitative materials and ideas.	Arithmetic Reasoning: Ability to reason abstractly using quantitative concepts and symbols.
Mechanical Reasoning: Comprehension of mechanical principles and devices, and the laws of everyday physics.	Mechanical Ability: Ability to determine the functional inter-relationships of parts within a mechanical system.
Space Relations: Ability to visualise, to "think in three dimensions" or picture mentally objects when shown only a picture or pattern.	Spatial Visualisation: Ability to manipulate visual images in two or three dimensions mentally.
Language Usage: A measure of how well one can distinguish between correct and improper grammar, punctuation and capitalisation.	Oral Communication: Ability to communicate ideas with gestures or spoken or written words.

In summary, the present study identified conceptual equivalence between 5 DAT factors and PAQ attributes, and is an investigation of the accuracy of PAQ "indications" of the associated DAT (actual) "requirements" of jobs.

3.3.1.4 The Predictors in the Study

The objective of the study is to determine whether PAQ can yield valid estimates of the attribute requirements of jobs. It has been noted that reliable associations have been established by Mecham (1969) and Marquardt (1972) between PAQ job elements (items) and 76 human attributes. It has also been noted that a variety of techniques can be employed to derive profiles for particular jobs of overall attribute requirements. Three approaches to this issue have been evaluated in the current research. The present study examines the validities of "additive", "cross-product" and "critical behaviour" assembly techniques.

The computational procedures associated with these three techniques are detailed in Appendix 4 and have been outlined in the study on differential reliability (Section 3.2). From the point of view of the present study these three techniques highlight different psychological assumptions concerning the relationships between traits and human behaviour.

The "additive" technique has been developed in the course of the current research. This approach expresses the relationship between traits and human behaviour in simple terms. The assumption is that particular job behaviours (PAQ elements) each require the possession of particular traits. Where a job involves a wide variety of job behaviours, the extent to which a particular trait is required is a function of the range of job duties performed. This degree of requirement can be represented by the cumulative total of relevance weightings across PAQ items (expressed as a percentage of the total possible attainable score).

The "cross product" technique was developed by Shaw & McCormick (1976). The assumption here is that the degree to which an attribute is required is a function of the degrees of involvement of associated activities in a job. Using written materials extensively in a job, for example, is being postulated to require a higher degree of verbal reasoning than where such materials are used rarely.

The "critical behaviour" technique was also developed by Shaw & McCormick (1976). The assumption here is that attributes are only required in instances of job behaviours which are conducted the most extensively.

The methodologies are no more than attempts to estimate the overall ability requirements of jobs, and logically cannot conceptually relate descriptors of behaviour to "statistical representations" of cognitive consistencies. Their purpose is to indicate the contexts across which psychometric validities can be generalised. Since one is talking of statistical associations between statistical representations of cognitive structure, the approaches cannot be interpreted literally as psychological models. Nevertheless, they constitute techniques with relative emphases upon abilities being required either as a function of the range of behaviours performed, the extent to which they are performed, or a conception that they only figure in exceptionally frequent job behaviours. The techniques are alternative attempts to formulate a "technology" of synthetic validity which can estimate the traits associated with particular job behaviours.

3.3.1.5 The Sample of Jobs and Measures Taken in the Study

The present study utilised incumbents from 7 different jobs. The jobs were chosen to reflect a range of job duties, but are clearly not a stratified sample of the UK job market. They do however represent a range of job levels and types and as such can serve as an adequate sample for the current purposes. The job groups chosen for study are listed in Table 17.

Table 17 The job groups chosen for study with DAT and PAQ

Job Title	No. of respondents
Careers Officers	5
Motor Vehicle Fitters	5
Secretaries	5
Primary School Teachers	5
Library Assistants	5
Mechanical Workshop Technicians	5
Labourers	5

Five incumbents from each of the jobs were chosen and felt to be "highly familiar" with the demands of the jobs. Each incumbent had been performing his/her job for more than one year. The PAQ was administered to each incumbent individually in the interview format. Each interview lasted approximately 2 hours. Reliability figures were calculated for each of the sets of ratings in terms of overall PAQ reliability, and the reliabilities of the attribute profiles derived by the three alternative techniques (ie. "additive", "cross product", and "critical behaviour").

Each of the 35 incumbents was administered the Differential Aptitude Test Battery over two 2-hour testing sessions. The test materials were scored and standardised to the British norms for 5th year boys and girls (Hodgkiss, 1979).

3.3.1.6 The Major Experimental Hypothesis

The PAQ job analysis technique yielded estimates of the extent to which 5 particular attributes were involved in each of 7 jobs according to three techniques of attribute profile assembly. Actual (DAT) test scores were established for each of the 5 factors for each job. The major experimental hypothesis was that the indicated degrees of attribute requirement by PAQ were significantly associated with actual degree of attribute requirement as expressed through the mean test scores for each job.

3.3.2 ANALYSIS AND RESULTS

The first objective of the analysis was to determine whether the 7 job groups (Factor A) significantly differed across the 5 aptitudes (Factor B) as indicated by each profile technique. Two way analyses of variance (treating aptitudes as a repeated measure), were computed for each of the three sets of PAQ "indications". Table 18 details the analysis of variance summary table for the additive assembly technique.

Table 18 Analysis of Variance Summary Table of "Additive" Indications of Scores for 5 Aptitudes for 7 Jobs

Source	SS	DF	MS	F
Between Subjects	725.156	34		
A	569.419	6	94.903	17.063
Subjects within Groups	155.737	28	5.562	
Within Subjects	4829.980	140		
B	1963.220	4	490.805	70.793
AB	2090.264	24	87.094	12.562
B x S.W.G.	776.495	112	6.933	

It can be seen from Table 18 that there are significant differences between the additive profiles of 5 aptitudes across the 7 jobs. ($F = 12.562$; $df(24,112)$; $p < .001$). Subsequent simple main effects and multiple comparison of means analyses (Winer, 1971) identified 41 significant differences ($p < .01$) between the mean scores of the 5 aptitudes for the 7 job groups. These findings are summarised in Table 19.

Similar analyses were performed for the cross product and critical behaviour indications. Table 20 details the analysis of variance summary table for the cross product assembly technique.

Table 20 Analysis of Variance Summary Table of "Cross product" Indications of Scores for 5 aptitudes for 7 jobs

Source	SS	DF	MS	F
Between Subjects	20696.964	34		
A	11288.643	6	1881.440	5.599
Subjects within Groups	9408.322	28	336.011	
Within Subjects	6323.704	140		
B	267.403	4	66.851	8.458
AB	5171.087	24	215.462	27.261
B x S.W.G.	885.214	112		

TABLE 19 The significant differences between job groups on PAQ attributes according to the additive technique ($p < 0.01$)

PAQ Attribute	Direction of Significant Difference	No. of Significant Differences
Verbal Reasoning	C>L, C>WT, C>F, PST>L, LA>L, S>L, PST>WT, PST>F, LA>WT, S>WT, LA>F, C>S, S>F, C>LA, C>PST	15
Language Usage	C>L, C>WT, C>F, PST>L, LA>L, PST>WT, S>L, PST>F, LA>WT, C>S, LA>F, S>WT, C>LA, S>PST, C>PST	15
Numerical Ability	S>L, C>L, LA>L, PST>L	4
Spatial Reasoning	WT>C, L>C, F>C	3
Mechanical Reasoning	WT>C, F>C, L>C, S>C	4
TOTAL		41

KEY:

C = Careers Officer
L = Labourer
LA = Library Assistant
S = Secretary
WT = Workshop Technician
PST = Primary School Teacher
F = Fitter

It can be seen from Table 20 that there are significant differences between the cross product profiles of 5 aptitudes across the 7 jobs ($F = 27.261$; $df(24,112)$; $p < .001$). Subsequent simple main effects and multiple comparison of means analyses identified 86 significant differences ($p < .01$) between the mean scores of the 5 aptitudes for the 7 job groups. These findings are summarised in Table 21.

Table 22 details the analysis of variance summary table for the critical behaviour assembly technique.

Table 22 Analysis of Variance Summary Table of "Critical Behaviour" Indications of Scores for 5 aptitudes for 7 jobs

Source	SS	DF	MS	F
Between Subjects	13365.021	34		
A	6113.045	6	1018.841	3.934
Subjects Within Groups	7251.975	28	258.999	
Within Subjects	2542.248	140		
B	31.377	4	7.844	0.971
AB	1606.275	24	66.928	8.287
B x S.W.G.	904.597	112	8.077	

It can be seen from Table 22 that there are significant differences between the critical behaviour profiles of 5 aptitudes across the 7 jobs ($F = 8.287$; $df\ (24,112)$; $p < .001$). Subsequent simple main effects and multiple comparison of means analyses identified 53 significant differences ($p < .01$) between the mean scores of the 5 aptitudes for the 7 job groups. These findings are summarised in Table 23.

TABLE 21 The significant differences between job groups on PAQ attributes according to the Cross Product technique ($p < 0.01$)

PAQ Attribute	Direction of Significant Differences	No. of Significant Differences
Verbal Reasoning	C>F, C>S, C>LA, C>L, PST>F, PST>S, PST>LA, PST>L, WT>F, WT>S, WT>LA, WT>L, F>S, F>LA, F>L, S>L, LA>L	17
Language Usage	C>F, C>S, C>LA, C>L, PST>F, PST>S, PST>LA, PST>L, WT>F, WT>S, WT>LA, WT>L, F>S, F>LA, F>L, S>L, LA>L	17
Numerical Ability	WT>F, WT>PST, WT>C, WT>S, WT>LA, WT>L, F>C, F>S, F>LA, F>L, PST>S, PST>LA, PST>L, C>S, C>LA, C>L, S>L	17
Spatial Reasoning	WT>F, WT>L, WT>PST, WT>S, WT>LA, WT>C, F>L, F>PST, F>S, F>LA, F>C, L>PST, L>S, L>LA, L>C, PST>S, PST>LA, PST>C	18
Mechanical Reasoning	WT>F, WT>L, WT>PST, WT>S, WT>C, WT>LA, F>L, F>PST, F<S F>C, F>LA, L>S, L>C, L>LA, PST>S, PST>C, PST>LA	17
TOTAL		86

KEY:
C = Careers Officer
L = Labourer
LA = Library Assistant
S = Secretary
WT = Workshop Technician
PST = Primary School Teacher
F = Fitter

TABLE 23 The significant differences between job groups on PAQ attributes according to the Critical Behaviour technique ($p < 0.01$)

PAQ Attribute	Direction of Significant Difference	No. of Significant Differences
Verbal Reasoning	PST>WT, PST>LA, PST>L, PST>S, F>LA, F>L, F>S, C>LA, C>L, C>S, WT>LA, WT>L, WT>S	13
Language Usage	No significant differences	0
Numerical Ability	F>PST, F>C, F>LA, F>L, F>S WT>PST, WT>C, WT>LA, WT>L, WT>S, PST>LA, PST>L, PST>S, C>LA, C>L, C>S	16
Spatial Reasoning	F>L, F>PST, F>C, F>LA, F>S WT>L, WT>PST, WT>C, WT>LA, WT>S, L>S, PST>S	12
Mechanical Reasoning	F>PST, F>L, F>C, F>LA, F>S WT>PST, WT>L, WT>C, WT>LA, WT>S, PST>S, L>S	12
TOTAL		53

KEY:
- C = Careers Officer
- L = Labourer
- LA = Library Assistant
- S = Secretary
- WT = Workshop Technician
- PST = Primary School Teacher
- F = Fitter

All three techniques appeared capable of discriminating between jobs in terms of their indicated ability requirements. The major issue is, however, whether or not the indications of difference are valid. This aspect was investigated in two ways. Tables 19, 21 and 23 detail the "indications" of differences between the job groups for each aptitude according to the alternative assembly techniques. The mean standardised test scores (ie. the "actual" scores) were computed for each job group for each aptitude. These data are reproduced in Table 24.

At the simplest level the data for "actual" test scores can be associated with "indicated" test scores using the sign test (Siegel, 1956, p.74). Here the direction of PAQ indications of differences are contrasted with the direction of differences on actual test scores.

Table 25 summarises the results of these analyses.

An inspection of Table 25 shows that all three techniques are able to make indications of directional differences between the mean test scores for jobs which are significantly better than chance. The additive technique, whilst yielding fewer "indications" than the crossproduct and critical behaviour techniques, did make predictions which were correct more frequently than the alternative assembly techniques. Over 90% of the "indications" in directional terms were confirmed.

TABLE 24 The mean DAT scores for the samples of 5 incumbents for the 7 jobs

Job Title	Aptitude				
	Verbal Reasoning	Language Usage	Numerical Ability	Space Relations	Mechanical Reasoning
Careers Officer	1.070	1.718	1.478	-0.524	-0.270
Motor Vehicle Fitter	-0.132	0.064	-0.454	0.086	0.626
Secretary	0.984	1.404	0.818	0.102	-0.402
Primary School Teacher	1.670	1.900	1.706	1.080	0.494
Library Assistant	0.390	1.276	-0.046	-0.174	-0.364
Workshop Technician	0.770	0.982	0.796	0.456	1.374
Labourer	0.150	0.300	-0.546	0.104	0.344

TABLE 25 The number of "correct" directional indications of the alternative assembly techniques

Association Between Actual and Indicated Directional Differences Between Jobs	Assembly Technique		
	Additive	Cross Product	Critical Behaviour
No. and % of correct indications	37 (90.24%)	66 (76.7%)	38 (71.7%)
No. and % of incorrect indications	4 (9.76%)	20 (23.3%)	15 (28.3%)
Total	41	86	53
z (Sign. Test)	-5.00	-4.86	-3.01
P	$p < 0.001$	$p < 0.001$	$p < 0.01$

Three one-tailed X^2 tests were computed to compare the distributions of "correct" and "incorrect" indications for the three techniques (Siegel, 1956, p. 174). The "additive technique" was found to be significantly more accurate than the critical behaviour technique ($x^2 = 4.930$; df (1); $p < 0.025$). Similarly the additive technique was found to be significantly more accurate than the crossproduct technique ($x^2 = 3.305$; df (1); $p < 0.05$). There was no significant difference between the crossproduct and critical behaviour techniques ($x^2 = 0.443$; df (1)). It was concluded that the additive technique was statistically the most accurate of the assembly techniques in estimating the attribute requirements of jobs.

The second approach which has been employed to examine the association between "indicated" and "actual" aptitude scores was the assessment of correlation between the two sets of data. The mean estimate for each of the 5 "indicated" attributes for each of the seven jobs was computed. These data and the mean estimates of "actual" (DAT) scores for the 5 attributes for each of the seven jobs were correlated. Table 26 summarises the produce moment correlation coefficients between the "indicated" and actual" scores for each attribute according to the three assembly techniques.

Due to the small sample size, the correlation required to reach significance is quite high. Each technique only manifested significant correlations between "indicated" and "actual" scores on one of the five attributes. A comparison between the techniques across the five factors was conducted. The average correlation between additive and actual (DAT) scores was 0.657. The average

TABLE 26 <u>The product-moment correlations between "indicated" and "actual" test scores for the 5 attributes, according to alternative assembly techniques</u>

Attribute / Assembly Technique	Verbal Reasoning	Language Usage	Numerical Ability	Spatial Reasoning	Mechanical Reasoning	Average Correlation
Additive	.647	.856*	.641	.423	.591	.657
Cross Product	.546	.418	.364	.361	.928*	.599
Critical Behaviour	.261	.057	.077	.194	.848*	.353

*p < 0.01 (one tailed test)

correlation between crossproduct and actual scores was 0.599. The average correlation between critical behaviour and actual scores was 0.353. Correlated t-tests were computed to compare the assembly techniques. The difference between additive and crossproduct methodologies was not significant ($t = 0.323$; df (4); $p < 0.9$). The differences between additive and critical behaviour methodologies was not significant ($t = 1.425$; df (4); $p < 0.4$). The difference between crossproduct and critical behaviour methodologies was significant ($t = 8.297$; df(4); $p < 0.01$).

The magnitude of the correlations between "indications" and "actual" aptitude scores are substantively higher than those identified by Shaw & McCormick's (1976) multiple regression methods for "micro" models of estimation. It will be recalled that the average multiple correlation for the crossproduct model was 0.36 in their study (the present study yielded an average zero-order correlation of 0.599). Similarly the average multiple correlation for the critical behaviour model was 0.30 in their study (the present study yielded an average zero-order correlation of 0.353). The present study also utilised the "additive" technique and the average zero-order correlation with this technique (0.657) was the highest (thought not statistically significantly different) of the three techniques.

3.3.3 CONCLUSIONS

In order for the objective of negating the need for context-specific empirical validation of traits to be met, a "technology" of synthetic validity needs to be established. The job component approach utilising the additive system of profile assembly has been shown to yield reliable profiles (see Section 3.2). The present study has shown that the accuracy of predictions associated with this technique was significantly greater than that associated with cross-product or critical behaviour approaches. The average correlation between "additive" PAQ indications and actual mean test scores was quite respectable.

In general it can be concluded that the analysis of jobs by PAQ and subsequent derivation of additive attribute profiles can prodive reliable and valid indications of the mean test scores for those jobs. Several caveats need to be placed before one can conclude that the technique constitutes an acceptable "technology" of synthetic validity.

Firstly, the study was conducted upon a small sample of jobs and whilst the sample constituted a comprehensive coverage of job levels and types, additional large scale research is advocated. Secondly, the present study only "validated" 5 of the 76 traits derivable from PAQ. It is unlikely that any single study could attempt to concurrently validate all 76 traits but further studies covering the range of attributes are advocated. Whilst there are no strong a priori grounds to suggest that the findings with the 5 attributes in the present study could not be generalised, several potential mediating factors are worthy of mention. The reliabilities of the item/attribute assessments of reliability by Mecham (1969) and Marquardt (1972) were generally able to yield mean estimates with high reliability (> 0.70). Three of the 76 attributes however were not rated reliably. "Working alone", "variety of duties" and "measurable/verifiable criteria" had unacceptable levels of inter-rater reliability. As such, it may be that the validity of these three factors might be moderated by lower levels of reliability.

The present study has provided a more "focussed" (Dunnette, 1976) assessment of the validities of PAQ-derived attribute scores than those of Shaw & McCormick (1976), Mecham (1977) and McCormick, Denisi & Shaw (1979). The restriction of predictors to "conceptually relevant" content provides a valid test of the associations between attribute profile indications and actual mean test scores. It has been noted that a large number of studies have identified significant differences between the mean test scores of jobs in terms of intelligence (Stewart, 1947), aptitude scores (Dodge, 1935; Barnette, 1950), personality measures (Cattell et al., 1956) and interests (Creaser, 1976). An analysis of the current sample of jobs across the 5 DAT factors similarly found significant differences ($F = 3.854$; df (24,112); $p < 0.001$) between the mean aptitude test scores of the 7 jobs. The "gravitation" hypothesis accounts well for such consistently obtained findings and provides good grounds for the adoption of mean test scores as a criterion. The use of such a criterion is not necessarily however, an assessment of the "ability "requirements" for a job there is a need for proven association between such traits and job performance. The extension of the investigation of the ability of PAQ additive profile scores to encompass true "ability requirements" is discussed and evaluated in Section 3.4.

3.4 A STUDY OF THE CONCURRENT AND PREDICTIVE VALIDITIES OF APTITUDES INDICATED BY PAQ AS BEING REQUIRED FOR PERFORMANCE ON A CASE STUDY JOB

3.4.1 INTRODUCTION

It has been noted that personnel selection usually necessitates the identification of the human requirements needed for job performance and the subsequent assessment of applicants in those terms. The empirical selection paradigm (Freyd, 1923) was outlined in Section 3.1 and schematically represented in Fig. 5. The paradigm suffers from two basic problems. The major problem lies in the context specificity of empirically-established test validities. The establishment of a synthetic validation paradigm has been the focus of Sections 3.2 and 3.3. The second problem is that even within the empirical paradigm there are difficulties in the process of translation of job descriptions into the attributes hypothesised to be required to attain appropriate levels of performance. Generally this process is conducted intuitively and, as Guion (1976) remarks, is only based on some more or less plausible relationship between job duties and human attributes. The establishment of a systematic translation between descriptors of jobs and human attributes can be of practical assistance therefore both within the empirical validity paradigm and in the synthetic validity paradigm.

The present research has investigated the reliability and validity of a job component approach to synthetic validation. It was shown in

Section 3.2 that the "additive" technique of assembling attribute profiles from item/attribute associations yielded profiles with higher levels of reliability than the "crossproduct" or "critical behaviour" techniques. The validities associated with the three alternative techniques were investigated in Section 3.3. PAQ "indications" of the attributes required in jobs were compared to the mean levels of corresponding aptitudes of incumbents in a range of jobs. Sign tests of the accuracies of the predictions yielded by the three alternative assembly techniques demonstrated that all three techniques were able to make indications of directional differences between the mean test scores for jobs which were significantly better than chance. Chi-squared tasks between the three techniques in terms of the accuracy of their indications demonstrated that the additive technique was significantly more valid than the crossproduct and critical behaviour techniques. Similarly the average correlation between PAQ indications and actual test scores was highest (though not statistically different) for the additive technique.

It was noted in Section 3.3 however, that the mean test scores associated with incumbents are not necessarily the "ability requirements" of a job. In the absence of proven statistical association between performance (success) and attribute scores, such a criterion is only a corollary of the ability requirements of jobs.

In order to fully evaluate the utility of the PAQ job component approach to synthetic validity it is necessary to demonstrate that those abilities indicated by PAQ are those which are <u>predictive</u> of job performance, ie. those abilities which are "required" by jobs.

The objective of the present study is to determine whether the abilities indicated by PAQ as being required for job performance can be operationalised and demonstrated to be valid predictors of actual job performance, ie. to determine whether PAQ can yield the ability requirements of jobs.

3.4.2 THE RESEARCH METHODOLOGY AND RESULTS

In the course of the "Grouping of Skills" research, (see Section 4.1.1) detailed task and job analyses were conducted upon a range of jobs within several industries (Patrick, Spurgeon, Barwell & Sparrow, 1980). One of the case study companies in the grouping of skills research was particularly interested in developing a selection procedure. The company was involved in plastics injection moulding and wished to determine the abilities required for recruits to perform effectively upon the job of machine setter. The evaluation of the utility of PAQ to indicate ability requirements which could subsequently be concurrently and predictively validated was conducted with this case study job.

The first concern was to identify a criterion which could distinguish between good and bad performance. Hierarchical Task Analysis (Annett & Duncan, 1967) conducted by another member of the research team had identified the structure and content of the setter's tasks. Although this detailed analysis was conducted in order to structure the training of setters, it also constituted an ideal data base for the derivation of multiple performance criteria. Job performance is multidimensional and there are different skills and abilities associated with the performance of different tasks. In order to develop a composite performance criterion, it is necessary to weight the constituent criteria in terms of their importance to overall performance on the job. Such a global performance criterion is therefore an abstraction of the overall performance standing of job incumbents,. Appendix 8 reproduces the performance measure used in the present study. It is possible to establish the concurrent validity of psychometric measures with incumbents' performances in terms of this criterion. It is also possible to establish the predictive validity of psychometric measures with recruits' performances in terms of this criterion. Both these forms of validation were conducted in the present study.

3.4.2.1 Administration of PAQ

The PAQ (Form B) was administered in an interview setting to 5 respondents. These ratings were given by three job incumbents, one senior setter and one company training officer. All raters were considered to be highly familiar with the job. Each interview lasted 1.5-2 hours.

The reliability of these ratings were then determined. The intra-class correlation coefficient (Winer, 1970) across the PAQ items was 0.654 yielding a mean estimate of reliability for the questionnaire of 0.904.

3.4.2.2 Derivation of the Attribute Profile

The additive method of assembling attribute profiles was adopted for the present study (see Appendix 4). The 5 resultant profiles of attributes were found to have an intra-class correlation of 0.992.

The reliability of the mean estimate for the profiles was 0.998. A highly reliable profile of the attribute requirements of the job was therefore yielded. It has been noted that 44 of the 76 attributes in the profile are of an aptitude nature. The evaluation of the PAQ indications was restricted to these 44 factors. Figure 7 details the mean profile of ratings for these factors.

3.4.2.3 Choice of Psychometric Tests

The profile of aptitudes indicated as being required by the job of setter (Fig. 7) shows a range of abilities being differentially required. In the applied context of the present study, it was not considered possible to test incumbents on all of the indicated factors. Clearly however there is a subjective component in the decision to restrict validation to a subset of factors. The balance of considerations concerning practical testing times against comprehensive coverage resulted in the decision to examine the validities of the 7 most highly important aptitudes for the job. The following factors were included in the next phase of the study:- Long term memory, intelligence, short term memory, near visual acuity, perceptual speed, convergent thinking and mechanical reasoning.

The development of a series of guidelines concerning the optimal restriction of operationalisation of tests from the profiles would seem to be a worthy exercise. It might be possible for example, for a criterion of a particular degree of involvement to act as a cut-off score. Attributes with "relevances" less than this score may be interpreted as not being worthy of operationalisation.

Figure 7.

The aptitude profile for the job of Setter.

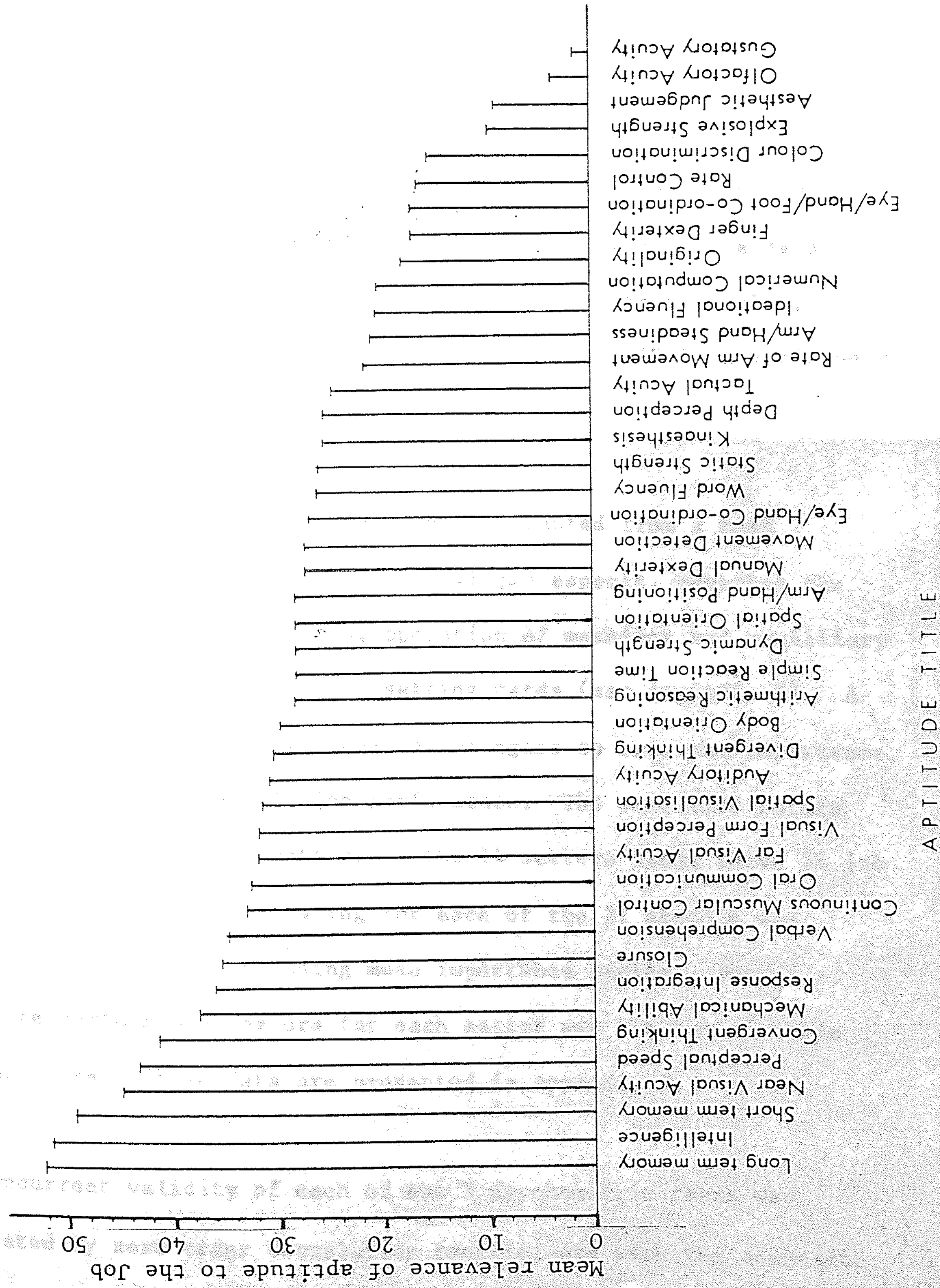


Figure 7. The aptitude profile for the job of Setter.

The translation of these seven factors into corresponding psychometric measures was relatively straightforward given the operational definitions provided by Marquardt (1972). Table 27 details the aptitude title, definition of aptitude and chosen psychometric measure for the study.

3.4.2.4 Concurrent Validation Procedure

A concurrent validation procedure was used involving all of the 14 setters within the company. Each incumbent was tested with the Wechsler Memory Scale (Wechsler & Stone, 1945), Raven's Standard Progressive Matrices (Raven, 1958), Standard Eye Chart (Emsley, 1976), Perceptual Speed Test (Thurstone & Jeffrey, 1966) and Birkbeck Test of Mechanical Comprehension (Birkbeck, 1960).

The composite job performance measure constructed from a task analysis of the setter's job assessed 21 job aspects, covering the use and identification of tools, operation of machines and ancilliary equipment, and interpretation of setting cards (see Appendix 8). A scale (1 to 10) was used by 5 company managers to rate the importance of the 21 duties to overall job performance. The same five raters were used to rate the competence of the 14 setters along these 21 job aspects. The performance rating for each of the 21 aspects was multiplied by its corresponding mean importance rating. The composite performance measure for each setter was the sum of these crossproducts. These data are presented in Appendix 9.

The concurrent validity of each of the 5 psychometric tests was calculated by zero order correlation coefficients with the composite

TABLE 27 Seven aptitudes and their measures for the job of setter

Aptitude Title	Definition of aptitude[a]	Chosen psychometric measure
Long-term memory	The ability to learn and store pertinent information and selectively to retrieve or recall, much later in time, that which is relevant to a specific context.	Wechsler Memory Scale (Wechsler & Stone, 1945)
Short-term memory	The ability to learn and store pertinent information and selectively to retrieve or recall, within a brief period of time, that which is relevent to a specific context.	Wechsler Memory Scale (Wechsler & Stone, 1945)
Intelligence	The level of abstraction or symbolic complexity with which one can ultimately deal	Raven's Standard Progressive Matrices (Raven, 1958)
Convergent thinking	The ability to select from possible alternative methods, the method of processing information that leads to the potentially best answer or solution to a problem.	Raven's Standard Progressive Matrices (Raven, 1958)
Near visual acuity	The ability to perceive detail at normal reading distance.	Standard Eye Chart read at 30 cm (Emsley, 1976)
Perceptual speed	The ability to make rapid discriminations of visual detail.	Perceptual Speed - identical forms (Thurstone & Jeffrey, 1966)
Mechanical ability	The ability to determine the functional interrelationships of parts within a mechanical system.	Birkbeck Test of Mechanical Comprehension (Birkbeck, 1960)

[a]From Marquardt (1972, pp. 40-45)

183

job performance measure for the 14 setters. These correlation coefficients are summarised in Table 28.

It can be seen from Table 28 that each of the hypothesised directions of correlation between test and performance was confirmed. On the five tests, the Birkbeck Test of Mechanical Comprehension and Raven's Standard Progressive Matrices were significantly correlated with overall job performance ($r = 0.89$, $p < 0.01$; and $r = +0.60$, $p < 0.05$, respectively).

Multiple regression was then used to determine the optimal combination of psychometric measures for the prediction of setter performance. Predictors were entered into the equation hierarchically in the order of their zero-order correlations with performance. The regression solutions obtained are summarised in Table 29. In view of the small number of incumbents actually performing the job, it was not possible to conduct a cross-validated design. Nevertheless, the multiple regression R, can be adjusted for the number of independent variables in the equation and the number of cases. This is a more conservative estimate of the percentage of variance explained, especially when the sample size is small (Thiel, 1971).

It can be seen from Table 29 that the highest adjusted R is given by the use of Birkbeck's Test of Mechanical Comprehension and Raven's Standard Progressive Matrices (Adjusted $R = 0.91$, $p < 0.01$). It is evident that prediction is not significantly improved by the inclusion of the other three measures. Consequently Birkbeck's Test

TABLE 28 Correlation coefficients, r, between job incumbents' scores on aptitude measures and job performance

Aptitude measure	r with job performance measure (n = 14)	p[a]
Wechsler Memory Scale	+0.29	ns
Raven's Standard Progressive Matrices	+0.60	0.05
Standard Eye Chart[b]	-0.41	ns
Perceptual Speed (Thurstone & Jeffrey, 1966)	+0.51	ns
Birkbeck Test of Mechanical Comprehension	+0.89	0.01

[a] One-tailed (directional) t test.

[b] Score was the number of errors on test; hypothesized correlation direction was therefore negative.

TABLE 29 Summary of regression solutions and multiple correlations between aptitude measures and job performance for setters ($p < 0.01$)

Aptitude measures entered in regression	Regression solution	Multiple correlation	Adjusted R	Standard error
Birkbeck, Raven	$Y = 369.10 + 13.36(B) - 1.89(R)$	+0.92	+0.91	57.12
Birkbeck, Raven, Perceptual Speed	$Y = 356.49 + 13.24(B) - 2.1(R) + 0.43(P)$	+0.92	+0.90	59.22
Birkbeck, Raven, Perceptual Speed, Eye Chart	$Y = 413.68 + 12.65(B) - 2.04(R) + 0.53(P) - 2.28(E)$	+0.92	+0.90	61.29
Birkbeck, Raven, Perceptual Speed, Eye Chart, Wechsler Memory	$Y = 427.14 + 12.65(B) - 2.13(R) + 0.32(P) - 2.99(E) + 3.30(W)$	+0.92	+0.89	63.51

KEY: B = Birkbeck Test of Mechanical Comprehension
R = Raven's Standard Progressive Matrices
P = Perceptual Speed
E = Standard Eye Chart
W = Wechsler Memory Scale

of Mechanical Comprehension and Raven's Standard Progressive Matrices were the tests recommended to the company for use in the future selection of setters.

It was concluded that the abilities indicated by PAQ as being required for the job of setter had concurrent validity.

3.4.2.5 Predictive Validation Procedure

In the absence of a cross-validation design, the concurrent validation of predictors against a criterion is a statistical procedure to maximise prediction. The abilities of present incumbents alongside their current performance, is not equatable, however, with a generalised prediction of recruits' potential performances on the job. This latter objective requires a predictive validation paradigm. Predictive validation studies whilst constituting a more rigorous examination of the ability requirements of jobs are however, notoriously difficult to operationalise in the field. There are problems associated with truncation of range of applicants, and additionally of recruits. Statistically, a random sample of applicants are required to be randomly selected for a post and their post-training performance assessed. In practice, the applicants attracted to jobs are a definitive subset of individuals who have self-selected themselves in terms of their perception of the job demands, and themselves.

Furthermore, even in studies where the 'to-be-validated' procedures are not employed in the selection decision, the criteria adopted by the selection decision-makers correlate with the 'to-be-visualised' procedures and thus truncate the range further. In the present context, the case study company wished to employ the concurrently-established selection methodology and used this technique alongside an interview procedure to select recruits from a pool of applicants. Any examination of these recruits' post-training performances therefore constitutes a highly conservative estimate of the predictive validity of the attributes in question. Since the company was at least willing to allow the investigator to follow up the performance of subsequently selected recruits, it was possible to make certain recommendations to the personnel officer concerning the design of a follow-up study. Whilst the test scores of applicants (and hence appointees) were known to those involved in the selection decision, these scores were not made available to the company afterwards, and strict instructions were placed with those in personnel not to divulge the relative standings of recruits on the psychometric and interview assessments. It was considered possible therefore to obtain assessments of post-training performance for recruits from persons not familiar with their standing on predictor assessments.

3.4.2.5.1 Internal Validation of the Training Programme

It has been noted that the case study company was co-operating in the grouping of skills research being conducted by a team of researchers at the University of Aston. Patrick, Spurgeon, Barwell & Sparrow (1980) report the progress made by the case study company in implementing the training recommendations outlined by the Aston team. The research team had conducted extensive task analysis of the job of setter and attempted to contribute towards training design decisions. The implementation "confirmed the previously observed difficulty in spanning the gulf between task analysis and training design (Duncan, 1975) ..... and whilst recommendations were presented by the Aston team, the final decisions involving design and administration of the programmes inevitably were taken by the company." (Patrick et al., 1980, p.63). It was possible, nevertheless, to report on the effectiveness of the training. Whilst the authors were not able to rigorously and unequivocally assess the training programme in the field, nor to obtain pre-training scores for the six individuals who took the programme, two different measures were used to evaluate the efficiency of the programme. Scores were obtained for each recruit on the Performance Assessment Rating outlined earlier and used in the concurrent validation procedure (see Appendix 8). Additionally an oral questionnaire assessing the learning of the trainees in particular task-specific areas was established by the authors. This questionnaire is reproduced in Appendix 10. Each trainee was presented with 26 randomly selected questions from the ten sections of the oral questionnaire (ie. 2 or 3 from each section). The authors note that that method was chosen because assessments could not occur simultaneously due to production constraints. Patrick et al. (1980) concluded that "all trainees had a satisfactory level of knowledge covering the material presented in the training programme" (Patrick et al., 1980, p.64). The scores of the six trainees upon this questionnaire constituted a second form of criterion for predictive validation. These data are presented in Appendix 11.

3.4.2.5.2 Results

In summary, it has been possible for the present investigator to examine the post training performance of six recruits selected on the basis of the aptitudes indicated as being required by PAQ and concurrently validated. Whilst the size of the sample is small, it is a 100% sample of the appointees to the job. The company subsequently faced general economic difficulties and were forced to defer recruitment until they felt economic considerations were more favourable. The small sample size highlights the problems of the empirical selection paradigm "in the field" where sample sizes are frequently small (Balma, 1959, see Section 3.1.1). Despite this limitation the study can still serve to demonstrate the simple association between "predictions" of post-training performance and "actual" post-training performance. Were any more elaborate statistical examinations required, it is doubtful whether such a limited sample size would suffice.

