Social Security Job Demands Project

Methodology to Identify and Validate Critical Job Factors

Deliverable 9

Submitted by

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Table of Contents

EXECUTIVE SUMMARY

This monograph serves as a final report and ninth deliverable to the Social Security Administration (the Agency or SSA) on one of the major Disability Research Institute (DRI) projects. The DRI was asked to develop a methodology to develop the optimal job demand variables that the Agency needs to compare the residual functional capacity (RFC) of claimants for disability benefits with the occupational demands of work. The Disability Research Institute was asked to recommend one or more approaches and identify the attendant issues that SSA should consider in its investigation of job demand variables that would be the most useful indicators of the ability to work. The desired results of the methodology were (a) a small enough number of variables to be manageable in the Agency's disability determination process; (b) a large enough number of variables to cover the areas of functioning which SSA currently uses in its process; (c) variables that are valid indicators representing the essential functions for work including physical and mental requirements; (d) utility by occupational analysts; (e) appropriately calibrated thresholds and scales for disability evaluation purposes; (f) measures that provide a means for comparing individuals' residual functional capacity in regard to that variable and the minimum level required by any given job; and (g) easy linkage of the variables to physical and mental impairments, and impairments to claimant functioning.

In its effort to develop these methods, the DRI was asked to describe variables that capture areas of functional deficit relevant to both the occupational requirements in today's labor market and the current population of persons with disabilities, both as they exist in the United States and with a review of how they might relate to international standards of practice. The DRI was asked to address issues of validity and reliability for the variables that are identified.

DRI staff accomplished several tasks to complete this project:

1. A literature review and analysis related to the goal of the project.

2. An investigation of public and private entities that collect data on job requirements or demands in addition to using or producing systems or software for delivering the data.

3. A description of Automated Concept Mapping (ACM) in order to develop methodologies for identifying optimal variables that SSA can use to compare residual functional capacities of disabled claimants with the occupational demands of work.

4. An investigation of how SSA should approach validating job demand variables and setting valid and reliable scales and thresholds appropriate for assessing the ability to work.

5. A review of the relevance of methodologies utilized for the DRI's Medical Listings Validation Project, particularly methodologies that are used to identify physical, mental, or social abilities for validating the predictive ability of a listing to indicate an inability to work. (During the course of this project, it became evident that the methodologies needed for job demand identification are distinct from those needed to validate Medical Listings.)

Job demand variables can be represented as the human attribute requirements demanded in a job or job family. These attribute requirements can be organized into five domains: physical, psychomotor, sensory, cognitive, and psychosocial (Fleishman, 1975, 1982, 1992).

Optimal job demand variables are reflected by the human attributes that are considered relevant to job performance across a wide range of jobs. In an effort to design a job analysis methodology that is both easily and effectively applied for the purpose of disability determinations, optimal job demand variables should be parsimoniously structured and clearly defined to represent key attribute requirements that exist across a range of job families. Job demand variables that are relevant to a small microcosm of jobs should not be included, since these would likely result in a more complex structure of variables while adding little utility in application.

An evaluation was conducted for five of the most widely researched and frequently utilized job analysis systems/questionnaires, including the Common Metric Questionnaire, Fleishman-Job Analysis Survey, Occupational Analysis Inventory, The Occupational Information Network (O*NET), and the Position Analysis Questionnaire. Each methodology and approach was evaluated in terms of the extent to which it has demonstrated reliability, validity, and usability in identifying job demand variables, with particular reference to applications relevant to establishing job families and enabling disability determination. On this basis, recommendations were made with regard to methodologies that show the greatest promise for effective use by SSA in building a structure and database for job demand variables that effectively facilitate making valid disability determinations. .

Because existing methodologies are generally limited with regard to cognitive and psychosocial domains, an innovative new approach (ACM) is considered as a way to gather data about what the vocational community believes are important job demands within these domains. However, we recommend a multi-faceted approach that builds on the best of existing approaches to job analysis, but which takes advantage of recent technological developments.

The methodology recommended consists of 7 components:

1. Review existing job demand approaches to create a list of job demand variables that is not redundant.

2. Create and administer a web-based survey to the widest possible audience of vocational experts that will (a) provide review and feedback on existing job demand variables and (b) generate a list of additional job demand variables significant for working in today's economy.

3. Analyze this survey data, utilizing current text analysis technology to create a comprehensive list of job demand variables.

4. Create a job analysis questionnaire that turns the job demands generated in step 3, into observable, measurable items.

5. Administer the questionnaire to incumbents, supervisors, and job analysts, having them rate all job demands for using frequency, importance, and level of proficiency scales.

6. Analyze this data, capitalizing on the strengths of both traditional item analysis and state-of-the-art psychometric analyses, selecting those job demands that are most critical to the widest range of jobs, that is, optimal job demands.

7. Use modern psychometric technology to set thresholds using the proficiency rating scale for the optimal job demands selected in step 6.

We propose a methodology for generating these optimal job demand variables that consists of four major phases: (1) Survey Development, (2) Identification of Survey Participants, (3) Survey Administration, and (4) Survey Analysis.

1. Survey Development: Development of a web-based survey of current practitioners and other stakeholders in the field of work disability. This survey will ask participants to respond to questions about existing job demand variables from the literature, and to provide information about job demand variables, particularly related to cognitive and psychosocial variables, that are important to work as it currently exists in the economy. While some of this data collected will be quantitative (rating scale format), the majority of the information will be qualitative (free-text format).

2. Identification of Survey Participants: It is recommended that the widest possible range of interested persons and stakeholders be included in this survey.

3. Survey Administration: We provide details and discussion on issues pertinent to developing a web-based survey, including the appropriate format of free–text responses and ensuring security and privacy of respondents.

4. Survey Analysis: It is recommended that survey data initially be analyzed using computer-based, free-text analysis. This analysis is described in some detail. The goal is to initially reduce the vast amounts of information obtained from recipients, into consistent groupings of ideas. From these initial groupings, subject matter experts (SMEs) will create a single list of non-redundant job demands variables. A description is made about how these variables are rated for importance and relevance by two separate groups of raters. Each set of ratings is then subjected to multi-dimensional scaling and cluster analysis. The results of this analytic procedure for each group are compared by SMEs and inconsistencies resolved.

Next, the procedures needed for assessing the accuracy and completeness of the list of optimal job demand variables is described. This assessment is an essential component of the validation of the job demand variables previously identified. Validity provides a check on how well a questionnaire or a list of optimal job demand variables fulfills its function. While the quality of the methods and procedures used in developing such a list of job demand variables is a necessary prerequisite to establishing the validity and comprehensiveness of such a list, this in itself may not be sufficient to assure the validity of the end product.

Finally, the process of validating job demands is described. Emphasis is placed on the need for content and construct validation. Because one of the aims of this project is to propose how to develop a minimum data set, it is critical that the job demands selected are the best representatives of the constructs and represent what is most commonly seen in jobs currently in

the economy. This means the demands cover an appropriate range of the content of the previously identified clusters. As long as the individual elements that comprise those clusters can be identified with specific measures, SSA can understand from the ratings of the deconstructed items what the measure for the entire cluster means in terms of a claimant's RFC. For example, SSA's current use of the *Dictionary of Occupational Titles* (DOT) strength categories is possible because each category (cluster) is defined by actual measures that relate to human functions (i.e., lift by weight, sit by amount of time, etc.) for the items within the cluster and these items cover the range of difficulty of those demands seen in the work place.

Procedures are described for development of a questionnaire for rating jobs and job families based on the job demand variables identified and validated earlier in the process. Development of a psychometrically sound mechanism for generating a description or profile for each job or job family using relevant job demand variables is described. Such a description or profile should be capable of furnishing reliable information on what the relevant job demand variables are for each job or job family and the minimum level of proficiency required on these variables for successful job performance by an incumbent. This would require:

1. Development of a questionnaire with Likert-type items (or other appropriate type of format) covering all job demand variables,

2. Use of the questionnaire and it's different scales to rate a representative sample of jobs or job families and,

3. Establishment of minimum proficiency levels (or thresholds) for jobs or job families.

In summary, this methodology will help SSA develop an instrument that enables job analysts to accurately measure the critical job factors considered relevant for making determinations of disability. Once the job analysis method has been developed, the next steps will be to determine what jobs should be analyzed,

- who will collect this data,

- what type of database will result,

- how this database will be integrated into the disability determination process, and

- whether the job analysis method is reliable, accurate, and valid.