Two forms of post-training performance criterion were utilised. Firstly a composite assessment of work performance and secondly an oral questionnaire of job knowledge. The estimate of performance for each of the six trainees was calculated by the multiple regression equation established concurrently and detailed in Table 29, ie. $Y = 369.10 + 13.36\ (B) - 1.89\ (R)$. This estimate of expected performance was correlated with actual performance as assessed by the composite assessment of work performance (see Appendix 12). The product-moment correlation coefficient was +0.69 ($p < 0.05$).

Similarly, the estimate of expected performance was correlated with actual performance as assessed by the oral questionnaire of job knowledge (see Appendix 11). The product-moment correlation coefficient was +0.88 ($p < 0.005$).

It was concluded that the abilities indicated by PAQ as being required for the job of setter had predictive validity.

3.4.3 CONCLUSIONS

The study has demonstrated that the aptitudes indicated by PAQ using the additive profile technique have concurrent and predictive validity in terms of the performance of incumbents and trainees on the case study job. The methodology is one which can be operationalised by psychologists to identify the aptitudes which are associated with performance on a particular job. To this extent, the approach reduces the role of inference in the translation of the job descriptions into the attributes required to attain appropriate levels of performance. The approach would seem to have considerable utility within the empirical validation paradigm in the initial identification of measures hypothesised to be predictive of performance. Additionally, and more importantly the study has demonstrated that PAQ can synthetically establish the ability requirements of jobs. The aptitudes indicated by PAQ as being the "ability requirements" of the job all correlated with actual performance (see Table 28). At the simplest level of evaluation therefore, applicants with high scores on each of these factors would have performed to a higher standard on the job than applicants with low scores on each of the factors, ie. the indicated abilities for the job were the actual ability demands of the job. It was noted in Section 3.4.2.5, however, that the predictive validation study was not able to evaluate the post-training performance of recruits with low scores on the tests. The significant correlation between aptitudes and post-training performance of this truncated range of trainees is therefore a stringent test of predictive validity.

PAQ offers a means by which an aptitude bank can be systematically linked to a comprehensive set of job elements. However, subjective-inference is not totally removed from the empirical selection paradigm since there is a need to select the appropriate /corresponding psychometric measures from the attributes which have been identified as relevant to the job. In this particular case study the selection of tests was readily apparent. It is worth noting however that the concurrent and predictive validities demonstrated in the present study encompasses the efficacy of this procedure of matching PAQ attributes to psychometric measures.

Generalisations concerning the potential usefulness of the current methodology for personnel selection need to be tempered by the limitations of the present study. Only one job within a particular industrial context has been analysed using the 44 aptitudes of the attribute bank available with PAQ. Furthermore, this particular job highlights and therefore samples only a subset of those aptitude-type attributes, and intelligence was one of those attributes identified as being highly involved in the job. The potency of the intelligence factor in personnel selection has been abundantly demonstrated in the past (eg. Ghiselli, 1973) and consequently may partly explain the high concurrent and predictive validities of the present study. Clearly there is a need for a comprehensive range of jobs and corresponding attributes to be investigated using the techniques described in this study.

3.5 DISCUSSION AND CONCLUSIONS

It will be recalled that information of an ability/trait form has been postulated as a representation of cognitive structure. The traditional need to establish the ability requirements of jobs empirically and thence assess job similarity in terms of trait similarity, whilst potentially offering a sound basis upon which to predict transfer effects would have suffered from many practical drawbacks.

The studies outlined above have demonstrated that the ability requirements of jobs can be established synthetically (ie. directly from job analysis). If job similarity is expressed in terms of the similarity of attribute profiles then this form of representation of the shared cognitive structure of incumbents might usefully serve as a content base upon which to predict transfer effects. Issues surrounding the assessment of "similarity" are discussed in Section 4.1 of this report, and the validity of transfer predictions constituted by attribute profile similarity is examined in Section 4.3. The utility of PAQ as a "technology" of synthetic validation has been evaluated with this objective in mind. This application of the technology is novel however. Before discussing some of the issues surrounding its adoption, it is appropriate to consider some of the more traditional applications which might stem from this technology.

The first output from the technology could be a wider scale implementation of the synthetic establishment of the ability requirements detailed in Section 3.4. It is apparent from that study that the profile of abilities generated by PAQ is always a listing of 76 attribute scores. The differences between profiles lie in the differences between relative scores on each of the 76 factors. In the concurrent and predictive validation study reported, 'important' aptitudes were simply operationalised as the highest scoring 7 factors. Whilst the criterion is rather crude it nevertheless successfully identified those abilities with actual empirical validity on the job. Further study is advocated to identify a criterion for the selection of 'important' factors for operationalisation as measures. In effect this output from the studies is a technique of systematising the step in the empirical selection paradigm (see Figure 5) from 'Job Analysis' to the 'Derivation of Human Abilities'. This process is generally conducted intuitively and is only based on some more or less plausible relationship between job duties and human attributes. The reduction of the role of inference in this process is therefore a useful output from PAQ's ability to assemble attribute profiles.

If the attributes indicated as 'important' to job performance by PAQ are valid, then a second output from the research might negate the need to establish the actual (empirical) validity of identified factors. The selection of individuals might be made in terms of such factors without subsequent validation. At the simplest level, applicants with high scores on 'important' factors might be considered more likely to perform well on the job. The weighting of factors in this decision is however a consideration. Whilst the technology as it stands would predict that an applicant who scores highly on all 'important' factors would perform better than an applicant who scored less highly on all the 'important' factors, in practice discriminations between applicants might be less clear-cut. The essence of a multiple regression empirical prediction is the identification of relative contributions of chosen factors. The question therefore becomes one of determining the 'weight' (corresponding conceptually to the beta weights in a multiple regression equation) that should be attached to each of the 'important' factors in an attribute profile. It is apparent from the consideration of this aspect that it is a corollary of the whole issue of 'importance' of factors to job performance. There are a priori grounds to assert that the importance of each PAQ attribute (ie. its 'weight') is indicated by its actual 'score' for the job. Research is required however to determine whether or not the validities of factors correlate with their relative standing in a PAQ attribute profile. Such research is advocated. A study addressing this issue would require a large sample of jobs, each with large samples of incumbents, and there would be several issues to overcome. The statistical index of validity is the correlation coefficient. The size of correlation coefficient is influenced by the discriminatory power and truncation of range. Relative sizes of correlations could only be contrasted meaningfully in the context of such a study where the populations of applicants were identically normally distributed on each of the measures selected for validation. If this were not the case, then the 'weighting' of each factor (as indicated by its relative correlation with performance) might be a contaminated criterion by which to assess the association of PAQ factor importance as indicated by relative attribute scores. The study detailed in this report has shown that 'important' factors do have validity, and the theory and practice of personnel selection would suggest that less "important" factors (eg. Olfactory Acuity and Gustatory Acuity) should have significantly less validity in the prediction of job performance on the case study job. As such it serves as a starting point and rationale for the larger scale (and wider meaning) research into the use of synthetic validation as a personnel selection system.

The third more traditional potential outcome from the studies is the application of synthetic validation to "validity generalisation". This application has been the focus of most of the current research by psychologists into synthetic validation. As Pearlman (1980) has pointed out, the solution of a number of pressing problems in personnel selection such as combining jobs for validation purposes, and applying previous validation results to new jobs and situations rests on the development of a generalisable body of knowledge about human attribute-job performance relationships. As Lawske & Balma (1966) have defined it, validity generalisation entails the induction of a test's validity to a family of jobs from its validity for individual jobs and the consequent deduction of validity for additional jobs, based on their similarity to the job family. Dunnette & Kirchner (1959) is the only reported attempt to develop clusters of jobs with validity generalisation in mind on the basis of task-oriented content descriptors. The authors isolated several types of sales jobs with similar functions and concluded that different jobs within the identified occupational groups would be combinable for test validation purposes. No validation work was carried out as part of their study and it seems highly questionable, as has been noted in Section 1 of this report, whether job similarity in task (systems) terms carries any psychological meaning which would justify such a 'conclusion'. Pearlman (1980) cites a study conducted by Cunningham, Phillips & Spetz (1976) which utilised worker-oriented descriptors (The Occupational Analysis Inventory) as a basis for clustering 25 jobs in a state system. Their purpose was to assess the generalisability of test validities within such clusters of jobs. They found that about one third of the bivariate test correlations were statistically significant within OAI-based job clusters, although few of the multiple regressions held up under cross validation. Colbert & Taylor (1978) as noted in Section 1.4.2, clustered insurance company jobs on company-specific PAQ dimensions and found that prediction equations based on jobs within each family cross-validated to other jobs within the same family. Additional hypotheses regarding the ability of job family membership to moderate the relationship between test and job performance (ie. hypotheses of discriminant/differential validity between families) were not clearly supported.

A series of papers by Schmidt, Hunter & Urry (1976); Schmidt & Hunter (1977); Schmidt & Hunter (1977); Shane (1978); Schmidt, Hunter, Pearlman & Shane (1979); Pearlman, Schmidt & Hunter

(1980); Schmidt, Gast-Rosenberg & Hunter (1980); Schmidt & Hunter (1980); Schmidt, Hunter & Caplan (1981) and Schmidt, Hunter & Pearlman (1981); have addressed the issue of validity generalisation. Their postulation is that the ability to test discriminant/differential validity is limited if statistical power is low. The authors have demonstrated that in the vast majority of the corrected distributions of validity coefficients, the estimated true validity was sufficiently high and the variance sufficiently low to allow a conclusion of generalisability of validity to additional jobs in 'families' to a large extent independent of task differences. Indeed the title of one of the papers, "Task differences as moderators of aptitude test validity in selection: A red herring" captures the significance of their findings. In essence their argument means that validity can readily be generalised within job families (or extended to 'similar' jobs). Further, that the specificity of job families constituted in detailed task terms may overstate the limits to validity generalisation such that validity may often be generalisable between such clusters or "families". The pooling of task behaviours into job elements in PAQ and thence additively into profiles of abilities is therefore given considerably more face validity and justification by this body of research. Further, it seems highly probable that validity could be generalised from one job to another with a 'similar' attribute profile in PAQ terms. Such poolings of jobs may bear little relationship to conventional classifications of tasks, industries or job levels but may be valid expressions of jobs with shared ability demands. The question will become a mechanical one of identifying 'how different' attribute profiles need to be before there is legitimate discriminant validity. The evidence amassed by Schmidt and his co-workers would indicate that surprisingly diverse profiles may foster validity generalisation. In summary the study of the relationship between job behaviours and human abilities is moving from a science blighted by apparent limitations of the empirical paradigm and discriminant validity into one with widespread applicability. The utility of PAQ to serve as a vehicle for assessing the generalisability/extension of validity to jobs with 'similar' attribute demands clearly should become the focus of further research.

The fourth and final potential outcome from the studies concerns the utility of attribute profiles to serve as a content base to formulate transfer predictions. To some extent the requirement for PAQ to represent the shared cognitive structure of job incumbents was adequately demonstrated in Section 3.3 where mean test scores of incumbents were shown to be significantly associated with corresponding PAQ attribute scores. The subsequent determination of whether or not such indications reflect the "ability requirements" of jobs (in Section 3.4) is not strictly speaking, a requirement for the application of attribute profiles in the transfer context. Since the concern is to obtain estimates of the abilities/traits shared by sets of job incumbents, the issue of whether 'gravitation' results in attribute homogeneity above and beyond the "requirements" of jobs is in practice secondary. What is important is the ability of PAQ to estimate the trait possession of job incumbents. Whilst in general it may be concluded that PAQ seems able to yield such data, to an extent at least which justifies the subsequent examination of validity in transfer terms, further research is required. As noted in Section 3.3.3, the study reported was conducted on a small sample of jobs and only operationalised 5 aptitudes for validation. The extension of the study into a larger scale investigation examining the validity of PAQ estimates of other aptitudes and personality and temperament factors is a clear future research need.

For the purposes of the present research programme, it may be concluded that several pre-requisite properties of PAQ's ability to yield an attribute/trait content base for the prediction of transfer effects have been sanctioned. The overall research programme, outlined in Section 1.5 and represented in Figure 2 has attempted to highlight many of the intermediate steps/assumptions in assigning transfer effects to job similarity. Issues surrounding the reliability of PAQ items, attribute-item linkages, and alternative techniques of "assembling" overall attribute profiles; the ability of such profiles to reflect attribute/trait homogeneity and constitute the ability requirements of jobs have all been highlighted in these studies. The next step in the current research programme is to examine some of the issues surrounding the concept of similarity in ability/trait terms and the prediction of transfer effects in terms of the current abilities of incumbents (as expressed by PAQ) in relation to the ability/trait demands of a novel job.

SECTION 4

THE TRANSFER IMPLICATIONS OF SCORES DERIVABLE FROM PAQ

4.1 THE MEANING OF SIMILARITIES AND DIFFERENCES BETWEEN PAQ DESCRIPTIONS OF JOBS

The major objective of the current research programme is to evaluate the utility of PAQ as a job analysis instrument and generator of descriptors to predict task learning and performance. Section 2.3 examined the reliabilities of two broad sets of scores derivable from PAQ. The first set of scores are referred to as job dimensions. The second set of scores are referred to as attribute profiles. Attention was focussed in Section 3 upon the differential reliabilities of alternative techniques for deriving attribute profiles and upon two intermediate aspects of validity, ie. whether PAQ attribute profiles reflect differences in the mean aptitude scores of incumbents of jobs, and whether an attribute profile reflects the actual ability requirements of jobs. The purpose of these studies was to determine whether PAQ provides a technology of synthetic validity which can negate the need to empirically determine the abilities/traits of job incumbents for every job. The meaning of similarities/differences between jobs in terms of PAQ attribute profiles is therefore that such jobs require similar/different abilities to perform them, and that incumbents of respective jobs generally possess differential levels of these abilities. The consequences of this technology might therefore include the prediction of job transfer learning and performance on the basis of job/task similarity in ability terms.

The set of scores referred to as job dimensions are potentially more difficult to interpret. It will be recalled that principal component analyses of PAQ item scores for a stratified sample of jobs, yielded two sets of factor structures (Marquardt & McCormick, 1974). These are referred to as general job dimensions and divisional job dimensions . In both aspects, dimension scores may be regarded as statistical representations of job behaviours. The general job dimensions are effectively 14 higher order factors derived from factoring across all PAQ items (see Appendix 3). The 30 divisional job dimensions are lower order factors which were derived from the six separate divisions of PAQ. Thus there are 5 divisional job dimensions associated with Information Input behaviours; 2 dimensions associated with Mental Processes; 7 dimensions associated with Work Output; 6 dimensions associated with Relationships with Other Workers; 3 dimensions associated with Job Context; and 7 dimensions associated with Other Job Characteristics (see Appendix 2). The meaning of any descriptor is established through examinations of its association with other descriptors. Thus PAQ job dimensions have been associated with, for example, job compensation rates; (Mecham & McCormick, 1969; Harris & McCormick, 1973; McCormick, Denisi & Marquardt, 1974; Taylor, 1978), work satisfaction (Calitz, Hilaael, McCormick & Peters, 1973) and occupational stress (Shaw & Riskind, 1983) (see Section 1.4). These studies, and indeed all of those cited in the context of job component validity have utilised the divisional job dimensions. It seems clear that the level of description associated with general job dimensions is rather gross and perhaps lacks the a priori level of discrimination sought by investigators. As such they are rarely used by investigators. In brief, research with PAQ divisional job dimensions has sought to establish whether statistical representations of job <u>content</u> are associated with a range of psychological factors (eg. job satisfaction, stress). The concept of validity in science is construct specific, ie. the association between a descriptor and another construct (eg. pay, satisfaction or stress) lends specific meaning to that descriptor. The application of a descriptor to a new construct (eg. trait prediction, job transfer prediction) is aided by previously established associations to the extent that they lend support to the reliability, discriminability and comprehensiveness of job description, but the validity in terms of a specific construct has to be empirically established. It is this reasoning which has led investigators to examine the association of PAQ divisional job dimensions with constructs of more relevance to the present research. Not least amongst these investigations has been the research programme conducted at the University of Aston under the aegis of the Grouping of Skills Research Programme. It is appropriate therefore to summarise the research and findings of that research programme since they are of extreme relevance to the current investigation of predicting job transfer learning and performance.

4.1.1 THE GROUPING OF SKILLS RESEARCH PROGRAMME

A team of researchers at the University of Aston conducted a series of studies in the area of Grouping of Skills specifically addressing redeployment by upgrading to technicians. This research is reported fully by Patrick & Spurgeon (1978), Sparrow & Patrick (1978), Spurgeon & Patrick (1979),&Patrick, Spurgeon, Barwell & Sparrow (1980). The objectives of the research were to develop a systematic framework for making upgrading decisions which could be used for training, selection and other manpower problems. Such objectives clearly required the identification and analysis of descriptors of human work behaviours rather than restricting attention to psychometric approaches to trait measurement. The rationale behind the entire Grouping of Skills research programme was that occupational mobility of personnel would have to be increased in the future and that this might be achieved by the development and refinement of sets of skill descriptors. In the aspect investigated by the Aston team, anticipated fundamental restructuring of the workforce would place an emphasis upon the redeployment of skilled labour (made available through, for example, redundancies) to technician-type employment (ie. upgrading).

The authors concluded that there were three components in an upgrading situation - "identifying a need, selecting a group of workers for upgrading and finally training them" (Patrick et al., 1980, p.73). Further, the authors concluded that "after considering techniques which might be used to make the decisions involved in these three components" that "if the same technique was used to make decisions for all components of the upgrading situation, then this would reduce the overall efficiency of the strategy. Different types of information are required to answer these different questions". (Patrick et al., op cit., p. 73). The Aston research therefore focussed upon the development of techniques to cope efficiently with the three general components of an upgrading situation, and the interface between these techniques and how they might be combined into a successful upgrading strategy. In essence the distinction referred to by the authors was one of relating systems/task analyses to human characteristics. The identification of upgrading need was rooted in systems/task analysis (referred to by the authors as

Overview Task Analysis). The identification of specific training content was felt best accomplished by Hierarchical Task Analysis. These techniques generate descriptors of systems/task objectives which require inference to determine their implication in behavioural/transfer terms. The context specificity of the descriptors required decontextualisation in order to formulate predictions concerning the suitability of diverse potential recruitment jobs. The objective of formulating performance/transfer/upgrading assessments of suitability was attempted with the analysis of jobs by PAQ. Whilst this technique was felt to be capable of yielding behavioural (and potentially trait) information it did not generate the task specific information necessary for the identification of need or specific training content. Whilst the Aston research programme identified a vast range of information and findings of relevance to overall upgrading decisions, the emphasis of this brief review of studies will only address the findings concerning the discriminability and validity of PAQ.

A study reported in Patrick & Spurgeon (1978) sheds light on both these issues. A case study examination of a target (technician) job and two potential recruitment/upgrading (skilled level) jobs in the plastics industry utilised an analysis of variance approach (after Arvey & Mossholder, 1977) to compare the three jobs in terms of their Divisional Job Dimension Scores. Significant differences were found between the three jobs ($F = 3.4$, $df\ (60,180)$ $p < 0.01$) on divisional job dimensions. Simple main effects analysis identified significant differences on 8 of the 30 divisional job dimensions. It was concluded that in the case study examination that PAQ was able to discriminate between jobs in dimensional terms even though the three jobs were from the same industry/company and involved essentially industrial psychomotor skills in interaction with the same plastics injection moulding machines. The question of whether the level of discriminability yielded by the analyses was adequate raised a fundamental issue. The essence of PAQ descriptors is that they assess behavioural similarity across contexts. It is quite legitimate to accept that jobs might actually be different and yet be relatively similar in PAQ terms, since one is contrasting task/context differences with fundamental behavioural similarities. And yet it would be desirable to know whether PAQ (as a technique) has identified all the fundamental behavioural differences that exist between the jobs, ie. what is the true meaning of similarities/differences between jobs in PAQ dimension terms, and are these valid findings? The authors attempted to shed light on this issue by effecting a comparison between the PAQ job dimensions and the statements obtained from the hierarchical task analyses of the three jobs (see Patrick and Spurgeon, 1978, p.48-53). The procedure was effectively therefore, a structured assessment of the face validity of PAQ job dimensional discriminations. The authors' account of the study highlights the implicit conceptual problem in assessing the face validity of PAQ findings:-

> "The process of moving from very specific task statements to general descriptors has no principles or guidelines around which it might be organised. The nature of the problem is clear. Those taxonomies which themselves operate at the task statement level offer no solution, merely an alternative set of statements. The choice of a broader, more general, set of descriptors also raised numerous problems. Any particular set that might be chosen would

> operate at a particular level and it is not clear how these might map on to PAQ descriptors in order to allow comparison".
>
> (Patrick & Spurgeon, 1978, p.72-73)

This difficulty was not surprising and confirmed the dilemma illustrated by Prien (1977) of having "difficulty in reconciling the two approaches because the worker-oriented data contains items without parallel in the task-oriented items or the reverse." Patrick & Spurgeon (1978) utilised PAQ material in order to focus the comparison with the task analysis material and felt that despite the element of over inclusiveness that presents the major weakness of broad taxonomies that "there was sufficient overlap to be encouraging". (Patrick & Spurgeon, 1978, p.75). In brief, the PAQ divisional job dimension differences between the three jobs had an acceptable degree of face validity.

A subsequent comparison between a target job and two potential recruitment jobs in a plastics company is reported in Spurgeon & Patrick (1979). In this case study, differences were investigated between the jobs in terms of divisional job dimension scores and item (job element) scores. There were no significant differences between the jobs in either set of terms (Spurgeon & Patrick, 1979, p.16). The inability of PAQ to discriminate between the three jobs was discussed by the authors, and an additional facet of discriminability and validity was highlighted. Three interpretations of the findings were proferred. The first explanation was of a statistical nature. In examining the differences between jobs with an analysis of variance procedure (as advocated by Arvey & Mossholder, 1977), one essentially compares the variance between the jobs and within each job. Clearly the variation between jobs must be greater than that within the jobs for there to be a significant difference in the jobs. Arvey & Mossholder (1977), anticipating this dilemma, suggested that the intra-class correlation should be at least 0.7 for each job under discussion. Whilst this minimum level of reliability might generally reduce the number of failures of the technique to identify significant differences, it is clearly not an invariable statistical safeguard/guarantee of the power of the approach to yield all differences between jobs. The reliability of the technique clearly interacts with the discriminability of its applications. There is no universal minimum (beneath 1.0) of reliability which can maximise discriminability. The second explanation, postulated by the authors was that there were "in reality" no "differences" between the three jobs under scrutiny. Differences whilst minor, were identified however, in the Hierarchical Task Analyses for the jobs (see Spurgeon & Patrick, 1979, p. 37-55) and this interpretation was not felt to be tenable. The final interpretation was that whilst there were differences between the jobs, PAQ regardless of reliability considerations was incapable of distinguishing these differences between jobs. The data available was unable to distinguish between the alternative explanations but can serve to highlight the dependence of the approach upon "adequate" levels of inter-rater agreement.

Sparrow & Patrick (1978) drew attention to another aspect of the meaning of similarity/difference in PAQ dimensional terms. Further analysis of the three job groups studied by Patrick & Spurgeon (1978) demonstrated that one could attempt to discriminate between the two alternative recruitment jobs in terms of their respective suitabilities for retraining/upgrading. Accepting the validity of the discriminations between the jobs and the target job still left the question of relative weight or importance of particular deficits. In other words it was difficult to determine whether the training consequences of deficits in PAQ dimension terms were equitable or not. In identifying differences between the abilities/traits associated with job performances one is asserting that such trait differences are difficult to rectify, since they reflect fundamental differences in cognitive structure. Further there are no a priori grounds to assert that there are different re-training demands to "rectify" trait deficits. The position with PAQ job dimensions is less clear. In assessing the work behaviours of incumbents, one is attempting to utilise information which is of a skill nature, ie. learned. Further, that such behaviours have effectively been acquired at the workplace. Whilst PAQ job dimensions are orthogonal statistical representations of such behaviours there is no implicit guarantee of their reflecting the training (acquisition) times associated with such classes of behaviour. Sparrow & Patrick (1978) noted for example the greater psychomotor behavioural similarities between the recruitment job of setter and the target job of technician. The authors merely questioned whether or not the deficit of the setter in terms of the two dimensions associated with mental processes (which the alternative recruitment job was not deficient in) could be a "severe obstacle to his performance of the technician's functions" (Sparrow & Patrick, 1978, p.53). The reflection of such dimensions of behaviours involving educational background, use of mathematics, etc. may mean that such behaviours are less easily rectified than those associated with dimensions which reflect essentially psychomotor behaviours. It should be noted therefore that in assessing job similarity in dimension terms there is an assumption of equal trainability of the classes of behaviour reflected by job dimensions.

Patrick, Spurgeon, Barwell & Sparrow (1980) report a study where PAQ was applied to a wider set of "hypothetical" recruitment jobs to identify potential "suitability" for retraining as kiln burners in the cement industry (Patrick et al., 1980, p. 22-24). The authors note that case study work by necessity required the choice of potential recruitment jobs for a particular job to be "sensible" and "realistic" in the co-operating company's perspective. The Grouping of Skills concept, however, suggests the need for the removal of some of these potentially erroneous perspectives. The authors' objective was to examine whether the degree of occupational mobility that exists in skill terms between jobs, might demonstrate that "apparently similar" jobs are not necessarily the best recruitment job choice. Analyses of the relationships between 5 hypothetical recruitment jobs and the "target" job of kiln burner were conducted in terms of divisional job dimensions. The two-way analysis of variance procedure advocated by Arvey & Mossholder (1977) and utilised throughout the Aston research programme, was used to identify significant differences between the jobs. The authors found that two jobs from within the cement industry (and traditionally considered as potential recruitment jobs by the industry) were not as similar as other "apparently" less related jobs. The authors concluded that job similarity can exist across conventional industry barriers and that "it is extremely doubtful whether conventional job analysis (with its reliance upon task-specific content) would have highlighted the structual similarity of each of the recruitment jobs to that of Kiln Burner" (Patrick et al., 1980, p.24). The study demonstrates the difficulties in establishing the meaning of job similarities/differences in PAQ job dimension terms. The technique may have sufficient reliability to enable discriminations to be made between jobs but the corroboration (and meaning) of such similarities/differences cannot be readily established beyond the level of face validity.

In summary, the aspect of Grouping of Skills researched by the Aston team examined the discriminations and face validity of PAQ divisional job dimensions and enables six broad conclusions to be drawn.

1. Whilst PAQ is felt to be capable of yielding behavioural information it does not generate the task specific information necessary for the identification of need or specific training content.

2. The technique can be administered with sufficient reliability to discriminate between jobs in terms of job dimensions utilising an analysis of variance procedure.

3. There are difficulties in determining the validity (meaning) of PAQ discriminations in job dimension terms, but a comparison between the findings within a case study company identified sufficient overlap to be encouraging.

4. The reliability of the technique interacts with the discriminability of its applications. There is no universal minimum of reliability (beneath 1.0) which can maximise discriminability, ie. "inadequate" levels of reliability will artefactually reduce the ability of the technique to identify differences between jobs.

5. In assessing job similarity in job dimension terms there is an assumption of equal trainability of the classes of behaviour reflected by job dimensions.

6. Structural job similarity in job dimension terms can exist across conventional industry barriers, ie. jobs from different industries can have "similar" job dimension scores. The meaning (validity) of this apparent structural similarity requires study (see Section 4.3).

4.1.2 JOB STRUCTURE AND HUMAN ABILITIES

A further dimension of meaning may be given to the scores derivable from PAQ by examining the inter-relationships between the derived scores themselves. It has been noted that principal component analyses and subsequent Varimax rotations of the PAQ item data yielded two sets of job dimensions. These have been referred to as divisional and general job dimensions (Marquardt & McCormick, 1974). McCormick (1974) interprets these two sets of factors as reflecting "the extent to which the job elements tend to occur in combination as they actually exist in jobs" (McCormick, 1974, p.7).

Marquardt & McCormick (1973) subsequently conducted parallel factor analyses upon the matrices of correlations between and among the job elements of the PAQ across the ratings of attributes established by Marquardt (1972). These "attribute dimensions" may be interpreted "as reflecting the extent to which different groupings of PAQ job elements have similar (rated) attribute requirements" (McCormick, 1974, p.7).

McCormick (1974) notes that "despite the fact that there are distinct differences between the nature of the data on which the dimensions were based, it is still interesting to note that there are at least moderate parallels in the dimensions resulting from these two sets of data", and that "they have reasonable similarity in terms of their context"(McCormick, 1974, p.7). As Dunnette (1976) stated "the underlying similarity of the two sets of factor structures is, in a way, a kind of first requirement for concluding that fundamental similarities exist between taxonomies based on estimated importance of task elements for getting jobs done and the aptitudinal and adaptive attributes judged to be important in each of those task elements" (Dunnette, 1976, p.507). This finding lays the conceptual groundwork for the further argument (basic to the concept of synthetic validity) that if a given kind of work activity, task element or job dimension is found to be common to different jobs, then the human attributes necessary for doing those jobs ought also to be the same or similar. PAQ job dimensions in reflecting job behaviours do relate to ability/trait information. The studies by Mecham (1977) and McCormick, Denisi & Shaw (1979) reviewed in Section 3.1 of this report, demonstrated a relationship between job dimensions and abilities.

An analysis of the attributes associated with the constituent items of each of the PAQ job dimensions could shed further light upon the meaning of job dimensions. The present investigator conducted an analysis of the attributes associated with the constituent items of each divisional job dimension and each general job dimension. It will be recalled that there are a set of relevance scores for each PAQ item in terms of 76 attributes (Marquardt, 1972). The listing of the constituent items for each PAQ job dimension (Marquardt and McCormick, 1974) can be used to identify a set of profiles of attributes which are associated with each particular job dimension, i.e. those associated with each constituent item. It is thus possible to determine whether the sets of profiles associated with each PAQ dimension have a sufficient degree of commonality for there to be significant differences between the attributes generally associated with PAQ job dimensions. This procedure was used to contrast the attribute profiles associated with each divisional job dimension. A similar procedure was used to analyse each general job dimension. A two-way repeated measures least squares solution was used to contrast the attribute profiles associated with different job dimensions. Significant interactions were identified between general job dimensions and attributes ($F = 10.360$, $df(975, 18150)$, $p < 0.001$) and between divisional job dimensions and attributes ($F = 17.093$, $df(1875, 17625)$, $p < 0.001$). There are therefore definitively different abilities associated with different job dimensions. Job dimensions statistically reflect both independent groups of work behaviours <u>and</u> significantly different profiles of abilities/traits. This test of relationship between the two sets of data derivable from PAQ constitutes a more rigorous examination than the observations of McCormick (1974) detailed above.

4.1.3 SUMMARY

In summary, the job dimension scores derivable from PAQ may be regarded as having meaning in psychological terms. Further they constitute a basis to predict the transfer (learning and performance) potential between jobs/tasks related in their terms. Job dimensions reflect the behaviours of work and may be interpreted as operating as the "skill level" of description. The alternative set of scores derivable from PAQ (attribute scores) may be interpreted as reflecting more fundamental individual differences. Aptitudes (both cognitive and motor) and personality traits reflect consistencies in human cognitive structures and performance and also constitute a basis to predict the transfer (learning and performance) potential between jobs/tasks related in their terms. A study contrasting the utility of job dimensions and attribute profiles derived from PAQ in "predicting" transfer is reported in Section 4.3. A subsequent discussion of the meaning/validity of both sets of scores in the transfer context is held in Section 5.

4.2 ASSESSING SIMILARITY BETWEEN JOBS

Pearlman (1980) in reviewing the implications of job families for personnel selection identifies three broad issues in the development of job families. Firstly, the objective for which jobs are to be grouped. For a taxonomy to be useful, the type of information classifed and the method by which it is classified must be appropriate for its intended purpose. Secondly, the question of the content basis of a job taxonomy or job family system. This concerns the job characteristics, units of analysis, or descriptive criteria on which the system will be built. Current approaches to classifying person-task relationships have been reviewed in terms of their objectives and content bases in Section 1.3. The third issue in developing job families concerns the grouping methods used in the construction of job families. Pearlman (1980) notes that there are 4 broad forms of techniques for grouping jobs:- Rational methods, Cluster Analysis, Factor Analysis, and ANOVA-based strategies.

Jobs are grouped by essentially rational methods where the descriptors themselves reflect the overall nature of the job, ie. information of a qualitative nature. Examples of this approach include CODOT, the classification of ten thousand careers by Thorndike & Hagen (1959), and the grouping of jobs used by Ghiselli (1966, 1973) in reviewing the validity of aptitude tests. Job family development has become increasingly based on objective statistical techniques, in contrast to the subjective methods used in earlier times. Statistical techniques are appropriate where the descriptors are of a quantitative nature. Cluster analytic techniques for grouping jobs have come to be widely used in recent years. Christal (1974) has incorporated an iterative clustering method using incumbents' task inventory responses. Brush & Owens (1979) used the method to form clerical job families using worker-oriented and attribute descriptors. Cornelius, Carron & Collins (1979) used the methodology to examine differences in the grouping solutions derived from different types of descriptor. Tornow & Pinto (1976) used this procedure to form clusters of managerial positions, and Taylor (1978) used the methodology to group insurance company occupations as described by PAQ.

Factor analysis has been used to group occupations using task-oriented descriptors by Prien (1965) and Dowell & Wexley (1978). Person-oriented descriptors have been used in the identification of groupings of jobs by Palmer and McCormick (1961). Arvey and Mossholder (1977) proposed a univariate analysis of variance approach with person-oriented descriptors. Lissitz, Mendoza, Huberty & Markos (1979) explored the use of multivariate analysis of variance. It has been noted (Section 3.5) that much of the work in grouping jobs has been oriented towards validity generalisation, ie. attempting to formulate "families" of jobs which are similar. Although there is clearly a range of statistical procedures which can address this issue, the above studies have restricted their interest to the procedures themselves and have left evaluation of resultant clusters/groups/families at the level of face validity. The constitution of families of jobs will depend upon the content base of description and the statistical procedures utilised to assess and maximise similarity/discrimination. Levine, Ash and Bennett (1980) for example, demonstrated different outcomes associated with four different job analysis methods, and Cornelius, Carron and Collins (1979) demonstrated that the number and type of resulting job clusters was clearly dictated by the type of job analysis data that is used. Blashfield (1976) has demonstrated that different grouping methods in themselves may produce different grouping structures even when operating on similar data.

Pearlman (1980) observes that the merits and limitations of the many quantitative approaches to job grouping have been the subject of increasing debate. He notes that although there is a current lack of consensus regarding the best grouping method for the purposes of job family development, it is "naive to frame the problem in such terms, since the appropriateness of different grouping methods is highly dependent on both the purpose at hand and the nature of the available descriptor output data", and that "the controversy over alternative methods may be lending an unwarranted degree of importance to this issue, relative to more substantive psychological questions concerning job family development" (Pearlman, 1980, p.15).

Pearlman's review and the studies cited within it have indeed masked substantive psychological questions. The decisions concerning grouping strategy, clustering algorithms, factor analytic procedures, and the power of ANOVA-based designs have omitted a major pre-requisite for such an objective: The measurement of profile similarity itself. Researchers using these techniques happily adopt correlations between profiles (in factor analysis) or d^2 measures (in cluster analysis) as meaningful and appropriate assessments of similarity for subsequent analysis. A closer inspection of the issues reveals that such adoptions are premature since alternative measures of profile similarity per se carry alternative psychological interpretations.

4.2.1 THE PSYCHOLOGICAL ASSUMPTIONS IMPLICIT WITHIN ALTERNATIVE PROFILE SIMILARITY MEASURES

The output from structured job analyses such as PAQ is a profile (or set of profiles) of scores. In the case of PAQ two broad sets of profiles, dimensions and attributes, are generated, but the objective with each set of profiles is the same. The assessment of similarity between the profiles of scores associated with different jobs. Cronbach & Gleser (1953) note that a great number of investigations attempt to deal with similarity between profiles and that whilst "such studies vary widely with regard to the problems posed and the specific variables used, they have in common an attempt to deal with several scores or traits simultaneously" (Cronbach & Gleser, 1953, p.456).

The various available methods of measuring profile similarity yield different results. Proper choice of a measure for a specific investigation requires knowledge of the assumptions, limitations, and information to be utilised in the alternative methods of measuring profile similarity (Cronbach & Glaser, 1953). A statistical composite of similarity makes several assumptions affecting the meaning of the resultant index. The implications of these indices for job profile comparisons are outlined below with attention focussed upon the 5 most commonly applied indices. These are correlation, Σd, Σd^2, $\Sigma(w \times d)$, $\Sigma(w \times d^{2})$.

The correlation between two profiles of scores is, in addition to being a measure of association, an index of similarity. Statistically, the correlation coefficient assesses the "shape" of profiles. It does not incorporate "elevation" information. It is possible for example for two profiles to be perfectly correlated and yet for one to be uniformly higher in its constituent scores than the other. Cattell (1949) and du Mas (1947) have noted that differences in level between profiles are generally important and should be included in the index. Correlation as an index of similarity also attaches the same (unitary) weight (importance) to each of the constituent scores within a profile. It may be that the investigator wishes to attach greater import to particular scores within a profile.

The Euclidean distance between pairs of scores is referred to as d. This measure may be summed across scores within a profile to yield an overall similarity measure. This index incorporates the "elevation" factor. It also gives equal weight to each of the composite scores. In addition, the 'sign' of the difference between pairs of scores is preserved by this index. In instances where one is examining whether Profile A is generally higher or lower than Profile B, the d index preserves the necessary information.

The squared Euclidean distance (d^2) between pairs of scores incorporates "elevation", gives unitary weight to each of the constituent scores, and by virtue of "squaring" the differences, ignores the concept of surplus or deficit and provides an index of modulus similarity.

The importance of constituent scores can be weighted and included in the derivation of an overall Euclidean distance measure ($\Sigma(w \times d)$. This index incorporates elevation and the concept of surplus/deficit and can weight the importance/contribution of constituent scores.

Finally, the squared weighted Euclidean distance measure (Σ (w x d^2)) may be examined. This index incorporates elevation, but ignores the concept of surplus/deficit. It can weight the importance /contribution of constituent scores to overall similarity.

Whilst the validity (appropriateness) of these alternative indices in assessing job similarity in PAQ terms warrants empirical study, (and is examined in Section 4.3), some of the major psychological implications can be usefully summarised.

Three considerations are highlighted by the alternative similarity indices; elevation, weighting of constituent scores, and the concept of surplus/deficit. In the analysis of jobs one could hypothesise that the level of scores is an important facet of similarity. The shape of respective profiles may have a bearing upon similarity but the non-inclusion of elevation information of the correlation similarity index could cast doubt upon the utility of similarity assessed in this way. The profile which results from the analysis of a "target" job (ie. a job to which one is anticipating to assess transfer potential) manifests differences in the importance of constituent scores (dimensions or attributes). It might be hypothesised therefore that the importance of constituent pairs of scores in a profile comparison could be usefully weighted according to the scores importance in the "target" job. On the other hand, it might be argued that overall similarity is not solely a function of the relative degrees of constituent scores in the "target" job, and that on balance assigning unitary (equal)weights to constituent scores is the most tenable position. In applications where one is attempting to assess the similarity of jobs then the direction of differences between constituent score pairs may be of relevance. For example, if one is examining the transfer potential from one job to another, then the issue of whether the "recruitment" job requires less of a feature (ie. a deficit) may carry different implications from a situation where the recruitment job manifests a surplus. In ability terms for example, the possession of "too-high" a level of verbal reasoning may not preclude a particular task performance, whereas "too low" a level of the ability may have performance consequences. One may hypothesise that in the prediction of behaviour across contexts that the concept of surplus/deficit is of relevance in assessing similarity.

In summary it can be seen that the 5 commonly-used indices of similarity carry different psychological implications in the study of job similarity. In the present context, where one is endeavouring to assess the transfer potential of incumbents of a job to a "target" job, it seems that elevation information may be of importance, the concept of surplus/deficit may be relevant, but that the decision concerning the weighting of constituent items (scores) is not clear-cut. As such one may hypothesise that the most appropriate similarity index might be Σd or $\Sigma(w \times d)$. The correlation index (r), squared distance index (Σd^2) and weighted squared distance index ($\Sigma(w \times d^2)$), yield assessments which might have potentially less tenable assumptions in the present context.

4.3 A STUDY OF THE PREDICTIVE VALIDITY OF PAQ IN TRANSFER TERMS

4.3.1 INTRODUCTION

The major objective of the current research has been to study the utility of the Position Analysis Questionnaire to generate descriptors which characterise jobs and which constitute a valid basis for the prediction of transfer between contexts.

Two broad sets of derived scores have been evaluated. PAQ has been found to have adequate levels of reliability in the assessment of job dimensions (Section 2.3) and attribute profiles (Section 3.2). The attribute profiles have in turn been found to validly reflect the abilities associated with incumbents of jobs (Section 3.3). Job dimensions have been found to have validity in several contexts (Section 4.1). It remains to be established whether or not such sets of descriptors can represent the skills and abilities of incumbents so that "predictions" may be formulated on the basis of the relative similarity of an incumbent's job and a "target" job in either job dimension terms or attribute terms.

Laboratory studies of the transfer between tasks generally utilise behaviours of a unique, though perhaps, artificial, nature. Nonsense syllables, for example, are not expected to generally carry other connotations by subjects, and transfer findings are felt to be attributable to the source material per se. In applied research, however, the knowledge/skills associated with a particular job are not necessarily the only skills in the possession of incumbents. Nor are they strictly speaking the only skills/knowledge that incumbents of a job have <u>in common</u>. The relating of current and target jobs in terms of their constituent skills or abilities carries the assumption therefore that the skills or abilities indicated for a current job are the only characteristics common to incumbents. The empirical validation of tasks related in PAQ terms is in part therefore, a test of the tenability of this assumption. Acceptable levels of validity for predictions of job transfer potential based upon PAQ will have incorporated this feature, as must any approach if it is to address the practical issue of mobility.

In summary, previous applications of PAQ in job transfer/upgrading decisions have made certain assumptions. These may be summarised as:-

1. That the demands of a job group's present job constitute an adequate assessment of their common skills and abilities.

2. Description of a job by the Position Analysis Questionnaire provides an adequate representation of the demands of that job.

3. The subsequent identification of a degree of "deficiency" for a particular job (in relation to a target job) is a legitimate measure of its incumbent's prospective learning and performance on that target job.

Supportive evidence for these assumptions accrued during the Aston research (Patrick et al., 1980, p.28), but a rigorous test of their validity is needed. An ideal test of these assumptions would necessitate studying an organisation which recruits from a large random sample of job groups for a particular job. All applications would have to be selected regardless of any differences between them, and their performance would have to be monitored over several months. It would then be possible to correlate the relative degree of "deficiency" of each group of incumbents prior job demands with their performance on the new job. A comprehensive picture of the validity of PAQ in practical job transfer decisions would be achieved. This situation will clearly never arise in the real employment world. The present study (and its precursor) reported in Patrick et al., 1980) was developed and conducted at the University of Aston in an attempt to "simulate" a job transfer situation.

4.3.2 THE EXPERIMENTAL DESIGN AND METHODOLOGY

Seven groups of full-time employed job incumbents co-operated in the study. All subjects rated their respective jobs with PAQ. All job groups "transferred" to a simulation of an assembly job, and measures of each individual's performance were taken. "Predictions" of the learning and task performances of job groups were postulated on the basis of the similarity between their current job and the target job. The accuracy with which PAQ "predicted" learning and performance on the simulated job was calculated.

4.3.2.1 The Job Groups Studied

Five incumbents from each of 7 job groups co-operated in the study. The job groups were:

Careers Officers
Motor Vehicle Fitters
Secretaries
Primary School Teachers
Library Assistants
Workshop Technicians
Labourers

Co-operation of job groups was obtained primarily through contacts of the Aston research team and are considered to cover a reasonable range of the employment world in terms of education and skill level and type. Professional, technical, skilled, semi-skilled and unskilled occupations are reflected in the sample. Each of the incumbents within each of the jobs had held the job for over one year. The sample contained male and female respondents and no discrimination was placed upon their respective results.

4.3.2.2 The Predictor Measures

Each subject was interviewed separately by the investigator to complete the anglicised version of PAQ. The Divisional Job Dimension scores, General Job Dimension scores, Additive Attribute scores, Cross-Product Attribute scores, and Critical Behaviour Attribute scores were calculated for each rating of each job. The intra-class reliabilities and reliabilities of the mean estimates for PAQ items and the 5 derived scores are reproduced in Table 30.

It can be seen from Table 30 that the mean estimate of reliability (the figures in brackets) for the divisional and general job dimensions and three forms of attribute profile are generally extremely high (greater than 0.90). The profiles derived with the Critical Behaviour technique are generally less satisfactory. The mean profiles of each of the derived scores for each job were used as alternative representations of the job dimension and attribute demands of each of the jobs. In summary predictions were formulated in terms of 5 alternative content bases; Divisional Job Dimensions, General Job Dimensions, Additive Attribute Profiles, Cross Product Attribute Profiles and Critical Behaviour Attribute Profiles.

4.3.2.3 The Simulated Job and Criterion Measures

Jobs are difficult to simulate. In particular the interpersonal aspects of jobs are difficult to reproduce in a laboratory context. Similarly environmental features of employment cannot readily be operationalised. The major requirement in the present context is the establishment of a series of tasks which place alternative emphases upon the skills and abilities required for their execution. It would clearly be ideal to comprehensively sample major dimensions of the world of work and study a complex of different jobs/tasks. In practice it has been possible to structure a series of tasks (and hence criterion measures) with potentially differing psychological demands around an employment theme. The employment theme adopted for study was one of microswitch assembly. Assembly tasks were felt

TABLE 30 The reliability of Job Ratings for the Seven Job Groups in the Validity Study

Job Title	No. of Raters	Reliability Data					
		Items	Divisional Dimensions	General Dimensions	Additive Attributes	Cross Product Attributes	Critical Behaviour Attributes
Careers Officer	5	.719 (.928)	.913 (.981)	.838 (.963)	.978 (.995)	.972 (.994)	.683 (.915)
Motor Vehicle Fitter	5	.459 (.809)	.755 (.939)	.847 (.965)	.991 (.998)	.617 (.889)	.270 (.649)
Secretary	5	.635 (.897)	.865 (.970)	.818 (.957)	.973 (.994)	.788 (.949)	.070 (.275)
Primary School Teacher	5	.704 (.923)	.884 (.975)	.896 (.977)	.967 (.993)	.942 (.988)	.692 (.918)
Library Assistant	5	.662 (.907)	.866 (.970)	.901 (.979)	.964 (.993)	.659 (.906)	.180 (.523)
Workshop Technician	5	.731 (.931)	.922 (.983)	.955 (.991)	.992 (.998)	.779 (.946)	.514 (.841)
Labourer	5	.444 (.800)	.837 (.963)	.922 (.983)	.988 (.997)	.749 (.937)	.466 (.814)

KEY: Top line gives intra-class correlation coefficient
Second line (figure in brackets) is the reliability of the mean profile for 5 raters

capable of alternative structuring to highlight differing psychological demands and implicitly involve perceptual, cognitive and psycho-motor aspects of human behaviour.

The test piece (microswitch unit) consisted of 28 pieces of varying size, weight, texture, colour and function. The subject's task was essentially to identify, manipulate and assemble the component pieces into a complete microswitch module. Eight scores (criterion measures) were derivable from the assembly theme. A full specification of the criterion tasks, scoring procedures and administration instructions are given in Appendix 13.

The eight elements of the assembly "job" may be summarised as:-

1. Identification of components which were necessary for the assembly of the microswitch from a box which included redundant parts. The task was of an essentially perceptual-motor skill type where rapid perceptual discriminations between small electronic components was required.

2. <u>Assembly</u> of Components Trial 1 3. <u>Assembly</u> of Components Trial 2 4. <u>Assembly</u> of Components Trial 3 5. <u>Assembly</u> of Components Trial 4 6. <u>Assembly</u> of Components Trial 5	) A task of sensori-motor skill where in addition to discriminations between components, motor and fine dextrous movements were required to assemble an electronic microswitch. Cognitively the task required the correct location of pieces.

7. <u>Rate of Learning</u> The rate of learning across the 5 assembly trials was expressed as $\frac{\text{Trial 1}}{\text{Trial 5}}$. The measure assessed the learning of subjects with intrinsic task feedback and extrinsic feedback of performance-time at the end of each trial.

8. <u>Plan time</u> A task of sensori-motor skill where in addition to perceptual discrimination and motor/fine dextrous movements, a problem-solving element was involved. Subjects were required to assemble a microswitch in accordance with a restrictive set of arithmetic and logistic rules.

Performance was measured in terms of the times taken to correctly identify the correct components, the times to assemble the microswitches (for each of the 5 trials) and the time taken to develop an assembly plan which met the rule requirements.

The three broad aspects of the simulated job (identification, assembly and plan) were rated using PAQ by the investigator and another member of the Aston research team. Both could be considered to be "highly familiar" with the demands of the simulated job. Table 31 summarises the reliabilities of these ratings for each of the derived scores for each of the three aspects of the assembly "job". It can be seen from Table 31 that the mean estimate of reliability for the divisional and general job dimensions and three forms of attribute profile are extremely high. The mean profile of the 2 ratings for each of the derived scores for each of the three elements /tasks of the "job" were used as alternative representations of the job dimension and attribute demands of each of the tasks. In summary the "target" job/task demands were expressed in terms of 5 alternative content bases; Divisional Job Dimensions, General Job Dimensions, Additive Attribute Profiles, Cross Product Attribute Profiles and Critical Behaviour Attribute Profiles. It will be recalled that each of the "recruitment" jobs' demands were expressed in the same set of terms (Section 4.3.2.2). The fact that the micro-switch assembly tasks constitute only a simulation of a "job" was apparent from the PAQ profiles. 14 of the 30 divisional job dimensions were not "involved" in the identification tasks, assembly tasks or plan task. These included all the dimensions concerning relationships with other people, and job factors such as hours of work, etc. There are clear dangers therefore in attempting to generalise the result of such a study unequivocally to the world of employment. Nevertheless the tasks constitute a useful basis to examine the learning and performance of novel tasks and the ability of PAQ descriptors to "predict" such measures.

TABLE 31 The reliability of Ratings for the Three Elements of the Microswitch Assembly "Job"

"Job" Element	No. of Raters	Reliability Data					
		Items	Divisional Dimensions	General Dimensions	Additive Attributes	Cross Product Attributes	Critical Behaviour Attributes
Identification	2	.972 (.986)	.994 (.997)	.998 (.999)	.997 (.999)	.994 (.997)	.964 (.982)
Assembly	2	.908 (.952)	.977 (.989)	.975 (.987)	.995 (.998)	.963 (.981)	.902 (.948)
Plan	2	.955 (.977)	.985 (.992)	.994 (.997)	.998 (.999)	.949 (.974)	.723 (.839)

KEY: Top line gives intraclass correlation coefficient
Second line (figure in brackets) is the reliability of the mean profile for 2 raters

232

4.3.2.4 The Experimental Hypotheses

The validity study investigated three major hypotheses:

1. Do the job groups differ on the job performance/learning criteria? If there are no differences between the performances of the specific job groups of incumbents of different jobs, then there are no general transfer effects associated with prior job experience. It follows therefore that neither PAQ (nor any other job analysis technique) could demonstrate its validity in such a circumstance. This is not a totally remote possibility. There are many tasks which nearly everybody can do. If the simulated job tasks were too easy, then any observed differences in individual performance scores may in fact be so fine-grain that one could not predict them with any technique. The identification of significant differences between the learning/performance of job groups is confirmation of the concept of transfer, ie. that the prior learning/experience of individuals may have a bearing upon the subsequent learning/performance of related tasks.

2. Do the job groups differ in PAQ terms? Clearly if there are no differences between the job groups in job dimension terms (ie. they are all performing structurally identical jobs) then one could not predict incumbents of such jobs to perform differentially well on the tasks in these terms. Similarly, if there are no differences between the job groups in attribute requirement terms, then one could not predict incumbents of such jobs to perform differentially well on the tasks in these terms.

3. <u>Does the degree of "similarity" between the "recruitment" jobs and "target" job correlate with the learning/performance of the job groups?</u> This shows the respective validities of 5 indices of similarity between jobs (ie. r, Σd, Σd^2, $\Sigma(w \times d)$, $\Sigma(w \times d^2)$) and the 5 alternative content bases of descriptors derived from PAQ (ie. Divisional Job Dimensions; General Job Dimensions; Additive, Cross-product and Critical Behaviour Attribute Profiles). This is an examination of the utility of PAQ to yield descriptors which are associated with transfer in learning/performance. There are two broad sets of descriptors, dimensional and attribute. These sets may be regarded as representations of skills/job behaviours and traits respectively. The utility of both sets of descriptors is examined. The major hypothesis is that job incumbents will manifest greater learning and performance on a task which is similar in demands (as represented by PAQ). The mean performance scores on criterion measures of the 7 job groups should correlate with the similarity between the job and task requirements. Specifically, two aspects will be investigated:

(a) The validities generally associated with the 5 "similarity" measures.

(b) The validities associated with the 5 sets of derived scores from PAQ.

TABLE 32 Summary of the "Job" Performance Results for the 7 Job Groups (Means)

Job Group	Identification	Assembly						Plan
		1	2	3	4	5	R.L.	
Careers Officers	3.47	7.55	5.07	4.26	3.72	3.37	2.18	33.91
Fitters	2.31	5.92	4.77	4.09	3.57	3.26	1.89	22.35
Secretaries	3.59	10.81	5.16	3.81	3.75	3.27	3.08	49.42
Teachers	2.50	6.67	4.59	3.83	3.09	2.92	2.34	31.52
Library Assistants	3.91	9.74	4.58	3.85	3.27	3.03	3.22	53.84
Technicians	2.25	6.79	4.32	4.19	3.67	3.55	1.91	44.85
Labourers	2.15	8.54	5.76	4.89	4.81	4.30	1.94	60.00

4.3.3 THE ANALYSIS AND RESULTS OF THE STUDY

4.3.3.1 Differences in the Job Groups Performances on the Simulated Job

The first set of analyses conducted concern the overall evidence for differential transfer of the 7 job groups in terms of their learning/performance of the microswitch assembly simulated "job", i.e. to determine whether or not the job groups significantly differed in their performance of the criterion tasks. The scores of each of the 35 subjects on each of the criterion measures are reproduced in Appendix 14. Table 32 reproduces the mean performance scores for the 7 job groups on the criterion measures.

An examination of Table 32 shows that the job groups differ on their scores on the criterion measures. A one-way analysis of variance contrasting the scores of the 7 job groups on the Identification task was conducted. The job groups were found to significantly differ on performance ($F = 2.624$, $df(6,28)$, $p < 0.05$). A two-way repeated measures analysis of variance contrasting the scores of the 7 job groups across the 5 Assembly trials was conducted. The job groups were found to significantly differ on Trial 1 ($F = 3.806$, $df(6,140)$ $p < 0.05$). A one-way analysis of variance contrasting the 7 job groups on Rate of Learning (Trial 1 divided by Trial 5) was conducted. The job groups were found to signficantly differ on learning performance ($F = 2.999$, $df(6,28)$ $p < 0.05$). The analysis of variance summary tables for these analyses are reproduced in Appendix 15.

An examination of the scores on the Plan task of the 35 subjects (Appendix 14) shows that 15 of the subjects failed to complete the task within the one hour allocated. Although the Plan task had been piloted, mean time and standard deviation calculated, and the 99th percentile time expected to be less than one hour, a substantial number of subjects in the actual study failed to complete the task. Failed plan completions have therefore been treated as tied scores and analysed non-parametrically. A Kruskal-Wallis test contrasting the performance of the 7 job groups on the Plan task was conducted. The job groups were found to differ significantly on performance ($H = 16.99$, df(6), $p < 0.01$).

In summary, incumbents of each of the 7 job groups could be considered to be homogeneous in respects which were associated with differential performance on the tasks in the simulated job. The identification of transfer effects associated with job groups is a pre-requisite of their prediction by PAQ descriptors.

4.3.3.2 Differences in The PAQ Derived Scores for the 7 Job Groups

The second set of analyses conducted concerns the PAQ derived scores of the 7 job groups, i.e. to determine whether the job groups represent different kinds of jobs in PAQ terms. It was noted in Section 4.3.2.2 that the 5 incumbents of each of the 7 job groups completed PAQ. The ratings for each job in terms of 5 derived scores were found to have acceptable levels of reliability (Table 30). It is appropriate therefore to examine whether the 7 job groups significantly differ in terms of the PAQ derived scores.

A two way repeated measures analysis of variance was conducted to contrast the 7 job groups across the 30 Divisional Job Dimensions. The job groups were found to differ significantly in terms of their scores ($F = 10.823$, $df(174,812)$ $p < 0.001$).

A similar analysis contrasted the 7 job groups across the 14 General Job Dimensions and identified a significant interaction ($F = 7.986$, $df(78,364)$, $p < 0.001$).

Two way repeated measures analyses of variance were conducted to contrast the 7 job groups across the 76 attribute scores. The job groups were found to differ significantly in terms of the Additive Attribute Scores ($F = 14.104$, $df(450,2100)$, $p < 0.001$); Cross Product Attribute Scores ($F = 23.509$, $df(450,2100)$, $p < 0.001$); and Critical Behaviour Attribute Scores ($F = 5.385$, $df(450,2100)$, $p < 0.001$). The respective ANOVA Summary Tables are reproduced in Appendix 16. It was concluded that the incumbents of the respective job groups could be regarded as differing significantly in terms of their job skills and traits.

4.3.3.3 The "Similarity" Between each Job and Criterion Task

The major hypothesis (Section 4.3.2.4) is that a job group whose current job demands are most "similar" to the criterion task demands will learn and perform the task to a higher standard than a less similar job group. This hypothesis is to be investigated using 8 measures of three classes of performance task (Identification, Assembly and Plan. Overall similarity has two facets. Firstly the statistical method used to calculate similarity; and secondly, the content basis used to describe job content.

It has been noted that there are 5 frequently employed similarity indices. These are Σd, Σd^2, Σwd, Σwd^2 and r. The statistical and psychological implications of these measures were discussed in Section 4.2. Since the reliabilities of the PAQ scores for the jobs were acceptably reliable (Section 4.3.2.2.) the mean scores for each job can be treated as good estimates of the "true" scores for that job. Similarity was calculated between the mean scores for each job and each task using the 5 alternative calculation methods. Details of the calculation and interpretation of these 5 similarity indices are given in Appendix 17.

These calculations were each computed to assess similarity in terms of each of the 5 alternative content bases. Appendix 18 reproduces all of the resultant similarity/distance scores calculated according to the Σd, Σd^2, Σwd, Σwd^2 and r indices for PAQ divisional job dimensions, general job dimensions, additive, cross-product and critical behaviour attribute profiles for the three elements of the criterion job (i.e. identification of components, assembly trials and plan task).

The first area of investigation will concern the validities generally associated with the 5 alternative similarity indices. Having identified the similarity index with the highest level of validity, the utilities of the 5 alternative content bases will be examined in terms of this index.

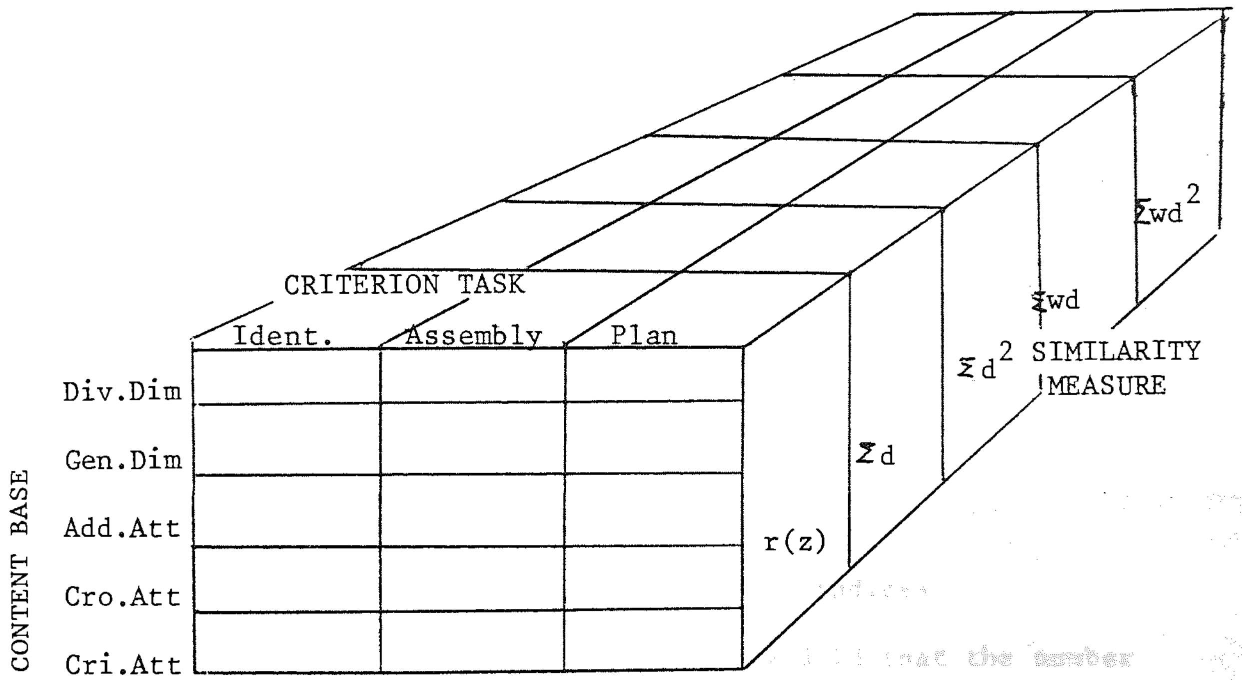
It will be recalled that the 5 content bases represent two broad classes of descriptor; job dimensions and attribute profiles. The next stage of the analysis aims to identify the more valid basis for dimensional predictions, i.e. whether similarity when examined in terms of job dimensions is more valid than when expressed interms of general job dimensions. Similarly, the three alternative forms of attribute profiles will be contrasted to determine whether any particular technique is associated with higher validity.

The final comparison to be conducted will contrast the more effective dimensional content base with the most effective attribute profile content base to identify their relative merits. Figure 8 illustrates the total number and form of job/task similarity comparisons made in the study. It can be seen that similarity has been initially calculated in 75 terms (i.e. 5 alternative similarity indices x 5 alternative content bases x 3 alternative task themes). From this overall analysis the roles of similarity index, content base and transfer performance task will be evaluated.

4.3.3.4 The Association between Current Job/Criterion Task Similarity and Criterion Task Performance

Table 32 detailed the mean performance scores for the 7 job groups on the criterion measures. It is possible to determine whether greater similarity between each job group's current job and criterion task demands is associated with higher levels of performance on the criterion tasks. Appendices 19, 20, 21, 22 and 23 show the correlations between job/task similarity and criterion task performance, associated with the alternative content bases derived

Figure 8 A Representation of the Similarity Comparisons Made for each of the 7 Job Groups



from PAQ, by alternative similarity index for each task criterion.

It can be seen from Appendices 19, 20, 21, 22 and 23 that the association between job/task similarity and performance on the plan task has been calculated using Spearman's Rank Correlation Coefficient. It will be recalled that 15 of the 35 subjects failed to complete the plan task in the allotted time (Section 4.3.3.1) and that these scores were of necessity treated as tied. A non-parametric analysis of association was therefore necessary. It can be seen from the Appendices that there were no significant correlations between job/ task similarity and plan performance. This finding is further discussed in Section 4.3.4. The Plan Task results do not figure in any of the further analyses of data.

4.3.3.4.1 The utility of alternative similarity indices

It can be seen from Appendices 19, 20, 21, 22 and 23 that the number of statistically significant ($p < 0.05$) product-moment correlations between job/task similarity and criterion performance is not uniformly distributed across the 5 indices of similarity ("r", "Σd", "Σwd", "Σd^2", "Σwd^2"). Table 33 summarises the number of significant product-moment correlations associated with the 5 similarity indices.

TABLE 33 <u>The Number of Significant Correlations between Job/ Task Similairty and Criterion Task Performance for the 5 Alternative Similarity Indices</u>

Similarity Index	r	Σd	Σd^2	Σwd	Σwd^2
No. of Significant Correlations	2	10	4	5	0

A one-sample X^2 comparison of this distribution of results (Siegel, 1956, p.42) showed that the "Σd" index of similarity yielded significantly more significant correlations than the other indices ($X^2 = 13.52$, df(4), $p < 0.01$). The construct validities of the alternative similarity indices in the current context were discussed in Section 4.2. The results demonstrate the greater empirical validity of the "Σd" measure in the current context. Having demonstrated the greatest utility of this similarity index it is appropriate to examine the validities associated with the alternative content bases using this similarity index.

4.3.3.4.2 The utility of alternative content bases

Table 34 details the subset of results associated with the "Σd" index of similarity. It can be seen from Table 34 that a substantial proportion of the correlation coefficients are significant at the $p < 0.05$ level. The magnitude of the correlations (regardless of sign) across the 5 PAQ content bases appear to differ. A one-tailed correlated t-test comparing the modulus correlation coefficients associated with the alternative job dimension derived scores (Divisional vs. General) demonstrated that the modulus correlations of the Divisional Job Dimension Derived Scores are significantly greater than those associated with the General Job Dimension Scores ($t = 2.4320$, $p < 0.05$). One-tailed correlated t-tests comparing the modulus correlation coefficients associated with the three alternative attribute derived scores (Additive, Cross Product, Critical Behaviour) found no significant differences between the content bases across the criterion tasks (Additive vs. Critical Behaviour, $t = 1.078$; Additive vs. Cross Product, $t = 1.2345$;

TABLE 34 The product-moment correlations between job/task similarity and criterion task performance associated with the "Σd" index of similarity

PAQ Content Base Criterion Task Measure	Divisional Dimensions	General Dimensions	Additive Attributes	Cross Product Attributes	Critical Behaviour Attributes
Identification	0.781*	0.554	-0.496	0.743	0.694
Assembly 1	0.798*	0.530	-0.425	0.785*	0.880**
Assembly 2	0.390	0.501	0.485	0.455	0.400
Assembly 3	-0.289	0.087	0.941**	-0.147	-0.165
Assembly 4	-0.062	0.121	0.738	0.036	0.079
Assembly 5	-0.236	-0.002	0.815*	-0.124	-0.054
Rate of Assembly Learning	-0.805*	-0.513	0.800*	-0.758*	-0.774*
Mean of Modulus Correlation	0.544	0.348	0.727*	0.499	0.515

* $p < 0.05$

** $p < 0.01$

Cross Product vs. Critical Behaviour, t = -0.4772). The mean modulus correlation co-efficient associated with the Additive Attribute content base was the highest of the three attribute approaches and was statistically significant (Mean modulus correlation = 0.727, $p < 0.05$). The modulus correlation coefficient is of prime importance in personnel selection research since it reflects the overall strength and significance of an association. The sign associated with a correlation is of secondary importance in prediction. The above comparisons have been made therefore in terms of the strengths of associations between "predictors" and criteria.

The signs associated with the correlation coefficients are of importance however in the interpretation of the meaning of results. Table 35 details a more specific subset of validity results. The Table lists the correlations associated with the "$\sum d$" similarity measure for the Divisional Job Dimension Content Base alongside those associated with the Additive Attribute Profile Content Base.

An examination of Table 35 reveals that the Divisional Job Dimension content base was associated with positive significant correlations for the identification task, and first assembly trial performance. Later Assembly trials were not significantly correlated with job/task similarity expressed in Divisional Job Dimension terms. Conversely, the Additive Attribute Profile content base was not associated with significant correlations for the identification task and early assembly trials. Later Assembly trials were however significantly positively correlated with job/task similarity expressed in Additive Attribute Profile terms.

TABLE 35 The Product-Moment Correlations between Job/Task Similarity and Criterion Task Performance associated with the Σd Index of Similarity for Divisional Job Dimensions and Additive Attribute Profiles

PAQ Content Base Criterion Task	Divisional Dimensions	Additive Attributes
Identification	0.781*	-0.496
Assembly 1	0.798*	-0.425
Assembly 2	0.390	0.485
Assembly 3	-0.289	0.941*
Assembly 4	-0.062	0.738
Assembly 5	-0.236	0.815*
Rate of Learning	-0.805*	0.800*

* $p < 0.05$

The rate of learning across assembly trials was significantly negatively correlated with Divisional Dimension job/task similarity. It was significantly positively correlated with Additive Attribute Profile job/task similarity.

The implications of these findings and those detailed earlier are discussed in Section 4.3.4.

4.3.4 CONCLUSIONS OF THE VALIDATION STUDY

The major aim of the study was to determine whether or not the degree of "similarity" between a group of incumbents' current job (recruitment jobs) and the simulated "job" (target job) correlated with the learning/performance of the job group on the target job. Meaningful and significant correlations were identified for the " d" index of similarity between recruitment and target jobs in terms of their Divisional Job Dimension and Additive Attribute demands. These two alternative content bases of prediction were associated with conflicting conceptions of success/utility. Initial trial performance (immediate transfer performance)was significantly associated with similarity in divisional job dimensions. Later performance trials (post training/learning performance) was significantly associated with similarity in attribute terms. Before discussing the meaning and implications of these findings, it is appropriate to discuss the more general findings concerning the criterion tasks, the assessment of "similarity", and the alternative content bases of "prediction".

4.3.4.1 The Criterion Tasks

The present study utilised a simulated "job" as the target position for transfer. There are severe limitations therefore to the generalisability of the results. Although the simulated job was an attempt to re-create an employment "theme" with tasks of differing psychological demands/emphases, it bore limited resemblance to actual jobs in terms of interpersonal and environmental demands. It is not possible therefore to assert that the findings of the study would be applicable to jobs where such factors are a feature. Whilst these dimensions may not be different in kind, the study has not randomly addressed the job dimensions and attribute demands of jobs and cannot necessarily be generalised to such contexts. Further, the tasks of the simulated "job" of necessity were ones which in themselves sample a limited range of skills and abilities. Indeed, the task formulated to place a higher emphasis on cognitive/problem-solving behaviours suffered in operationalisation and did not constitute a comparable aspect. Because of the relative lack of discrimination of this "plan" task, a less powerful statistic (non-parametric) was required. It remains an issue therefore as to whether the observation of no significant associations between similarity of similarity index) reflects inadequacies in the criterion task (and hence statistics) or an inability on the part of the technique to "predict" such classes of performance. As such, the results of the study must be interpreted as demonstrating the validity of PAQ derived scores in "predicting" transfer to essentially psychomotor tasks. Whilst this is a more limited finding than would be revealed by an examination of a stratified range of real employment situations, it nevertheless constitutes the first empirical evidence concerning the transfer implications of descriptors generated from job analyses. As such it constitutes an adequate basis for the discussion of issues pertinent to such approaches to transfer.

4.3.4.2 The Calculation of Similarity Indices

The 5 alternative indices of similarity commonly employed in assessing profile similarity were found to have significantly different degrees of utility ($X^2 = 13.52$, df(4), $p < 0.01$). It was noted in Section 4.2 that alternative similarity indices carry different statistical and psychological meaning in the contexts in which they are operationalised. In the present study, the "Σd" index was associated with substantially more significant results than alternative indices. The "model" of transfer associated with this index may usefully be appropriately contrasted with the models associated with the alternative indices. The "Σd" index may be interpreted as an unweighted surplus/deficit model. Optimum similarity is being operationalised as the extent to which a recruitment job has the greatest "surplus" across constituent scores (dimensions /attributes). Where a recruitment job has higher scores on constituent dimensions/attributes than a target job then one is predicting high positive transfer. Where a job has lower scores on constituent dimensions/attributes than a target job then one is predicting less positive transfer. Indeed the study has demonstrated significant linear relationships between similarity in these terms and criterion performance. It is important to note that all of the indices of similarity are models which attempt to predict degrees of positive transfer. The "Σw.d." measure was an attempt to determine whether the concept of surplus/deficit could usefully be extended to differential weightings of the importance/contribution of constituent dimensions/attributes. The weighting of importance by multiplicatively combining the degrees of relevance of a constituent score to the target job and the surplus/deficit associated with alternative recruitment jobs (Σwd) would seem a less valid "model" of transfer. Whilst the issue of weighting constituent scores has conceptual appeal, a more appropriate statistical model requires development. The models of transfer operationalised by squared distance measures (Σd^2, Σwd^2) are hypotheses that optimal similarity is reflected by closeness of target and recruitment jobs regardless of direction of difference. In other words that equal transfer/similarity exists for a recruitment job whose relation to a target job was below the target job's "levels" of requirements but yielded identical summed squared distance as a recruitment job whose relation to a target job was above the target job's "levels" of requirements. Both weighted and unweighted calculations of this index were associated with poor validity. It seems clear, therefore, that the measurement of similarity by techniques which disregard the concept of surplus and deficitis not an appropriate strategy in the context of the prediction of transfer-effects. The final "model" of transfer which is operationalised in a measure of similarity is that associated with correlation. The correlation between recruitment and target job profiles represents the degree to which the "shape" or distribution across scores is shared. The poor validity of this model has demonstrated that it is not an appropriate technique for similarity measurement in the present context.

In summary, the statistical and psychological assumptions implicit in alternative indices of similarity are associated with differential validity/utility in the prediction of transfer effects. The assessment of psychological similarity would appear on both a priori and empirical grounds to be most appropriately made in terms of an unweighted model which incorporates the concept of surplus and deficit. Transfer can be considered to be maximised in instances where a recruitment job has the highest overall surplus in terms of the constituent scores of the content base.

4.3.4.3. Alternative Content Bases

The utilities of alternative content bases using the "Σd" index of similarity are also worthy of comment. The two representations of skill-type descriptors operationalised in general and divisional job dimensions were found to have differential validity ($t = 2.4320$, $p < 0.05$). The specificity afforded by the description of job demands in terms of divisional job dimensions was associated with a significantly higher level of correlations. This finding makes intuitive sense in that the validity and discrimination associated with general job dimensions may be too gross to constitute an optimal representation for transfer prediction. This argument however raises the additional question of how one defines on a priori grounds the "optimal" statistical level of factors derived by factor analysis. The principles of simple structure expounded by Thurstone (1947) and referred to earlier, may constitute a statistical basis for maximising the explanation of variance, but clearly are subject to the level of description (data) to which they are applied. The general job dimensions are statistically orthogonal representations of the factors which characterise job behaviours. The divisional job dimensions are 6 sets of factor analyses of PAQ associated with the separate divisions of PAQ. Whilst the 6 divisions are not necessarily statistically orthogonal, the resultant combined factor (dimension) scores demonstrate greater validity in the current context. This issue is clearly worthy of further investigation and is discussed in Section 5 of this report.

The validities associated with the alternative formulations of attribute requirements of jobs were also found to differ. The additive technique of assembling profiles was found to offer generally higher levels of inter-rater reliability (Section 3.2), greater validity in terms of association with mean psychometric test scores (Section 3.3) and was shown to have concurrent and predictive validity in a case study personnel selection exercise (Section 3.4). In the present context, the additive technique was the technique associated with the highest levels of modulus correlation and was found to have a significant mean modulus correlation ($F = 0.727$, $p < 0.05$) with transfer performance. The technique offers therefore a technology of synthetic validity which can formulate predictions concerning the potential learning/performance of job groups on novel tasks in terms of the respective attribute demands of the target and recruitment jobs. The implications of these findings and those generally associated with the cross-product and critical behaviour attribute approaches are discussed further in Section 5.

Of final note is the finding of differential utility for divisional job dimension and additive attribute content bases across performance trials. It seems reasonable to interpret the relative successes of the two content bases in terms of the process of transfer/learning itself. The representation of knowledge structures in terms of skill-type descriptors is associated with immediate post-transfer learning /performance. Later learning, where the effects of new skill acquisitions may moderate such predictions, is still associated with more static and robust (higher order) representations of knowledge structure, ie. attributes/traits. The degree to which learning/training can moderate predictions based upon skill-type descriptors is difficult to quantify. The criterion assembly task used in the present study was a simple intrinsic(and minimally extrinsic feedback) form of training. Even so, the learning across trials was such that prior levels of related job behaviours were not associated with terminal performance. As such, the robustness of predictions constituted on the basis of PAQ skill-type descriptor similarity would appear to be prone to moderation by limited degrees of learning. Terminal performance in the current context was significantly associated with job/task similarity when expressed in attribute terms ($r = +0.815$, $p < 0.05$). As such, the degree of training/learning implicit across trials can be considered insufficient to moderate the prediction. Post-training performance frequently remains associated with trait scores when psychometrically assessed and studied in actual selection/training studies in occupational psychology. It is this lack of transience of traits which has been the cornerstone of occupational psychology. The current study has demonstrated that the synthetic validity paradigm can yield attribute requirements and indications of attribute homogeneity within jobs which are valid and which can be used to predict post-training/learning performance.