Chapter 1

Introduction

Vocational factors are critical in determining disability at all levels of the Social Security Administration's (SSA) adjudication process. Of the initial and reconsidered determinations finding a claimant disabled, approximately 40% are based on vocational factors. Steps four and five of SSA's five-step process for determining disability requires a contemporary understanding of work, as it exists in the national economy. The Social Security Administration uses the *Dictionary of Occupational Titles* (DOT), a Department of Labor (DOL, 1991) document, as its primary source of vocational information. The Department of Labor's decision to abandon the DOT and to create a successor system called the *Occupational Information Network* (O*NET) creates a dilemma for SSA. O*NET does not adequately describe job demands to meet SSA's current program requirements and, therefore, the needs of SSA's Disability Determination adjudicators and vocational specialists, and Administrative Law Judges and Vocational Experts in the Office of Hearings and Appeals.

This chapter provides (a) an overview of activities SSA planned to create a transition from the DOT to O*NET, or that is, updated occupational data that are usable for disability adjudication, (b) a conceptual model for identifying optimal job demands, and (c) summarizes the work plan used by the Disability Research Institute (DRI) to develop the subsequent chapters in this monograph. The initial section is drawn from materials developed by Sylvia Karman in SSA's Office of Disability to help guide project team members as they began their work in 2001.

Overview of SSA Transition from DOT to O*Net

SSA uses the DOT and its companion volume, *Selected Characteristics of Occupations*, as a primary source in the medical-vocational portion of its sequential evaluation for disability determinations. The DOL has begun to replace the DOT with the O*NET. O*NET represents a significant conceptual departure from the DOT. Because SSA's medical-vocational rules are based on DOT constructs, a transition from DOT to O*NET would spell profound changes in how SSA evaluates disability cases at Steps 4 and 5 of the sequential evaluation process. However, since the DOT is no longer being updated and will eventually become obsolete, SSA must develop an alternative strategy. This chapter describes the concerns SSA faces in making a transition away from the DOT and how the Office of Disability (OD) is working to address them. Since work began on this project, SSA has revised its concept to mean a transition from DOT to updated occupational data that are usable for disability adjudication. While SSA is working with DOL, they do not know as of yet whether the resulting occupational data will merely crosswalk to O*NET (while still under Standard Occupational Classification – SOC) or reside within SOC-O*NET structure. SSA intends for the new data to be gathered using the prescribed rubric of the SOC used by the Bureau of Labor Statistics and the Census Bureau for labor market data. However, because SSA requires information about jobs to be grouped in a way that differs substantially from the way work is organized in O*NET occupational units, it may not be possible to classify many of those jobs under existing O*NET occupational units.

SSA's Concerns Regarding O*NET

From November 1999 through November 2000, SSA staff evaluated the O*NET for evidentiary purposes in SSA's disability determination process. SSA contracted with the American Institutes for Research (AIR) to assess how well O*NET would fit in SSA's medical-vocational evaluation process. AIR conducted data analyses and forums involving SSA adjudicators and policy experts as well as private experts involving occupational data, vocational assessment, psychiatric and physical medicine, and disability law. The evaluation results identified three areas of concern: (1) data aggregation, (2) measures of work/worker, and (3) data collection.

Data Aggregation Issues

The DOT contains over 12,000 job titles; some of these no longer exist in the national economy while other jobs have evolved that the DOT does not include. The way in which the occupations are grouped or aggregated within O*NET significantly reduces the number of job titles and results in a loss of specificity that SSA requires in its disability decision process. The O*NET taxonomy clusters nearly 9,500 DOT job titles into approximately 900 groupings, called occupational units (OUs). Many of the OUs contain a large, heterogeneous mix of jobs with a wide range of required job demands (e.g., strength requirements and skill level). For example, the range of job requirements in one O*NET OU might span several levels of effort: sedentary, light, medium, heavy and very heavy for strength levels. An adjudicator could not determine if the OU reflects work that requires a specific strength level.

Examples of key data aggregation issues involving the use of O*NET include:

- Task lists and occupational requirements for OU do not adequately reflect task lists and requirements for a number of jobs that were folded into that OU.

- Users are unable to discern what constitutes entry-level work from examining, for example, the journeyman-level work within OU. The aggregation of O*NET OUs conceals the true differences among jobs, differences that are central to SSA's ability to assess disability claimants' vocational profiles in terms of the mental or physical limitations resulting from impairments.

- Averaging of tasks combined with the averaging of ratings results in flattened scores. Therefore, in O*NET many occupations seem to require lower or higher ability levels than they might require in actuality. This prevents adjudicators from making accurate comparisons to claimants' residual functional capacity (RFC) to perform past relevant work (PRW) or any other work in the national economy.

These findings imply that an adjudicator who attempts to cite an O*NET OU as possible work that a disability claimant could perform cannot tell if the OU reflects work that is actually performed at the strength and skill level appropriate for the claimant's residual functional capacity and vocational profile.

Job Demands and Measures

Approximately 50 of the more than 200 O*NET descriptors of occupational demands, such as "Standing" and "Sitting" appear to be relevant to the medical-vocational process. In fact, some of these variables, like "Selective Attention" and "Conflict Situations" refer to cognitive and psychosocial demands of work that may be very useful in assessing the medical-vocational profile for claimants with mental impairments. Many of the descriptors in O*NET reflect global, theoretical constructs that are not measured (or reported) in terms of observable manifestations of the construct. Unfortunately, the manner in which the descriptors were developed and measured prevents SSA from readily adopting them for disability determinations. As such, many of the descriptors and their ratings cannot be related to human function, as is necessary in disability adjudication. Therefore, SSA is concerned about the extent to which the descriptors validly and accurately reflect the type and level of functioning required in an occupation. Furthermore, adjudicators cannot use the descriptors reliably to assess a claimant's ability to perform work.

Examples of job demand and measurement concerns include:

- Many of the descriptors are difficult to observe in the work place and difficult to relate to the claimant or prospective worker. For example, it is unclear how someone might be able to rate the minimum amount of "Static Strength" or "Problem Sensitivity" required to perform a given job. Also, it is unclear as to how an adjudicator would assess the level of "Static Strength" or "Problem Sensitivity" that claimants could perform given their residual functional capacity, and then relate the scores for these descriptors on a given occupation to medical evidence regarding human function.

- Because the measures for O*NET descriptors involve the use of numerical scales rather than interval scales, the user cannot know what the descriptor scores mean in terms of the functional level required to perform the occupation. Scales are also applied unevenly. For example, some descriptors involve scales for which the highest possible score may be a 5; however, the scale spans 1 through 7.

- Uneven scaling may also be related to problems with the anchors. Anchors for the scales, of which many are vague or irrelevant to actual work experience, compromise the reliability of the descriptor ratings. They also compromise the validity of the survey questions used to rate the descriptors because it is uncertain if the survey questions are capturing what they are intended to measure.

Data Collection Issues

A primary concern for SSA regarding the O*NET data collection plans is that the resulting data must provide users with information about the existence and prevalence of representative work at all levels of requirements (i.e., including unskilled and entry-levels, as well as higher levels).

In July 2000, the O*NET development staff asked SSA to review a draft of DOL's request for clearance by the Office of Management and Budget of the O*NET Data Collection Plan.

The nature of the comments made by SSA staff to the O*NET Survey Design team in August 2000 is reflected below:

- There is a need for data regarding unskilled and lower-level work for SSA's use based on the law and regulations.

- SSA would need access to the full range of incumbent and analyst ratings, as well as the mean values of their scores.

- SSA is concerned about the reliability of occupational data provided by job incumbents.

- There is concern regarding the representativeness of samples for large OUs and lower level work.

- There is a need for measures of work requirement levels, regardless of importance rating.

Activities to Address Concerns about O*NET and Obsolescence of DOT

The prospect of the losing the DOT, combined with the problems identified regarding the use of O*NET, has significant legal and programmatic impact for SSA. To negotiate the changes required by the imminent obsolescence of the DOT, SSA is planning several activities to resolve the concerns about O*NET while simultaneously investigating options for updating its medical-vocational policies as well. Because of the complexity of the O*NET concerns and relevant medical-vocational policy issues, SSA staff have focused their efforts in three separate but coordinated tracks of activity. The second track includes the efforts resulting in this final report:

1. Aggregation and data collection issues

   - Involves working with DOL and private professional vocational rehabilitation association members.

2. Demands and measures of work issues

   - Involves working with the Office of Policy and Office of Research and Evaluation (OP/ORES) and the Disability Research Institute (DRI) on the Job Demands project.

   - Involves continued collaboration with experts in the fields of vocational and physical rehabilitation, as well as psychiatric and physical medicine.

3. Medical-vocational policy issues

   - Involves contracted studies of non-medical factors.

Defining the Conceptual Model and Domains of Interest for Identifying Optimal Job Demands

DRI researchers were guided by comments from Richard Balkus (SSA's Office of Disability and Income Assistance Policy) during the course of our activities. Extracted below are comments he provided to help define a conceptual model relevant to the definition of job demands.

Disability Determination within SSA

Validating the list of job demand variables (i.e., assessing the relevance or completeness of these variables) requires determining how the variables fit within the current rules and procedures established for disability determination.

The following brief review of the definition of disability under the Social Security programs and the five-step sequential evaluation process highlights the complex relationship with the use of job demand variables at the different steps in the process. The review further defines the domains of interest for identifying optimal job demands.

The Social Security program uses a stringent test for determining disability. Specifically, section 223(d)(1)(A) of the Social Security Act states:

> Disability means the "inability to engage in any substantial gainful activity by reason of any medically determinable physical or mental impairment which can be expected to result in death or which has lasted or can be expected to last for a continuous period of not less than 12 months.

Disability based on blindness is defined in Section 216(i)(1) of the Act and requires that the claimant's corrected vision not be better than 20/200 or that his or her visual field be limited to 20 degrees or less with the best correction.

Under the Act and regulations, a medically determinable physical or mental impairment is defined as an impairment that results from anatomical, physiological or psychological abnormalities, which can be demonstrated by medically acceptable clinical and laboratory diagnostic techniques. The impairment must be established by medical evidence consisting of signs, symptoms, and laboratory findings and cannot be established only by the individual's statement of symptoms.

Section 223(d)(2)(A) further prescribes that an individual will be found disabled only if his or her impairment(s) "are of such severity that he is not only unable to do his previous work but cannot, considering his age, education, and work experience, engage in any other kind of substantial gainful work which exist in the national economy, regardless of whether such work exists in the immediate area in which he lives, or whether a specific vacancy exists for him, or whether he would be hired if he applied for work."

The SSA Five-Step Sequential Evaluation Process

The following five-step sequential evaluation process for evaluating disability claims as stated in the regulations follows the statutory definition.

1. Is the individual engaging in substantial gainful activity?

If the individual is working and his or her work is substantial gainful activity (SGA) as defined in the law and regulations, then the individual is not disabled for Social Security purposes. The amount of monthly earnings considered as SGA depends on the nature of a person's disability. The Act specifies a higher SGA amount for statutorily blind individuals, and the regulations specify a lower amount for non-blind individuals. Both SGA amounts increase with increases in the national wage index. That amount for 2002 is $780 a month for non-blind individuals. The dollar amount for 2002 for blind persons is $1,300. Monthly earnings above these amounts usually constitute substantial gainful activity and would direct a finding of not disabled.

2. Does the individual have an impairment or combination of impairments that significantly limits his or her physical or mental ability to do basic work activities?

For an impairment(s) to be found not severe and a direct finding of not disabled at this step, "there must be a slight abnormality (or combination of slight abnormalities) that has no more than a minimal effect on the ability to do basic work activities" (See SSR 96-3p).

The regulations define basic work activities as the abilities and aptitudes to do most jobs. Abilities include walking, standing, sitting, lifting, seeing, hearing, and speaking. Aptitudes include use of judgment and understanding, carrying out, and remembering simple instructions, responding appropriately to supervision, co-workers and usual work situations, and dealing with changes in a routine work setting.

This step, therefore, has relevance to the identification of optimal job demand variables. Within this context, one would expect that basic work activities would be at least a subset of the optimal job demands generated from the methodology being proposed. Such basic work activities (By definition, basic work activities are essential to the performance of most jobs.) should be included in any list of optimal job demand variables, as these can constitute core job demands as well. As core job demands, they become relevant again in evaluating disability at steps four and five of the sequential evaluation process.

3. Does the individual's impairment(s) meet or equal a listed impairment in Appendix 1 to Subpart P of the Regulations Part 404 (Listing of Impairments)?

The Listing of Impairments describes impairments for each body system that are considered severe enough to prevent the person from engaging in any gainful activity. Part A contains medical criteria that apply to evaluating claims for persons 18 and older and Part B contains additional criteria for evaluating claims for persons under age 18. A finding that the claimant's impairment meets the listing requires that the medical records include the medical

criteria for the impairment specified in the listing. A finding of medical equivalence requires that the medical findings for the claimant's impairment(s) are at least equal in the severity and duration of the listed findings. The absence of a listing-level impairment does not direct a finding of not disabled, but requires that the adjudicator to continue evaluating the claim under the fourth step.

The criteria for meeting the listing for certain physical impairments, includes functional limitations that are also relevant job demands. For example, the preamble to the revisions in the musculoskeletal listings notes the importance of evaluating the person's ability to ambulate and perform fine and gross movements effectively on a sustained basis in determining whether the impairment is of listing severity. These revisions parallel changes to other listings, representing more emphasis on evaluating the impact of the impairment on an individual's ability to function and perform any gainful activity.

The current criteria for evaluating mental disorders, found in paragraphs B and C, also indicate the connections between job demand variables and the different steps in the process. In each of the areas of functional limitations, activities or abilities are cited that are relevant to the world of work and, some, by definition, are job demand variables. For example, "concentration, persistence and pace is one of the four areas and refers to the ability to sustain focused attention sufficiently long to permit the timely completion of tasks commonly found in work." The following statement from the introduction to the mental impairment listings clearly recognizes the connection between such functional criteria for the mental impairment listings and the person's RFC, which is determined if a person does not meet or equal a listing. "RFC complements the criteria in paragraphs B and C of the listings for mental disorders by requiring consideration of an expanded list of work-related capacities which may be impaired by a mental disorder when the impairment is severe but does not meet or equal a listed mental impairment."

4. Does the individual's impairments prevent the claimant from performing his or her past relevant work?

This step requires that the adjudicator first determine the claimant's RFC or what he or she can still do despite any physical and mental limitations caused by a medically determined impairment(s) and related symptoms. The RFC is then compared to the physical and mental demands of work that the claimant performed in the last 15 years. If the claimant has the RFC to perform such work, he or she is then found not disabled.

The RFC reflects an assessment of a person's abilities to do the demands of work activities. The regulations cite as examples of physical demands "sitting, standing, walking, lifting, carrying, pushing, pulling, or other physical functions (including manipulative or postural functions, such as reaching, handling, stooping or crouching)." The mental demands of work include "understanding, remembering, and carrying out instructions, and in responding appropriately to supervision, co-workers, and work pressures in a work setting." The regulations also recognize that certain impairments may cause environmental restrictions, which would affect other work-related abilities.

5. Does the individual's impairment(s) prevent him or her from performing other work?

At this final step in the evaluation process, the adjudicator considers the claimant's RFC and his or her age, education, and past work experience to see if he or she can do other work. If the claimant cannot, he or she is judged disabled.

Appendix 2 to Subpart P of Part 404 contains specific numbered table rules (referred to as the "Grid") for use at the fifth step. The rules are laid out in three tables, each of which addresses a particular exertional level. Each table establishes the presence of an occupational base that includes a full range of the unskilled occupations. The base is broadened to include skilled and semi-skilled occupations when the individual has transferable skills. The rules take administrative notice of the approximate numbers of unskilled jobs that exist throughout the national economy. To use a particular rule, the individual must have only an exertional or strength limitation(s) and the vocational factors must match the criteria of a particular rule. Each rule directs a finding of disabled or not disabled. If the claimant has non-exertional limitations (e.g., fine manipulation or postural limitations or mental limitations) or cannot perform the full range of work at a particular exertional level, the rules are used as a framework in the decision-making process.

Each exertional level represents a number of physical job demands. For example,

sedentary work involves lifting no more than 10 pounds at a time or occasionally lifting or carrying articles like docket files, ledgers and small tools. Although a sedentary job is defined as one that involves sitting, a certain amount of walking and standing is often necessary in carrying out job duties. Jobs are sedentary if walking and standing are required occasionally and other sedentary criteria are met.

The requirements for each skill level also represent a set of job demands. For example,

semi-skilled work is work that needs some skills but does not require doing the more complex work duties. Semi-skilled jobs may require alertness and close attention to watching machine processes; or inspecting, testing or otherwise looking for irregularities; or tending or guarding equipment, property, materials, or persons against loss, damage or injury; or other types of activities which are similarly less complex than skilled work by more complex than unskilled work. A job may be classified as semi-skilled where coordination and dexterity are necessary, as when hands or feet must be moved quickly to do repetitive tasks.

The above summary of the sequential evaluation process indicates that the reference points for assessing physical and mental abilities are job demands. The basic work activities or core job demands at the second step in the process are further defined and supplemented in the third, fourth, and fifth steps of the process. The second step is a "screen out" process using general and very basic work activities to find claimants with relatively minor impairments who are not disabled. The third step defines the functional limitations required to meet listing-level severity. This step is a "screen in" process, which identifies persons with very severe work-related

limitations that would preclude the likelihood of performing any work. The functional limitations defined in terms of job demands, such as ability to ambulate and perform fine and gross movements, are relevant to the performance of most gainful activity. The fourth and fifth steps move from a screening mode to a more individualized assessment and, therefore, require a more precise measurement of the person's ability and job demands. Step four requires a specific assessment of the person's abilities, which also are job demands or can be translated as job demands, and a description of the specific job demands of the person's past work. Step 5 builds on this individualized assessment by considering the person's age and education and identifying other jobs with demands consistent with the person's RFC. At these last two steps, core job demands such as lifting are further defined for specific exertional levels. Threshold requirements result in some job demands defined with greater specificity and with measurements identified as separate job demands. Figure 1.1 summarizes the type of job demand variables at the relevant steps in the process.