The dichotomy between the "successes" of behavioural and trait descriptor similarity predictions is encapsulated in the findings concerning the "rate-of-learning" criterion measure. This criterion is a simple expression of the gain from initial to terminal performance. The rank correlation between the 7 job group's first trial and final trial performance was +0.33 which is not significant. There was differential improvement in performances across the trials. These differential improvements were statistically significantly different ($F = 2.999$, $df(6,28)$, $p < 0.05$). The differential improvements in performance were such that the job dimension predictions were significantly negatively correlated with overall rate of learning ($r = -0.805$, $p < 0.05$). The attribute predictions were significantly positively correlated with overall rate of learning ($r = +0.800$, $p < 0.05$). The moderation of predictions based upon behavioural (skill-type) assessments would appear therefore to be potentially severe.

4.3.4.4 General Conclusions

The criterion tasks despite their limitations have highlighted a range of pertinent issues to the wide scale application of derived scores from PAQ in the transfer context. The choice of similarity index, content base of description and strength/degree of training all have an influence upon the validity of PAQ descriptors in the transfer context. The implications of these results to the widescale application of PAQ in transfer decisions are further discussed in Section 5.

SECTION 5

DISCUSSION AND CONCLUSIONS

5.1 THE CONSIDERATIONS RAISED BY THE RESEARCH

The studies conducted in the present research programme have highlighted a large number of issues of practical and theoretical importance to the prediction of transfer effects. These issues are perhaps most appropriately summarised and discussed with reference to the two broad applied postulations of manpower policy-makers detailed in Section 1.1 and reiterated here.. The fundamental observation in employment research that all individuals do not learn all new job skills equally easily, together with the pressing nature of the frequency and form of job changes facing society, led policy makers towards two postulations.

A. Perhaps workers in need of re-training (whilst not necessarily being able to learn all new jobs) could more readily learn a job "similar" to the one they have been doing.

B. If this were true, then perhaps there are "families" of jobs within which people can more readily move and learn the specific demands of constituent jobs.

The examination of the psychological issues raised by these postulations has provided a significant contribution to the body of knowledge concerning their tenability. The findings can be summarised under 5 major headings:

(a) The Content Bases of Job Similarity

(b) The Determination of Job Behaviour Content

(c) The Non-Empirical Determination of Attribute Requirements

(d) The Measurement of Similarity

(e) The Limitations on the Prediction of Transfer implicit within the Present Approach

Before drawing any final conclusions concerning the tenability of the 2 broad applied postulations, it is appropriate to discuss the issues highlighted within each of the above considerations.

5.1.1 THE CONTENT BASES OF JOB SIMILARITY

The suggestion that people might more readily learn a job which is similar to their current job immediately raises the question - "Similar in what terms?" Jobs can be related to each other in myriad terms. The examination of theories of the process of transfer (Section 1.2) demonstrated that individuals may encode novel experiences in varieties of ways. The constructs used in the encoding process are a reflection of cognitive structure, and current theories would suggest that transfer is a function of whether or not a novel experience is an instance of a class for which the individual has an appropriate schema (or schemata). Empirical studies of the transfer process have demonstrated that the generalisability of schemata can be influenced through experience within a variety of contexts (eg. McCracken & Stelmach, 1977; Magill & Reeve, 1978; Siegel & Davis, 1980; Margolis & Christina, 1981). Whilst training for transfer might usefully structure contexts to highlight unifying principles (and foster schemata) there is clear evidence that discovery learning can also facilitate transfer (eg. Singer & Peace, 1976; Hermann, 1978). i.e. Individuals can interpret novel experiences in terms of their current cognitive structure and appropriately formulate more comprehensive/embrasive schemata. As such it might be hypothesised that this process could be more complete where two contexts are similar in a large number of terms, rather than only being relatable in terms of limited number of constructs, ie. multidimensionally similar. The question becomes one therefore, of identifying a technique which can relate jobs in multitudinous terms, each of which might serve as schemata, ie. terms which have construct validity in the transfer process.

The examination of the occupational psychology literature (Section 1.3) identified 4 broad sets of constructs which might be used to relate jobs. These were the traits demanded for job performance, the basic skills required for job performance, the tasks of the jobs, and the worker-oriented behaviours of the jobs. Several issues concerning the suitability of each of these sets of constructs as content bases to predict transfer effects have been highlighted:-

5.1.1.1 Transfer in Terms of the Traits Demanded for Job Performance

Traits are statistical representations of cognitive structure. They have consistently served as a basis for the psychometric prediction of job learning and performance. As such they have a high degree of construct validity in the transfer context although there are potential difficulties in determining the number of traits that "exist" and in identifying the traits demanded for job performance. This latter process is traditionally conducted empirically and is expressed as a statistical degree of association between molar standards of job performance and scores of tests in specific contexts. This context-specificity of trait-task relationships has been shown in the current research to raise practical and theoretical difficulties if jobs are to be generally related in terms of the traits demanded for their performance. This issue is further discussed below (Section 5.1.3). Traits as they are measured by psychologists are reflections of cognitive structure which operate at a level designed to be relatively free from later learning (eg. work experience). Whilst they constitute an appropriate basis upon which to relate jobs it might be therefore that they are not a sufficient basis in themselves.

5.1.1.2 Transfer in Terms of the Basic Skills Demanded for Job Performance

The educational system aims to equip young people with a range of basic competencies. These basic skills are aspects of knowledge which are considered to constitute a useful foundation to job performance. Since there is a broad consensus upon the skill content of literacy and numeracy, research has addressed techniques of identifying the basic skills demanded by job performance. This research has been conducted in parallel with the current research programme by Professor Warr and his co-workers (eg. Banks, Jackson, Stafford & Warr, 1983), and Freshwater (eg. Freshwater, 1980, 1981). As a basis upon which to predict transfer effects these approaches suffer from several deficiencies. As specific lower-order skills, there is an additional requirement for individuals to know how to organise them to achieve transfer. The need for subjects to know how to organise sub-skills to achieve transfer has been demonstrated for example by Livesey & Laszlo (1979) and Petitto (1980). Secondly, these unspecified higher-order skills may constitute a more substantial proportion of job behaviours than basic skills per se. Whilst research concerning the transfer implications of relating jobs in terms of basic skills is eagerly awaited, it seems clear that such skills would not consititute a sufficient basis in themselves upon which to relate jobs. The role of these skills has not been empirically studied in the present research and they represent an additional feature of job inter-relationships which are worthy of investigation, and potentially incorporation in job transfer decisions.

5.1.1.3 Transfer in Terms of the Task Characteristics of Jobs

The systematic identification of the tasks implicit in jobs has been addressed by psychologists, and comprehensive logical techniques have been developed which yield molecular breakdowns of jobs (eg. Annett & Duncan's (1967) Hierarchical Task Analysis). By definition these techniques express jobs in systems terms, ie. in terms of objectives in specific contexts. Relating jobs across contexts is therefore an inferential process. The question in essence, is one of the psychological meaningfulness of the fulfilment of related systems objectives. Whilst there may be some transfer consequences associated with the encoding of the single higher-order principle of shared "systems functions", the associated behaviours may bear no relationship. The difficulties of unambiguously identifying the behavioural similarities underlying systems objectives would therefore cast doubt on the sufficiency of relating jobs in terms of task characteristics (eg. as by Hayes, Fonda & Stewart, 1983).

5.1.1.4 Transfer in Terms of the Worker-Oriented Behaviours of Jobs

The examination of the psychological literature identified three forms of the description of jobs based upon worker-oriented behaviours i.e. those addressing subsets of jobs, subsets of job behaviours and general job taxonomies (see Section 1.3.2.2.2). Several investigators have attempted to describe the duties of particular sub-sets of jobs in worker-oriented terms (eg. Tornow & Pinto, 1976; Ronan, 1977). The research has in general attempted to develop comprehensive sets of descriptors which characterise particular classes of jobs. The focus of such studies upon limited sets of jobs means that they cannot serve as general methodologies to relate all jobs. Similarly, research which has focussed upon particular sub-sets of job behaviours which occur across jobs (eg. fault diagnosis as studied by Brooke, Duncan & Cooper, 1980), whilst comprehensively examining the utility of constituent worker-oriented (psychological) constructs, do not constitute a comprehensive basis to express general job inter-relationships. General job taxonomies have been developed which attempt to describe jobs in terms of comprehensive sets of worker-oriented descriptors. Each of the descriptors in such taxonomies are psychological constructs (processes) which are postulated to have transfer consequences. The current research has examined whether or not jobs related across a range of such terms (PAQ items/dimensions) have transfer implications. Extensive further research is required to determine the transfer consequences of particular constituent constructs. The Position Analysis Questionnaire utilises the Stimulus-Organism-Response paradigm in an attempt to achieve exhaustivity in constituent constructs, and the level of description further determines the number of items (job elements) included in the taxonomies. The statistical properties of factor analysis eliminates the statistical redundancy across items, such that orthogonal (mutually exclusive) categories of worker-oriented behavioural descriptors are generated. The continued refinement of PAQ is however required, to progressively incorporate categorisations of psychological processes as they are developed. Detailed examinations of the item content of PAQ broadly confirmed its status as the most comprehensive available categorisation of worker behaviours. This is not to say that it constitutes the ultimate state of the art. In terms of the objectives of the current research, the Position Analysis Questionnaire represented the concept of "relating jobs in terms of their worker-oriented behaviours". The conclusions of the research concern the utility of such a concept in general to predict transfer effects and specifically the utility of the current version of PAQ itself.

The current research programme has evaluated the role of two broad sets of constructs as content bases to express job similarity and thence predict transfer effects. Job similarity has been expressed in terms of job behaviours and attribute requirements. Several further considerations have been highlighted in the derivation of each of these alternative content bases.

5.1.2 THE DETERMINATION OF JOB BEHAVIOUR CONTENT

The Position Analysis Questionnnaire is a set of descriptors. The determination of the content of jobs in PAQ terms is determined by raters. Section 2.1 of the report identified several issues related to inter-rater reliability and the reliability of mean estimates of job content, and these are summarised below.

5.1.2.1 <u>Assessing the Reliability of Profiles of Job Demands</u>

The objective in assessing jobs with PAQ is to obtain a "true" estimate of the job's demands. The use of the intra-class correlation coefficient (Winer, 1971) as a technique for determining inter-rater reliability is advocated. Whilst the product-moment correlation coefficient highlights the level of association between raters, it does not incorporate the "elevation" effect. It is possible therefore for ratings to correlate highly and yet significantly differ in magnitude terms (as tested by a correlated t-test for example). Such an assessment of association is not optimal for the assessment of the ability of ratings to be combined to constitute a 'true' mean estimate. The intra-class correlation coefficient incorporates elevation in its computation and provides an assessment of the reliability of the mean estimate across raters. From a practical point of view it is possible to sample, for example, 2 raters from a potential pool of raters; assess reliability; and determine upon this basis, the minimum number of further ratings required to yield a mean estimate with a criterion level of reliability. This statistical measure is therefore to be generally advocated.

5.1.2.2 The Choice of Respondents

Ratings of PAQ items (or any taxonomic job data) should be made by persons who can be considered to be "highly familiar" with the demands of the job in question. The examination of pertinent literature (Section 2.1.1.1) has revealed that respondents might usefully be classified as "external" and "internal". External ratings of PAQ in general seem to be less reliable than internal ratings, e.g. an average reliability coefficient of 0.74 compared to 0.89 with "internal" respondents. For external analysts to rate the demands of a job requires them to become familiar with the job, and there are clear difficulties in ensuring the extent of their familiarity or in providing them with guidelines for an analysis strategy. Internal respondents include job incumbents, supervisors and personnel/training officers. It has been noted that it is difficult to ensure the familiarity of such raters. A minimum period of association with the job of one year has been adopted in the current research, but additional criteria should be investigated. There are problems in utilising subject variables such as age, sex or race criteria to select incumbents as raters, and similar problems in using ability criteria. Each of these factors may co-vary with the "job" actually being performed by such incumbents, and any "pre-screening" of incumbents may therefore yield contaminated estimates of the overall/general job content. It was noted in Section 2.4 that there are some potential problems associated with social desirability biases with internal ratings, (e.g. the "inflation" of job demands by incumbents and/or the "deflation" of demands by supervisors) and this issue warrants further specific empirical study. To some extent it is an inevitable problem with the adoption of rating devices but its potential influence should be minimised.

5.1.2.3 The Comprehension of Item Content

An issue of general importance in the taxonomic analysis of job content concerns the comprehension of item content. It was noted in Section 2.1.1.2 that the readability level of PAQ is higher than that associated with the incumbents of many jobs i.e. requiring a reading level associated with college students (Ash and Edgell, 1975). Many of the concepts (constructs/ processes) assessed by PAQ (or any worker-oriented job taxonomy) may be of a conceptually high or abstract form. Techniques of presenting directions and item content to respondents to minimise ambiguity and improve comprehensibility are in general need of research. The current research programme administered the questionnaire in a structured interview setting. The objective was to provide a feedback loop to respondents to progressively 'define' or clarify PAQ constructs. The study reported in Section 2.2 demonstrated a significant increase in the reliability of PAQ ratings with this presentation format. The interview method of presentation demonstrated significantly higher levels of inter-rater agreement across PAQ items ($t = 7.283$, $df(5)$, $p < 0.001$). There were however several limitations to the study. The sample of jobs upon which the study was based was small, and an extension of the study to a large stratified sample of jobs across job levels is advocated. The study of any difference in relative improvements of the interview format associated with "job level" would be of particular interest. The current study utilised only the present investigator as interviewer. Whilst the evidence concerning structured data gathering with 'interviewers' would suggest limited response-bias associated with the role-independent characteristics of interviewers (eg. Dijkstra & van der Zouwen, 1982), the procedure warrants further investigation. In addition to research addressing the role-independent characteristics of interviewers and respondents, studies into the cognitive process of construct definition through progressive feedback on exemplars is also advocated. The literature on structured interviewing suggested that there may be problems associated with the use of interviewers who have a role within the organisation (through response bias) and whilst this issue should be specifically examined with PAQ, it seems unlikely to be a generally desirable form of data gathering.

5.1.2.4 The Differential Reliabilities of Derived Scores

Detailed examinations of studies utilising PAQ as a generator of predictor descriptors revealed that the index of overall item reliability was often treated as an indication of the reliability of the scores actually used in prediction (eg. job dimension scores, attribute profile scores) (eg. McCormick, Denisi & Shaw, 1979; Taylor 1978). It was noted in Section 2.1.1.3 that the scores derivable from PAQ draw upon items in alternative ways and that the 'intermediate' reliability across items is not equatable with the specific reliabilities of job dimension scores or attribute profile scores. The data gathered in the course of the current research was evaluated in terms of the inter-rater reliability of each score set (Section 2.3) and the number of raters required to obtain ratings reliable at a criterion level of 0.9 was found to significantly differ across the derived scores of PAQ (x^2 = 13.273, df (5), $p < 0.05$). It has been concluded that a minimum of 4 ratings are on average required to obtain estimates of job content in terms of PAQ items, divisional and general job dimensions, and additive and cross-product attribute profiles. In situations where only one particular set of scores are sought, then on average only 4, 3, 2, 1 and 3 raters respectively are required. The study reported in Section 2.3 indicated however that 10 raters would be required to assess job demands in terms of the critical behaviour method of indicating attribute demands at the 0.9 level. As such, the utility of critical behaviour attribute scores is clearly questionable.

The average reliabilities of PAQ scores on the sample of British jobs examined throughout the research programme (Section 2.3) were found to be broadly in line with previous American findings. The main intra-class correlation for ratings of PAQ items in the present research was 0.69. This level of reliability is in line with findings ranging from 0.59 (Smith and Hakel, 1979) to 0.79 (McCormick et al., 1972). It can be concluded that PAQ can generally be reliably completed by internal respondents in a structured interview setting.

5.1.2.5 The Meaning of Job Dimension Scores

Job dimensions are the output from the factor analysis of PAQ items. As such they are a statistical representation of the extent to which job behaviours tend to occur in combination within jobs. The output from factor analysis is a set of maximally orthogonal dimensions. This orthogonality is a useful taxonomic property (Miller, 1967) in its elimination of redundancy between items. As sets of constructs, job dimensions can be assessed in terms of reliability and specific context validities. Their abstractness however means that their "meaning" can only be established empirically. Further, the nature of the statistical process of factor analysis is such that resultant dimensions are a function of the sample of jobs and range of variables (items) assessed. Extensive research with PAQ has addressed those dimensions derived from both divisional and general factor analyses of the questionnaire. In general the statistical representations of job structure through job dimensions have been found to have meaning in job evaluation, job satisfaction, stress and ability terms. More specifically, the level of description associated with general job dimensions appears to assess jobs in more limited and gross terms and as such tends only to relate to constructs of gross and apparent importance to work structure. Divisional job dimensions, whilst possessing inter-divisional redundancy, operate at a level of description which can make more discriminations between jobs that relate to many psychological constructs (e.g. Taylor, 1978; Calitz et al., 1973; Shaw and Riskind, 1983).

The content base of job dimensions is a set of worker-oriented descriptors of jobs, and to this extent job dimensions may reflect skill information. This is not to say that job dimensions are skills in their own right. It is interesting to speculate nevertheless upon the usefulness of job dimensions to serve as higher order unifying principles (categories) for the structuring of broad-based training. Denisi (1976) discusses the implications of job clustering for training programmes and the concept might be extended to the dimensions which characterise work performance in general. This aspect of meaning for job dimensions is worthy of further investigation. For the present, the 'scores' of a particular job in job dimension terms are merely an expression of its degree of possession of statistical structural aspects of work. The current research has used these raw scores for study, but additional meaning might be added if normative data were incorporated. The American norm system is not generally available and is unlikely to be of complete appropriateness within Britain. The establishment of British norms would clearly be a useful area of research. Such a research programme would also enable continuous updating of the factor structures of jobs in Britain rather than relying upon American studies to formulate job dimensions.

5.1.3 THE NON-EMPIRICAL DETERMINATION OF ATTRIBUTE REQUIREMENTS

Mental constructs by virtue of their inferential status are difficult to validate. In practical terms the quest for predictive power has yielded reliable and valid factors which have been labelled as "abilities" and include "intelligence", "mental abilities" and "psycho-motor abilities". Hunt (1961) issued the necessary reminder however that ability tests consist essentially of samplings of behaviour and that attempts to specify meaning are probably best conceived as "systems of co-ordinates which simplify the comparing of people" but probably "have little or nothing to do with the natural structures, schemata, operations and concepts organised within individuals". Similar views are held by Anastasi (1958) although a few psychologists, notably Holzinger (1937), Thurstone (1938), Guilford (1956) and Cattell (1958) argue that the factors are genuine causal entities. More recently, psychologists have generally viewed aptitudes (traits) in terms of a cumulative formation of more and more complex and flexible schemata (Piaget, 1950) or phase sequences (Hebb, 1949) or plans (Miller, Gallanter & Pribram, 1960) or cognitive structures (Ausubel, 1963) which develop through interaction between the growing organism and its environment. Vernon (1965) thus regards intelligence as referring to, "the totality of concepts and skills, the techniques or plans for coping with problems, which have crystallised out of the child's prvious experience." Traits as they are measured and defined by psychologists are therefore merely statistical representations of natural mental processes.

The idea that job requirements can be expressed usefully in terms of their "ability requirements" has been the cornerstone of personnel selection research. As a model of transfer, abilities may be regarded as statistical representations of cognitive structure, and the demands of job performances may be expressable in similar terms. Traditionally, statistical relationships are only established between molar descriptions of job performance and individual test scores. Comprehensive studies yielded the "ability requirements" of jobs (sometimes referred to as the Occupational Aptitude Patterns, eg. Barnette, 1950). The synthetic validity paradigm argues that the actual behaviours of work are to some extent a function of cognitive structure (as represented by traits) and that behaviour/trait linkages can be established to synthetically assemble the overall "attribute requirements" of jobs. Such postulations therefore shed more light on the relationships between job behaviours and abilities, and constitute a model of the transfer process itself. Rather than loosely relating abilities with overall job performance and regarding significantly correlated abilities as the ability requirements of jobs, the synthetic validity paradigm offers the prospect of expressing both cognitive structure and job requirements in ability terms upon logical grounds.

However, several issues have been highlighted by the current research in the actual process of synthetic validation. The exhaustivity (representativeness) of lists of traits is difficult to guarantee. For job comparisons to have maximum meaning and validity they should be made in terms of an exhaustive set of constructs. Whilst psychometric research has evolved a broad consensus upon the most consistently identified factors there remains a question of their exhaustivity.

The statistical determination of traits means that their verbal description is potentially contentious. Whilst the labels have become a language amongst psychologists, their "meaning" is perhaps less uniformly agreed. The studies by Mecham (1969) and Marquardt (1972) whilst demonstrating that psychologists can consistently relate traits to specific behaviours, (with reliabilities greater than 0.70) expressed the degree of relatedness (relevance) on a relatively crude rating scale. It is doubtful whether psychologists could yield more refined quantitative information concerning the relationships with sufficient degrees of agreement. Whilst applied research adopts a pragmatic stance, the adequacy of 'expert' ratings of relationships in such terms remains a matter for concern.

The establishment of item/trait linkages is only the first step in the synthetic validity paradigm. The assembly of overall attribute profile for jobs from this data base is a further consideration.

The present research has evaluated three broad forms of assembly. The "additive" technique regards the extent to which a particular trait is generally required as a function of the range of job duties performed. The "cross product" technique expresses attribute requirements as a further function of the degrees of involvement of associated behaviours in a job. The "critical behaviour" technique regards the extent to which a particular trait is generally required as a function solely of those job behaviours conducted the most extensively. Section 3.2 examined the inter-rater reliabilities associated with these three techniques and found that the additive technique was significantly more reliably constituted ($r_1 = 0.985$) than the cross product ($r_1 \doteq 0.766$)

and critical behaviour techniques (r_1 = 0.466). Section 3.2.3 of the report noted how the reliability with which raters assign values of "5" to PAQ items is not equatable with overall item reliability and leads to lower levels of inter rater reliability for the critical behaviour technique. The weighting of item reliabilities implicit within the cross-product methodology can lead to lower levels of reliability. The more simple rating task of whether an activity "is" or "is not" performed in a job (implicit in the additive assembly technique) yields extremely high levels of inter-rater reliability.

The study reported in Section 3.3 demonstrated that the additive technique was more accurate in its "prediction" of related actual mean test scores than the other two assembly techniques. In relation to the cross product technique (x^2 = 3.305, df (1), $p < 0.05$) and in relation to the critical behaviour technique (x^2 = 4.930, df (1), $p < 0.025$). The study reported in Section 3.4 demonstrated the concurrent and predictive validity of tests indicated by the additive technique. A concurrent shrunken multiple correlation of +0.91 ($p < 0.01$) was found with tests chosen on the basis of additive attribute profile information. Post-training job performance was predictively validated with the same measures ($r = 0.69$, $p < 0.05$) and similarly post-training job knowledge ($r = 0.88$, $p < 0.005$). The implicit limitation of discriminability of the additive technique (by virtue of its discriminating between jobs solely in terms of behaviour presence or absence rather than degree of use or importance) does not appear to be associated with any reduction in validity. This broadly relates to the recent observations by Schmidt and his co-workers (eg. Schmidt, Hunter and Pearlman, 1981) that minor task differences do not in general moderate the validities of aptitude tests. Validity may be generalisable across jobs far more readily than has hitherto been asserted. The expression of job demands in trait terms may therefore offer an appropriate applied strategy.

However, further considerations have been highlighted in postulations of the transfer potential of incumbents to "similar" jobs. The issue of "requirements" in the term ability requirements is highlighted in employing the synthetic validity paradigm in this context. The observation that incumbents tend to be homogeneous in terms of particular traits, is not in itself proof that these abilities are "required" by the job. Whilst this latter criterion is not necessarily required in the use of current job duties to express incumbents' abilities (since even artifactually observed homogeneities can legitimately serve as predictors), it is an important consideration in the establishment of the "true" ability requirements of a criterion job. The study reported in Section 3.3 which examined the association of PAQ indications and actual mean test scores was therefore not an examination of the ability of the technique to yield the "true" ability requirements. The study nevertheless demonstrated that the mean test scores of incumbents of particular jobs are associated with the demands of their respective jobs as expressed by PAQ attribute profiles. The average correlation between PAQ additive attribute "indications" of aptitude scores with actual mean aptitude scores was +0.657 ($p < 0.10$).

The study in Section 3.4 further demonstrated that tests chosen on the basis of PAQ indications have concurrent and predictive empirical validity. To this extent PAQ may be regarded as capable of yielding the "true" ability requirements of jobs. As noted in Section 3.5, however, research is required to determine whether or not the validities of particular traits correlate with their preciserelative standing in a PAQ attribute profile. The study reported in this research programme demonstrated that factors indicated to be "important" to job performance by PAQ, do have concurrent/ predictive validity. This simple dichotomisation of attributes as "important" as opposed to "unimportant" is only a first step in the necessary research to demonstrate the utility of PAQ to constitute a technology of synthetic validity.

The ability of PAQ to yield the 'true' ability requirements of jobs has been further addressed in the research programme. In terms of the applied focus of the current research programme, indications of attribute requirements yielded by PAQ were found to constitute a basis for the prediction of transfer effects (Section 4.3). As such PAQ can generally be regarded as capable of yielding the true attribute requirements of jobs.

Many further years of research are nevertheless required to create a complete technology of synthetic validation. The resurgence of cognitive psychology offers potential for the establishment of psychometric assessments which in addition to being statistical representations of cognitive structure, reflect particular cognitive processes. Such measures would further clarify the relationships between 'abilities' and task performance. The marriage between psychometicians and cognitive psychologists offers much hope for the future. The current research programme has demonstrated that cognitive models of the transfer process can be operationalised "in the field" and that relatively intransient features of cognitive structure can be represented in both person and task requirement terms.

5.1.4 THE MEASUREMENT OF SIMILARITY

The major feature of taxonomic approaches to studying phenomena is that they are a "language" to relate entities. By expressing entities in a finite set of common terms they may be contrasted. The "meaning" of similarity between entities in terms of taxonomies is however influenced by the taxonomic classes themselves. In numerical taxonomies where constituent classes are dimensions which carry quantitative information the expression of similarity must incorporate this concept. In the present context where particular jobs are classified as having certain degrees of taxonomic classes (eg. job dimensions or abilities), similarity may have to incorporate the concept of surplus/deficit. In other words a job may be relatively similar to another job in a particular respect but have more or less of the property than its counterpart. The psychological assumptions underlying alternative indices of profile similarity were summarised in Section 4.2. The nature of job dimensions and psycho-logical abilities is such that indices which incorporated the concept of surplus/deficit (eg Σd, Σwd) were hypothesised to have more 'meaning' (validity) in the transfer context.

A further feature highlighted in assessing similarity concerned the 'weighting' of constituent items (taxonomic classes). The issue concerns the equality of contribution of each constituent item to the issue in question. In the present context, it is difficult to determine differential degrees of import for particular dimensions or abilities in the prediction of transfer. Whilst the issue of weighting constituent scores has conceptual appeal, a more appropriate statistical model requires development.

The study reported in Section 4.3 demonstrated that alternative indices of similarity were associated with varying degrees of validity in the transfer context ($x^2 = 13.52$, df (4), $p < 0.01$). The Σd index of similarity was found to most consistently yield signficant predictions of transfer effects across content bases. This index incorporates the concept of surplus/deficit and weights constituent classes equally.

This finding has major import to the applied study and prediction of transfer. The Σd index of similarity yields "directional" hypotheses of transfer. In other words greater transfer is postulated (and demonstrated in the study) when a recruitment job has a surplus across constituent job dimensions or attributes in relation to the target job. In other words the index does not provide a model of transfer reciprocity. It is an asymetrical transfer situation. As such it is not meaningful to establish job families in terms of this index of similarity since the index is influenced by the choice of target or recruitment job, ie. there are two indices for each job comparison. The implication is therefore, that networks of jobs are more appropriately established which demonstrate the range of jobs to which one would hypothesise high positive transfer from a particular job. This is a radically different conception to that of the manpower policy makers of "families" of similar jobs within which transfer is expected to be reciprocally high.

In summary the measurement of similarity itself, regardless of the content base of job comparisons can have a major bearing on the formulation of transfer hypotheses. The researchcasts doubt upon the meaning of the studies with PAQ which have clustered jobs in terms of the Σd^2 index of similarity (eg. Marquardt and McCormick, 1973; Taylor, 1978; Taylor and Colbert, 1978). The present research found such an index to be less valid in the transfer context and its meaning and sensibility with scores derivable from PAQ (and potentially all numerical taxonomies) is therefore questionable. The Σd index whilst having greater construct validity and predictive validity in the current research negates the formation of job clusters or families and thus adds a further complication to the applied problem of increases in job changes in the labour market. It seems inappropriate to consider the establishment of job families with transfer reciprocity. Job similarity in terms of numerical taxonomies may generally indicate that transfer is asymetrical. When jobs are related in terms of PAQ divisional job dimensions or additive attribute profiles then transfer effects seem to be influenced by the relative possession of dimensions/traints rather than general bi-directional similarity.

5.1.5 THE LIMITATIONS ON THE PREDICTION OF TRANSFER IMPLICIT WITHIN THE PRESENT APPROACH

The prediction of transfer effects on the basis of scores derived from PAQ carries at least two implicit limitations. They concern two facets of the transfer process highlighted in empirical studies of transfer; negative transfer and vertical transfer.

In certain situations, prior experience can have an adverse effect upon the learning of a new task. In such instances the transfer effects are described as negative. Examples of small, but important, ergonomic differences between tasks have been shown to be associated with intrusive errors (negative transfer) (eg. Bilodeau & Bilodeau, 1961). These effects, however, generally convert from negative to positive transfer as transfer trials progress (eg. McCormack, 1958). Whilst there are no reported studies which demonstrate that job transfer effects are generally negative after training, it should be noted that the current approach is incapable of formulating predictions of negative transfer. Transfer is ultimately a task-specific process and the present representations of cognitive structure and job demands are not operating at a level capable of making such fine-grain predictions. Rather, relative degrees of facilitation are postulated to be associated with relative degrees of 'surplus' of particular dimensions/traits. The current approach yields a job transfer "surface" (relationship) which is linear. Facilitation is hypothesised to be greatest when a recruitment job has the greatest 'surplus' of job requirements, and least when a recruitment job has the greatest 'deficit' of job requirements.

The second limitation of the current approach concerns its cognisance of the process of vertical transfer. Cognitive psychologists have argued that cognitive structures may be structured hierarchically (eg. Miller, Galanter & Pribram, 1960). Transfer has been shown to be a function of similarity both to specific category instances and to higher-order category information abstracted from these instances (eg. Elio & Anderson, 1981). Vertical transfer requires subjects to know how to organise sub-skills (eg. Livesey & Laszlo, 1979; Petitto, 1982). This process is not characterised by the representations of cognitive structure operationalised by PAQ. It seems clear that the unique nature of schemata and hierarchical organisation operate at the task level and PAQ fails to characterise such distinctions. Where PAQ is addressing an instance of transfer from a lower level (embedded) job to a higher level job, transfer is solely characterised in terms of gross structural similarities between the jobs. Whilst greater cognitive complexity may be represented by higher scores of the target job (such that the recruitment job would manifest a deficit), PAQ would not distinguish between lateral deficits and vertical deficits. It is difficult to see therefore how any general job taxonomy could operate at a level which incorporated the concept of vertical transfer.

Whilst the processes of negative and vertical transfer are not incorporated in the present approach, and are worthy of mention, it seems unlikely therefore for them to be included in predictive approaches to transfer which operate at the job level.

5.2 THE APPLIED IMPLICATIONS OF THE RESEARCH

The current research programme has demonstrated a role for the analysis of current job demands in the prediction of performance of incumbents on new jobs. Job groups have been shown to perform differentially well on a 'new' job. Further these relative group performances are associated with the relationship between the current (recruitment) and new (target) job. The terms used to express this relationship appear to be associated with job transfer performance differentially as learning progresses. Descriptors which characterise the behavioural structure of jobs (skill-based representations) are associated with the prediction of initial transfer performance, e.g. r = 0.781 for 1st Assembly trial. Descriptors which characterise the ability requirements of jobs (trait-based representations) are associated with the prediction of later transfer performance (r = 0.815 for final assembly trial) and rate of learning (r = 0.800). In general therefore, it seems possible to systematically assess work demands for the prediction of future job performance. It was noted in Section 1.5 that the traditional need to empirically determine the relationship between psychometric measures of traits and job performance in order to predict future job performance (ie. the empirical selection paradigm) had major practical limitations. Figure 2 schematically represented the applied limitations of the traditional selection approach as the "empirical validity paradigm for traits" itself, and the "non-incorporation of attainments and skills" in such predictions.

The present research programme was structured in order to investigate the utility of a particular technique to overcome these limitations and to highlight those considerations which have general relevance to the issue of using current-job descriptions to formulate transfer predictions. These considerations have been elucidated in Section 5.1 of this report but it remains to summarise applied implications of these factors and of the research in total.

The research has addressed the general feasibility of systematically incorporating work demands in the prediction of new job performance. Individual job performance is a function of individual experience. The current research has addressed the performances generally associated with groups of individuals who currently perform the same job. Their future job performance has been shown in general to be associated with their current job demands. Work experience is being summarised in a statement of current job demands. Inappropriate 'fits' between personal skills/abilities/preferences are attended to in restricting respondents (subjects) who have been in the job for more than one year. This attempt to incorporate leaving behaviour (either voluntary or involuntary) as a measure of fit clearly suffers from inadequacies. General economic considerations, for example, can moderate the leaving behaviours associated with mis-match. Further the skills and abilities of individuals are not completely represented through descriptions of their work experiences. Non-work behaviours can have an influence upon skill development and possession. It does not follow from the above observations however that the current research has no bearing upon the prediction of individual job performance. It may be possible for example, to include measures of current job demands (as established in the current studies) alongside individual assessments, and improve the predictions of future individual performance beyond those obtained on the basis of trait information alone. Such approaches are worthy of further examination. For the present the applied implications of the research will rest in the main upon the utility of using current job demands to express job group transfer potential.

The systematic analysis of current job demands afforded by PAQ yields two sets of descriptors. These are behavioural and attribute descriptors. The behavioural descriptors are of a worker-oriented nature. As such they enable contrasts between jobs to be made across contexts in terms which are expected to have psychological correlates including estimates of transfer potential. This is in contrast to systematic analysis procedures which address the task characteristics (systems objectives) of jobs. This latter form of descriptor, by virtue of its context dependence expresses job relatedness in terms of shared objectives. The transfer implications between jobs considered to be similar in such respects has not been empirically studied. The research programme headed by Hayes of the Institute of Manpower Studies (eg. Hayes, Fonda & Stewart, 1983) may address this issue. The results of such research are eagerly awaited. A similar situation obtains with the expression of job relatedness in terms of shared minimum competencies. Whilst on a prior grounds their adequacy to solely represent the transfer implicatins of job inter-relationships is questionnable, the results of studies being conducted by Professor Warr on the transfer implications of minimum competencies are of high relevance.

5.2.1 THE UTILITY OF WORKER-ORIENTED DESCRIPTORS IN THE PREDICTION OF TRANSFER

Three major features of worker oriented approaches to transfer are worthy of discussion. Firstly the process of determination of job content in such terms. Research with PAQ has utilised a variety of sources of respondents to determine job content. It is clear that the choice of respondent, scaling techniques, and mode of presentation all have a bearing upon the reliability of the analysis of job demands. In general, internal respondents may be considered to be preferable to external analysts. The preference for such respondents may well be heightened when a structured interview mode of presentation is adopted. The role of feedback in the reduction of ambiguity of interpretation and response seems a fruitful avenue of research. Similarly the establishment of criteria to maximise the familiarity of respondents would be welcome. PAQ provides quantitative information on each constituent item. This is an advantage over the application of a simple checklist. Research might usefully further address the role of particular scales and the degree of quantitative information which might usefully be obtained from raters. The current research programme has demonstrated that acceptably reliable mean estimates of job content can generally be obtained with PAQ in an interview setting with 4 raters. Such ratings are effectively placing jobs along a series of 6 point scales. The subsequent scoring of jobs in divisional and general dimensions appears to offer acceptable levels of reliability, discriminability and validity, but the study of these issues should continue. More fine-grain, valid discriminations are the continual quest of psychologists.

Secondly, the adoption of factor analysis by McCormick in his research offers two distinct advantages in the comparison of the worker-oriented behaviours of jobs. Firstly, the resultant factor structures are more parsimonious sets of descriptors which facilitate the interpretation of job differences. Secondly, they reduce item redundancy and yield mutually exclusive categories (taxonomic classes) of description. This property is of importance in calculating (evaluating) the similarity between PAQ profiles. Item redundancy would otherwise create difficulties in contrasting job demands. Whilst generally agreed strategies are evolving concerning factor analysis, statisticians would argue that the number of factors extracted is a subjective decision. It is difficult therefore to draw general conclusions concerning the general utility of factor analysis in the representation of job demands. The current research demonstrated that the level of discrimination afforded by the 30 divisional job dimensions of PAQ was associated with higher validity in the prediction of transfer effects than the 14 overall/general (higher order) job dimensions derivable from PAQ. The optimum level of description (factor extraction) clearly depends upon the item content of the instrument in question.

The third major feature of worker-oriented approaches to transfer concerns the findings in the study of transfer effects. It has been noted that the descriptors of PAQ (and hence the dimensions) reflect skill-type information. Psychometricians have argued that information of this type is of so transient a nature as to negate its usage in the prediction of performance over time. The study reported in Section 4.3 indicated that whilst initial transfer performance was associated with job similarity when expressed in divisional job dimension terms ($r = 0.798$, $p < 0.05$), later trial performance was not significantly associated ($r = -0.236$), and overall rate of learning was negatively correlated with divisional job dimension similarity ($r = 0.805$, $p < 0.05$). Whilst it might be argued by trainers that well-structured training ought to be able to moderate initial subject differences, the rapidity with which the initial predictions dissipated in the study may reflect a more alarming feature. Namely that gross behavioural structural similarity is a poor index of transfer in the realm of work where training is a consideration. There are difficulties in drawing such a strong conclusion, however. The relative 'power' of training in specific tasks is not quantifiable. It may be that the 'ease' with which the criterion assembly task could be learned was such that the implicit learning/training was a "powerful" factor. Performance on multitudes of tasks in the real employment situation may not necessarily be so vulnerable to moderation. Further there are, as have been noted in Section 4.3.4, limitations to the simulated "job" used in the current research. The dissipation effect (and the contrary increase in validity of trait-based descriptors) highlighted in the present research is a major finding in its own right, but its universal presence (and quantifiable identification of its transience) remains to be established.