Figure 1.1: Job demands in the sequential evaluation process
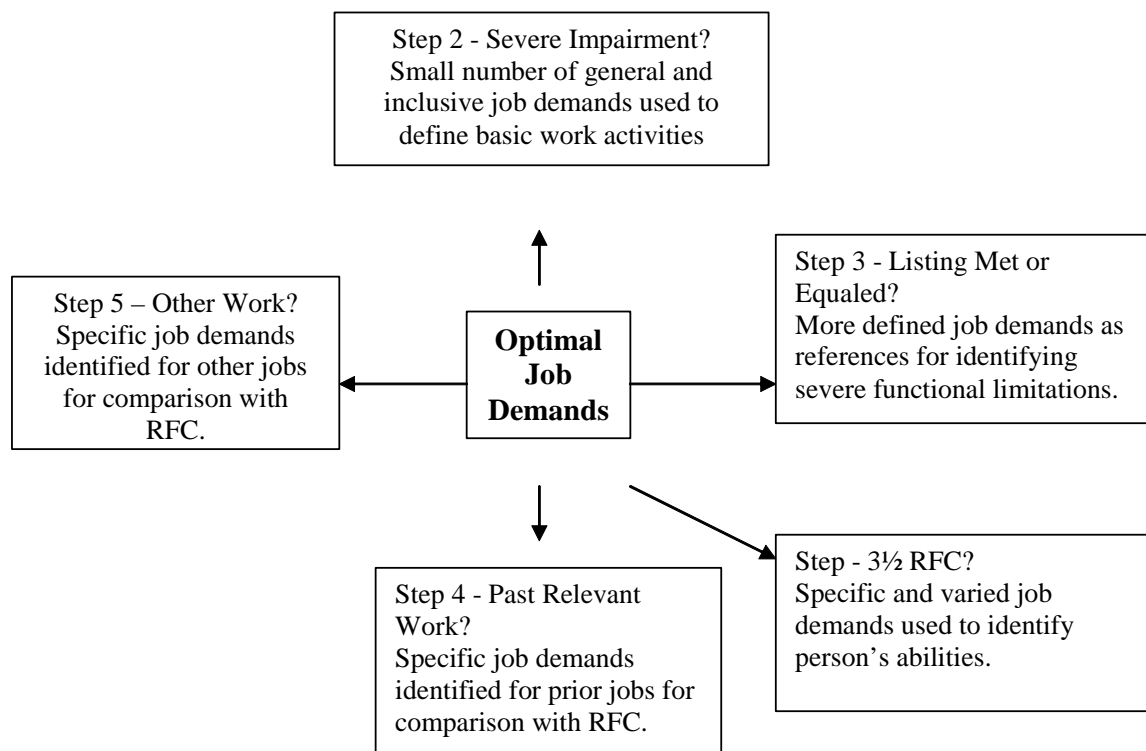
The use of job demand variables at the different steps in the process defines the domains of interest and points to two criteria for assessing content validity.

First, the variables must represent the essential functions of work. This is important for each of the four steps that include job demand variables. Secondly, the variables should reflect

the demands of a wide range of jobs so that a limitation resulting from a physical or mental impairment would result in the inability to perform a number of jobs or occupations. This is particularly important for the fourth and fifth steps of the process.

Scales for the variables that are appropriately calibrated for evaluation at the different steps of the process can be established.

The disability environment provides clues for identifying two additional criteria for assessing content validity. A major factor is the projected increase in disability claims and the need for the most efficient process possible within expected budget constraints. Another is the ongoing concern about disparities in disability outcomes at and between the different levels of adjudication.

The number of variables is small enough to be manageable in terms of the job analysis required to gather data and in terms of their use in the disability process, as well as large enough to cover the areas of functioning that SSA currently uses in the process.

Disability adjudicators at all levels can readily apply the variables, and the findings using job demand variables improve consistency in decision-making. Disability adjudicators should be able to link the job demand variables to physical and mental impairments (as documented by medical records) and recognize the variables when assessing these impairments and their effects on functioning.

In view of the policies, rules, and needs of SSA with respect to the disability adjudication process, and for the purposes of this research investigation, the domain of interest is defined as follows:

Optimal job demand variables should reflect the demands of a wide range jobs so that a limitation resulting from a physical or mental impairment that precludes the ability to meet a particular job demand would result in the inability to perform a number of jobs or occupations.

To summarize, the rules and procedures associated with the SSA disability adjudication process must provide the basis for all procedures associated with the identification and validation of job demand variables. As such, all participants in this process (e.g., survey respondents, subject matter expert panel members) should receive standardized instructions that direct their input to the identification or validation of job demand variables. These instructions must establish an accurate and consistent working knowledge of the rules so that the final list of optimal job demand variables is consistent with and supportive of the needs and policies SSA with respect to the disability adjudication process.

The Current Project

The goal of this "Job Demands" Project commissioned by SSA is to develop a methodology to launch an investigation regarding the optimal job demand variables that SSA needs to compare the RFC capacity of claimants for disability benefits with the occupational demands of work. The DRI was asked to recommend one or more approaches and identify the attendant issues that SSA should consider in its investigation of job demand variables that would

be the most useful indicators of the ability to work. A "useful" methodology is one that SSA could use to identify, validate, and calibrate exertional and non-exertional factors that are the most salient and useful indicators of claimants' ability to meet job demands. The methodology should produce the following results:

1. The number of variables is small enough to be manageable in terms of the job analysis required to gather data and in terms of their use in SSA's disability process, as well as large enough to cover the areas of functioning which SSA currently uses in its process.

2. The variables are valid indicators representing the essential functions for work. The variables should reflect the demands of a wide range of jobs so that a limitation resulting from a physical or mental impairment that precludes performance of a particular job demand would result in the inability to perform a number of jobs or occupations.

3. Occupational analysts can observe and measure the variables.

4. Thresholds and scales for the variables that are appropriately calibrated so disability evaluation can be established. Such measures should provide a means for comparing individuals' residual functional capacity in regard to that variable and the minimum level required by any given job.

5. Disability adjudicators can readily apply the variables. Disability adjudicators should be able to link the variables to physical and mental impairments and recognize the variables when assessing these impairments and their effects on functioning.

In its effort to develop one or more methodologies, the DRI was asked to identify examples of variables that meet the above criteria. The goal was to describe variables that capture areas of functional performance relevant to both the occupational requirements in today's labor market and the current population of persons with disabilities, both as they exist in the United States and with a review of how they might relate to international standards of practice. The DRI was asked to address issues of validity and reliability for the variables that are identified. Completion of this project will allow pilot testing of the proposed methodology in subsequent years.

In accomplishing the project's goal, the DRI was asked by SSA to evaluate benchmarks used by selected private and public entities that develop or work with occupational databases to determine if there exist methodologies for identifying optimal variables. Salient questions included: How do these entities identify the salient physical and mental requirements for jobs? What measures do they use and how do they address issues of validity and reliability? In conjunction with this investigation, the DRI was charged with considering the usefulness of the occupational databases and related systems and software used by these entities and SSA as the Agency moves forward in considering an approach and product for transitioning from the DOT.

The following issues describe how this Job Demands Project fits within the current strategy to move forward in developing an approach for transitioning from the DOT as the primary source of vocational information.

- Steps 4 and 5 of the sequential evaluation process require more specificity than what DOT's proposed replacement, O*NET, provides. More specifically, the medical-vocational process requires a classification of work in the US economy that is representative of the full range of levels of work in terms of skill level (e.g., entry level through journeyman, supervisory, professional) and in terms of levels of exertional and non-exertional abilities. This means that the jobs must be grouped in a manner that permits enough specificity for users to be able to distinguish between and among the various levels of skill and ability within each occupation.

- SSA's recent evaluation of O*NET for use in the disability determination process reveals three main areas of concern. For two of the areas, SSA is addressing its concerns through collaborative interagency projects with the Department of Labor. These areas involve (1) the aggregation (or grouping) of the former DOT job titles into large occupational units which do not provide the level of specificity described above; and (2) the manner in which occupational data are being collected.

- This Job Demands Project was designed to develop a methodology that helps SSA address the third area of concern: the need for valid job demand variables that can be calibrated for use in evaluating disability.

- The impending obsolescence of the DOT also creates an opportunity for SSA to reevaluate its use of non-medical factors (i.e., age, education, and work experience) in determining whether an individual is unable to work. Another objective of this effort is to explore ways in which SSA could be less reliant on occupational data for addressing these factors.

Methodology

The DRI undertook the following activities to complete this project:

1. DRI completed a literature review and analysis related to the goals of the project, including a prior literature review and an analysis relevant to the project's goal.

2. As part of its literature review and analysis, the DRI investigated public and private entities that collect data on job requirements or demands in addition to using or producing systems or software for delivering the data. We sought to address the following questions:

    - What methodologies do these entities use in identifying the physical and mental requirements for work?

    - What types of scales or ratings exist for measuring these variables?

    - How do these entities approach the issues of validity and reliability?

    - What methods do they use in collecting, updating, and providing the data?

3. The DRI was asked to describe the use of Automated Concept Mapping (ACM) in order to develop methodologies for identifying optimal variables that SSA can use in comparing of disabled claimants with the occupational demands of work. As described in Chapter 3, this procedure allows the expertise of a large sample of

professionals to be accessed and analyzed in order to identify a hierarchy of minimal core job demands.

4. The DRI investigated how SSA should approach validating job demand variables and setting valid and reliable scales and thresholds appropriate for assessing the ability to work. The validity investigation focused on content and criterion aspects of validity.

5. The DRI considered the relevance of methodologies utilized for its Medical Listings Validation Project, particularly methodologies that are used to identify physical, mental or social abilities for validating the predictive ability of a listing to indicate an inability to work.[1]

Deliverables

The following deliverables evolved into Chapters in this Final Report, originally known as Deliverable 9:

1. A list of articles from the literature search.

2. A report that provides a summary and critical review of pertinent literature on validation criteria including those for validating job demands. (Appendix A)

3. An annotated bibliography of the literature search completed as Deliverable 1. (Appendix C)

4. A preliminary report that describes the methods by which ACM could be used to identify job demands concept maps. (Part of Chapter 3)

5. A summary report on databases and the systems and software that utilize job demand data in evaluating disability or return to work potential. (Appendix B)

6. A report that describes the methodology (or methodologies) developed for identifying the optimal job demand variables. (Chapter 2)

7. A description of the procedures for validating the job demand variables. (Chapter 3)

8. A report of the methods for developing scales, thresholds and rating procedures to assess job demand variables. (Chapter 4)

9. The final report that includes a review and discussion of potential issues, including approaches for SSA to consider in transitioning from the DOT. (This document)

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[1] During the course of work on this project, DRI staff realized that, while the Medical Listing Validation Project and this Job Demands Project have complementary objectives, the methodologies for identifying job demands are necessarily distinct from those required to validate the Medical Listings.

Overview of the Proposed Procedures for Identifying Optimal Job Demands

The process of validating job demands involves a number of major steps. These include:

1. Creating a list of job demand variables currently in use
   a. A comprehensive review of existing job analyses (Chapter 2)
   b. Subject matter expert input about necessary job demands (Chapter 3)
2. Creating a more comprehensive list that includes the most valuable existing job demand variables and identifies new variables not represented by current job analyses
   a. Development of a web-based questionnaire to survey relevant parties about optimal job demands (Chapter 3)
   b. Design and implementation of the web-based survey (Chapter 3)
   c. Content analysis of the survey data using automated concept mapping (including multi-dimensional scaling and cluster analysis) (Chapter 3)
   d. Refine the list of job demands and comparing it to existing job demands (Chapter 4)
3. Describing jobs in the economy with this new, comprehensive list of job demand variables
   a. Develop a job demands questionnaire (Chapter 5)
   b. Implement a pilot test of the job demands questionnaire (Chapter 5)
   c. Analyze data from the job demands questionnaire; develop the final item sets (Chapter 6).

The following flowchart (Figure 1.2) illustrates a proposed methodology for identifying job demands. In addition to outlining the flow of the steps presented above, it also details the significant sub-tasks that must be completed as part of those steps. The flowchart indicates in which chapter the steps and sub-tasks are discussed.

Figure 1.2

Flowchart: Job Analysis Review and Questionnaire

CH2: Comprehensive Review of

- Content Analysis of major job analysis systems
- Create comprehensive list of non-overlapping variables
- Rate frequency with which these variables are utilized in practice
- Select comprehensive list
- Comprehensive list of most salient, currently available job demands

CH3: Subject Matter Expert Input

- Convene SMEs to review list of job demands variables
- SMEs Input on necessary job demands

CH3: Develop

- Develop potential survey questions
- Convene SME panels to review survey
- Finalized Survey Questions

CH3: Design & Implement Web-based

- Design web pages, implement security features, and data collection requirements
- Identify survey participants
- Contact participants, provide instructions and support
- Administer web-based survey

CH3: Content Analysis of Survey Data Using

- Web-based Questionnaire — Step 1
- Random Assignment
- Group A
- Group B
- Generate List A — Step 2
- Generate List B
- A1
- A2
- Sort List B
- Rate List B
- Sort List A
- Rate List A — Step 3
- ACM
- ACM
- Multidimensional scaling Cluster analysis
- Multidimensional scaling Cluster analysis — Steps 4 & 5
- Concept Maps
- Concept Maps
- Compare Concept Maps
- Identify discrepancies & congruence of clusters
- Expert panels resolve discrepancies
- Create preliminary master list of job demands

Flowchart: Questionnaire Design, Data collection and

Is cost a factor?

NO

YES

CH5: Develop Job Demands

CH4: Refine List of Job Demands

Convert Job Demand variables to observable items

Convene <u>new</u> SME panels to review item list

Create scoring/rating scale for these items on 3 scales (frequency, importance, &

Create refined list of Job Demands

Select sample and conduct cognitive interviewing

Maybe iterative

CH4: Compare to Existing Job

Revise items, forms

CH5: Implement Pilot Test of Job Demands

Select appropriate range of occupations to be observed

Compare to refined list to those generated in 6A

Create final score sheets and other appropriate data collection materials

Select appropriate range of occupations to be

Establish degree of congruence between existing and new job demands

Create training materials

Set up data collection contracts or arrangements with data collection sites, policies for transmission of data,

Create complete list of optimal job demand variables

Train job analysts to administer survey

Gather survey and observational data

Collect data at central site, store, manage data entry, quality, etc

CH6: Analyze Data from Job Demands

Analyze data for content validity traditional item analysis, factor analysis, & IRT

Select final items

Analyze final set of items for reliability, content validity, traditional item analysis, factor analysis, & IRT

Advisory Board and Consultants

Several staff members from the University of Illinois (Chrisann Schiro Geist, Richard Roessler, Tanya Gallagher, Tiffany Neuman, Emer Broadbent, Michael Welge, Duane Searsmith), Northwestern University and the Rehabilitation Institute of Chicago (Allen Heinemann, Trudy Mallinson, Christine Chen, Hagay Amir, Patricia Taylor, Robert Trieweiler, Maureen Stress, Nicole Thorne), University of Wisconsin – Stout (Karl Botterbusch), and Illinois Institute of Technology (Nambury Raju, Bruce Fisher).

The DRI worked through the Office of Research, Evaluation, and Statistics, collaboratively with the Office of Disability (Sylvia Karman) and the Office of Disability and Income Assistance Policy (Richard Balkus) during the course of this Project.

Chapter 2

Review of Job Analysis Methodologies

The primary objective of this chapter is to review job analysis methodologies in order to identify optimal job demand variables. This review of the current literature identifies the best of existing approaches to job analysis as they relate to the disability determination process and to also identify where new methodologies might be needed. To this end, we have conducted a critical review and evaluation of existing major job analysis approaches and methodologies. Each methodology and approach has been evaluated in terms of one or all of the following criteria: a) demonstrated reliability, b) demonstrated validity, c) potential usability, and d) practicality in its application to identify optimal job demand variables. For explanatory purposes, we present a discrete evaluation of each method. In practice, several methods are usually used in conjunction with one other to ensure a comprehensive definition of job content and context.

Job demand variables can be represented as the human attribute requirements demanded (i.e., essential to job performance) in a job or job family. Based on a review of the job analysis literature, these attribute requirements can be organized into five domains: physical, psychomotor, sensory, cognitive, and psychosocial (Fleishman, 1975, 1982, 1992).

Optimal job demand variables are reflected by those human attributes that are considered relevant (i.e., important) to job performance across a wide range of jobs in the world of work. In an effort to design a job analysis methodology that is both easily and effectively applied for the purpose of disability determinations, optimal job demand variables should be parsimoniously structured and clearly defined to represent key attribute requirements that exist across a range of job families. Job demand variables that are relevant to a small microcosm of jobs would not be included, since these would likely result in a more complex structure of variables, while adding little utility in application.

Our evaluation of methodologies for the identification of optimal job demand variables has considered all commonly used job analysis methodologies, including:

- Review of job materials,
- Direct observation,
- Job performance,
- Interviews,
- SME panels,
- Critical incidents,
- Functional job analysis,
- Task inventories,
- Standardized job analysis systems/questionnaires.