5.2.2 THE UTILITY OF TRAIT DESCRIPTORS IN THE PREDICTION OF TRANSFER

A substantial proportion of the current research programme has addressed the derivation and utility of ability (trait) descriptors of job demands. It has been noted that traits have been used by psychologists as the basis of prediction of individual job performance for over 60 years. The tangential observation that particular jobs are associated with identifiable homogeneities of traits amongst respective incumbents, has led psychologists to study techniques of identifying attribute requirements in systematic non-empirical ways. The current research has shed light upon many of the issues surrounding this concept of synthetic validity. Three general conclusions can be drawn from the studies conducted.

Firstly, whilst it is possible for psychologists to estimate the relevance of a range of traits to particular worker-oriented descriptors of work, concern has been expressed about the exhaustivity of trait lists, and the crudity of the index of relevance (a six-point rating scale - see Section 3.1.1.3).

Secondly, the issue of assembling profiles of the overall attribute demands of jobs raises many consideratins. Alternative methods of assembly carry differing psychological assumptions and interpretations (see Sections 3.1.1.3 and 3.5). Whilst there are a wide range of alternative mathematical manipulations which can be applied to derive alternative scores, attention must be paid to 'meaning' of such scores. The current research has investigated three major approaches to assembling attribute profiles, and has concluded that in terms of reliability and validity, the additive method of assembly seems to offer the greatest potential. This approach places emphasis upon the range of job behaviours associated with particular traits and regards the overall importance of each trait as the prevalence of related behaviours across a whole job. The validity of these descriptors of job demands has been investigated in two intermediate ways. The indications have been shown to be significantly associated with the mean test scores of incumbents on corresponding psychometric measures. Further, measures chosen on the basis of PAQ indications have been shown to significantly associate concurrently with job incumbents' job performance, and the post-training performance of new recruits to a job. As such it may be concluded that it is possible to systematically (and non-empirically) identify the traits required for job performance. The advent of psychometric measures more related to cognitive strategies offers great hope for the extension of this additive technique of synthetic validation.

The third general conclusion which can be drawn from the research concerning the utility of trait descriptors stems from the study of their ability to serve as a content base in the prediction of transfer effects. Whilst initial transfer performance was not significantly associated with job similarity in trait terms ($r = -0.425$), later trial performance ($r = 0.815$, $p < 0.05$) and the overall rate of learning ($r = 0.800$, $p < 0.05$) were significantly correlated with the predictions. In summary, therefore, it seems possible to systematically identify a range of ability requirements for jobs and formulate predictions of general job group transfer performance upon the basis of similarity between incumbents' current job and future job.

5.2.3 THE CONTRIBUTION OF THE RESEARCH TO THE ISSUE OF JOB MOBILITY

It was noted in the introduction to the report that applied research is driven by particular applied problems. The current research programme was set against a backcloth of concern about changes in the structure of employment. In particular, anticipated increases in the requirement for individuals to change jobs led manpower policy makers to postulate that current job behaviours/experience might have a role in the prediction of future job performances. Specifically, two broad questions were raised. Firstly, whether or not the performance of groups of individuals on future jobs was to some extent predictable on the basis of inter-relationships between their current and future jobs. The current research has shed considerable light upon this issue and provisionally demonstrated that two complimentary sets of job descriptors can be used to assess job similarity in terms which are predictive of future job learning and performance. The second question raised by manpower policy makers concerned the subsequent feasibility of the establishment of "families" of similar jobs with transfer reciprocity. The current research has noted that job similarity may not be best conceived as bi-directional, and that job transfer effects may generally be asymetrical, i.e. whilst incumbents of one job may demonstrate positive transfer to a job with lower levels of divisional demands or attribute demands, it does not follow that incumbents of the latter job could transfer as readily to the first job (with its associated higher demands). Job inter-relationships might best be expressed as a series of 'target' jobs with lower demands than a "particular" recruitment job. These series of jobs would not be a family of jobs per se, but simply a set of jobs whose demands manifest a 'deficit' in relation to a particular recruitment job. There would be as many sets/series of these jobs as there are actual jobs. As such, it would seem that networks of jobs might be establishable, which could usefully summarise job inter-relationships in transfer terms, but that the concept of clusters of jobs with reciprocal transfer connotations is not the optimal summary when job similarity is expressed in terms derivable from the Position Analysis Questionnaire.

APPENDICES

LIST OF APPENDICES

APPENDIX 1

The Position Analysis Questionnaire (Form B)
Questionnaire Format (Anglicised)

THE POSITION ANALYSIS
QUESTIONNAIRE (FORM B)

QUESTIONNAIRE FORMAT (ANGLICISED)

1.

POSITION ANALYSIS QUESTIONNAIRE (PAQ)

General Purpose

This questionnaire is used for describing certain job activities and certain aspects of situations in which jobs are performed. Before beginning your job analysis using this questionnaire, carefully read the explanatory material which follows. Once you have the instructions clearly in mind, read through the remainder of the questionnaire to familiarize yourself with its content.

Organisation of the Questionnaire

The questionnaire is divided into the six major divisions listed below. In addition to the division titles a "question" is included which you can keep in mind when going through each division.

DIVISIONS:

1. Information Input (Where and how you get the information that you use in performing your job?) Pages 1 to 4.

2. Mental Processes (What reasoning, decision-making, planning, and information processing activities are involved in performing the job?) Pages 5 to 8.

3. Work Output (What physical activities do you perform and what tools or devices do you use?) Pages 9 to 14.

4. Relationships With Other Workers (What relationships with other people are required in performing the job?) Pages 15 to 18.

5. Job Context (In what physical and social contexts is the work performed?) Pages 19 to 21.

6. Other Job Characteristics (What activities, conditions, or characteristics other than those described above are relevant to the job?) Pages 22 to 27

The divisions listed above are further divided into sections and subsections. Each section or subsection is made up of a group of related job elements (in the questionnaire these are referred to as "items"). Each job element describes some general work activity, work condition, or job characteristic. In most cases examples are given to illustrate the "central idea" of the job element. However, these examples are intended only to help illustrate the idea and include only a few of the possible examples that could characterize the job element.

How To Use The Questionnaire

For each job element, provision is made for using "rating scales" Several different rating scales are used throughout the questionnaire and are located on those pages to which they pertain. In general they look like this:

Code	Extent of Use (U)
0	Does not apply
1	Nominal/very infrequent
2	Occasional
3	Moderate
4	Considerable
5	Very substantial

OR

Code	Importance to This Job (I)
0	Does not apply
1	Very minor
2	Low
3	Average
4	High
5	Extreme

2.

At the beginning of each job element you will find a code with one or more capital letters indicating the scale to be used for that element. For example, answer blank number one looks like this:-

1. U____

   I____

The "U" refers to the "Extent of Use (U)" rating scale which is shown above. The "I" refers to the "Importance to the job (I)" scale which is also shown above.

LETTER	RATING SCALE
U	Extent of Use (shown above)
T	Amount of Time
I	Importance to the Job (shown above)
P	Possibility of Occurrence
A	Applicability
S	Special Code (When this code is used, it applies only to the job element of which it is a part.)
	Note that some "Special (S)" rating scales do not have a "____ Does not apply" answer because the statement applies to some degree to every job.

Caution: For each statement use only the rating scales identified by the capital letter/s in the answer blank. Each "Special (S)" rating scale applies only to the job element of which it is a part.

You should make your responses to each question on the answer sheet which has been provided. Do not write anything on the questionnaire booklet.

Other instructions will be given as you go through the questionnaire. Please read and follow them carefully.

Example Answers

Item 1 $\frac{U}{I}$ Written materials.

Here you are asked to rate the extent to which you use written materials as a source of information in performing your job (U) and to rate how important this activity is to the completion of your job (I). You can see this because item 1 has the code:-

$\frac{U}{I}$

You should mark your answers on the answer sheet by drawing a circle round the number which is true for your job. First on the extent of use (U) scale (0,1,2,3,4 or 5), then on the Importance (I) scale (0,1,2,3,4,or 5)

e.g. 1. U 0 1 2 3 4 5 I 0 1 2 3 4 5

Most of the items in the questionnaire ask you to use these two scales.

3.

Here is a different example:-

Item 20 | S Near visual differentiation

Here you are asked to rate the amount of detail you must see in your job by using the Special Scale (S) written underneath the item. You can see this because item 20 has the code:

| S

You should mark your answer on the answer sheet by drawing a circle round the number which is true for your job. Look at the Special Scale (S) under item 20. You could answer 0, 1, 2, 3, 4 or 5.

e.g. 20

S	0	1	2	3	4	5

BE SURE TO USE THE RIGHT SCALES FOR EVERY ITEM. MOST ITEMS REQUIRE 2 ANSWERS. SOME ONLY REQUIRE 1.

POSITION ANALYSIS QUESTIONNAIRE
(QUESTIONNAIRE FORMAT)

1. INFORMATION INPUT

1.1. Sources of Job Information

Rate each of the following items in terms of the extent to which it is used by you as a source of information in performing your job, and also in terms of how important each activity is to the completion of the job.

Note on rating "Importance to this job"

Each of the items in the questionnaire which uses the 'Importance to the job (I)' scale is to be rated in terms of how important the activity described in the item is to the completion of the job, as compared with the other activities which are part of this job. Consider such factors as amount of time spent, the possible influence on overall job performance if you did not properly perform the activity, etc..

Code	Extent of Use (U)
0	Does not apply
1	Nominal/very infrequent
2	Occasional
3	Moderate
4	Considerable
5	Very substantial

Code	Importance to This Job (I)
0	Does not apply
1	Very minor
2	Low
3	Average
4	High
5	Extreme

1.1.1. Visual Sources of Job Information

1 U__ I__ Written materials (books, reports, office notes, articles, job instructions, signs, etc.)

2 U__ I__ Quantitative materials (materials which deal with quantities or amounts, such as graphs, accounts, specifications, tables of numbers, etc.)

3 U__ I__ Pictorial materials (pictures or picture-like materials used as sources of information, for example, drawings, blueprints, diagrams, maps, tracings, photographic films, X-ray films, TV pictures, etc.)

4 U__ I__ Patterns/related devices (templates, stencils, patterns, etc., used as sources of information when observed during use; do not include here materials described in item 3 above)

5 U__ I__ Visual displays (dials, gauges, signal lights, radar scopes, speedometers, clocks, etc.)

1.1.1. Visual Sources of Job Information (contd).

Code	Extent of Use (U)
0	Does not apply
1	Nominal/very infrequent
2	Occasional
3	Moderate
4	Considerable
5	Very substantial

Code	Importance to This Job (I)
0	Does not apply
1	Very minor
2	Low
3	Average
4	High
5	Extreme

6 U__ I__ Measuring devices (rules, calipers, tyre pressure gauges, scales, thickness gauges, pipettes, thermometers, protractors, etc., used to obtain visual information about physical measurements; do not include here devices described in item 5 above)

7 U__ I__ Mechanical devices (tools, equipment, machinery, and other mechanical devices which are sources of information when observed during use or operation)

8 U__ I__ Materials in process (parts, materials, objects, etc., which are sources of information when being modified, worked on, or otherwise. processed, such as bread dough being mixed, workpiece being turned in a lathe, fabric being cut, shoe being resoled, etc.)

9 U__ I__ Materials not in process (parts, materials, objects, etc., not in the process of being changed or modified, which are sources of information when being inspected, handled, packaged, distributed, or selected, etc., such as items or materials in inventory, storage, or distribution channels, items being inspected, etc.)

10 U__ I__ Features of nature (landscapes, fields, geological samples, vegetation, cloud formations, and other features of nature which are observed or inspected to provide information)

11 U__ I__ Man-made features of environment (structures, buildings, dams, highways, bridges, docks, railroads, and other "man-made" or altered aspects of the indoor or outdoor environment which are observed or inspected to provide job information)

12 U__ I__ Behaviour (observing the actions of people or animals, for example, in teaching, supervising, sports officiating, etc., where this is a source of job information)

13 U__ I__ Events or circumstances (those events you visually observe and in which you may participate, such as flow of traffic, movement of materials, airport control tower operations, etc.)

14 U__ I__ Art or decor (artistic or decorative objects or arrangements used as sources of job information, for example, paintings, sculpture, jewellery, window displays, interior decoration, etc.)

3.

1.1.2. Non-visual Sources of Job Information

Code	Extent of Use (U)
0	Does not apply
1	Nominal/very infrequent
2	Occasional
3	Moderate
4	Considerable
5	Very substantial

Code	Importance to This Job (I)
0	Does not apply
1	Very minor
2	Low
3	Average
4	High
5	Extreme

15 U___ I___ Verbal sources (verbal instructions, orders, requests, conversations, interviews, discussions, formal meetings etc,; consider only verbal communication which is relevant to job performance)

16 U___ I___ Non verbal sounds (for example, noises, engine sounds, sonar, whistles, musical instruments, signals, horns, etc).

17 U___ I___ Touch (pressure, pain, temperature, moisture, etc,; for example, feeling texture of surface, etc.)

18 U___ I___ Odour (odours which you need to smell in order to perform your job; do not include odours simply because they happen to exist in the work environment)

19 U___ I___ Taste (bitter, sour, sweet, or salty qualities which are sources of job information, for example, wine taster, candy taster, etc.)

1.2. Sensory and Perceptual Processes

20. S___ Near visual differentiation (using the code below, rate the amount of detail you must see to adequately obtain job information from objects, events, features, etc. within arm's reach)

Code	Degree of Detail
0	Does not apply (worker is blind or works in total darkness)
1	Very little detail (for example, that required in moving boxes, dumping trash, opening desk drawers, etc.)
2	Limited detail (for example, that required in bagging groceries, taking tickets, grinding hamburger, etc.)
3	Moderate detail (for example, that required in hammering nails, reading typed letters, reading dials and gauges, etc.)
4	Considerable detail (for example, reading small legal print, setting ignition points, etc.
5	Extreme detail (for example, that required in diamond cutting, repairing watches, assembling small electrical transistors, etc.)

4.

Code	Extent of Use (U)
0	Does not apply
1	Nominal/very infrequent
2	Occasional
3	Moderate
4	Considerable
5	Very substantial

Code	Importance to This Job (I)
0	Does not apply
1	Very minor
2	Low
3	Average
4	High
5	Extreme

21 U__ I__ Far visual differentiation (seeing differences in the details of objects, events, or features beyond arm's reach, for example, operating a vehicle, landscaping, sports officiating, etc.)

22 U__ I__ Depth perception (judging the distance from the observer to objects, or the distances between objects as they are positioned in space, as in operating a crane, operating a dentist's drill, handling and positioning objects, etc.)

23 U__ I__ Colour perception (differentiating or identifying objects, materials, or details thereof on the basis of colour)

24 U__ I__ Sound pattern recognition (recognising different patterns, or sequences of sounds, for example, those involved in Morse code, heart beats, engines not functioning correctly, etc.)

25 U__ I__ Sound differentiation (recognising differences or changes in sounds in terms of their loudness, pitch, and/or tone quality, for example, piano tuner, sound-system repairman, etc.)

26 U__ I__ Body movement sensing (sensing or recognising changes in the direction or speed at which the body is moving without being able to sense them by sight or hearing, for example, as in flying aircraft, working in a submarine, etc.)

27 U__ I__ Body balance (sensing the position and balance of the body when body balance is critical to job performance, as when walking on "I" beams, climbing high poles, working on steep roofs, walking on slippery floors, etc.)

1.3. Estimation Activities

In this section are various operations involving estimation or judging activities. In each case consider activites in which you use any or all of the senses, for example, sight, hearing, touch, etc..

28 U__ I__ Estimating speed of moving parts (estimating the speed of the moving parts associated with stationary objects, for example, the revolutions per minute of a motor, the speed at which a lathe turns, etc.)

29 U__ I__ Estimating speed of moving objects (estimating the speed of moving objects or materials relative to a fixed point or to other moving objects, for example, the speed of vehicles, materials on a conveyor belt, flow of liquids in transparent pipes, etc.)

5.

Code	Extent of Use (U)
0	Does not apply
1	Nominal/very infrequent
2	Occasional
3	Moderate
4	Considerable
5	Very substantial

Code	Importance to This Job (I)
0	Does not apply
1	Very minor
2	Low
3	Average
4	High
5	Extreme

30 U__ I__ Estimating speed of processes (estimating the speed of on-going processes or a series of events while they are taking place, for example, chemical reactions, assembly operations, timing of food preparation in a cafeteria etc.)

31 U__ I__ Judging condition/quality (estimating the condition, quality, and/ or value of objects, for example, antique dealer, appraiser, jeweller, used car dealer, coin dealer, etc.)

32 U__ I__ Inspecting (inspecting products, objects, materials, etc., either one's own workmanship or that of others, in terms of established standards, for example, identifying defects, classifying by grade, etc.; do not include here activities described in item 31 above)

33 U__ I__ Estimating quantity (estimating the quantity of objects without direct measurement, including weight, number, volume, etc., for example, estimating the board feet of lumber in a log, the weight of a beam, the number of bacteria in an area by looking through a microscope, etc.)

34 U__ I__ Estimating size (estimating the dimensions of objects without direct measurement, including length, thickness, etc., for example, estimating the height of a tree, judging sizes of boxes or furniture in loading a lorry etc.)

35 U__ I__ Estimating time (estimating the time required for past or future events or work activities, for example, judging the amount of time to make a delivery, estimating the time required to service a worn machine part or piece of equipment, judging the length of time required to change a production line procedure, etc.)

6.

2. MENTAL PROCESSES

2.1. Decision Making, Reasoning, and Planning/Scheduling

36 S___ Decision making (indicate, using the code below, the level of decision making typically involved in your job, considering: the number and complexity of the factors that are taken into account; the variety of alternatives available; the consequences and importance of the decisions; the background experience, education, and training required; the precedents available for guidance; and other relevant considerations. The examples given for the following codes are only suggestive)

Code	Level of Decision
1	Low ("decisions" such as those in selecting parts in routine assembly, shelving items on a warehouse, pasting labels on cartons, tending automatic machines, etc.)
2	Below average ("decisions" such as those in operating a wood planer, dispatching a taxi, lubricating an automobile, etc.)
3	Average ("decisions" such as those in setting-up machines tools for operation, ~~designing~~ mechanical disorders of aircraft, ordering office supplies several months in advance, etc.)
4	Above average ("decisions" such as those in determining production quotas, making personnel decisions such as promoting and hiring., etc.)
5	High ("decisions" such as those in approving corporation annual budget, recommending major surgery, selecting the location for a new plant, etc.)

37 S___ Reasoning in problem solving (indicate, using the code below, the level of reasoning that is required of you in applying your knowledge, experience, and judgment to problems).

Code	Level of Reasoning in Problem Solving
1	Low (use of common sense to carry out simple, or relatively uninvolved instructions, for example, caretaker, deliveryman, hod carrier, etc.)
2	Below average (use of some training and/or experience to select from a limited number of solutions the most appropriate section or procedure in performing the job for example, sales clerk, postman, electrician apprentice, keypunch operator, etc.)
3	Average (use of relevant principles to solve practical problems and to deal with a variety of concrete variables in situations where only limited standardization exists, for example, draftsman, carpenter, farmer, etc.)
4	Above average (use of logic or scientific thinking to define problems. collect information, establish facts, and draw valid conclusions for example, mechanical engineer, personnel director, manager of a store, etc.)
5	High (use of principles of logical or scientific thinking to solve a wide range of intellectual and practical problems, for example, research chemist, nuclear engineer, managing director, or manager of a large branch or plant, etc.

7.

2.1. Decision Making, Reasoning, and Planning/Scheduling (cont.)

38 S Amount of planning/scheduling (indicate, using the code below, the amount planning/scheduling you are required to do which affects your own activities and/or the activities of others)

Code	Amount of Planning
0	Does not apply (have no opportunity to plan even your own activities; the specific activities are virtually predetermined for you)
1	Very limited (have limited opportunity to plan or schedule your own activities, for example, ticket seller at a theatre "typical" assembly line worker, etc.)
2	Limited (some planning is required but not a great deal, for example, the planning that would be done by a milkman, janitor, etc.)
3	Moderate (a moderate amount of planning of your own or other activities is required, for example, a carpenter who must plan the best way to build a structure, a taxi dispatcher, etc.)
4	Considerable (a fairly large amount of planning)/scheduling is required, for example, a foreman who must plan the activities of his subordinates, a teacher who must prepare lectures or lesson plans, a material co-ordinator who must plan/schedule the arrival and distribution of materials, etc.)
5	Extensive (substantial amount of planning/scheduling is required, for example, a department store manager, an executive who must plan the activities of different work groups, an architect, a scientist who must make comprehensive and detailed plans to perform experiments, etc.)

2.2. Information Processing Activities

In this section are various human operations involving the "processing" of information or data. Rate each of the following items in terms of the extent to which it is done by you, and also in terms of how important the activity is to the completion of the job.

8.

Code	Extent of Use (U)
0	Does not apply
1	Nominal/very infrequent
2	Occasional
3	Moderate
4	Considerable
5	Very substantial

Code	Importance to This Job (I)
0	Does not apply
1	Very minor
2	Low
3	Average
4	High
5	Extreme

39 U_ I_ Combining information (combining, synthesizing, or integrating information or data from two or more sources to establish new facts, hypotheses, theories, or a more complete body of related information, for example, an economist using information from various sources to predict future economic conditions, a pilot flying aircraft, a judge trying a case, etc.)

40 U_ I_ Analysing information or data (for the purpose of identifying underlying principles or facts by breaking down information into component parts, for example, interpreting financial reports, diagnosing mechanical disorders or medical symptoms, etc.).

41 U_ I_ Compiling (gathering, grouping, classifying, or in some other way arranging information or data in some meaningful order or form, for example, preparing reports of various kinds, filing correspondence on the basis of content, selecting particular data to be gathered, etc.)

42 U_ I_ Coding/decoding (coding information or converting coded information back to its original form, for example, "reading" Morse Code, translating foreign languages, or using other coding systems such as shorthand, mathematical symbols, computer languages, drafting symbols, replacement part numbers, etc.)

43 U_ I_ Transcribing (copying or posting data or information for later use, for example, copying meter readings in a record book, entering transactions in a ledger, etc.)

45 U_ Other information processing activities, Specify (on answer sheet)

2.3. Use of Learned Information

45 U_ I_ Short term memory (learning and retaining job related information and recalling that information after a brief period of time, for example, waitress, short-order cook, telephone operator, etc.)

46 S_ Education (indicate, using the code below, the level of education generally or typically required by persons who are selected for this job; include education in elementary, high school, colleges, etc.: do not include technical or vocational school training - see item 48)

9.

Code	Education (give level or equivalent)
0	Does not apply (little or no school education required)
1	Leaving school but with no examinations taken.
2	Leaving school with C.S.E.'s or 'O' levels.
3	Some college education
4	University degree (degree requiring 3 years or more to complete, for example, B.A., B.Sc, etc.)
5	Higher degree (M.Sc, Ph.D, M.D., etc.)

47 S Job-related experience (indicate, using the code below, the amount of all previous job-related experience in other related or lower-level jobs generally required by persons selected for the job; do not include formal education as described in item 46)

Code	Job-related Experience
0	Does not apply (no experience required)
1	Less than 1 month
2	Over 1 month up to and including 12 months.
3	Over 1 year up to and including 3 years.
4	Over 3 years up to and including 5 years.
5	Over 5 years.

2.2. Information Processing Activities (cont.)

48 S Training (indicate, using the code below, the total amount of training generally required for persons who have had no prior job training to learn to perform adequately on this job; consider all types of required job-related training except for education described in item 46; include training at hairdressing schools, technical and vocational schools, business schools., as well as apprentice, on-the-job, off-the-job and orientation training, etc.).

Code	Training
0	Does not apply or very limited (no more than one day's training required)
1	Over 1 day up to and including 30 days.
2	Over 30 days up to and including 6 months.
3	Over 6 months up to and including 1 year.
4	Over 1 year up to and including 3 years.
5	Over 3 years.

10.

49 S__ Using mathematics (indicate, using the code below, the highest level of mathematics required by the job)

Code	Level of Mathematics
0	Does not apply
1	Simple basic(counting, addition and subtraction of 2-digit numbers or less)
2	Basic (addition and subtraction of numbers of 3-digits or more, multiplication, division, etc.)
3	Intermediate (calculations and concepts involving fractions, decimals, percentages, etc.).
4	Advanced (algebraic, geometric, trigonometric, and statistical concepts, techniques, and procedures, usually applied in standard practical situations)
5	Very advanced (advanced mathematical and statistical theory, concepts and techniques, for example, calculus, topology, vector analysis, factor analysis, probability theory, etc.)

3. WORK OUTPUT

3.1. Use of Devices and Equipment

3.1.1. Hand-held Tools or Instruments

Code	Extent of Use (U)
0	Does not apply
1	Nominal/very infrequent
2	Occasional
3	Moderate
4	Considerable
5	Very substantial

Code	Importance to This Job
0	Does not apply
1	Very minor
2	Low
3	Average
4	High
5	Extreme

Consider in this category those devices which are used to move or modify work pieces, materials, products, or objects. Do not consider measuring devices here.

Manually-powered

50 U__ I__ Precision tools/instruments (that is, tools or instruments powered by the user to perform very accurate or precise operations, for example, the use of engraver's tools, watchmaker's tools, surgical instruments, etc.)

51 U__ I__ Non-precision tools/instruments (tools or instruments powered by the user to perform operations not requiring great accuracy or precision, for example, hammers, wrenches, trowels, knives, scissors, chisels, putty knives, strainers, hand grease guns, etc; do not include long-handle tools here)

11.

3.1.1. Hand-held Tools or Instruments (contd).

Code	Extent of Use (U)
0	Does not apply
1	Nominal/very infrequent
2	Occasional
3	Moderate
4	Considerable
5	Very substantial

Code	Importance to This Job (I)
0	Does not apply
1	Very minor
2	Low
3	Average
4	High
5	Extreme

52 U__ I__ Long-handle tools (hoes, rakes, shovels, picks, axes, brooms, mops, etc.)

53 U__ I__ Handling devices/tools (tongs, ladles, dippers, forcepts, etc., used for moving or handling objects and materials; do not include here protective gear such as asbestos gloves, etc.)

Powered (manually controleed or directed devices using an energy source such as electricity, compressed air, fuel, hydraulic fluid, etc., in which the component part which accomplishes the modification is hand held, such as dentist drills, welding equipment, etc., as well as devices small enough to be entirely hand-held.

54 U__ I__ Precision tools/instruments (hand-held powered tools or instruments used to perform operations requiring great accuracy or precision, such as dentist drills, soldering irons, welding equipment, saws, etc. used for especially accurate or fine work)

55 U__ I__ Non-precision tools/instruments (hand-held, energy-powered tools or instruments used to perform operations not requiring great accuracy or precision, for example, ordinary power saws, drills, sanders, clippers, hedge trimmers, etc., and related devices such as electrical soldering irons, spray guns or nozzles, welding equipment, etc.)

3.1.2. Other Hand-held Devices

56 U__ I__ Drawing and related devices (instruments or devices used in writing, sketching, illustrating, drafting, etc., for example, pens, pencils, drawing instruments, artist's brushes, drafting equipment, etc.; do not include measuring instruments here, see item 58)

57 U__ I__ Applicators (brushes, rags, paint rollers, etc., which are hand-held and used in applying solutions, materials, etc.; do not consider devices covered by items 50-55 above)

58 U__ I__ Measuring devices (rules, measuring tapes, micrometers, calipers, protractors, squares, thickness gauges, levels, volume measuring devices, tyre gauges, etc.)

59 U__ I__ Technical and related devices (cameras, stopwatches, slide rules, etc.)

60 U__ I__ Other hand-held tools and devices (Specify on answer sheet).

12.

3.1.3. Stationary Devices

Code	Extent of Use (U)
0	Does not apply
1	Nominal/very infrequent
2	Occasional
3	Moderate
4	Considerable
5	Very substantial

Code	Importance to This Job (I)
0	Does not apply
1	Very minor
2	Low
3	Average
4	High
5	Extreme

61 U___ I___ Machines/equipment (used to process, fabricate, or otherwise modify parts, objects, materials, etc.: use this category in addition to indicating the controls used in the subsection which follows)

62 U___ I___ Activation controls (hand or foot operated devices used to start, stop, or otherwise activate energy-using systems or mechanisms, for example, light switches, electric motor switches, ignition switches, etc.).

63 U___ I___ Fixed setting controls (hand or foot operated devices with distinct positons, detents, or definite settings, for example, TV selector switch, gear-shift etc.)

64 U___ I___ Variable setting controls (hand or foot operated devices that can be set at the beginning of operation, or infrequently, at any position along a scale, for example, TV volume control, room thermostat, rheostat, etc).

65 U___ I___ Keyboard devices (typewriters, adding machines, calculators, pianos, key-punch machines, etc.)

Frequent adjustment controls (used in making <u>frequent</u> adjustments of mechanisms)

66 U___ I___ Hand-operated controls (controls operated by hand or arm for making <u>frequent</u>, but not continuous, adjustments, for example, hand controls on a crane or bulldozer, helm or ship, etc.)

67 U___ I___ Foot-operated controls (controls operated by foot or leg for making <u>frequent</u> but <u>not</u> <u>continuous</u>, adjustments, for example, automobile brakes, etc.)

Continuous controls (used <u>continuously</u> in operation or use)

68 U___ I___ Hand-operated controls (controls operated by hand and used <u>continuously</u> for adjusting to changing, or possible changing, situations, for example, use of steering wheel, controls on a "tracking" device, etc.)

69 U___ I___ Foot-operated controls (controls operated by foot and used <u>continuously</u> for adjusting to changing, or possibly changing, situations, for example, accelerator, etc.).

13.

3.1.5. Transportation and Mobile Equipment

Code	Extent of Use (U)
0	Does not apply
1	Nominal/very infrequent
2	Occasional
3	Moderate
4	Considerable
5	Very substantial

Code	Importance to This Job (I)
0	Does not apply
1	Very minor
2	Low
3	Average
4	High
5	Extreme

70 U__ I__ Man-powered vehicles (bicycles, rowboats, canoes, etc.)

71 U__ I__ Powered highway/rail vehicles (vehicles intended primarily for road or railway transportation, for example, buses, trains, etc.)

72 U__ I__ Powered mobile equipment (movable vehicles not primarily intended for highway use, for example, warehouse trucks, fork lifts, self-propelled lawn mowers, road graders, tractors, combines, etc.)

73 U__ I__ Powered water vehicles (ships, submarines, motor boats, etc.)

74 U__ I__ Air/space vehicles (planes, helicopters, balloons, gliders, rocketships, etc.)

75 U__ I__ Man-moved mobile equipment (hand-pushed lawn mowers with or without powered blades, hand trucks, wheel barrows, floor polishers and buffers, etc.)

76 U__ I__ Operating equipment (cranes, hoists, elevators, etc.)

77 U__ I__ Remote-controlled equipment (conveyor systems, etc.)

3.2. Manual Activities

This section describes manual activities in which tools may or may not be used.

78 U__ I__ Setting up/adjusting (adjusting, calibrating, aligning and/or setting up of machines or equipment, for example, setting up a lathe or drill press, adjusting an engine carburetor, adjusting, calibrating, and aligning electric circuitry, etc.)

79 U__ I__ Manually modifying (using hands directly to form or otherwise modify materials or products, for example, kneading dough by hand, folding letters, massaging, etc.)

80 U__ I__ Material-controlling (manually controlling or guiding materials being pro cessed, for example, in operating sewing machine, jig saws, etc.)

81 U__ I__ Assembling/disassembling (either manually or with the use of hand tools putting parts or components together to form more complete items, or taking apart or disassembling items into their component parts)

14.

3.2. Manual Activities (contd)

Code	Extent of Use (U)
0	Does not apply
1	Nominal/very infrequent
2	Occasional
3	Moderate
4	Considerable
5	Very substantial

Code	Importance to This Job (I)
0	Does not apply
1	Very minor
2	Low
3	Average
4	High
5	Extreme

82 U ___ I ___ Arranging/positioning (manually placing objects, materials, persons, animals, etc., in a specific position or arrangement, for example, arranging library books, window displays, stocking shelves, positioning patients for certain medical and dental procedures, etc.; do not include here arranging/positioning which is a part of the operations listed in items 78-81)

83 U ___ I ___ Feeding/off-bearing (manually inserting, throwing, dumping or placing materials into or removing them from machines or processing equipment; this category is not to be used in describing operations in which you manually guide or control the materials or parts during processing, as in item 80).

84 U ___ I ___ Physical handling (physically handling objects, materials, animals, human beings, etc., either manually or with nominal use of aiding devices, for example, in certain warehousing activities, loading/unloading conveyor belts, trucks, packaging, farming activities, hospital procedures, etc.; typically there is little requirement for careful positioning or arrangement of objects; include here relatively uninvolved handling operations not provided for in item 78-83)

3.3. Activities of the Entire Body

85 U ___ I ___ Highly skilled body coordination (activities involving extensive, and often highly-learned coordination activities of the whole body, for example, athletics, dancing, etc.)

86 U ___ I ___ Balancing (maintaining body balance or equilibrium to prevent falling when standing, walking, running, crouching, etc., on narrow, slippery, steeply, inclined or erratically moving surfaces, for example, walking on narrow elevated beam, working on steep roof, etc.)

3.4. Level of Physical Exertion

87 S ___ Level of physical exertion (indicate, using the code below, the general level of body activity, considering the frequency and effort required to perform job tasks involving pushing, pulling, carrying, lifting, etc., during an average work day)

Code	Level of Physical Exertion
1	Very light (occasionally walking or standing and/or occasionally moving light objects, materials, etc., such as secretary, draftsman, watchmaker, telephone operator, etc.).

scale continued overleaf.

15.

87

Code	Level of Physical Exertion (contd).
2	Light (frequently walking or standing and/or frequently exerting force equivalent to lifting up to approximately 10 pounds and/or occasionally exerting force equivalent to lifting about 20 pounds, for example, sales clerk, bank teller, etc.)
3	Moderate (frequently exerting forces equivalent to lifting up to approximately 25 pounds and/or occasionally exerting forces equivalent to lifting up to approximately 50 pounds, for example car mechanic, coin vending machine serviceman, bus driver, etc.)
4	Heavy (frequently exerting forces equivalent to lifting up to approximately 50 pounds and/or occasionally exerting forces equivalent to lifting up to approximately 100 pounds, for example, general labourer, millwright, bulldozer operator, baggage porter, etc.)
5	Very heavy (frequently exerting forces equivalent to lifting <u>over</u> 50 pounds and/or occasionally exerting forces <u>over</u> that required to lift 100 pounds, for example, hod carrier, quarry miner, etc.)

3.5. Body Positions/Postures

Indicate by code the approximate proportion of working time engaged in the following activities. (Nos. 88-92).

Code	Amount of Time (T)
0	Does not apply (or is very incidental)
1	Under 1/10 of the time
2	Under 1/3 of the time
3	Between 1/3 and 2/3 of the time
4	Over 2/3 of the time
5	Almost continually

88 T___ Sitting

89 T___ Standing (do <u>not</u> include walking)

90 T___ Walking/running

91 T___ Climbing (for example, house painter, telephone lineman etc.,)

92 T___ Kneeling/stooping, crawling, crouching, and other related body positions which may be uncomfortable or awkward)

3.6. Manipulation/Co-ordination Activities

Rate the following items in terms of the extent to which you do it and also in terms of how important the activity is to the completion of the job. (See overleaf for scales).

93 U___ I___ Finger manipulation (making careful finger movement in various types of activities, for example, fine assembly, use of precision tools, repairing watches, use of writing and drawing instruments, operating keyboard devices, etc.; usually the hand and arm are <u>not</u> involved to any great extent)

94 U___ I___ Hand-arm manipulation (the manual control or manipulation of objects through hand and/or arm movements, which may or may not require continuous visual control, for example, repairing automobiles, packaging products, etc.)

95 U___ I___ Hand-arm steadiness (maintaining a uniform, controlled hand-arm posture or movement, for example, using a welding torch, performing surgery, etc.)

16.

Code	Extent of Use (U)
0	Does not apply
1	Nominal/very infrequent
2	Occasional
3	Moderate
4	Considerable
5	Very substantial

Code	Importance to This Job (I)
0	Does not apply
1	Very minor
2	Low
3	Average
4	High
5	Extreme

96 U__ I__ Eye-hand/foot coordination (the coordination of hand and/or foot movements where the movement must be coordinated with what is seen, for example, driving a vehicle, operating a sewing machine, etc.)

97 U__ I__ Limb movement without visual control (movement of body limbs from one position to another without the use of vision, for example, reaching for controls without looking, playing a musical instrument, touch typing, etc.)

98 U__ I__ Hand-ear coordination (the coordinatin of hand movements with sounds or instructions that are heard, for example, tuning radio receivers, tuning musical instruments by ear, piloting aircraft by control tower instructions, etc.)

4. RELATIONSHIPS WITH OTHER WORKERS

Rate the following items in terms of the extent to which you perform the activity and also in terms of how important the activity is to the completion of the job. Some jobs may involve several or all of the items in this section.

4.1.1. Oral (communicating by speaking)

99 U__ I__ Advising (dealing with individuals in order to counsel, and/or guide them with regard to problems that may be resolved by legal, financial, scientific, technical, clinical, spiritual, and/or other professional principles)

100 U__ I__ Negotiating (dealing with others in order to reach an agreement or solution for example, labour bargaining, diplomatic relations, etc.)

101 U__ I__ Persuading (dealing with others in order to influence them toward some action or point of view, for example, selling, political campaigning, etc.)

102 U__ I__ Instructing (the teaching of knowledge or skills, either in an informal or formal manner, to others, for example, a public school teacher, a craftsman teaching an apprentice, etc.)

103 U__ I__ Interviewing (conducting interviews directed toward some specific objective, for example, interviewing job applicants, census taking etc.)

104 U__ I__ Routine information exchange (the giving and/or receiving of information of a routine or simple nature, for example, ticket agent, taxi-cab dispatcher, receptionist, etc.)

17.

Code	Extent of Use (U)
0	Does not apply
1	Nominal/very infrequent
2	Occasional
3	Moderate
4	Considerable
5	Very substantial

Code	Importance to This Job (I)
0	Does not apply
1	Very minor
2	Low
3	Average
4	High
5	Extreme

105 U__ I__ Non-routine information exchange (the giving and/or receiving of information of a non-routine or complex nature, for example, professional committee meetings, engineers discussing product design, etc.)

106 U__ I__ Public speaking (making speeches or formal presentations before relatively large audiences, for example, political addresses, radio/TV broadcasting, delivering a sermon, etc.)