Specifically, our evaluation included an analysis of five of the most widely researched and frequently utilized job analysis systems/questionnaires, which included: The Common Metric

Questionnaire, Fleishman-Job Analysis Survey, Occupational Analysis Inventory, O*NET, and Position Analysis Questionnaire.

Each methodology and approach was evaluated in terms of the extent to which it has demonstrated reliability, validity, and usability (practicality) in identifying job demand variables, with particular reference to applications relevant to the needs of SSA (e.g., establishing job families, enabling disability determination). On this basis, recommendations are made with regard to methodologies that show the most promise for use by SSA in building a structure and database for job demand variables that will be effective in making valid disability determinations under the SSDI and SSI programs.

To the extent that all existing methodologies have some limitations for this application, a new approach (ACM) is considered as a complement to other recommended approaches. Thus, we recommend a multi-faceted approach, which takes advantage of recent advances in technology (e.g., Internet) and data analytic techniques.

<div align="center">Level 3 Review of Job Materials</div>

A variety of source materials are frequently used to define job demands. These materials include:

Job descriptions:

> Organizations' job descriptions frequently describe job demands as a basis for defining selection requirements for individual positions/jobs in an organization. However, in terms of adopting job descriptions as source data for identifying optimal job demands, their narrative format and lack of consistency in data language present problems. Further, the purpose for which job descriptions have been developed varies. As a result, job descriptions are often incomplete and inadequate for some uses (Jones, Hulbert, & Haase, 1953). Their utility as a basis for identifying optimal job demand variables is highly questionable.

Dictionary of Occupational Titles (DOT) descriptions:

> DOT descriptions were derived from functional job analysis interviews (U.S. Department of Labor (DOL), 1991) conducted by occupational analysts in U.S. Employment Services offices. The DOT provides a standardized format, which describes over 13,000 jobs in terms of ratings on dimensions of people, data and things. In addition, ratings are provided on approximately 60 job demand variables (e.g., aptitudes, interests, temperaments, physical demands, and working conditions). Estimates of test-retest reliability of these ratings are generally above .70 (Cain & Green, 1983), and internal consistency estimates of reliability of ratings generally exceed .80 (Geyer, Hice, Hawk, Boese, and Brannon, 1989). Still, there are a number of potentially serious problems with the use of DOT descriptions/ratings as a basis for identifying optimal job demand variables. Most of the demand variables have not been updated since the mid-1970's and most of the data refer to work requirements in the mid-1960's (National Research Council, 1980). Changing work demands

resulting from growth in information processing occupations and team-based work are not likely to be represented accurately. Finally, the time and expense involved in updating the DOT has prompted the DOL to develop a replacement and, as a result, DOT data will become increasingly outdated. On this basis, sole reliance on DOT data may not be an acceptable methodology for identification of optimal job demands variables.

Training manuals and related materials:

A review of training manuals and related job materials can provide an effective source of input to job analysis through which inferences can be made regarding job demands. However, the unstandardized nature of these materials makes it difficult to employ as a key job analysis methodology for identifying optimal job demand variables.

Direct Observation

Direct observation of incumbents' job performance is appropriate for jobs that require primarily manual, standardized and short-cycle tasks. In such situations, and where job analysts are trained to use a standardized format for documenting observations (e.g., functional job analysis; Fine, 1989), reasonably high reliabilities can be expected. However, it is an inappropriate methodology for jobs that require substantial mental activity (Cascio, 1991; Fisher, 2002). While direct observation may be a useful building block for additional job analysis methodologies, it is seldom sufficient, and it cannot be recommended as the sole methodology for identifying optimal job demand variables.

Performance

Job performance is an appropriate job analysis methodology under circumstances where job analysts can readily learn to perform the job. Similar to direct observation, this methodology is usually appropriate for jobs that require primarily manual, standardized and short-cycle tasks, and inappropriate for jobs requiring substantial mental activity. Again for manual tasks, where job analysts are trained to use a standardized format for documenting observations (e.g., functional job analysis; Fine, 1989), reasonably high reliabilities can be expected. Still, because of its limited applicability across the universe of jobs, job performance cannot be recommended as an independent methodology for identifying optimal job demand variables.

Interview

The job analysis interview with job incumbents and/or supervisors is probably the most widely used job analysis methodology. As a check of information obtained, it is important to interview more than one incumbent, as well as the immediate supervisor who knows the job. With the use of a structured interview guide, the interview can provide valid and reliable data regarding job demands (McCormick, 1979). Further, it is considered more broadly applicable

than the observation and performance methods. The interview has been used as a source of data for the development of many other methodologies, including critical incidents, task inventories and standardized questionnaires. As a stand-alone methodology, it is acceptable for limited applications. However, the time-intensive nature of the process and the need for trained interviewers suggest that it is not an appropriate as a sole methodology for a large scale process designed to identify optimal job demand variables across numerous job families.

Subject Matter Experts (SME) panels

Panels of SMEs, typically composed of six to eight individuals, are often utilized as a job analysis methodology. In these situations, it is important that the SMEs are representative of various types of expertise. For within organization applications, both incumbents and supervisors are included. For cross-organization applications, incumbents and supervisors may be joined by trained job analysts from diverse fields (industrial/organizational psychology, rehabilitation psychology). It is also important that SME panels represent diversity in terms of race, gender, age, and disability. SME panels can provide an effective vehicle for identifying job demands, and this is accomplished through questionnaires and/or panel interviews. SMEs are encouraged to discuss issues and disagreements openly and to work toward consensus. Regardless of the approach to data collection, SME input should be captured through carefully developed instrumentation and psychometric analysis (Hughes & Prien, 1989). Inter-rater reliability is an appropriate method for evaluating data quality. For the purpose of identifying optimal job demand variables, SME panels show some promise, particularly if panels are established to review specific job families of which they have great knowledge. Within this context, SME panels could be effectively utilized as a source of data review and integration following broader data collection efforts.

Critical incidents

The critical incident approach involves collecting behavioral examples (typically from job incumbents and supervisors) that describe particularly good or poor performance. The emphasis on observable behaviors yields particularly good job analysis data, which can be translated into job demand variables. It is considered a highly useful technique when used in conjunction with other methodologies (Page & Van De Voort, 1989). There are, however, serious limitations in its potential use for identifying optimal job demand variables across a broad range of jobs. First, it is a very costly technique, since hundreds of critical incidents must be gathered to represent a single job family. Further, the emphasis on critical incidents, which are designed to represent exceptionally good and poor performance, overlooks behaviors associated with "average" performance and may, on this basis, fail to identify many routine job demands. In view of these factors, the critical incidents methodology would not be appropriate for a broad scale project to identify optimal job demands across a range of job families.

Functional Job Analysis (FJA)

FJA defines the exact tasks of a specific job or occupation. FJA is based on the premise that every job requires a worker to function in relation to Things, Data and People (factors) in varying degrees. (Appendix A presents additional detail regarding the way in which FJA analyzes the structure of work.) A level is determined for each of the three areas for each worker function. A measure of emphasis was developed by assigning percentages to weight each factor. The level at which a worker functions in relationship with Things, Data and People together with the weights form a functional profile. FJA has been shown to result in reliable and valid ratings of functional job analysis scales (Bernotavicz & Huff, 1988, Levine, Maye, Ulm, & Gordon, 1997; Schmitt, & Fine, 1983). This notwithstanding, FJA is a costly, time-intensive methodology that may not be the most efficient approach for large-scale analysis of multiple job family.

Task inventories

Structured surveys of job tasks enable a quantifiable analysis of job content. These task inventories are typically developed for individual jobs or job families as a list of tasks or job activities, which have been identified through interviews and/or observations. Respondents (e.g., incumbents, supervisors, job analysts) typically rate each task in terms of time spent (or frequency) and importance. Test-retest reliabilities for these data have been reported at or above .70 (Christal, 1974). While this methodology is highly effective for many personnel applications, it is a very expensive and time-consuming process to develop a task inventory. In addition, this methodology is not an effective method for discerning worker/behavioral requirements of jobs. In view of these limitations, the task inventory method is not recommended for use in a large-scale analysis of job demands across a range of job families.

Standardized job analysis systems/questionnaires

Standardized job analysis systems/questionnaires have been a preferred approach to large-scale job analysis for many years. As a result, there is a plethora of standardized job analysis questionnaires available for use by qualified job analysts. There is also a wealth of data regarding job demand variables, which can be distilled from these questionnaires. Data across a variety of standardized questionnaires indicate good reliability and validity. A comprehensive review of all standardized job analysis instruments is not practical. However, a review of the most widely used and well-researched questionnaires may yield great insight into the most reliable, valid and useful methods for defining job demands for a range of job families. On this basis, the next section presents an evaluation of five standardized questionnaires, which are among the most frequently cited instruments used in research and practice in the United States, including Common Metric Questionnaire (CMQ), Fleishman's Job Analysis Survey (F-JAS), Occupational Analysis Inventory (OAI), O*NET (Occupational Network Information), Positional Analysis Questionnaire (PAQ).

This section provides a critical review of five popular job analysis systems. In addition, to a review of development procedures, content domains, orientation, reliability, validity, and usability/practicality, Appendices A - E present a comprehensive summary of the structure for job demand variables utilized by each of these methods. These data may provide an effective foundation for identification of optimal job demand variables.

Common Metric Questionnaire (CMQ)

Development

The CMQ was developed to address some of the limitations its author identified with existing job analysis questionnaires. To do this, the author conducted an analysis of what was effective in other methods and settled on the PAQ and Job Element Inventory (JEI, Cornelius & Hackel, 1978) as generally effective instruments. These two instruments were factor analyzed to extract both general-purpose work dimensions, as well as managerial work dimensions. The resulting dimension categories were combined to form the 3 main categories (i.e., interpersonal dimensions; decision making/information processing activities; and physical, mechanical, and contextual aspects of work). Items were then written for each of the dimensions (Harvey, n.d.).

Content Domains

The CMQ includes 80 general work and managerial activities that were derived from the PAQ and JEI. These 80 general work and managerial activities map into three main categories. These categories are interpersonal dimensions; decision making/information processing; and physical, mechanical, and contextual aspects of work.

Reliability Evidence

The analysis included 904 occupational titles and evaluated the reliability of the 80 CMQ scales. The internal consistencies of the scales were generally acceptable. The median internal consistency for CMQ scales that included at least 6 items was .86.

Validity Evidence

Criterion related validity was demonstrated through a stepwise regression methodology to evaluate the relationship between items on the CMQ dimensions and pay as well as exempt status. Results yielded a multiple R of .86 for pay and .74 for exempt status. It should be noted that the stepwise regression methodology looked only at the best predictors from the pool of 80 items and as a result all items were not included in either of the final regression equations.

Content and construct validity were not directly assessed, though the CMQ dimensions were based on dimensions directly extracted from the existing PAQ and JEI measures. As a result we can infer content and construct validity based on the evidence for the PAQ and JEI.

Demonstrated Application The CMQ is useful in describing both exempt and non-exempt positions as well as predicting compensation. The measure also has the potential to provide the necessary information to create a comprehensive occupational database.

Usability Information The purpose in developing the CMQ was to create a tool that was more behaviorally based than other job analysis questionnaires and more easily understood by raters. The CMQ can be completed in 2 hours or less by untrained job incumbents or supervisors. Additionally, the items were written at an 8th grade reading level.

Fleishman Job Analysis Survey (F-JAS)

Development Most of the 52 ability constructs included in the Fleishman Job Analysis Survey (F-JAS) come from several comprehensive literature reviews, which present repeated linkage of a specific ability to job task performance. Hence, the F-JAS is based on a well-researched criterion/ performance foundation. The lists of abilities were analyzed and reevaluated by subject matter experts and industrial psychologists for various jobs. These revisions were made in an iterative fashion, until the refinement appeared to result in operationally viable definitions and descriptions of each category yielded high inter-rater agreement (Fleishman & Mumford, 1991).

Content Domains The F-JAS is a job analysis tool based on 52 items, which assess physical, sensory, psychomotor, cognitive, and social/interactive abilities, as well as job skills and knowledge.

Orientation/Focus The F-JAS consists of behavioral anchored rating scales that assess job related abilities. The social/interactive dimension and the job skill/knowledge dimension are more recent developments. These add a focus on the interpersonal and job-specific skills and knowledge to the Fleishman's job analysis method.

Reliability Evidence Studies on the F-JAS are quite comprehensive (Fleishman & Mumford, 1991, Fleishman 1992). Inter-rater reliability

coefficients across ability ratings have generally been good. Some studies reported them to range from the mid .80s to mid .90s. Other studies list supervisor-incumbent coefficients of .80 to .90, supervisor-job analyst coefficients in the .mid 60s to mid .70s, and incumbent- job analysis coefficients in the mid .60s.

Validity Evidence   Research investigating the validity of the F-JAS has concentrated on establishing internal validity evidence as well as construct validity evidence. Research has shown that the ability taxonomy can account for 70% to 85% of the tasks that are required for a specific job. When introducing the job knowledge and skill dimension an additional 10-15% of the tasks can be correctly classified. Research generally concludes that the content of the ability taxonomy carries good validity (Fleishman & Mumford, 1991). Hence, tasks can be assigned to ability categories in an interpretable and meaningful fashion. Further, by investigating ability constructs to one-another and across different task requirements, evidence of convergent and discriminate validity has been reported.

Evidence of external validity has also been established. It has been found that ability ratings can be generalized across work site locations, establishing cross-validity evidence. Ability ratings have also been linked to empirically derived task performance ratings, giving evidence for criterion related validity. Ability scale ratings have predicted performance ratings with a multiple correlation of .35 up to .80 (concurrent and predictive design). Overall, it appears that there is good evidence for the content, construct, and criterion related validity of the F-JAS ability dimensions.

Demonstrated Application The F-JAS appears to find its application in the creation of job families, the selection of incumbents, and performance appraisals. One of its strengths is the possibility to use the ability rating scale for the determination of job-related ability requirements. This aspect of the F-JAS makes it a good candidate for the development of disability scores related to various jobs.

Usability / Practicability   The F-JAS is a relatively brief questionnaire, which is easily understood and administered. As mentioned earlier, it appears that one of the F-JAS major advantages is the possibility to calculate job and task specific ability scores. Such ability score could potentially be linked to the definition of disability levels across jobs.

Occupational Analysis Inventory (OAI)

Development

The Occupational Analysis Inventory (OAI) was developed for use as a taxonomic tool, through deriving a broad set of human work dimensions (factors) based on a questionnaire, and establishing some degree of construct validity for the resultant dimensions. 602 OAI work elements (items) were subjected to several factor analyses based on the ratings of 1,414 jobs on the elements and ratings of the elements on their requirements for 102 defined human attributes. The resultant factors were significantly related to the tested abilities of relevant jobholders. It was concluded that job-rating factors should be fairly reflective of the various types of work activities and conditions extant in the world of work and unique in their coverage of information relevant to occupational, education, and career decision making (Cunningham, Boese, Neeb, & Pass, 1983).

Content Domains

The OAI was designed to yield more specific job information than other multi-job questionnaires such as the PAQ while still capturing work requirements for virtually all occupations. The major categories of items are five-fold**:** (1) Information Received, (2) Mental Activities, (3) Work Behavior, (4) Work Goals, and (5) Work Context. OAI respondents rate each job element on one of four rating scales: part-of-job, extent, applicability, or a special scale designed for the element. The OAI has been used to gather information on 1,400 jobs selected to represent five major occupational categories (Parry-Hill, 1975).

Orientation/Focus

The OAI is an instrument containing work elements describing work activities and conditions on which jobs and occupations are rated (Parry-Hill, 1975). OAI describes occupations in terms of work activities and conditions, and attribute-requirement estimates characterizing occupation in terms of various human requirements (Cunningham, 1972).

Reliability Evidence

The most utilized methodology for evaluating reliability of the OAI is inter-rater reliability (Parry-Hill, 1975; Cunningham et al, 1983). Empirical work has been completed to evaluate the reliability and validity of the OAI (Cunningham et al., 1983). A study of the reliability of OAI ratings was conducted using 12 job analysts and 21 trained psychology graduate students who rated 215 jobs using written task descriptions from the U.S. Employment Service. Correlations were computed between two independent raters for each OAI work element. The mean correlation was .53 and the median was .56. Another source states that reliabilities

obtained with the OAI have been moderate, somewhat lower than those achieved with the PAQ (Source: http://www.hr-guide.com/data/G012.htm). However, when shortening of the OAI was attempted (going from 622 to 229 items) the inter-rater reliabilities from four raters over 150 jobs were substantial (Parry-Hill, 1975).

Validity Evidence

Several studies aimed at evaluating the construct validity of the OAI have been conducted, including the comparisons of clusters of occupations obtained with the OAI on several tests and inventories (68 of the 92 measures showed statistically significant discrimination between the clusters), the prediction of mean occupational scores on the General Aptitude Test Battery using OAI factor scores, (median cross-validated multiple correlations were .60 for mental and .24 for motor abilities), bivariate correlations between OAI attribute-requirement estimates and mean scores of job incumbents (statistically significant correlations at the .05 level were found for 38 of 55 analyses), and analyses of variance to relate OAI need-requirement estimates to job satisfaction scores (12 of 15 analyses provided supporting evidence) (Cunningham, 1972; Cunningham, et al, 1983). In addition, OAI ratings were performed on written job descriptions of a 1,414 representative job sample (Boese & Cunningham, 1975). Eight separate sections of OAI elements were factor analyzed, and the resultant first-order factors were, in turn, subjected to an overall (higher-order) factor analysis. These analyses produced 132 first-order and 28 general higher-order work dimensions, which are readily interpretable and meaningful. Analyses of factorial stability derived from two subsamples of 707 jobs each indicated some degree of stability in the derived work dimensions. It was concluded that the OAI dimensions should be broadly representative of the kinds of activities and conditions existent in the world of work.