4.1.2. Written (communicating by written/printed material)

107 U__ I__ Writing (for example, writing or dictating letters, reports, etc., writing copy for ads, writing newspaper articles, etc.; do not include transcribing activities described in item 42)

4.1.3. Other Communications

108 U__ I__ Signaling (communicating by some type of signal, for example, hand signals, semaphore, whistles, horns, bells, lights, etc.)

109 U__ I__ Code communications (telegraph, crypotography, shorthand, etc.)

4.2. Miscellaneous Interpersonal Relationships

110 U__ I__ Entertaining (performing to amuse or entertain others, for example, on stage, TV, nightclubs, etc.)

111 U__ I__ Serving/catering (attending to the needs of, or performing personal service for, others, for example, waiting on tables, hairdressing, etc.)

4.3. Amount of Job-required Personal Contact

112 S__ Job-required personal contact (indicate, using the code below, the extent of job-required contact with others, individually or in groups, for example, contact with customers, patients, students, the public, superiors, sub ordinates, fellow employees, prospective employees, official visitors, etc consider only personal contact which is definitely part of the job)

Code	Extent of Required Personal Contact
1	Very infrequent (almost no contact with others is required)
2	Infrequent (limited contact with others is required)
3	Occasional (moderate contact with others is required)
4	Frequent (considerable contact with others is required)
5	Very frequent (almost continual contact with others is required)

18.

4.4. Types of Job-required Personal Contact

This section lists types of individuals with whom you must have personal contact in order to perform your job. Indicate the extent to which you have to have contact with each of the types of individual and also indicate the importance of contact with each of the types of individual. Consider personal contact not only with personnel within the organisation or company, but also with personnel from other organisations, if contact with them is part of the job.

Code	Extent of Use (U)
0	Does not apply
1	Nominal/very infrequent
2	Occasional
3	Moderate
4	Considerable
5	Very substantial

Code	Importance to This Job (I)
0	Does not apply
1	Very minor
2	Low
3	Average
4	High
5	Extreme

113 U__ I__ Executives/officials (managing directors, government administrators, plant superintendents, etc.)

114 U__ I__ Middle management/staff personnel.

115 U__ I__ Supervisors (those personnel who have immediate responsibility for a work group, for example, foremen, office managers, etc.)

116 U__ I__ Professional personnel (doctors, lawyers, scientists, engineers, teachers, consultants, etc.)

117 U__ I__ Semi-professional personnel (technicians, draftsmen, designers, photographers, surveyors, and other personnel who are engaged in activities requiring fairly extensive education or practical experience but which typically involve a more restricted area of operation than that of professional personnel)

118 U__ I__ Clerical personnel (personnel engaged in office work, such as clerks, book keepers, receptionists, etc.)

119 U__ I__ Manual and service workers (personnel in skilled, semi-skilled, unskilled, agricultural, fishing, forestry, service, and related types of occupations etc.)

120 U__ I__ Sales personnel

121 U__ I__ Buyers (purchasing agents, not public customers)

122 U__ I__ Public customers (as in shops, restaurants, etc)

123 U__ I__ The public (not including customers or persons in other specified categories; include the "public" as contacted by, for example, park attendants, police officers, etc.)

19.

Code	Extent of Use (U)
0	Does not apply
1	Nominal/very infrequent
2	Occasional
3	Moderate
4	Considerable
5	Very substantial

Code	Importance to This Job (I)
0	Does not apply
1	Very minor
2	Low
3	Average
4	High
5	Extreme

124 U__ I__ Students/trainees/apprentices

125 U__ I__ Clients/patients/counselees

126 U__ I__ Special interest groups (stockholders, lobbyists, fraternal organizations, property owners, etc.)

127 U__ I__ Other individuals (include here types of persons not described in items 113-126 above, but, whenever possible, use one of the above categories)

4.5. Supervision and Coordination

4.5.1. Supervision/Direct Given

128 S__ Supervision of non-supervisory personnel (indicate, using the code below, the number of persons directly supervised who are actually involved in the production of goods and services and do not supervise others; this item would apply, for example, to most "first line" supervisors, most foremen and section heads, service managers in garages, head butchers in meat departments of grocery stores, head pharmacists, plumbers with assistants, etc.)

Code	Number of Non-supervisory Personnel Supervised
0	Does not apply
1	1 or 2 workers
2	3 to 5 workers
3	6 to 8 workers
4	9 to 12 workers
5	13 or more workers

129 S__ Direction of supervisory personnel (indicate, using the code below, the number of supervisory personnel – those who have responsibility for the supervision of direction of others - who report directly to the person holding this position; this item would apply to many middle and upper managers, but would also apply to managers of many small businesses or other activities who delegate supervisory authority to others, etc.)

Code	Number of Supervisory Personnel Directed
0	Does not apply (does not direct supervisors)
1	1 or 2 supervisory personnel
2	3 to 5 supervisory personnel
3	6 to 8 supervisory personnel
4	9 to 12 supervisory personnel
5	13 or more supervisory personnel

S ___ Total numbers of personnel for whom responsible (indicate, using the code below, the total number of personnel for whom persons holding this job are either directly or indirectly responsible, for example, the managing director of a company would be responsible for all company employees, the branch manager would be responsible for personnel in his branch, a foreman for personnel he supervises, a plumber for his assistant, etc.; use this item in addition to 128 and/or 129.

Code	Total number of personnel for whom responsible
0	Does not apply (not responsible for other personnel)
1	10 or fewer workers
2	11 to 50 workers
3	51 ro 250 workers
4	251 to 750 workers
5	751 or more workers

4.5.2. Other Organizational Activities

This subsection includes activities of a coordinating staff, or supervisory nature.

Code	Extent of Use (U)
0	Does not apply
1	Nominal/very infrequent
2	Occasional
3	Moderate
4	Considerable
5	Very substantial

Code	Importance to This Job (I)
0	Does not apply
1	Very minor
2	Low
3	Average
4	High
5	Extreme

131 U ___ I ___ Supervise non-employees (students, patients, campers, etc.)

132 U ___ I ___ Coordinate activities (coordinate, monitor, or organise the activities of others to achieve certain objectives, but do not have line management authority, for example, social director, committee chairman, etc.)

133 U ___ I ___ Staff functions(advise, consult, or give other types of assistance to line management personnel, for example, legal adviser, administrative assistant, etc.)

21.

4.5.3. Supervision Received

S__ Supervision received (indicate, using the code below, the level of supervision you typically receive)

Code	Level of Supervision Received
1	Immediate supervision (receive close supervision relating to specific work activities, including assignments, methods, etc.; usually receive frequent surveillance over job activities)
2	General supervision (receive general supervision relating to work activities)
3	General direction (receive only very general guidance relating to job activities, primarily guidance with respect to general objectives; have rather broad latitude for determining methods, work scheduling, how to achieve objectives, etc., for example, first-line supervisors, lower management individuals, most staff personnel, people whose work is quite independent of others, etc.)
4	Nominal direction (receive only nominal direction or guidance in job, as in the case of a manager of an organisation or a major subdivision thereof, and am therefore subject only to very broad policy guide lines, for example, some research scientists who are giving virtual free reign, many plant superintendents, etc.)
5	No supervision (this category is applicable to those personnel who function independently, for example, owner-managers of shops independent physicians, independent consultants, etc.)

5. JOB ENVIRONMENT AND WORK SITUATION

5.1. Physical Working Conditions

This section lists various working conditions. Rate the average amount of time exposed to each condition during a typical work period.

5.1.1. Outdoor Environment

Code	Amount of Time (T)
0	Does not apply (or is very incidental)
1	Under 1/10 of the time
2	Under 1/3 of the time
3	Between 1/3 and 2/3 of the time
4	Over 2/3 of the time
5	Almost continually

135 T__ Out-of-door environment (susceptible to changing weather conditions)

5.1.2. Indoor temperatures (do not consider indoor temperature conditions that are simply a function of the weather, for example, heat in summer; consider only those conditions which are associated with this job regardless of the natural climate in which it might be performed).

Code	Amount of Time (T)
0	Does not apply (or is very incidental)
1	Under 1/10 of the time
2	Under 1/3 of the time
3	Between 1/3 and 2/3 of the time
4	Over 2/3 of the time
5	Almost continually

136 T__ High temperature (conditions in which you might experience severe discomfort of heat stress, such as in boiler rooms around furnaces, etc.; typically this would occur in dry atmosphere at about 90°F. and in a humid atmosphere at about 80°F. or 85°F.

137 T__ Low temperature (conditions in which you are exposed to low temperatures which are definitely uncomfortable even though clothing appropriate for the conditions may be worn, such as in refrigerated rooms, etc.).

5.1.3. Other Physical Working Conditions

138 T__ Air conditioning (dust, fumes, smoke, toxic conditions, disagreeable odours etc., consider here air contamination or pollution which is an irritating or undesireable aspect of the job)

139 T__ Vibration (vibration of whole body or body limbs, for example, driving a tractor or truck, operating an air hammer, etc.)

140 T__ Improper illumination (inadequate lighting, excessive glare, etc.)

141 T__ Dirty environment (an environment in which you and/or your clothing easily become dirty, greasy, etc., for example, environments often associated with garages, foundries, coal mines, highway construction, furnace cleaning, etc.)

142 T__ Awkward of confining work space (conditions in which the body is cramped or uncomfortable)

143 S__ Noise intensity (indicate, using the code below, the typical noise level you are exposed to)

Code	Noise Intensity
1	Very quiet (intensive care ward in hospital, greenhouse, photo lab, etc.)
2	Quiet (many private offices, libraries, etc.)
3	Moderate (business office where typewriters are used, light automobile traffic, department store, etc.)
4	Loud (many factories, heavy traffic, machine shops, carpenter shops, etc.)
5	Very loud (close to jet engines, large earth-moving equipment, riveting, etc.)

5.2. Physical Hazards

The four items which follow describe accidents or illnesses which may result from exposure to hazards. Rate the possibility of the occurrence of each of the types of accidents/illnesses to the typical worker on this job. In making the ratings consider the safety/accident record of employees on this job, and/or the possibility of accidents due to factors as: travelling at high speeds, being in high places, working with machinery, sharp tools, hot or very cold materials, exposure to falling objects, dangerous chemicals, explosives, toxic fumes, radiation, etc.

Code	Possibility of Occurrence (P)
0	No possibility
1	Very limited
2	Limited
3	Moderate
4	Fairly high
5	High

144 P__ First-aid cases (minor injuries or illnesses which typically result in a day or less of "lost" time and are usually remedied with first-aid procedures)

145 P__ Temporary disability (temporary injuries or illnesses which prevent the worker from performing his job from one full day up to extended periods of time but which do not result in permanent disability or impairment)

146 P__ Permanent partial impairment (injuries or illnesses resulting in the amputation of permanent loss of use of any body member or part thereof, or permanent impairment of certain body functions)

147 P__ Permanent total disability/death (injuries or illnesses which totally disable the worker and permanently prevent his further gainful employment, for example, loss of life, sight, limbs, hands, radiation sickness, etc.)

5.3. Personal and Social Aspects

This section includes various personal and social aspects of jobs. Indicate the extent to which they are demanded by your job and the importance of coping with them in your job.

Code	Extent of Use (U)
0	Does not apply
1	Nominal/very infrequent
2	Occasional
3	Moderate
4	Considerable
5	Very substantial

Code	Importance to This Job (I)
0	Does not apply
1	Very minor
2	Low
3	Average
4	High
5	Extreme

148 U__ I__ Civic obligations (because of the job you assume or are expected to assume, certain civic obligations or responsibilities)

Code	Extent of Use (U)
0	Does not apply
1	Nominal/very infrequent
2	Occasional
3	Moderate
4	Considerable
5	Very substantial

Code	Importance to This Job (I)
0	Does not apply
1	Very minor
2	Low
3	Average
4	High
5	Extreme

149 U__ I__ Frustrating situations (job situations in which attempts to deal with problems or to achieve job objectives are obstructed or hindered, and may thus contribute to frustration on the part of the job holder)

150 U__ I__ Strained personal contacts (dealing with individuals or groups in "unpleasant" or "strained" situations, for example, certain aspects of police work, certain types of negotiations, handling certain mental patients, etc.)

151 U__ I__ Personal sacrifice (being willing to make certain personnel sacrifices while being of service to other people or the objectives of an organisation, for example, policemen, ministry, social work, etc.; do not consider physicalhazards here)

152 U__ I__ Interpersonal conflict situations (job situations in which they are virtually inevitable differences in objectives, opinions, or viewpoints between you and other persons or groups of persons, and which may "set the stage" for conflict, for example, persons involved in labournegotiations, supervisors who must enforce an unpopular policy, etc.)

153 S__ Non-job required social contact (indicate, using the code below, the opportunity to engage in informal, non-job-required conversation, social interaction, etc. with others while on the job, for example, barber, taxi driver, receptionist, journeyman and apprentice, etc.; do <u>not</u> include here the personal contacts <u>required</u> by the job as described in item 112)

Code	Opportunity for Non-job Required Social Contact
1	Very infrequent (almost no opportunity)
2	Infrequent (limited opportunity)
3	Occasional (moderate opportunity)
4	Frequent (considerable opportunity)
5	Very infrequent (almost continual opportunity)

6. OTHER JOB CHARACTERISTICS

6.1. Apparel Worn

Code	Applicability (A)
0	Does not apply
1	Does apply

For each item mark a zero (0) if the item does not apply, a one (1) if the item applies. Note: One or more items in this section may be applicable.

154 A___ Business suit or dress (expected to wear presentable clothing such as tie and jacket, street dress, etc., as customary in offices, stores, etc.)

155 A___ Specific uniform/apparel (nurse, doorman, bus driver, etc.)

156 A___ Work clothing ("blue collar" apparel worn in factories, construction work, etc.)

157 A___ Protective clothing or gear (clothing or equipment worn as a regular part of the job to protect you, for example, safety helmets, goggles, noise suppressors, safety shoes, insulated gloves or clothing, protective masks, etc.; this item does not apply if only worn occasionally or rarely)

158 A___ Informal attire (sports wear, etc.)

159 A___ Apparel style optional.

6.2. Licensing

160 A___ Licensing/certification required.

6.3. Work Schedule

In each of the three groups of items (in boxes) below: enter one (1) for the item in each boxed group that most nearly applies, enter a zero (o) for all other items in the boxed group.

6.3.1. Continuity of work (as relevant to total year)

161	A___	Regular work
162	A___	Irregular work (depending on weather, season, production changes, etc.)

6.3.2. Regularity of working hours

163	A___	Regular hours (same basic work schedule every week)
164	A___	Variable shift work (work shift varies from time to time)
165	A___	Irregular hours (work variable or irregular hours, depending on requirements of employer, convenience of customers, etc., for example, insurance agents, etc.)

6.3.3. Day-night schedule

166 A Typical day hours

167 A Typical night hours (including evening work)

168 A Typical day and night hours (work some days and some nights, depending on work shifts, job demands, schedules, or other job factors, for example, some policemen, some lorry drivers, some steel workers, etc.)

6.4. Job Demands

This section lists various types of demands that the job situation may impose upon you, usually requiring that you adapt to these in order to perform your work satisfactorily. Rate the following items in terms of the extent to which they are demanded in your job and also in terms of how important it is that you cope with them.

Code	Extent of Use (U)
0	Does not apply
1	Nominal/very infrequent
2	Occasional
3	Moderate
4	Considerable
5	Very substantial

Code	Importance to This Job (I)
0	Does not apply
1	Very minor
2	Low
3	Average
4	High
5	Extreme

169 U I Specified work pace (on continuous assembly line, etc.)

170 U I Repetitive activities (performance of the same physical or mental activities repeatedly, without interruption, for periods of time)

171 U I Cycled work activities (performance of a sequence or schedule of work activities which typically occur on a weekly, daily, or hourly basis and which typically allow you some freedom of action so long as you meet a schedule, for example, a postman or milkman making rounds on his route, a security guard patrolling his beat, etc.; do not include here activities more nearly described as repetitive activities in item 170 above)

172 U I Following set procedures (need to follow specific set procedures or routines in order to obtain satisfactory outcomes, for example, following check-list to inspect equipment or vehicles, following procedures for changing a tyre, performing specified laboratory tests, etc.)

173 U I Time pressure of situation (rush hours in a restaurant, urgent time deadlines, rush jobs, etc.)

174 U I Precision (need to be more than normally precise and accurate)

175 U I Attention to detail (need to give careful attention to various details of one's work, being sure that nothing is left undone)

27

Code	Extent of Use (U)
0	Does not apply
1	Nominal/very infrequent
2	Occasional
3	Moderate
4	Considerable
5	Very substantial

Code	Importance to This Job (I)
0	Does not apply
1	Very minor
2	Low
3	Average
4	High
5	Extreme

176 U__ I__ Recognition (need to identify, recognize, or "perceive" certain objects, events, processes, behaviour, etc., or aspects, features, or properties thereof; this item is primarily concerned with "recognition" of that which is "sensed" by vision, hearing, touch, etc.)

177 U__ I__ Vigilance: infrequent events (need to continually search for very infrequently occurring but relevant events in the job situation, for example, forest look-out watching for forest fires, worker observing instrument panel to identify infrequent change from "normal" etc.)

178 U__ I__ Vigilance: continually changing events (need to be continually aware of variations in a continually of frequently changing situation, for example, driving in traffic, controlling aircraft traffic, continually watching frequently changing dials and gauges, etc.)

179 U__ I__ Working under distractions (telephone calls, interruptions, disturbances from others, etc.)

180 U__ I__ Updating job knowledge (need to keep job knowledge current, being informed of new developments related to the job)

Code	Extent of Use (U)
0	Does not apply
1	Nominal/very infrequent
2	Occasional
3	Moderate
4	Considerable
5	Very substantial

181 U__ Special talent (using the code above indicate if your job requires some particularly unique talent or skill that is not covered by other items; typically this item would apply to jobs in which the very unique skill or characteristic of the worker is clearly dominant, as in certain entertainment activities; the item may be used however, in certain other kinds of situations, but only where there is some distinctly unique or special skill or talent involved)

Code	Amount of Time (T)
0	Does not apply (or is very incidental)
1	Under 1/10 of the time
2	Under 1/3 of the time
3	Between 1/3 and 2/3 of the time
4	Over 2/3 of the time
5	Almost continually

6.4. Job Demands (contd).

182 T__ Travel (indicate by code the proportion of time you are required to spend away from his home because of your job)

6.5. Responsibility

This section includes types of responsibility which may be associated with the decisions and actions of the worker. Indicate by code the degree of each type of responsibility involved in the job.

183 S__ Responsibility for the safety of others (indicate, using the code below, the degree to which the work requires diligence and effort to prevent injury to others; do not include hazards beyond the control of the individual concerned with the job)

Code	Degree of Responsibilty for the Safety of Others
0	Does not apply
1	Very limited (you have minimum responsibility for the safety of others, for example, you only use small hand tools, non hazardous machines, etc.)
2	Limited (you must exercise reasonable care in order to avoid injury to others, for example, operating lathes, punch presses, and other industrial machines, etc.)
3	Intermediate (you must be especially careful in order to avoid injury to others, for example, operating overhead cranes, driving vehicles, etc.)
4	Substantial (you must exercise constant and substantial care in order to prevent serious injury to others, for example, handling dangerous chemicals, using explosives, etc.)
5	Very substantial (the safety of others depends almost entirely on the correct action of the employee, for example, piloting an aircraft, performing major surgery, etc.)

184 S__ Responsibility for material assets (indicate, using the code below, the degree to which you are directly responsible for waste, damage, defects, or other loss of value to material assets or property, such as materials, products, parts, equipment, cash, livestock, etc., that might be caused by inattention or inadequate job performance).

(see overleaf for scale).

29.

Code	Degree of Responsibility for Material Assets
1	Very limited (for example, a few pounds)
2	Limited (for example, up to about twenty five pounds)
3	Intermediate (for example, a few hundred pounds)
4	Substantial (for example, one or two thousand pounds)
5	Very substantial (for example, more than two thousand pounds)

S___ General responsibility (indicate, using the code below, the degree of "general" responsibility associated with this job in terms of the extent to which you are "responsible" for any of a number of activities such as: accounting, analyzing, composing, developing, designing, evaluating, forecasting, initiating, planning, programming, proposing, scheduling, sponsoring, staffing, writing, etc., do not consider here responsibility for the safety of others or responsibility for assets as described in item 183 and 184).

Code	Degree of General Responsibility
1	Very limited
2	Limited
3	Intermediate
4	Substantial
5	Very substantial

6.6. Job Structure

186 S___ Job structure (indicate, using the code below, the amount of "structure" of the job that is, the degree to which the job activities are "pre-determined" for you by the nature of the work, the procedures, or other job characteristics; the more highly-structured jobs permit less deviation from pre-determined patterns, and little if any need for innovation, decision making, or adaptation to changing situations)

Code	Amount of Job Structure
1	Very high structure (virtually no deviation from a pre-determined job "routine", for example, routine assembly work, etc.)
2	Considerable structure (only moderate deviation from pre-determined work "routine" is possible, for example, bookkeeper, stock handler, etc.)
3	Intermediate structure (considerable change from a "routine" is possible; work activities change considerably from day to day or even from hour to hour, but usually within some reasonable and expected bounds, for example, carpenter, automobile mechanic, machinist, etc.)
4	Limited structure (relatively little routine work; the job is characterized by considerable opportunity for improving methods, devices, etc. and the necessity for making decisions, for example, store manager, industrial engineer, etc.)

(see overleaf for scale)

30.

Code	Amount of Job Structure (contd).
5	Very low structure (virtually no established "routine" of activities; the position involves a wide variety of problems which must be dealt with; the solution to these problems allows for unlimited resourcefulness and initiative, for example, research chemist, corporation vice-president, etc.)

6.7. Criticality of Position

187 S__ Criticality of position (indicate, using the code below, the degree to which inadequate job performance by you in this position is critical in terms of possible detrimental effects on the organizational operations, assets, reputation, etc. or on the public or other people; consider the duration of such consequences, whether immediate or long term, their seriousness, and the extent to which they have restricted or widespread effects).

Code	Degree of Criticality of Position
1	Very low
2	Low
3	Moderate
4	High
5	Very High

AMENDED RESPONSE SHEET

FOR

PAQ (FORM B)

(QUESTIONNAIRE FORMAT)

NAME OF JOB HOLDER --------------------------------

JOB TITLE/DESCRIPTION --------------------------------

ORGANISATION --------------------------------

DATE --------------------------------

TIME YOU HAVE BEEN DOING THIS JOB --------------------------------

PAQ RESPONSE SHEET

DRAW A CIRCLE ROUND ONE NUMBER FOR EACH SCALE

VISUAL SOURCES OF JOB INFORMATION	1	U	0 1 2 3 4 5	I	0 1 2 3 4 5		
	2	U	0 1 2 3 4 5	I	0 1 2 3 4 5		
	3	U	0 1 2 3 4 5	I	0 1 2 3 4 5		
	4	U	0 1 2 3 4 5	I	0 1 2 3 4 5		
	5	U	0 1 2 3 4 5	I	0 1 2 3 4 5		
	6	U	0 1 2 3 4 5	I	0 1 2 3 4 5		
	7	U	0 1 2 3 4 5	I	0 1 2 3 4 5		
	8	U	0 1 2 3 4 5	I	0 1 2 3 4 5		
	9	U	0 1 2 3 4 5	I	0 1 2 3 4 5		
	10	U	0 1 2 3 4 5	I	0 1 2 3 4 5		
	11	U	0 1 2 3 4 5	I	0 1 2 3 4 5		
	12	U	0 1 2 3 4 5	I	0 1 2 3 4 5		
	13	U	0 1 2 3 4 5	I	0 1 2 3 4 5		
	14	U	0 1 2 3 4 5	I	0 1 2 3 4 5		
NON-VISUAL SOURCES OF JOB INFORMATION	15	U	0 1 2 3 4 5	I	0 1 2 3 4 5		
	16	U	0 1 2 3 4 5	I	0 1 2 3 4 5		
	17	U	0 1 2 3 4 5	I	0 1 2 3 4 5		
	18	U	0 1 2 3 4 5	I	0 1 2 3 4 5		
	19	U	0 1 2 3 4 5	I	0 1 2 3 4 5		
SENSORY AND PERCEPTION PROCESSES	20					S	0 1 2 3 4 5
	21	U	0 1 2 3 4 5	I	0 1 2 3 4 5		
	22	U	0 1 2 3 4 5	I	0 1 2 3 4 5		
	23	U	0 1 2 3 4 5	I	0 1 2 3 4 5		
	24	U	0 1 2 3 4 5	I	0 1 2 3 4 5		
	25	U	0 1 2 3 4 5	I	0 1 2 3 4 5		
	26	U	0 1 2 3 4 5	I	0 1 2 3 4 5		
	27	U	0 1 2 3 4 5	I	0 1 2 3 4 5		
ESTIMATION ACTIVITIES	28	U	0 1 2 3 4 5	I	0 1 2 3 4 5		
	29	U	0 1 2 3 4 5	I	0 1 2 3 4 5		
	30	U	0 1 2 3 4 5	I	0 1 2 3 4 5		
	31	U	0 1 2 3 4 5	I	0 1 2 3 4 5		
	32	U	0 1 2 3 4 5	I	0 1 2 3 4 5		
	33	U	0 1 2 3 4 5	I	0 1 2 3 4 5		
	34	U	0 1 2 3 4 5	I	0 1 2 3 4 5		
	35	U	0 1 2 3 4 5	I	0 1 2 3 4 5		

DRAW A CIRCLE ROUND ONE NUMBER FOR EACH SCALE

MENTAL PROCESSES	36			S 1 2 3 4 5
	37			S 1 2 3 4 5
	38			S 0 1 2 3 4 5
	39	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	40	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	41	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	42	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	43	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	44	U 0 1 2 3 4 5	I 0 1 2 3 4 5	Specify ....
	45	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	46			S 0 1 2 3 4 5
	47			S 0 1 2 3 4 5
	48			S 0 1 2 3 4 5
	49			S 0 1 2 3 4 5
USE OF HAND-HELD TOOLS/DEVICES	50	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	51	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	52	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	53	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	54	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	55	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	56	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	57	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	58	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	59	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	60	U 0 1 2 3 4 5	I 0 1 2 3 4 5	Specify.................
Stationary Devices	61	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
USE OF CONTROL DEVICES	62	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	63	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	64	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	65	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	66	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	67	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	68	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	69	U 0 1 2 3 4 5	I 0 1 2 3 4 5	

DRAW A CIRCLE ROUND ONE NUMBER FOR EACH SCALE

OPERATION OF TRANSPORTATION/ MOBILE EQUIPMENT	70	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	71	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	72	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	73	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	74	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	75	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	76	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	77	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
MANUAL ACTIVITIES	78	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	79	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	80	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	81	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	82	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	83	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	84	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
ENTIRE BODY ACTIVITIES	85	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	86	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	87			S 1 2 3 4 5
BODY POSTURES	88			T 0 1 2 3 4 5
	89			T 0 1 2 3 4 5
	90			T 0 1 2 3 4 5
	91			T 0 1 2 3 4 5
	92			T 0 1 2 3 4 5
MANIPULATION/ COORDINATION ACTIVITIES	93	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	94	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	95	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	96	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	97	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	98	U 0 1 2 3 4 5	I 0 1 2 3 4 5	

DRAW A CIRCLE ROUND ONE NUMBER FOR EACH SCALE

COMMUNICATIONS	99	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	100	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	101	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	102	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	103	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	104	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	105	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	106	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	107	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	108	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	109	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	110	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	111	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	112			S 1 2 3 4 5
TYPE OF JOB REQUIRED PERSONAL CONTACT	113	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	114	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	115	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	116	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	117	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	118	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	119	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	120	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	121	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	122	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	123	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	124	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	125	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	126	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	127	U 0 1 2 3 4 5	I 0 1 2 3 4 5	Specify............
SUPERVISION AND COORDINATION	128			S 0 1 2 3 4 5
	129			S 0 1 2 3 4 5
	130			S 0 1 2 3 4 5
	131	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	132	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	133	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	134			S 1 2 3 4 5

DRAW A CIRCLE ROUND ONE NUMBER FOR EACH SCALE

PHYSICAL WORKING CONDITIONS	135			T 0 1 2 3 4 5
	136			T 0 1 2 3 4 5
	137			T 0 1 2 3 4 5
	138			T 0 1 2 3 4 5
	139			T 0 1 2 3 4 5
	140			T 0 1 2 3 4 5
	141			T 0 1 2 3 4 5
	142			T 0 1 2 3 4 5
	143			S 1 2 3 4 5
HAZARDS	144			P 0 1 2 3 4 5
	145			P 0 1 2 3 4 5
	146			P 0 1 2 3 4 5
	147			P 0 1 2 3 4 5
PERSONAL AND SOCIAL ASPECTS	148	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	149	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	150	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	151	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	152	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	153			S 1 2 3 4 5
APPAREL	154			A 0 1
	155			A 0 1
	156			A 0 1
	157			A 0 1
	158			A 0 1
	159			A 0 1
License	160			A 0 1
WORK SCHEDULE	161			A 0 1
	162			A 0 1
	163			A 0 1
	164			A 0 1
	165			A 0 1
	166			A 0 1
	167			A 0 1
	168			A 0 1

MARK '1' FOR ONE ITEM IN EACH BLOCK AND '0' FOR ALL OTHER ITEMS IN EACH BLOCK

DRAW A CIRCLE ROUND ONE NUMBER FOR EACH SCALE

JOB DEMANDS	169	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	170	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	171	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	172	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	173	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	174	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	175	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	176	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	177	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	178	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	179	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	180	U 0 1 2 3 4 5	I 0 1 2 3 4 5	
	181		Specify............	U 0 1 2 3 4 5
	182			T 0 1 2 3 4 5
RESPONSIBILITY AND MISCELLANEOUS	183			S 0 1 2 3 4 5
	184			S 0 1 2 3 4 5
	185			S 1 2 3 4 5
	186			S 1 2 3 4 5
	187			S 1 2 3 4 5

APPENDIX 2

The Divisional Job Dimensions of PAQ (Form B)
Source: Marquardt & McCormick (1974)

Alphanumeric Label	Verbal Title
J1-1	Perceptual Interpretation
J1-2	Evaluation of Sensory Input
J1-3	Visual Input from Devices/Materials
J1-4	Input from Representational Services
J1-5	Environment Awareness
J2-6	Decision Making
J2-7	Information Processing
J3-8	Manual/Control Activities
J3-9	Physical Co-ordination in Control/Related Activities
J3-10	General Body versus Sedentary Activity
J3-11	Manipulating/Handling Activities
J3-12	Adjusting/Operating Machines/Equipment
J3-13	Skilled Technical Activities
J4-14	Use of Miscellaneous Equipment/Devices
J4-15	Interchange of Ideas/Judgements/Related Information
J4-16	Supervisory/Staff Activities
J4-17	Public/Related Personal Contact
J4-18	Communicating Instructions/Directions/Related Job Information
J4-19	General Personal Contact
J5-20	Job-related Communications
J5-21	Potentially Stressful/Unpleasant Environment
J5-22	Potentially Hazardous Job Situations
J6-23	Personally Demanding Situations
J6-24	Attentive Job Demands
J6-25	Vigilant/Discriminating Work Activities
J6-26	Structured vs. Unstructured Work Activities
J6-27	Regular vs. Irregular Work Activities
J6-28	Work/Protective vs. Business Clothing
J6-29	Specific vs. Non-specific Clothing
J6-30	Continuity of Work Load

APPENDIX 3

The General Job Dimensions of PAQ (Form B)
Source: Marquardt & McCormick (1974)

Alphanumeric Label	Verbal Title
JG1	Decision/Communication/Social Responsibilities
JG2	Environmental Demands/General Body Control
JG3	Equipment/Machine Operation
JG4	Environmental Awareness
JG5	Manual Control Activities
JG6	Office/Related Activities
JG7	Evaluation of Sensory Input
JG8	General/Public-related Personal Contact
JG9	Use of Technical/Related Materials
JG10	General Physical Activities vs. Sedentary
JG11	Hazardous/Personally Demanding Situations
JG12	Attentive/Vigilant Work Activities
JG13	Routine/Controlled Work Activities
JG14	Supervision/Co-ordination

APPENDIX 4

The Calculations involved in the "Assembly" of Total Attribute Profiles using the Additive, Cross-Product and Critical Behaviour Methods

Additive Technique

The "weightings" of relevance of each of the 76 attributes for each PAQ item obtained by Mecham (1969) and Marquardt (1972) are summed across items rated as non-zero, ie. items which the rater considers to be part of the job.

This results in a profile of the total "relevance" scores for each of the 76 attributes. The maximum possible score obtainable for each attribute is calculable by summing the relevance weightings across all 182 items of the questionnaire.

The commensurate score for each attribute for each rater is the "percentage of maximum" level of relevance, ie. the actual total relevance score divided by the total possible relevance scores multiplied by 100.

Cross Product Technique

The weightings of relevance for each PAQ item are multiplied by the score assogned by the rater to that item. The sums of these cross-products are the intermediate profile of 76 attribute scores for the job according to that rater.

The maximum score attainable for each attribute is calculable by summing the relevance weightings of each item multiplied by the maximum score possible for that item.

The commensurate score for each attribute is the "percentage of maximum" level of relevance, ie. actual total relevance score divided by the total possible relevance score multiplied by 100.

Critical Behaviour Technique

The weightings of relevance for each PAQ item are multiplied by '5' if the item was scored '5' by the rater. The sum of these scores is calculated for each of the 76 attributes and expressed as a percentage of the total possible score for that attribute.

APPENDIX 5

List of 76 Attributes developed by Mecham (1969) and Marquardt (1972) for the Position Analysis Questionnaire

MECHAM (1969)

Attributes of an "aptitude" nature

1. Verbal comprehension: ability to understand the meaning of words and the ideas associated with them.

2. Word fluency: ability to rapidly produce words associated with a given word.

3. Oral communication: ability to communicate ideas with gestures or spoken or written words.

4. Numerical computation: ability to manipulate quantitative symbols rapidly and accurately, as in various arithmetic operations.

5. Arithmetic reasoning: ability to reason abstractly using quantitative concepts and symbols.

6. Convergent thinking: ability to select from possible alternative methods, the method of processing information that leads to the potentially best answer or solution to a problem.

7. Divergent thinking: ability to generate or conceive of new or innovative ideas or solutions to a problem.

8. Intelligence: the level of abstraction or symbolic complexity with which one can ultimately deal.

9. Long-term memory: ability to learn and store pertinent information and selectively to retrieve or recall, much later in time, that which is relevant to a specific context.

10. Short-term memory: ability to learn and store pertinent information and selectively to retrieve or recall, within a brief period of time, that which is relevant to a specific context.

11. Aesthetic judgement: ability to make sensitive evaluations of artistic quality in one or more of the following: music, style, painting, sculpture, photography, architecture, etc.

12. Visual form perception: ability to perceive pertinent detail or configuration in a complex visual stimulus.

13. Perceptual speed: ability to make rapid discriminations of visual detail.

14. Closure: ability to perceptually organise a chaotic or disorganised field into a single perception.

15. Movement detection: ability to detect physical movement of objects and to judge their direction.

16. Spatial visualization: ability to manipulate visual images in two or three dimensions mentally.

17. Near visual acuity: ability to perceive detail at normal reading distance.

18. Far visual acuity: ability to perceive detail at distances beyond reading distance.

19. Depth perception: ability to estimate depth of distances or objects (or to judge their physical relationships in space).

20. Color discrimination: ability to perceive similarities or differences in colors or in shades of the same color, or to identify certain colors.

21. Auditory acuity: ability to perceive relevant cues by sound.

22. Olfactory acuity: ability to perceive relevant cues by smell.

23. Gustatory acuity: ability to perceive relevant cues by taste.

24. Tactual acuity: ability to perceive relevant cues by touch.

25. Body orientation: ability to maintain body orientation with respect to balance and motion.

26. Kinesthesis: ability to sense position and movement of body members.

27. Finger dexterity: ability to manipulate small objects (with the fingers) rapidly and accurately.

28. Manual dexterity: ability to manipuate things with the hands.

29. Arm/hand positioning: ability to make precise, accurate movements of the hands and arms.

30. Arm/hand steadiness: ability to keep the hands and arms immobilized in a set position with minimal tremor.

31. Continuous muscular control: ability to exert continuous control over external devices through continual use of body limbs.

32. Rate of arm movement: ability to make gross, rapid arm movements.

33. Eye-hand co-ordination: ability to co-ordinate hand movements with visual stimuli.

34. Eye-hand-foot co-ordination: ability to move the hand and foot co-ordinately with each other in accordance with visual stimuli.

35. Simple reaction time: the period of time elapsing between the appearance of any stimulus and the initiation of an appropriate response.

36. Response integration: ability to rapidly perform various appropriate psychomotor responses in proper sequence.

37. Dynamic strength: ability to make repeated, rapid, flexing movements in which the rapid recovery from muscle strain is critical.

38. Static strength: ability to maintain a high level of muscular exertion for some minimum period of time.

39. Explosive strength: ability to expend a maximum amount of energy in one or a series of explosive or ballistic acts (as in throwing, pounding, etc.).

40. Rate control: ability to make continuous anticipatory motor adjustments, relative to change in speed and direction of continuous moving objects.

41. Mechanical ability: ability to determine the functional interrelationships of parts within a mechanical system.

Attributes of an interest or temperament nature, as characterized by different types of job situations to which people must adjust

42. Variety of duties: duties often characterized by frequent change.

43. Repetitive/short-cycle operations: operations carried out according to set procedures or sequences.

44. Dealing with things/objects: preference for situations involving activities which deal with things and objects rather than activities concerned with people or the communication of ideas.

45. Processes/machines/techniques: situations which are non-social in nature, being primarily concerned with methods and procedures often of a mechanical or chemical nature.

46. Scientific/technical activities: using technical methods or investigating natural phenomenon using scientific procedures.

47. Dealing with people: ie. personal contacts beyond giving and receiving instructions.

48. Social welfare: working with people for their presumed good.

49. Influencing people: influencing opinions, attitudes, or judgements about ideas or things.

50. Directing/controlling/planning: operations involving the activities of others, or processes with which others are involved.

51. Empathy: seeing things from another person's point of view.

52. Personal risk: risk of physical or mental illness or injury.

53. Conflicting/ambiguous information: ability to tolerate and critically evaluate information of an uncertain or opposing nature.

54. Pressure of time: working in situations where time is a critical factor for successful job performance.

55. Sensory alertness: alertness over extended periods of time.

56. Attainment of set standards: attainment of set limits, tolerances, or standards.

57. Working under specific instructions: ie. those that allow little or no room for independent action or judgement in working out job problems.

58. Working alone: working in physical isolation from others, although the activity may be integrated with that of others.

59. Separation from family/home: separation for extended periods of time.

60. Stage presence: speaking to or performing for an audience.

61. Prestige/esteem from others: working in situations resulting in high regard from others.

62. Tangible/physical end-products: working with material elements or parts which ultimately result in a physical product.

63. Sensory/judgemental criteria: arriving at generalizations, judgements, or decisions which require sensory discrimination or cognitive appraisal.

64. Measurable/verifiable criteria: arriving at generalizations, judgements, or decisions based on known or obtainable standards, characteristics, or dimensions.

65. Interpretation from personal viewpoint: interpretation of feelings, ideas, or facts in terms of personal viewpoint or values.

66. Susceptibility to fatigue: diminished ability to do work, either physical or mental, as a consequence of previous and recent work done.

67. Dealing with concepts/information: preference for situations that involve conceptual or informative ideas and the possible communication of these ideas to others.

68. Creative activities: preference for situations involving the finding of new solutions to a problem or new modes of artistic expression.

MARQUARDT (1972)

Additional attributes of an "aptitude" nature

69. Ideational fluency: the ability to produce a number of ideas concerning a given topic. This attribute is only concerned with the number of ideas produced and does not extend to the quality of those ideas.

70. Originality: the ability to produce unusual or clever responses related to a given topic or situation. This attribute is concerned with the degree of creativity of responses and does not deal with the number of responses made.

71. <u>Problem sensitivity</u>: the ability to <u>recognize</u> or <u>identify</u> the <u>existence</u> of problems. This attribute does not include any of the reasoning necessary for the solution of a problem.

72. <u>Spatial orientation</u>: the ability to maintain one's orientation with respect to objects in space or to comprehend the position of objects in space with respect to the observer's position.

73. <u>Selective attention</u>: the ability to perform a task in the presence of distracting stimulation or under monotonous conditions without significant loss in efficiency.

74. <u>Time sharing</u>: the ability to utilize information obtained by shifting between two or more channels of information. The information obtained from these sources is either integrated and used as a whole or retained and used separately.

75. <u>Stamina</u>: this ability involves the capacity to maintain physical activity over <u>prolonged</u> periods of time. It is concerned with the resistance of the cardio-vascular system to breakdown.

76. <u>Speed of limb movement</u>: this ability involves the speed with which discrete movements of the arms or legs can be made. The ability deals with the speed with which the movement can be carried out after it has been initiated; it is not concerned with the speed of initiation of the movement.

APPENDIX 6

The Manual for the Administration of the Position Analysis Questionnaire (Form B) with Supplementary Scales (Interview Format)

THE MANUAL FOR THE ADMINISTRATION

OF THE

POSITION ANALYSIS QUESTIONNAIRE

(FORM B)

WITH SUPPLEMENTARY SCALES

ADMINISTRATION OF THE QUESTIONNAIRE

1. Introductory Comments

The first important consideration in using the questionnaire is, that at this stage of its development, it should be used as a highly-structured interview form. The items should not simply be read to the respondent verbatim. Respondents will clearly vary in educational level and verbal comprehension, and are unlikely to understand which activities every question is seeking to quantify. Each item must be elaborated as appropriate.

2. The Selection of Respondents

In using the questionnaire one is seeking to obtain an accurate description and quantification of a job's demands. The criteria in the selection of respondents is therefore the degree of familiarity with the job. Generally, this would indicate actual job incumbents. In some circumstances (e.g. only one incumbent; only one incumbent who has been performing the job for a long enough time to be regarded as fully familiar with the job; or no actual incumbents since the job is in the process of design), other respondents would be indicated. Generally, they may be drawn from the personnel or training departments of the organisation, or may be the supervisors of the position. In all instances one must be satisfied as to their familiarity with the job.

The number of respondents required to describe a job is variable. In most instances two raters will suffice, but there are rarely any reasons, other than increased administration time, why larger numbers of respondents should not be used. There is a statistical criteria available, which can indicate the minimum number of required respondents. It is calculable from the ratings of the first two respondents. On no account should the same respondent rate more than one job.

3. The Interview Environment

The conditions generally advocated for the administration of psychometric instruments apply here. The interview should be conducted in a reasonably sized room. A desk top should be available for the analyst to complete the questionnaire. The room should be well-ventilated,adequately lit, and of minimum noise intensity. Each interview must be conducted individually and no other persons should be present. The formality of the occasion can, and should be reduced, if the furniture can be positioned so as to avoid the impression of an interrogation.

4. The Time Required to Conduct each Interview

By virtue of using the questionnaire in an interview format, respondents are encouraged to talk around each item. They offer information which can be useful for the true understanding of the job. The degree to which this is done is largely in the hands of the analyst. As a general rule, respondents should be made to feel that the interview is getting the real flavour of their job, and the analyst should feel that he is not being swamped in inappropriate detail. The majority of interviews take between $1\frac{1}{2}$ and 2 hours, but rigid timetabling should be avoided. In some instances, production demands mean that respondents are not readily available for a two-hour period. It is possible for the interview to be conducted reasonably over two or three sessions if each session is curtailed at an appropriate point, e.g. at the end of divisions in the questionnaire.

2.

5. Interview Guidelines

It should be borne in mind that many respondents are nervous in what appears to them to be a formal setting. Incumbents are likely to perceive the questionnaire as a test of themselves, and will be trying to "do well". The first task for the interviewer therefore, is to allay the respondent's fears and explain the purpose of the investigation. This may vary from organisation to organisation and no specific guidelines are possible. An experienced job analyst or personnel/training officer should be able to strike up a good rapport with respondents with little difficulty.

6. The Administration Procedure

(a) Informing the respondent about which job he is to describe

Having informed the respondent of the purpose of the job description he/she should be told exactly what he is to describe. Each respondent must have a clear understanding of whose job he is describing. If he is the incumbent, he should understand that he is describing his own job as a sample of that job title, and not as an endeavour on the interviewer's part for individual performance appraisal. If he is a training/personnel officer or supervisor, then he will be trying to describe someone else's job and this is a difficult task. He should not be trying to describe a particular incumbent, but rather an average of all of the incumbents of the position in question.

(b) The completion instructions

These may be upon the following lines:

> "This is a list of activities which you (they) may or may not perform in your (their) job. The questionnaire has been devised so that it can describe all jobs. There will be many questions which are clearly not involved in your (their) job, and others which very obviously are. I will have to ask you all the questions even though I may often have a pretty good idea that you (they) don't actually perform the activities."
>
> "For each item, I will give you some example jobs to help you understand what the activity in question means. The example jobs are ones which involve a great deal of that activity. Your (their) job may not involve exactly the same sort of content, but you should try to assess the degree of involvement you (they) have with each activity."
>
> "Most of the questions use two scales. I might ask you whether you (they) use a certain item in your (their) job. If you do, then I will ask you to tell me how much you use that item. I would like you to use the following scale."

3.

GIVE THE RESPONDENT THE CARD WITH THE FOLLOWING CONTENT UPON IT.

THE EXTENT OF USE SCALE

0 DOES NOT APPLY

1 VERY INFREQUENTLY

2 OCCASIONALLY

3 MODERATELY

4 CONSIDERABLY

5 VERY SUBSTANTIALLY

READ THROUGH THE CARD, POINTING OUT EACH CATEGORY. IF YOU FEEL THAT THE RESPONDENT SUFFERS A READING DIFFICULTY, THEN THE CARD SHOULD BE READ THROUGH AFTER ASKING EACH QUESTION.

Although it formalises the interview to some extent, it is necessary to have the respondent give the actual number or category label for each response, rather than guess the response category from the general drift of his reply. This is not to say that the interview should descend to the ranks of a verbal questionnaire. The respondent should be encouraged to chat around each question. This serves two purposes; firstly, it ensures that he is conceiving the question correctly, and secondly, it gives additional detail to the interviewer which may be worthy of note. If the respondent's reply is including activities which the question is not requesting (commonly activities covered by questions to come), or not thinking of ways in which he might actually be performing the activities, then he should be gently guided.

> "If you do use a particular item in your job, I would like you to tell me how important you feel that activity is. What I mean here is for you to tell me how important it is for a person to do that activity for him to be able to satisfactorily perform the job. A good way of thinking of this is to imagine what the consequences might be if one didn't perform that particular activity. When we are talking about the importance of an activity in your job, I would like you to use this scale."

GIVE THE RESPONDENT THE CARD WITH THE FOLLOWING CONTENT UPON IT.

THE IMPORTANCE SCALE

0 DOES NOT APPLY (OF NO IMPORTANCE)

1 VERY MINOR IMPORTANCE

2 LOW IMPORTANCE

3 AVERAGE IMPORTANCE

4 HIGH IMPORTANCE

5 EXTREME IMPORTANCE

4.

AGAIN; READ THROUGH THE CARD WITH THE RESPONDENT, POINTING OUT EACH CATEGORY.

"Most of the items we will talk about will use these scales, but there are a few which will use other ones. I will show you these scales when we come to those items which use them."

"The questionnaire is split into six sections. The first set of questions ask you about the things you have to look at, listen to, or touch for example. Basically then, things which you use as sources of information to do your job."

"The other sections deal with the things you have to think about when you do your job, and the things you physically have to do. Finally, we'll talk about the job environment and the conditions in which you have to work."

"O.K.? Let's start with the sources of information you need in your job."

THE ACTUAL QUESTIONNAIRE IS REPRODUCED OVERLEAF. THE ITEMS GIVE THE CORE CONTENT BUT WILL OFTEN REQUIRE EMBELLISHMENT. ENSURE THAT THE RESPONDENT IS SEATED COMFORTABLY AND HAS THE COPIES OF THE "EXTENT OF USE" AND "IMPORTANCE" SCALES IN FRONT OF HIM.

DIVISION 1

INFORMATION INPUT

5.

"FIRST OF ALL WE ARE GOING TO TALK ABOUT VISUAL SOURCES OF INFORMATION".

1. "In some jobs, people use Written Materials as sources of information. These might be books, reports, office notes, articles, job instructions and signs for example. Basically it is anything with words written upon it."

(a) "Can you tell me in which ways you use written materials as information in your job?"

NOTE

IN THE RESPONDENT'S REPLY HE MAY INCLUDE NUMERICAL WRITTEN MATERIALS. HE SHOULD BE TOLD THAT THIS ASPECT WILL BE COVERED BY THE NEXT QUESTION. HE MAY ALSO START TO INCLUDE HIS USE OF WRITTEN MATERIALS IN THE SENSE THAT HE WRITES REPORTS OR NOTES, ETC. AGAIN HE SHOULD BE TOLD THAT THESE ACTIVITIES WILL BE COVERED LATER. HE MUST CONFINE HIMSELF TO THOSE SITUATIONS IN WHICH HE HAS TO READ WRITTEN MATERIAL.

PROCEDURE

HAVING DETERMINED THAT THE RESPONDENT IS CONCEPTUALISING THE QUESTIONS CORRECTLY YOU MIGHT SAY:

"Yes, I see. So looking at the "Extent of Use" scale, how much would you say you use written materials of this kind?"......................................

REPLIES LIKE "QUITE A BIT" SHOULD NOT BE INTERPRETED BY THE ANALYST. HE MUST GET THE RESPONDENT TO GIVE ONE OF THE RESPONSE CATEGORY LABELS OR NUMBERS. IF RESPONSE CATEGORY LABELS ARE GIVEN BY THE RESPONDENT, ENSURE THAT YOU ENTER THE CORRECT NUMBER ON THE RESPONSE SHEET. ANY ADDITIONAL NOTES MAY BE TAKEN SEPARATELY.

(b) "O.K. So you use written materials (e.g. considerably). How important are they to the successful completion/performance of your job?" ....

PROCEDURE

AGAIN ENSURE THAT ACTUAL RESPONSE CATEGORIES ARE GIVEN. OBVIOUSLY, IF CERTAIN ITEMS OR ACTIVITIES DO NOT OCCUR IN THE JOB, THEN THE "IMPORTANCE" COMPONENT OF THE QUESTION CAN BE OMITTED.

6.

2. DRAWING UPON THE CONTENT OF THE REPLY TO THE FIRST QUESTION, ASK:

(a) "What about quantitative information such as graphs, accounts, specifications, tables of numbers? In which ways do you use materials with numbers written upon them?" To what extent? ....

Then: (if appropriate)

(b) "How important are quantitative materials to the successful performance of your job?" ....

NOTE

IT IS OFTEN USEFUL TO FIND OUT THE WAYS IN WHICH OMISSION OR FAILURE TO PERFORM AN ACTIVITY WOULD AFFECT THIS OR ANY OTHER JOBS IN THE ORGANISATION.

---

3. "The next item is concerned with Pictorial Materials. These might include things like drawings, blueprints, diagrams, maps, films and T.V. pictures."

(a) "In what ways do you use pictorial materials in your job?"..
"How much would you say that you used them?"
....

NOTE

IT IS EXTREMELY IMPORTANT TO REMEMBER THAT THE OBJECTS GIVEN ARE EXAMPLES OF A PARTICULAR CLASS OR TYPE OF OBJECT. THE LIST IS BY NO MEANS EXHAUSTIVE. ENSURE THAT THE RESPONDENT DOES APPRECIATE THIS, AND THAT IN GIVING HIS REPLY, HE IS NOT RESTRICTING HIS ASSESSMENT TO A PARTICULAR OBJECT IN THE LIST, WHILST HE IN FACT ALSO USES OTHER OBJECTS OF THE SAME CATEGORY. THIS OBSERVATION APPLIES TO NEARLY ALL OF THE ITEMS IN THE QUESTIONNAIRE.

Then:

(b) "How important is your use of pictorial materials to your being able to do your job?"
....

FOR THE REMAINDER OF THE QUESTIONNAIRE ONLY THE CORE CONTENT OF EACH ITEM WILL BE GIVEN HERE. ALL OF THE CONSIDERATIONS HIGHLIGHTED ABOVE STILL APPLY. ITEMS WHICH ARE PERHAPS MORE AMBIGUOUS ARE GIVEN SLIGHT CLARIFICATION.

7.

4. Patterns/related devices (template, stencils, patterns, etc.). Used as sources of information when observed during use; do not include here materials described in item 3 above.

How? When?
Use? ....
Importance? ....

5. Visual Displays (Any form of dial, gauge, signal light, e.g. radar scope, speedometer, clock, etc.).

How? When?
Use?...............................
Importance? ....

6. Measuring Devices (Rulers, calipers, tyre pressure gauges, scales, thickness gauges, pipettes, thermometers, protractors, etc.). Used to obtain visual information about physical measurements. Do not include here devices described in item 5 above.

How? When?
Use? ....
Importance? ....

NOTE

Many modern measurement devices use displays controlled electronically. This item is only intended for physical measurement appliances.

7. Mechanical Devices. (Any form of tool, equipment, machinery). Does the job involve any form of contact with such devices?

How? When?
Use? ....
Importance? ....

8. Materials in Process. (Here it means does he/she use the parts/materials/objects or the product which is being made, worked on, or otherwise processed, as a source of information to him?) Examples might be bread dough being mixed or kneaded, a workpiece being turned on a lathe, fabric being cut.

How? When?
Use? ....
Importance? ....

8.

9. Materials not in Process. Does he/she have any involvement with materials (things, objects) in storage, or inventory? Does he use such materials as a source of visual information to him?

How? When?
Use? ....
Importance? ....

10. Features of Nature. Observing such things as landscapes, fields, cloud formations, geological samples.

How? When?
Use? ....
Importance? ....

11. Man-made features of the environment. Observing buildings, dams, roads, bridges, etc.

How? When?
Use? ....
Importance? ....

12. Behaviour. Does he/she have to observe/watch what other people or animals are doing?

How? When?
Use? ....
Importance? ....

13. Events or circumstances. Does the worker have to keep an overall eye upon events to see how things are progressing? e.g. watching flow of traffic, movements of materials, airport control tower operations.

How? When?
Use? ....
Importance? ....

14. Art or decor. Does he/she use paintings, sculpture, window displays, interior decoration, etc. as sources of visual information?

How? When?
Use? ....
Importance? ....

9.

"ALL OF THE ABOVE QUESTIONS HAVE BEEN DEALING WITH THINGS YOU HAVE TO LOOK AT IN ORDER TO DO YOUR JOB. THE NEXT FEW QUESTIONS DEAL WITH OTHER THINGS WHICH YOU HAVE TO DO TO GET INFORMATION TO DO YOUR JOB. ALL OF THESE QUESTIONS DEAL WITH NON-VISUAL SOURCES OF JOB INFORMATION."

15. Verbal Sources. This will include any verbal instructions, orders, requests, conversations, etc. that he needs to do the job. Telephone conversations are included. Consider only verbal communication which is relevant to job performance.

How? When?
Use? ....
Importance? ....

---

16. Non-verbal Sounds. Any noises which he listens for, or has to attend to, e.g. engine sounds, sonar, whistles, horns, bells, musical instruments.

How? When?
Use? ....
Importance ? ....

---

17. Sense of Touch. Does he have to use his sense of touch to determine pressure, temperature, moisture, texture, heat, vibration or pain?

How? When?
Use? ....
Importance? ....

---

18. Sense of Smell. Does he have to use his sense of smell in order to perform his/her job, e.g. something burning (overheating). Do not include odours simply because they happen to exist in the work environment.

How? When?
Use? ....
Importance? ....

---

19. Sense of Taste. Does he/she have to use his/her sense of taste in the job? To determine, for example, bitterness, sweetness, sourness, saltiness of things?

How? When?
Use? ....
Importance? ....

10.

20. "The next item requires you to use a different scale. What the question does is to ask you to rate the Amount of Detail you have to see to adequately obtain job information from objects, events or features which are within your arm's reach".

"For example, some jobs could be done by blind workers because they do not require people to see at all. Other jobs require a person to see only very little detail, like for example, if you were moving boxes around; you wouldn't have to see too much detail to be able to do that."

THE AMOUNT OF DETAIL WHICH HAS TO BE SEEN

0 DOES NOT APPLY. (A worker could be blind and do the job).

1 VERY LITTLE DETAIL. (That required to move boxes, or open drawers for example).

2 LIMITED DETAIL. (That required to place objects in a bag, or to take a ticket from somebody).

3 MODERATE DETAIL (That required to hammer a nail or read a typed letter or most dials and gauges, for example).

4 CONSIDERABLE DETAIL (That required to read small legal print or to set ignition points for example).

5 EXTREME DETAIL (That required in diamond cutting, or watch repairing, for example).

"O.K. Which of the levels of detail does this job require you to see?" ....

"I see, when do you have to see that much detail?"
....

11.

21. "Right. We're back to the other two scales again now. The last question asked you about looking at things at about arm's length. What about looking at more distant things? i.e. Far visual differentiation. Here we mean things at say more than 10 feet."

How? When?
Use? ....
Importance? ....

---

22. Depth Perception. That is, judging the distance from yourself to an object, or the distances between objects. Obviously a crane driver has to do this a lot. Do you ever have to judge distances?

How? When?
Use? ....
Importance? ....

---

23. Colour Perception. i.e. Having to tell the differences between objects, etc. in terms of shades of colour.

How? When?
Use? ....
Importance? ....

---

24. Sound Pattern Recognition. Sometimes when you are familiar with the pattern of sounds something makes, you are able to tell if it is sounding wrong. For example, an engine when it is not functioning correctly. Other examples might be heart beats or morse code. Do you ever use the patterns of sounds to tell you anything?

How? When?
Use? ....
Importance? ....

---

25. Sound Differentiation. We have talked about the patterns that sounds can have. What about having to tell the differences in sounds in terms of their loudness, pitch or tone. A piano tuner has to do this to a very substantial extent for example.

How? When?
Use? ....
Importance? ....

12.

26. Body Movement Sensing. Is it ever necessary for you to sense or recognise changes in the direction or speed at which your body is moving without being able to sense this by sight or hearing? An example would be if you were flying an aircraft.

How? When?
Use?....................................
Importance?............................

---

27. Body Balance. Are there ever occasions in this job when sensing the position and balance of your body is critical to job performance? For example if you were climbing high poles, working on steep roofs, or walking on slippery floors this would be the case.

How? When?
Use? ....
Importance? ....

"THE NEXT FEW QUESTIONS ARE CONCERNED WITH THINGS THAT YOU MIGHT HAVE TO JUDGE OR ESTIMATE IN YOUR JOB. THIS BASICALLY MEANS THINGS THAT YOU HAVE TO MONITOR WITHOUT DIRECTLY MEASURING."

28. The first one of these questions is about estimating the speed of a moving part. This might be the revolutions per minute of motors for example, or the speed at which a lathe is turning. You might, for example, look at a certain moving part and say to yourself that it is moving more quickly or slowly than it should.

How? When?
Use? ....
Importance? ....

NOTE

IT IS DIFFICULT FOR RESPONDENT'S TO CLEARLY DIFFERENTIATE BETWEEN JUDGING THE SPEED OF A MOVING PART AS OPPOSED TO THAT OF A MOVING OBJECT WHICH IS THE NEXT QUESTION. SOME GUIDANCE (ELABORATION) MAY BE NECESSARY.

---

29. Estimating the speed of moving objects. This is judging the speed of moving objects or materials relative to a fixed point or to other moving objects. For example, the speed of vehicles, materials on a conveyor belt, or the flow of liquids in transparent pipes.

How? When?
Use? ....
Importance? ....

13.

30. Estimating Speed of Processes. i.e. Judging the speed of an on-going process or a series of events while they are taking place, e.g. chemical reactions, assembly operations, timing of food preparation in a cafeteria. Basically is the process taking too long, or is it going too quickly?

How? When?
Use? ....
Importance? ....

---

31. Judging condition/quality. Basically estimating the condition, quality and value of objects, e.g. antique dealer, appraiser, jeweller, used car dealer.

How? When?
Use? ....
Importance? ....

NOTE

THIS QUESTION IS COMMONLY CONFUSED WITH THE NEXT QUESTION WHICH DEALS WITH INSPECTION. THIS QUESTION IS PRIMARILY CONCERNED WITH THE PLACING OF VALUE UPON OBJECTS.

---

32. Inspecting. The activity of inspecting products, objects, materials, equipment, etc., either one's own workmanship or others, in terms of established standards, e.g. identifying defects, classifying by grade, etc.

How? When?
Use? ....
Importance? ....

---

33. Estimating Quantity. Here one would be judging (not directly measuring) the weight, number or volume of something, or something which will be required. e.g. the weight of a beam, a volume of liquid.

How? When?
Use? ....
Importance? ....

---

34. Estimating Size. Here one would be estimating the dimensions of objects (without directly measuring them). This would include judging the length and thickness of objects, e.g. something might be too long, too short, too thick, too thin for what is required.

How? When?
Use? ....
Importance? ....

14.

35. Estimating Time. Here one might be required to estimate the time needed for past or future events or work activities, e.g. judging the amount of time to make a delivery; estimating the time to service a worn machine part or piece of equipment.

How? When?
Use? ....
Importance? ....

DIVISION 2

MENTAL PROCESSES

15.

"THE GROUP OF QUESTIONS WE HAVE JUST COVERED WERE ABOUT THE SORTS OF THINGS YOU HAVE TO LOOK AT OR LISTEN TO IN YOUR JOB. THE NEXT SECTION DEALS WITH THE TYPES OF DECISIONS YOU HAVE TO MAKE, AND THE SORT OF THINGS YOU HAVE TO THINK ABOUT TO DO YOUR JOB."

---

36. "The first question is about decision making itself. What it does is to list decisions in an order. Decisions can vary in terms of the number and complexity of factors that have to be taken into account; the number of alternative decisions that could be made; and the consequence and importance of the decisions. You have to rate the level of decision typically involved in this job.

The range of decisions is given below:

Code	Level of Decision
1	Decisions such as those selecting parts in routine assembly; shelving items in a warehouse; pasting labels on cartons; tending automatic machines, etc.
2	Decisions such as those in operating a wood plane; dispatching a taxi; or lubricating a car.
3	Decisions such as those in setting-up machine tools; diagnosing faults; ordering supplies several months in advance.
4	Decisions such as those in determining production quotas; or personnel decisions such as promoting and hiring.
5	Decisions such as those in approving a company's annual budget; recommending major surgery; or selecting the location for a new factory.

NOTE

THIS QUESTION IS ONE WHICH MANY RESPONDENTS MAY FIND DIFFICULT TO CONCEPTUALISE. IT MAY BE NECESSARY TO EXPLAIN HOW THE DIFFERENT LEVELS INVOLVE INCREASINGLY MORE CONSIDERATION OF FACTOR NUMBER AND COMPLEXITY, NUMBER OF ALTERNATIVES, AND IMPORTANCE OR CONSEQUENCES OF DECISIONS.

16.

37. "This question is similar to the one we've just covered, but this time I would like you to rate the level of reasoning that the job requires for you to apply your knowledge, experience and judgement to problems."

"Again the range is put into levels of the type of thinking people have to do in their jobs".

"Here is the scale".

Code	Level of Reasoning Required in Problem Solving
1	Where a person is required to use commonsense to carry out simple, relatively uninvolved instructions. For example, a hod carrier is told to carry something from here to there.
2	Where a person has to use some training and experience to select from a small number of possible answers, the best action or procedure. For example, a postman or a keypunch operator.
3	Where a person has to use some sort of principle to solve a problem. That is where for example a person might know that something overheating would have an effect, and he has to reason out the best remedy. Jobs which involve this type of reasoning might be carpenter, farmer or draftsman.
4	Where a person has to use logic and scientific thinking to define a problem, collect information, establish facts, and draw conclusions from the evidence he has gathered. Examples might be a personnel manager, or manager of a department store.
5	Where a person has to use principles of logical and scientific thinking to solve a very wide range of intellectual and practical problems. Examples might be nuclear engineer, research chemist or a very large company's director.

NOTE

AGAIN A DIFFICULT QUESTION. YOU MAY HAVE TO AMPLIFY THE TERMS PRINCIPLE, LOGIC, SCIENTIFIC THINKING, ETC.

17.

38. "This next question also uses a special scale. This time you rate the amount of planning/scheduling people are required to do in this job, either of their own or other people's activities".

"This is the scale:-"

Code	Amount of Planning
0	People have no opportunity to plan activities. All their activities are determined for them.
1	People have a very limited opportunity to plan their activities, e.g. an assembly line worker, or a ticket seller at a cinema.
2	People are required to do some planning but not a great deal. For example a milkman might have to plan the best way to do his round.
3	People are required to do a moderate amount of planning of their own or even other people's activities. For example, a carpenter has to plan the best way to build a structure. He has to think it out well in advance. A taxi dispatcher has to plan the best ways of getting taxis to callers.
4	People are required to do a fairly large amount of planning. For example, a foreman has to plan the activity of all of his subordinates; or a teacher who has to plan his lessons. This level of planning is more distant.
5	People are required to do a substantial amount of planning. For example, a department store manager who has to plan the arrival of stocks, which staff will be working, etc. Or, an architect. This type of planning is very complex, i.e. for things which are a long way in the future.

18.

"THE NEXT FEW QUESTIONS USE THE "EXTENT OF USE" AND "IMPORTANCE" SCALES AGAIN."

"THEY DEAL WITH THE WAYS YOUR MIND HAS TO ORGANISE INFORMATION".

---

39. "First of all combining information. This is where you have to relate information from two or more sources in your mind to reach a fact. Like a judge does when he is trying a case. One thing gives you information. Something else gives you some more. You have to put these two facts together in your mind to decide what to do."

"What sort of things require this type of thinking in this job?"

"How much would you say then, that it is required?" ....

"How important to being able to do the job is this type of thinking?" ....

---

40. "This question is about analysing information. This is where you have to think about all of the information coming to you and see if there is a trend in it. For example, something may be consistently happening which shouldn't and by analysing the information you will find it out. Examples might be therefore things like diagnosing a fault, or interpreting and finding the trend in financial reports of some kind."

"In what ways to you have to analyse information?"

"How much then, of this type of thinking would you say is required in this job?" ....

"How important to being able to do the job would you say this type of thinking is?" ....

---

41. "Another way in which the mind can deal with the information is to compile it. That is, to gather it and put it into some sort of order or form. For example a person might have to decide which products were satisfactory and which were not. Or a person might have to file letters on the basis of those needing immediate action or later attention".

"In what ways do you have to put information in your mind into some sort of order in this job?"

"How much of this type of thinking would you say was required in this job?" ....

"How important is it to being able to do this job that a person does this type of thinking?" ....

19.

42. "What about coding or decoding information? Obvious examples are things like translating a foreign language or reading shorthand. Many things now use symbols on them. A person in fact has to decode these in his mind to know what the thing is. For example, start and stop buttons can simply have symbols on them.

"Do you have to decode information in any way in this job? In what ways?"

"How much then, on the "extent of use" scale would you say you had to do this?" ....

"How important to being able to do the job is it that this is done?" ....

---

43. "Do you ever have to transcribe information? That is enter things into a record book or card. Like, for example, entering meter readings into a log book?"

"Do you have to do this?"

"What sort of things do you have to transcribe?"

"To what extent do you have to do this?"...........

"How important to this job is it that you do this?" ....

---

44. "Are there any other ways in which you have to process information in your mind?"

"What are they?"

NOTE

IT IS DIFFICULT TO SEE WHAT TYPES OF THINKING ARE MISSING FROM THOSE WHICH HAVE BEEN COVERED. IT IS IMPORTANT THAT YOU EXPLAIN TO WHICH CATEGORIES THINGS THE RESPONDENT MAY SUGGEST HERE, BELONG. IF THEY BELONG TO A CATEGORY ALREADY COVERED, THEN IT MAY BE THAT HIS PREVIOUS RESPONSE WILL REQUIRE AMENDMENT. TELL HIM WHAT HE PUT FOR THAT CATEGORY, AND ASK HIM IF HE NOW WANTS TO CHANGE IT.

"THE LAST FIVE QUESTIONS IN THIS SECTION DEAL WITH THE WAYS AND EXTENT TO WHICH THIS JOB REQUIRES PEOPLE TO USE LEARNED INFORMATION"

20.

45. "First of all short-term memory. Here it means that you have to look at something or perhaps listen to something for example, and hold it in your mind for a short time before doing something about it. For example, a waitress has to remember your order for maybe only 30 seconds or a minute, but it is important that she does. Other examples might be a telephone operator, or a job where you have to remember a meter reading whilst you go round a machine to check something else."

"In what situations in this job does a person have to use his short-term memory?"

"To what extent then would you say people have to use it?" ....

"How important is it that the person remembers the information for this short time?" ....

---

46. "What would you say that the level of education is that is typically required by persons selected to do this job? Not so much what your own education was, but that which is generally required."

"The question uses the following scale:-"

0	Little or no school education is required.
1	Leaving school but with no examinations taken.
2	Leaving school with CSE's or 'O' levels.
3	Some sort of college education
4	University degree (requiring 3 years or more to complete)
5	An Advanced Degree

---

47. "Is there any previous job-experience necessary before a person can do this job? By this I mean is it necessary for a person to have worked in another related lower level job or other related job before he could enter this job? Or could a person enter this job after leaving school, college or university straight away?"

DEPENDING ON THE RESPONDENT'S ANSWER, YOU MAY THEN NEED TO ASK:

"How much previous job experience? Would you say:-"

21.

Code	Job-Related Experience
0	Does not apply (no experience necessary)
1	Less than 1 month
2	Over 1 month and up to 12 months
3	Over 1 year and up to 3 years
4	Over 3 years and up to 5 years
5	Over 5 years

NOTE

NOT TO INCLUDE EDUCATION OR TRAINING ON THE JOB.

---

48. "Could you tell me the length of training generally required for people who have had no prior job experience to learn to perform adequately in this job?"

NOTE

A COMMON AND NATURAL RESPONSE IS TO ASK WHAT YOU MEAN BY "ADEQUATELY". SECONDLY TO SAY THAT SOME PEOPLE LEARN MORE QUICKLY THAN OTHERS. THIRDLY THAT ONE IS ALWAYS LEARNING ON THIS JOB. IT IS IMPORTANT THAT YOU EXPLAIN THAT YOU MEAN BASIC PROFICIENCY ON AVERAGE FOR JOB ENTRANTS.

THE RESPONSE SHOULD NOT INCLUDE PERIODS OF EDUCATION (QU.46).

Code	Training
0	Does not apply or very limited (no more than 1 day's training required).
1	Over 1 day and up to 6 weeks.
2	Over 6 weeks and up to 6 months.
3	Over 6 months and up to 1 year.
4	Over 1 year and up to 3 years
5	Over 3 years.

22.

49. "The final question in this section deals with <u>mathematics</u>". "Can you tell me, the <u>highest level</u> of mathematics required in this job?"

Code	Level of Mathematics
0	Does not apply
1	Counting, adding or subtracting 2 digit numbers or less
2	Adding, subtracting, multiplying, dividing, numbers of 3 digits or more.
3	Calculations using concepts such as fractions, decimals, percentages, etc.
4	Procedures involving algebra, geometry, statistical concepts.
5	Procedures which involve advanced mathematical theory, e.g. calculus, factor analysis, probability theory.

DIVISION 3

WORK OUTPUT

23.

"THE NEXT GROUP OF QUESTIONS DEALS WITH THE THINGS THAT YOU PHYSICALLY HAVE TO DO IN THIS JOB."

"AGAIN WE ARE MOSTLY USING THE "EXTENT OF USE" AND "IMPORTANCE" SCALES".

"FIRST OF ALL THEN I SHALL ASK YOU WHAT TYPES OF TOOLS, INSTRUMENTS OR DEVICES YOU HAVE TO USE IN THE JOB."

---

50. Precision tools/instruments (that is, tools or instruments powered by the user to perform very accurate or precise operations, for example, the use of engraver's tools, watchmaker's tools, surgical instruments, etc.)

Which? To do what?
Use? ....
Importance? ....

---

51. Non-precision tools/instruments (tools or instruments powered by the user to perform operations not requiring great accuracy or precision, for example, hammers, wrenches, trowels, knives, scissors, chisels, putty knives, strainers, hand grease guns, etc.; do not include long-handle tools here).

Which? To do what?
Use? ....
Importance? ....

---

52. Long-handle tools (hoes, rakes, shovels, picks, axes, brooms, mops, etc.)

Which? To do what?
Use? ....
Importance? ....

---

53. Handling devices/tools (tongs, ladles, dippers, forceps, etc., used for moving or handling objects and materials; do not include here protective gear such as asbestos gloves, etc.).

Which? To do what?
Use? ....
Importance? ....

24.

54. Precision tools/instruments (hand-held powered tools or instruments used to perform operations requiring great accuracy or precision, such as dentist drills, soldering irons, welding equipment, saws, etc. used for especially accurate or fine work).

Which? To do what?
Use? ....
Importance? ....

---

55. Non-precision tools/instruments (hand-held, energy-powered tools or instruments used to perform operations not requiring great accuracy or precision, for example, ordinary power saws, drills, sanders, clippers, hedge trimmers, etc., and related devices such as electrical soldering irons, spray guns or nozzles, welding equipment, etc.).

Which? To do what?
Use? ....
Importance? ....

---

56. Drawing and related devices (instruments or devices used in writing, sketching, illustrating, drafting, etc., for example, pens, pencils, drawing instruments, artist's brushes, drafting equipment, etc.; do not include measuring instruments here, see item 58).

Which? To do what?
Use? ....
Importance? ....

---

57. Applicators (brushes, rags, paint rollers, etc., which are hand-held and used in applying solutions, aterials, etc.; do not consider devices covered by items 50-55 above).

Which? To do what?
Use? ....
Importance? ....

---

58. Measuring devices (rules, measuring tapes, micrometers, calipers, protractors, squares, thickness gauges, levels, volume measuring devices, tyre gauges, etc.).

NOTE

THIS DOES NOT INCLUDE MECHANICAL, ELECTRICAL, OR ELECTRONIC DISPLAY MEASUREMENT DEVICES, e.g. ELECTRICAL RESISTANCE, TEMPERATURE MEASURES, etc.

Which? To do what?
Use? ....
Importance? ....

25.

59. Technical and related devices (e.g. cameras, stopwatches, calculators, hand-held geiger counters).

Which? To do what?
Use? ....
Importance? ....

60. Other hand tools and devices. Please specify.

Which? To do what?
Use? ....
Importance? ....

61. Stationary machines/equipment. Anything used to process, fabricate, or otherwise modify parts, objects, materials, etc. This question basically aims to assess the contact with any form of machine/equipment not covered above.

Which? To do what?
Use? ....
Importance? ....

"THE NEXT FEW QUESTIONS ARE CONCERNED WITH THE TYPE OF CONTROLS ON ANY EQUIPMENT THAT YOU USE IN THE JOB."

62. Activation controls (hand or foot operated devices used to start, stop or otherwise activate energy-using systems or mechanisms, for example, light switches, electric motor switches, ignition switches, etc.).

Which? To do what?
Use? ....
Importance? ....

63. Fixed setting controls (hand or foot operated devices with distinct positions, detents or definite settings, for example, TV selector switch, gear-shift, etc.).

Which? To do what?
Use? ....
Importance? ....

26.

64. Variable setting controls (hand or foot operated devices that can be set at the beginning of operation, or infrequently, at any position along a scale, for example, TV volume control, room thermostat; rheostat, etc.

Which? To do what?
Use? ....
Importance? ....

---

65. Keyboard devices (typewriters, adding machines, calculators, pianos, key-punch machines, etc.)

Which? To do what?
Use? ....
Importance? ....

"THERE ARE TWO DIFFERENT WAYS IN WHICH CONTROLS CAN BE USED. INTERMITTENTLY OR CONTINUOUSLY."

66. The hand controls that you use. Which ones do you use to make frequent but not continuous adjustments, eg. on a crane, bulldozer, helm of ship, etc.

To do what?
Use? ....
Importance? ....

---

67. Are there any foot controls that you use to make frequent but not continuous adjustments? e.g. car brakes.

Which? To do what?
Use? ....
Importance? ....

"NOW CONTROLS THAT YOU HAVE TO USE CONTINUOUSLY"

68. Hand-operated controls which are used continuously for adjusting to changing, or possible changing situations, e.g. steering wheel, controls on a "tracking" device.

Which? To do what?
Use? ....
Importance? ....

27.

69. Foot-operated controls which are used continuously for adjusting to situations, e.g. accelerator, etc.

Which? To do what?
Use? ....
Importance? ....

"THE NEXT FEW QUESTIONS DEAL WITH TRANSPORTATION AND MOBILE EQUIPMENT WHICH YOU MAY OR MAY NOT USE IN THIS JOB."

70. Man-powered vehicles (bicycles, rowboats, canoes, etc.)

Which? To do what?
Use? ....
Importance? ....

---

71. Powered highway/rail vehicles (vehicles intended primarily for highway or railroad transportation, for example, cars, trucks, buses, trains, etc.)

Which? To do what?
Use? ....
Importance? ....

---

72. Powered mobile equipment (movable vehicles not primarily intended for highway use, for example, warehouse trucks, fork lifts, self-propelled lawn mowers, road graders, tractors, combines, etc.)

Which? To do what?
Use? ....
Importance? ....

---

73. Powered water vehicles (ships, submarines, motor boats, etc.)

Which?
Use? ....
Importance? ....

---

74. Air/space vehicles (planes, helicopters, balloons, gliders, rocketships, etc.)

Which?
Use? ....
Importance? ....

28.

75. Man-moved mobile equipment (hand-pushed lawn mowers with or without powered blades, hand trucks, wheel barrows, floor polishers and buffers, etc.)

Which? To do what?
Use? ....
Importance? ....

76. Operating equipment, e.g. cranes, hoists, elevators, etc.

Which? To do what?
Use? ....
Importance? ....

77. Remote-controlled equipment, e.g. conveyor systems, etc.

Which? To do what?
Use? ....
Importance? ....

"THE NEXT FEW QUESTIONS DESCRIBE MANUAL ACTIVITIES IN WHICH TOOLS ARE NOT NECESSARILY INVOLVED"

78. Setting up/adjusting (adjusting, calibrating, aligning and/or setting up of machines or equipment, for example, setting up a lathe or drill press, adjusting an engine carburetor, adjusting, calibrating and aligning electric circuitry, etc.).

When?
Use? ....
Importance? ....

79. Manually modifying (using hands directly to form or otherwise modify material or products, for example, kneading dough by hand, folding letters, massaging, etc.).

In what ways?
Use? ....
Importance? ....

29.

80. Material-controlling (Manually controlling or guiding materials being processed, for example, in operating sewing machine, jig saws, etc.)

When?
Use? ....
Importance? ....

81. Assembling/disassembling (either manually or with the use of hand tools putting parts of components together to form more complete items, or taking apart or disassembling items into their component parts).

When?
Use? ....
Importance? ....

82. Arranging/positioning (manually placing objects, materials, persons, animals, etc. in a specific position or arrangement, for example, arranging library books, window displays, stocking shelves, positioning patients for certain medical and dental procedures, etc.; do not include here arranging/positioning which is a part of the operations listed in items 78-81.)

When?
Use? ....
Importance? ....

83. Feeding/off-bearing (manually inserting, throwing, dumping or placing materials into or removing them from machines or processing equipment; this category is not to be used in describing operations in which the worker manually guides or controls the materials or parts during processing, as in item 80).

When?
Use? ....
Importance? ....

84. Physical handling (physically handling objects, materials, animals, human beings, etc., either manually or with nominal use of aiding devices, for example, in certain warehousing activities, loading/unloading conveyor belts, trucks, packaging, farming activities, hospital procedures, etc.; typically there is little requirement for careful positioning or arrangement of objects; include here relatively uninvolved handling operations not provided for in item 78-83).

Handling what?
Use? ....
Importance? ....

30.

85. Highly skilled body co-ordination (activities involving extensive, and often highly-learned co-ordination activities of the whole body, for example, athletics, dancing, etc.).

In what way?
Use? ....
Importance? ....

---

86. Balancing (maintaining body balance or equilibrium to prevent falling when standing, walking, running, crouching, etc., on narrow, slippery, steeply inclined or erratically moving surfaces, for example, walking on narrow elevated beam, working on steep roof, etc.).

When?
Use? ....
Importance? ....

---

87. The next question uses a special scale. It is concerned with the level of physical exertion during the average day on this job.

Can you tell me the general level of body activity required in this job, considering the frequency and effort required to push, pull, carry, lift, etc. objects?

Code	Level of Physical Exertion
1	Very light (occasionally walking or standing and/or occasionally moving light objects, materials, etc., e.g. secretary, draftsman, watchmaker, telephone operator, etc.).
2	Light (frequently walking or standing and/or frequently exerting force equivalent to lifting up to approximately 10 lbs. and/or occasionally exerting force equivalent to lifting about 20 lbs. for example, sales clerk, bank teller, etc.).
3	Moderate (frequently exerting forces equivalent to lifting up to approximately 25 lbs. and/or occasionally exerting forces equivalent to lifting up to approximately 50 lbs., for example, auto mechanic, coin vending machine serviceman, bus driver, etc.).
4	Heavy (frequently exerting forces equivalent to lifting up to approximately 50 lbs. and/or occasionally exerting forces equivalent to lifting up to approximately 100 lbs., for example, general labourer, millwright, bull-dozer operator, baggage porter, etc.).

P.T.O.

31.

Code	Level of Physical Exertion
5	Very heavy (frequently exerting forces equivalent to lifting over 50 lbs. and/or occasionally exerting forces over that required to lift 100 lbs., for example, hod carrier, quarry miner, etc.).

To which category do you feel that this job belongs? ....

"THE NEXT FEW QUESTIONS USE THIS SCALE".
GIVE THE RESPONDENT THE CARD WITH THE FOLLOWING CONTENT UPON IT.

Code	Amount of Time
0	Does not apply (or is very incidental)
1	Under 1/10 of the time
2	Under 1/3 of the time
3	Between 1/3 and 2/3 of the time
4	Over 2/3 of the time
5	Almost continually

READ THROUGH THE CARD WITH THE RESPONDENT POINTING TO EACH CATEGORY

"O.K. Can you tell me the proportion of working time that you have to spend:"

88. Sitting

Response ....

89. Standing (not including walking)

Response ....

90. Walking/running

Response ....

91. Climbing (e.g. house painter, telephone lineman, etc.)
NOTE. NOT TO INCLUDE "CLIMBING" STAIRS

Response ....

92. Kneeling/stooping (i.e. any activity in which your body is uncomfortable or awkward.

Response ....

32.

"THE LAST FEW QUESTIONS IN THIS SECTION ARE ABOUT THE MANIPULATION OR CO-ORDINATION ACTIVITIES INVOLVED IN THIS JOB."

"THEY USES THE "EXTENT OF USE" AND "IMPORTANCE" SCALES AGAIN".

93. Finger manipulation (making careful finger movements in various types of activities, for example, fine assembly, use of precision tools, repairing watches, use of writing and drawing instruments, operating keyboard devices, etc.; usually the hand and arm are not involved to any great extent).

To do what?
Use? ....
Importance? ....

---

94. Hand-arm manipulation (the manual control or manipulation of objects through hand and/or arm movements, which may or may not require continuous visual control, for example, repairing automobiles, packaging products, etc.).

Use? ....
Importance? ....

---

95. Hand-arm steadiness (maintaining a uniform, controlled hand-arm posture or movement, for example, using a welding torch, performing surgery, using a screwdriver).

Use? ....
Importance? ....

---

96. Eye-hand/foot co-ordination (the co-ordination of hand and/or foot movements where the movement must be co-ordinated with what is seen, for example, driving a vehicle, operating a sewing machine, etc.)

To do what?
Use? ....
Importance? ....

---

97. Limb movement without visual control (movement of body limbs from one position to another without the use of vision, for example, reaching for controls without looking, playing a musical instrument, touch typing, etc.

To do what?
Use? ....
Importance? ....

33.

98. <u>Hand-ear co-ordination</u> (the co-ordination of hand movements with sounds of instructions that are heard, for example, tuning radio receivers, tuning musical instruments by ear, piloting aircraft by control tower instructions, etc.).

To do what?
Use? ....
Importance? ....

DIVISION FOUR

RELATIONSHIPS WITH OTHER WORKERS

34.

"THIS SECTION IS CONCERNED WITH THE DEALINGS THAT YOU HAVE WITH OTHER PEOPLE IN DOING THIS JOB."

"AGAIN THE QUESTIONS ARE IN TERMS OF THE "EXTENT OF USE" AND "IMPORTANCE" OF VARIOUS ACTIVITIES."

99. Advising (dealing with individuals in order to counsel, and/or guide them with regard to problems that may be resolved by legal, financial, scientific, technical, clinical, spiritual, and/or other professional principles).

On which occasions?
Use? ....
Importance? ....

---

100. Negotiating (dealing with others in order to reach an agreement or solution, for example, diplomatic relations, terms of a sale).

When?
Use? ....
Importance? ....

---

101. Persuading (dealing with others in order to influence them toward some action or point of view, for example, selling, political campaigning, etc.).

When?
Use? ....
Importance? ....

---

102. Instructing (the teaching of knowledge or skills, either in an informal or formal manner, to others, for example, a public school teacher, a journeyman teaching an apprentice, etc.).

Who? When?
Use? ....
Importance? ....

---

103. Interviewing (conducting interviews directed toward some specific objective, for example, interviewing job applicants, census taking, etc.).

When?
Use? ....
Importance? ....

35.

104. Routine information exchange (the giving and/or receiving of information of a routine or simple nature, for example, ticket agent, taxi-cab dispatcher, receptionist, etc.).

When?
Use? ....
Importance? ....

---

105. Non-routine information exchange (the giving and/or receiving of information of a non-routine or complex nature, for example, professional committee meetings, engineers discussing product design, etc.).

When?
Use? ....
Importance? ....

---

106. Public speaking (making speeches or formal presentations before relatively large audiences, for example, political addresses, radio/TV broadcasting, delivering a sermon, etc.).

When?
Use? ....
Importance? ....

"ALL OF THE ABOVE ACTIVITIES INVOLVED VERBALLY COMMUNICATING WITH PEOPLE."

"THE NEXT FEW ITEMS ARE ABOUT OTHER WAYS IN WHICH PEOPLE IN JOBS COMMUNICATE AND INTERACT WITH EACH OTHER."

107. Writing (for example, writing or dictating letters, reports, etc., writing copy for ads., writing newspaper articles, etc.; do not include transcribing activities described in item 42).

What? To Whom?
Use? ....
Importance? ....

---

108. Signalling (communicating by some type of signal, for example, hand signals, semaphore, whistles, horns, bells, lights, etc.).

How? To whom?
Use? ....
Importance? ....

36.

109. <u>Code communications</u> (telegraph, cryptography, shorthand, etc.)

What type? To whom?
Use? ....
Importance? ....

---

110. <u>Entertaining</u> (performing to amuse or entertain others, for example, on stage, TV, nightclubs, etc.).

When?
Use? ....
Importance? ....

---

111. <u>Serving/catering</u> (attending to the needs of, or performing personal services for, others, for example, waiting on tables, hairdressing, etc).

When?
Use? ....
Importance? ....

---

112. The next question gets you to use a special scale. It concerns the <u>amount of personal contact</u> with other people that this job <u>requires.</u>

Would you say that the contact the job requires is:-

Code	Extent of Required Personal Contact
1	Very infrequent (almost no contact with others is required).
2	Infrequent (limited contact with others is required).
3	Occasional (moderate contact with others is required)
4	Frequent (considerable contact with others is required).
5	Very frequent (almost continual contact with others is required).

Which category? ....

37.

"THE QUESTIONS WE HAVE COVERED SO FAR IN THIS SECTION HAVE BEEN ABOUT THE AMOUNT OF CONTACT WITH OTHER PEOPLE THAT THIS JOB REQUIRES."

"THE NEXT FEW ITEMS ASK YOU ABOUT THE TYPES OF PEOPLE WITH WHICH YOU REQUIRE CONTACT".

"AGAIN THEY USE THE "EXTENT OF USE" AND "IMPORTANCE" SCALES."

NOTE. IMPORTANCE AGAIN MEANS "IMPORTANCE TO THE SUCCESSFUL COMPLETION OF THE JOB", i.e. WHAT WOULD THE CONSEQUENCES BE IF CONTACT WAS NOT MADE?

N.B. NOT SOCIAL CONTACT.

113. Executives/officials (company chairman, government administrators, plant superintendents, etc.)

When? Why?
Use? ....
Importance? ....

---

114. Middle management/staff personnel

When? Why?
Use? ....
Importance? ....

---

115. Supervisors (those personnel who have immediate responsibility for a work group, for example, foreman, office managers, etc.).

When?
Use? ....
Importance? ....

---

116. Professional personnel (doctors, lawyers, scientists, engineers, professors, teachers, consultants, etc.).

When? Why?
Use? ....
Importance? ....

---

117. Semi-professional personnel (technicians, draftsmen, designers, photographers, surveyors, and other personnel who are engaged in activities requiring fairly extensive education or practical experience but which typically involve a more restricted area of operation than that of professional personnel).

When? Why?
Use? ....
Importance? ....

---

118. Clerical personnel (personnel engaged in office work, such as clerks, book keepers, receptionists, etc.).

When? Why?
Use? ....
Importance? ....

---

119. Manual and service workers (personnel in skilled, semi-skilled unskilled, agricultural, fishing, forestry, service and related types of occupations, etc.)

When? Why?
Use? ....
Importance? ....

---

120. Sales Personnel

When? Why?
Use? ....
Importance? ....

---

121. Buyers (purchasing agents, not public customers)

When? Why?
Use? ....
Importance? ....

---

122. Public customers (as in shops, restaurants, etc.)

When?
Use? ....
Importance? ....

39.

123. The Public (not including customers or persons in other categories covered, but in the sense of the "general public", e.g. as do policemen, park attendants).

When?
Use? ....
Importance? ....

---

124. Students/trainees/apprentices

When? Why?
Use? ....
Importance? ....

---

125. Clients/patients/counselees (i.e. a "service" occupation where the service offered the person is professional and private).

When?
Use? ....
Importance? ....

---

126. Special interest groups (e.g. shareholders, property owners)

When? Why?
Use? ....
Importance? ....

---

127 Other individuals (i.e. those not included in the categories above).

Which? Why?
Specify ______________________________

Use? ....
Importance? ....

40.

"THE NEXT THREE ITEMS ARE CONCERNED WITH THE NUMBER AND TYPES OF PEOPLE THAT YOU MAY OR MAY NOT HAVE TO SUPERVISE".

"THEY USE SPECIAL SCALES".

128. Supervision of non-supervisory personnel (indicate, using the code below, the number of persons directly supervised who are actually involved in the production of goods and services and do not supervise others; this item would apply, for example to most "first line" supervisors, most foremen and section heads, service managers in garages, head butchers in meat departments of grocery stores, head pharmacists, plumbers with assistants, etc.).

Code	Number of Non-supervisory personnel supervised
0	Does not apply
1	1 or 2 workers
2	3 to 5 workers
3	6 to 8 workers
4	9 to 12 workers
5	13 or more workers

Response ....

129. Direction of supervisory personnel (indicate, using the code below, the number of supervisory personnel - those who have responsibility for the supervision or direction of others - who report directly to the person holding this position; this item would apply to many middle and upper managers, but would also apply to managers of many small businesses or other activities who delegate supervisory authority to others, etc.).

Code	Number of Supervisory Personnel directed
0	Does not apply (does not direct supervisors)
1	1 or 2 supervisory personnel
2	3 to 5 supervisory personnel
3	6 to 8 supervisory personnel
4	9 to 12 supervisory personnel
5	13 or more supervisory personnel

Response ....

4 L

130. Total number of personnel for whom responsible (indicate, using the code below, the total number of personnel for whom the person holding this job is either directly or indirectly responsible for example, the managing director of a company would be responsible for all company employees, the branch manager would be responsible for personnel in his branch, a foreman for personnel he supervises, a plumber for his assistant, etc.; use this item in addition to 128 and/or 129).

Code	Total number of personnel for whom responsible
0	Does not apply (not responsible for other personnel)
1	10 or fewer workers
2	11 to 50 workers
3	51 to 250 workers
4	251 to 750 workers
5	751 or more workers

Response ....

---

131. Do you ever have to supervise non-employees? Like a nurse supervises patients, for example.

Who? When?
Use? ....
Importance? ....

---

132. Do you have to co-ordinate the activities of other people in any way? That is, organise other people like a social director does, or the chairman of a committee.

Who? When?
Use? ....
Importance? ....

---

133. Does this job involve staff functions? i.e. advising, consulting or giving other types of assistance to line management personnel. Like a legal adviser does, or an administrative assistant.

When?
Use? ....
Importance? ....

42.

134. How would you describe the level of supervision that people in this job typically receive?

Would you describe it as:-

Code	Level of Supervision Received
1	Immediate supervision (receives close supervision relating to specific work activities, including assignments, methods, etc.; usually receives frequent surveillance over job activities).
2	General supervision (receives general supervision relating to work activities).
3	General direction (receives only very general guidance relating to job activities, primarily guidance with respect to general objectives; has rather broad latitude for determining methods, work scheduling, how to achieve objectives, etc., for example, first-line supervisors, lower management individuals, most staff personnel, people whose work is quite independent of others, etc.).
4	Nominal direction (receives only nominal direction or guidance in job, as in the case of a manager of an organisation or a major subdivision thereof, and is therefore subject only to very broad policy guidelines, for example, some research scientists who are giving virtually free reigh, many plant superintendents, etc.).
5	No supervision (this category is applicable to those personnel who function independently, for example, owner-managers of stores, independent physicians, independent consultants, etc.).

Response ....

DIVISION FIVE

JOB CONTEXT

43.

"THIS SECTION DEALS WITH THE VARIOUS CONDITIONS IN WHICH YOU HAVE TO WORK."

"THE FIRST FEW QUESTIONS USE THE "AMOUNT OF TIME" SCALE AGAIN."

ENSURE THAT THE RESPONDENT HAS THE CARD WITH THE FOLLOWING CONTENT ON IT.

Code	Amount of Time (T)
0	Does not apply (or is very incidental)
1	Under 1/10 of the time
2	Under 1/3 of the time
3	Between 1/3 and 2/3 of the time
4	Over 2/3 of the time
5	Almost continually

"FIRST OF ALL THEN WHAT PROPORTION OF WORKING TIME DO YOU HAVE TO SPEND?:-"

135. Out-of-door environment (susceptible to changing weather conditions).

Response ....

---

136. DO NOT CONSIDER CONDITIONS THAT ARE SIMPLY A FUNCTION OF THE WEATHER, e.g. HEAT IN SUMMER.

High temperature (conditions in which the worker might experience severe discomfort or heat stress, such as in boiler rooms, around furnaces, etc.; typically this would occur in a dry atmosphere at about 90^{o}F, and in a humid atmosphere at about 80^{o}F or 85^{o}F.)

When?
Response ....

---

137. Low temperature (conditions in which the worker is exposed to low temperatures which are definitely uncomfortable even though clothing appropriate for the conditions may be worn, such as in refrigerated rooms, etc.).

When?
Response ....

44.

138. <u>Air contamination</u> (dust, fumes,smoke, toxic conditions, disagreeable odours, etc.; consider here air contamination or pollution which is an irritating or undesirable aspect of the job).

When?
Response ....

---

139. <u>Vibration</u> (vibration of whole body or body limbs, for example, driving a tractor or truck, operating an air hammer, etc.).

When?
Response ....

---

140. <u>Improper illumination</u> (inadequate lighting, excessive glare).
This could arise where one has to work in the shadow of a machine for example.

When?
Response ....

---

141. <u>Dirty environment</u> (an environment in which the worker and/or his clothing easily becomes dirty, greasy, etc., for example, environments often associated with garages, foundries, coal mines, road construction, furnace cleaning, etc.).

When?
Response ....

---

142. <u>Awkward or confining work space</u> (conditions in which the body is cramped or uncomfortable).

When?
Response ....

---

143. The next question uses a special scale. How would you use the typical noise level to which people in this job are exposed:

Code	Noise Intensity
1	Very quiet (intensive care ward in hospital; greenhouse, photo lab., etc.).
2.	Quiet (many private offices, libraries, etc.)
3	Moderate (business office where typewriters are used, light automobile traffic, department store, etc.).
4	Loud (many factores, heavy traffic, machine shops, carpenter shops, etc.).
5	Very loud (close to jet engines, large earth-moving equipment, riveting, etc.).

Response ....

"THE NEXT FEW QUESTIONS ARE ABOUT THE POSSIBILITIES OF VARIOUS TYPES OF INJURY TO WORKERS IN THIS JOB".

"THEY USE THIS SCALE."

GIVE THE RESPONDENT THE CARD WITH THE FOLLOWING CONTENT ON IT.

Code	Possibility of Occurrence (P)
1	No possibility
2	Very limited
3	Limited
4	Moderate
4	Fairly high
5	High

144. First-aid cases (minor injuries or illnesses which typically result in a day or less of "lost" time and are usually remedied with first-aid procedures).

Possibility ....

---

145. Temporary disability (temporary injuries or illnesses which prevent the worker from performing his job from one full day up to extended periods of time but which do not result in permanent disability or impairment).

Possibility ....

46.

146. Permanent partial impairment (injuries or illnesses resulting in the amputation or permanent loss of use of any body member or part thereof, or permanent impairment of certain body functions).

Possibility ....

147. Permanent total disability/death (injuries or illnesses which totally disable the worker and permanently prevent his further gainful employment, for example, loss of life, sight, limbs, hands, radiation, sickness, etc.

Possibility ....

"THE LAST FEW QUESTIONS IN THIS SECTION ARE ABOUT VARIOUS PERSONAL AND SOCIAL ASPECTS OF THE JOB".

"THEY USE THE "EXTENT OF USE" AND"IMPORTANCE" SCALES AGAIN".

148. Civic obligations (because of the job the worker assumes, or is expected to assume, certain civic obligations or responsibilities).

When?
Use?............................
Importance? ....

149. Frustrating situations (job situations in which attempts to deal with problems or to achieve job objectives are obstructed or hindered, and may thus contribute to frustration on the part of the worker).

When?
Use? ....
Importance? ....

150. Strained personal contacts (dealing with individuals or groups in "unpleasant" or "strained" situations, for example, certain aspects of police work, certain types of negotiations, handling certain mental patients, etc.).

When?
Use? ....
Importance? ....

47.

151. Personal sacrifice (being willing to make certain personal sacrifices while being of service to other people or the objectives of an organisation, for example, policemen, ministry, social work, etc.; do not consider physical hazards here).

When?
Use? ....
Importance? ....

---

152. Interpersonal conflict situations (job situations in which there are virtually inevitable differences in objectives, opinions, or viewpoints between the worker and other persons or groups of persons, and which may "set the stage" for conflict, for example, persons involved in labour negotiations, supervisors who must enforce an unpopular policy, etc.)

When?
Use? ....
Importance? ....

---

153. This next question uses a special scale. It is about non-job-required social contact. That is, the opportunity that you have to stop and have a chat with somebody, for example. Do not include personal contact required to do the job because we have already covered that.

How would you describe the opportunity?

Code	Opportunity for Non-job Required Social Contact
1	Very infrequent (almost no opportunity)
2	Infrequent (limited opportunity)
3	Occasional (moderate opportunity)
4	Frequent (considerable opportunity)
5	Very frequent (almost continual opportunity)

Response ....

DIVISION SIX

OTHER JOB CHARACTERISTICS

48.

"THIS LAST SECTION DEALS WITH OTHER CHARACTERISTICS OF THE JOB SUCH AS THE CLOTHING YOU HAVE TO WEAR, THE WORKING HOURS AND THE LEVEL OF RESPONSIBILITY OF THE WORK".

"THE FIRST FEW QUESTIONS USE THIS SCALE"

GIVE THE RESPONDENT THE CARD WITH THE FOLLOWING CONTENT ON IT

Code	Applicability
0	Does not apply
1	Does apply

"IT SIMPLY MEANS THAT YOU HAVE TO TELL ME WHETHER OR NOT THE QUESTION IS TRUE FOR THIS JOB".

"FIRST OF ALL THEN, THE CLOTHING THAT PEOPLE ON THIS JOB HAVE TO WEAR".

154. Business suit or dress (expected to wear presentable clothing such as tie and jacket, street dress, etc., as customary in offices, stores, etc.).

Applicability ....

155. Specific uniform/apparel (nurse, doorman, bus driver, etc.

Applicability ....

156. Work clothing ("blue collar" apparel work in factories, construction work, etc.).

Applicability ....

157. Protective clothing or gear (clothing or equipment worn as a regular part of the job to protect the workers, for example, safety helmets, goggles, noise suppressors, safety shoes, insulated gloves or clothing, protective masks, etc.; this item does not apply if only work occasionally or rarely).

Applicability ....

158. Informal attire (sports wear, etc.)

Applicability ....

49

159. Apparel style optional

Applicability ....

160. Is any form of license or certificate required in this job?

Applicability ....

"THE NEXT FEW QUESTIONS ARE ABOUT THE HOURS THAT YOU HAVE TO WORK IN THE JOB".

"AGAIN THEY USE THE APPLICABILITY SCALE"

IS THE WORK?":-

161. Regular work

Applicability ....

OR

162. Irregular work (depending on weather, season, production changes, etc.).

Applicability ....

OR

163. Regular hours (same basic work schedule every week)

Applicability ....

OR

164. Variable shift work (work shift varies from time to time)

Applicability ....

165. Irregular hours (works variable or irregular hours, depending on requirements of employer, convenience of customers, etc., for example, insurance agents, etc.).

Applicability ....

50.

Do you work:-

166. Typical day hours

Applicability ....

OR

167. Typical night hours (including evening work)

Applicability ....

OR

168. Typical day and night hours(works some days and some nights, depending on work shifts, job demands, schedules, or other job factors, for example some policemen, some lorry drivers, some steel workers, etc.)

Applicability ....

"WHEN WORKERS ARE DOING A JOB CERTAIN DEMANDS ARE PLACED UPON THEM BY THE WORK".

"THE NEXT FEW QUESTIONS COVER A RANGE OF DEMANDS THAT THIS JOB MAY OR MAY NOT PLACE UPON PEOPLE WHO WORK IN IT".

"THE QUESTIONS USE THE "EXTENT OF USE" AND "IMPORTANCE" SCALES".

169. Does this job demand a specified work pace from the workers in it?

To what extent? ....
How important is this consideration? ....

170. Repetitive activities (performance of the same physical or mental activities repeatedly, without interruption, for periods of time).

To what extent? ....
How important is this consideration? ....

51.

171. Cycled work activities (performance of a sequence or schedule of work activities which typically occurs on a weekly, daily, or hourly basis and which typically allows the worker some freedom of action so long as he meets a schedule, for example, a postman or milkman making rounds on his route, a security guard patrolling his beat, etc.; do not include here activities more nearly described as repetitive activities in item 170 above).

To what extent? ....
How important is this consideration? ....

172. Following set procedures (need to follow specific set procedures or routines in order to obtain satisfactory outcomes, for example, following check-out list to inspect equipment or vehicles, following procedures for changing a tyre, performing specified laboratory tests, etc.).

To what extent? ....
How important is this consideration? ....

173. Time pressure of situation. The sense of urgency in doing the job, e.g. rush jobs, rush hours in a restaurant.

To what extent? ....
How important is this consideration? ....

174. Precision (the need to be more than normally precise)

To what extent? ....
How important is this consideration? ....

175. Attention to detail (the need to give careful attention to various details of one's work, being sure that nothing is left undone).

To what extent? ....
How important is this consideration? ....

176. Recognition (the need to identify, recognise, or "perceive" certain objects, events, processes, behaviour, etc., or aspects, features, or properties thereof; this item is primarily concerned with "recognition" of that which is "sensed" by vision, hearing, touch, etc.)

To what extent? ....
How important is this consideration? ....

52.

177. Vigilance: infrequent events (need to continually search for very infrequently occurring but relevant events in the job situation, for example, forest look-out watching for forest fires, worker observing instrument panel to identify infrequent change from "normal" etc.).

To what extent? ....
How important is this consideration? ....

---

178. Vigilance: continually changing events (the need to be continually aware of variations in a continually or frequently changing situation, for example, driving in traffic, controlling aircraft traffic,continually watching, frequently changing dials and gauges, etc.).

To what extent? ....
How important is this consideration? ....

---

179. Working under distractions (e.g. telephone calls, interruptions, disturbances from others).

To what extent? ....
How important is this consideration? ....

---

180. Updating job knowledge (the need to keep job knowledge current, being informed of new developments related to the job).

To what extent? ....
How important is this consideration? ....

---

181. If I asked you what special talents or abilities this job demands of people to do it, what sort of things would you say?

Specify ____________________
To what extent? ....
How important? ....

53.

182. Are you required to spend any time away from home because of this job?

Can you rate the proportion of time you are required to spend away from home?

Use this scale:

GIVE THE RESPONDENT THE SCALE WITH THE FOLLOWING CONTENT ON IT.

Code	Amount of Time
0	Does not apply (or is very incidental)
1	Under 1/10 of the time
2	Under 1/3 of the time
3	Between 1/3 and 2/3 of the time
4	Over 2/3 of the time
5	Almost continually

Response ....

"THE NEXT THREE QUESTIONS ARE CONCERNED WITH THE THINGS FOR WHICH YOU ARE RESPONSIBLE".

"THEY USE SPECIAL SCALES".

183. Responsibility for the safety of others (indicate, using the code below, the degree to which the work requires diligence and effort to prevent injury to others; do not include hazards beyond the control of the individual concerned with the job).

Code	Degree of Responsibility for the Safety of Others
0	Does not apply
1	Very limited (worker has minimum responsibility for the safety of others, for example, he may only use small hand tools, non-hazardous machines, etc.).
2	Limited (worker must exercise reasonable care in order to avoid injury to others, for example, operating lathes, punch presses, and other industrial machines, etc.).
3	Intermediate (worker must be especially careful in order to avoid injury to others, for example, operating overhead cranes, driving vehicles, etc.).
4	Substantial (worker must exercise constant and substantial care in order to prevent serious injury to others, for example, handling dangerous chemicals, using explosives, etc.).
5	Very substantial (the safety of others depends almost entirely on the correct action of the employee, for example, piloting an aircraft, performing major surgery, etc.).

Response ....

54.

184. Responsibility for material assets (indicate, using the code below, the degree to which the worker is directly responsible for waste, damage, defects, or other loss of value to material assets or property, such as materials, products, parts, equipment, cash, livestock, etc., that might be caused by inattention or inadequate job performance).

Code	Degree of Responsibility for Material Assets
1	Very limited (for example a few poinds)
2	Limited (for example, up to about twenty five pounds)
3	Intermediate (for example, a hundred pounds)
4	Substantial (for example, one or two thousand pounds)
5	Very substantial (for example, more than two thousand pounds).

Response ....

185. General responsibility (indicate, using the code below, the degree of "general" responsibility associated with this job in terms of the extent to which the worker is "responsible" for any of a number of activities such as: accounting, analysing, composing, developing, designing, evaluating, forecasting, initiating, planning, programming, proposing, scheduling, sponsoring, staffing, writing, etc.; do not consider here responsibility for the safety of others or responsibility for the assets as described in items 183 and 184).

Code	Degree of General Responsibility
1	Very limited
2	Limited
3	Intermediate
4	Substantial
5	Very substantial

Response ....

55.

186. The next question also uses a Special Scale. It is concerned with the degree to which the work in this job is structured.

How would you describe the job?

Job structure (indicate, using the code below, the amount of "structure" of the job, that is, the degree to which the job activities are "predetermined" for the worker by the nature of the work, the procedures, or other job characteristics; the more highly-structured jobs permit less deviation from pre-determined patterns, and little, if any, need for innovation, decision making, or adaptation to changing situations).

Code	Amount of Job Structure
1	Very high structure (virtually no deviation from a predetermined job "routine", for example, routine assembly work, etc.).
2	Considerable structure (only moderate deviation from predetermined work "routine" is possible, for example, bookkeeper, stock handler, etc.).
3	Intermediate structure (considerable change from a "routine" is possible; work activities change considerably from day to day or even from hour to hour, but usually within some reasonable and expected bounds, for example, carpenter, motor mechanic, machinist, etc.).
4	Limited structure (relatively little routine work; the job is characterised by considerable opportunity for improving methods, devices, etc. and the necessity for making decisions, for example, shop manager, industrial engineer, etc.)
5	Very low structure (virtually no established "routine" of activities; the position involves a wide variety of problems which must be dealt with; the solutions to these problems allows for unlimited resourcefulness and initiative, for example, research chemist, company managing director, university professor).

Response ....

56.

187. The last question also uses a special scale. It concerns the criticality of this job.

Criticality of position (indicate, using the code below, the degree to which inadequate job performance by the worker in this position is critical in terms of possible detrimental effects on the organisational operations, assets, reputation, etc. or on the public or other people; consider the duration of such consequences, whether immediate or long term, their seriousness, and the extent to which they have restricted or widespread effects).

Code	Degree of Criticality of Position
1	Very low
2	Low
3	Moderate
4	High
5	Very high

HAVING COMPLETED THE QUESTIONNAIRE, TAKE UP ANY POINTS WHICH YOU FEEL UNSURE ABOUT. ASK THE RESPONDENT HOW ADEQUATE HE FEELS THE QUESTIONS WERE IN GETTING TO THE ESSENTIAL NATURE OF THE JOB.

THANK HIM FOR HIS CO-OPERATION.

Amended Response Sheet For:

P A Q (Form B)

Name of Incumbent: ....

Job Title / Description: ....

Organisation: ....

Date: ....

Period of Employment - (1) Current Job: ....

(2) Previous Jobs: ....

....

Analyst	
Incumbent	
Supervisor	
Training/ Personnel Officer	

Code: ....

University of Aston Applied Psychology Department

5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80

1	2	3	4	5	6	7	8
9	10	11	12	13	14	15	16
17	18	19	20	21	22	23	24
25	26	27	28	29	30	31	32
33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48
49	50	51	52	53	54	55	56
57	58	59	60	61	62	63	64
65	66	67	68	69	70	71	72
73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88
89	90	91	92	93	94	95	96
97	98	99	100	101	102	103	104
105	106	107	108	109	110	111	112
113	114	115	116	117	118	119	120
121	122	123	124	125	126	127	128

P A Q (Form B) page 1

Code: ....

University of Aston Applied Psychology Department

5 10	15 20	25 30	35 40	45 50	55 60	65 70	75 80
129	130	131	132	133	134	135	136
137	138	139	140	141	142	143	144
145	146	147	148	149	150	151	152
153	154	155	156	157	158	159	160
161	162	163	164	165	166	167	168
169	170	171	172	173	174	175	176
177	178	179	180	181	182	183	184
185	186	187	999				

P A Q (Form B) page 2

Code: ....

University of Aston Applied Psychology Department

APPENDIX 7

The jobs analysed in the current research together with the number of respondents and inter-rater reliability figures for 6 derived scores from PAQ

Office of Population Census and Statistics Classification	Job Title	Number of Raters	Intraclass Reliability					
			Items	Divisional Job Dimensions	General Job Dimensions	Additive Attribute Profiles	Cross Product Attribute Profiles	Critical Behaviour Attribute Profiles
Professional	Careers Officer	5	.719	.913	.838	.978	.972	.683
	Teacher	5	.704	.884	.896	.967	.942	.692
Intermediate	Mechanical Technician	5	.731	.922	.955	.992	.778	.514
	Product Dev. Technician	3	.644	.866	.879	NC	NC	NC
Skilled	Electrician	3	.841	.940	.974	.996	.652	.347
	Setter	5	.654	.873	.933	.992	.703	.257
	Instrument Mechanic	5	.725	.925	.960	.993	.880	.430
	Setter/ Operator	2	.612	.834	.909	.992	.359	.288
	Secretary	5	.635	.865	.818	.973	.788	.070
	Maintenance Fitter	2	.799	.950	.988	.993	.886	.782
	Library Assistant	5	.662	.866	.901	.964	.659	.180
	Service Engineer	3	.582	.769	.779	NC	NC	NC
	Setter	3	.663	.765	.939	NC	NC	NC
	Motor Vehicle Fitter	5	.459	.755	.847	.991	.617	.270
	Kiln Burner	3	.859	.917	.942	NC	NC	NC
Semi-Skilled	Automatics Operator	2	.530	.785	.858	NC	NC	NC
	Filter-Press Operator	2	.807	.811	.840	NC	NC	NC
	Slurry Tester	2	.826	.923	.937	NC	NC	NC
Unskilled	Labourer	5	.444	.837	.922	.988	.749	.466

APPENDIX 8

The Performance Assessment Rating
for the Job of Setter

PERFORMANCE QUESTIONNAIRE

This questionnaire is designed as a performance measure for Trainee Setters, Intermediate Setters, Setters and Moulding Technicians. The response to each question takes the form of a rating scale

Very Poor	1	2	3	4	5	6	7	8	9	10	Very Good

Please answer all the questions by putting a tick at the appropriate point on the scale. Also on the first questionnaire you fill in would you please rate each question out of 10 in the space provided in terms of how important you consider it to be in the carrying out of the job. Your answers are completely confidential and will only be used in statistical analysis.

1/...

Rater's Name

....

Employee's Name

....

How good is he at :

Question Rating

1. Sensing and interpreting job information ....

Very Poor 1 2 3 4 5 6 7 8 9 10 Very Good

2. Evaluating information (e.g. checking a tool type and number) ....

Very Poor 1 2 3 4 5 6 7 8 9 10 Very Good

3. Using vision for interpreting job related information (e.g. Identifying that a tool is correct) ....

Very Poor 1 2 3 4 5 6 7 8 9 10 Very Good

4. Evaluating the input from representational sources (e.g. Setting cards) ....

Very Poor 1 2 3 4 5 6 7 8 9 10 Very Good

5. Making decisions from the analysis of information (e.g. Which tool type and number are needed) ....

Very Poor 1 2 3 4 5 6 7 8 9 10 Very Good

6. Processing job related information ....

Very Poor 1 2 3 4 5 6 7 8 9 10 Very Good

2/...

Question Rating

7. Controlling tools and equipment (primarily hand guided tools - powered or non-powered) ....

Very Poor 1 2 3 4 5 6 7 8 9 10 Very Good

8. Co-ordinating movements in the performance of control tasks (e.g. Transiting a tool to a job) ....

Very Poor 1 2 3 4 5 6 7 8 9 10 Very Good

9. Coping with the considerable amount of time spent standing and moving about the factory ....

Very Poor 1 2 3 4 5 6 7 8 9 10 Very Good

10. Moving equipment with the hands and arms (e.g. Placing a tool in its next position) ....

Very Poor 1 2 3 4 5 6 7 8 9 10 Very Good

11. Operating and/or adjusting machines and equipment ....

Very Poor 1 2 3 4 5 6 7 8 9 10 Very Good

12. The more skilled and technical aspects of the job ....

Very Poor 1 2 3 4 5 6 7 8 9 10 Very Good

13. The general control of the various tools and devices he has to use (e.g. Transiting a tool) ....

Very Poor 1 2 3 4 5 6 7 8 9 10 Very Good

3/....