Demonstrated Applications The OAI is designed to be especially relevant to occupational education and guidance. In addition, many studies have evaluated the OAI in terms of hierarchical job families or clusters (Boese & Cunningham, 1975; Pass & Cunningham, 1975). A hierarchical cluster analysis produced 21 macro clusters, which subsumed 88 micro clusters. Subsequent modifications of the structure expanded the major clusters to 25 and reduced the micro clusters to 47. Statistical analyses of the macro clusters showed moderate to substantial within-cluster homogeneity, intercluster discriminability, and cluster stability (Pass & Cunningham, 1977).

Usability/Practicality	The OAI shows generally excellent measurement characteristics, when it is applied in the recommended manner--using college educated, trained analysts (Boese & Cunningham, 1975; Cunningham, 1972). Most of the reported empirical work has been conducted using "paper jobs," that is, written job descriptions from the U.S. Employment Service. It is not clear that it would work as well if used in the field by job incumbents, supervisors, or other occupational experts, many of whom would not be college-trained or be available for special training on the OAI.

The analysis of work represented by the OAI and the General Work Inventory (GWI, Cunningham & Ballentine, 1982) demonstrates well the utility of a descriptive system designed to be applied to the general population of occupations, but still retaining enough specificity to provide meaningful differentiations between occupations, to link to assessments of persons, and to form useful occupational structures based on the information obtained from the system. (Source: http://books.nap.edu/html/occup_analysis/app_B.html).

Occupational Information Network (O*NET)

Development	The O*NET was developed as a replacement of the DOT which was designed as a structured approach to describing occupations. This approach builds on, but is distinct from the F-JAS and is therefore included here as a separate system. The O*NET expanded on the features of the DOT by including multiple windows (i.e., different ways of describing a particular occupation and the world of work in general), a common language, and taxonomies and hierarchies of occupational descriptors. These basic principles as well as existing literature on job analysis guided the development of the O*NET content model (Peterson et al., 2001).
Content Domains	The content model of the O*NET includes six domains: worker characteristics, worker requirements, experience requirements, occupational requirements, occupation-specific requirements, and occupational characteristics.
Reliability Evidence	Peterson, Borman, Hanson, and Kubisiak (1999) looked primarily at inter-rater agreement coefficients as a measure of reliability. Reliability coefficients for 10 raters ranged from .45 to .86 with the majority of coefficients at or above .70 and estimated reliability coefficients for 30 raters ranged from .83 to .95.

Validity Evidence   Construct validity was assessed using 2,487 respondents within 29 different occupations with each occupation ranging in number of respondents from 19-264 individuals. The analysis looked at the extent to which similar domains from the O*NET correlated with similar and dissimilar constructs. The resulting relationships supported the construct validity of the instrument (i.e., that similar domains and work behaviors correlated positively and dissimilar domains and work behaviors exhibited low or negative correlations).

Demonstrated Applications The O*NET was developed as a means to identify, define, and classify occupations and provide a searchable database that individuals can use to understand occupations and make determinations as to the person-occupation fit based on a variety of domains.

Usability Information   While the measure itself is rather lengthy and actually contains several questionnaires, it seems to be very user friendly. The website offers a simple way to find occupations of interest based on individual differences such as work values or interests. This can be done by anyone with a basic knowledge of Internet navigation.

Position Analysis Questionnaire (PAQ)

Development   As a foundation for development of the PAQ, interviews with job incumbents and observations of performance in a wide variety of jobs were conducted. On this basis, the PAQ's predecessors (e.g., Checklist of Work Activities, Palmer & McCormick, 1961; Work Activity Profile, McCormick, Gordon, Cunningham, & Peters, 1962; and previous forms of the PAC McCormick, Jeanneret, & Mecham; 1971) were developed. More information regarding its development can be found in McCormick (1979) and McCormick and Jeanneret (1988).

Content Domains   The PAQ is a 195-item structured interview that has received extensive research. Its content framework is defined by six major content domains including: Information Input, Mental Processes, Work Outputs, Relationship with Other Persons, and Job Context. These content domains can be subdivided into 45 job dimensions.

Orientation/Focus   In order to assess a comprehensive amount of job components, the PAQ focuses primarily on job behaviors. Based on six different types of rating scales the interviewer is able to assess a behavior's

extent of use, importance to the job, amount of time, possibility of occurrence, applicability, and item specificity. Task specific information can be gathered based on pre-interview preparation. Results of the PAQ interview can be linked to job-specific KSA based on extensive research on general aptitude measures such as the General Aptitude Test Battery (GATB) and others.

Reliability Evidence   Evidence for its reliability has been well established (Taylor & Colbert, 1978; Frieling, Kannheiser, & Lindberg, 1974). Inter-rater reliabilities are rather good. The mean inter-rater reliability for different analysts is .68 (range: .35 to .95). The mean inter-rater reliability for the same analyst is .78 (range: .45 to .95). Reliability coefficients for the job dimension scores range from .60 (low quartile) up to .99 (high quartile).

Validity Evidence   Extensive research on the PAQ has indicated evidence for its validity (PAQ Technical manual, 1989). Several exploratory and confirmatory factor analyses have validated the conceptual structure of the 195 items and 45 job dimensions. Through the use of general aptitude tests, the PAQ's job component validity (synthetic criterion) has been well established. The PAQ's job dimensions and individual items have been related to several constructs of the GARB, reflecting job component validity.

Demonstrated Application   Research has confirmed its utility for areas such as job family development, selection, performance appraisal, job evaluation, compensation, and the prediction of exempt status.

Usability / Practicability   Previous comparisons have put the PAQ on top of the list regarding its usability and practicability (Levin, Ash, Hall, & Sistrunk, 1983; McCormick & Jeanneret, 1988). Some disadvantages, however, include a high reading level and its attendant need for rater/interview specialists. Such specialists need to be well trained and compensated. Preparing and conducting the interview takes about 3-4 hours on the interviewer side and 3-4 hours on the interviewee side. Extensive preparation before and after the interview appears to be important for the job analysis process. Some findings suggest that it is best suited for blue-collar rather than professional, managerial, and technical jobs.

A Critique of Existing Job Analysis Systems

Fleishman's research on JAS started with the development of a taxonomy of abilities underlying the world of work (Fleishman, 1975, 1982; Fleishman & Quaintance, 1984). The initial taxonomy consisted of 52 cognitive, physical, psychomotor, and sensory abilities. It was later expanded to include social-interactive abilities, job skills, and knowledge (Fleishman,

1992). This taxonomy has a strong research base and is very highly regarded by the professional community. In fact, McCormick et al. (1972) and Cunningham et al. (1983) used earlier versions of Fleishman's taxonomy as a basis for developing lists of attributes for the PAQ and OAI job analysis systems, respectively. Despite its strong psychometric foundation, the JAS taxonomy of abilities is somewhat old and may require significant updating to reflect jobs in the current economy, especially the dot com industry. Furthermore, JAS has not been applied to a large number of jobs in the US economy to generate an occupational database (National Research Council, 1999). (It should be noted that, while the number of jobs assessed with Fleishman's taxonomy is limited, there is information on the minimal levels of abilities required for successful performance on the jobs analyzed with the JAS. Thus, there is work here that may be leveraged later in the process of establishing thresholds for the job demand variables as related to the disability adjudication process.) There are, however, a number of factors that limit the applicability of the F-JAS for the disability determination process including: the global theoretical nature of Fleishman's descriptors and a lack of a sufficient occupational database.

As job analysis systems, PAQ and OAI have much in common in terms of their philosophy, development, item content, and score reports, except that OAI has more items and has a lower reading level than PAQ. Both systems report job level information on aptitudes, with 67 aptitudes for PAQ and 103 aptitudes for OAI. While some of these aptitudes are comparable in meaning to Fleishman's abilities, they are not empirically derived as Fleishman's abilities were. The aptitudes in PAQ and OAI were based on prior research by other investigators (e.g., Fleishman, 1975; French, Ekstrom, & Price, 1963) and on the information contained in the DOT. Several Division 14 (Society for Industrial and Organizational Psychology) members of the American Psychological Association (APA) and some psychology graduate students rated the relevance of each aptitude to each of the items in the PAQ. Only psychology graduate students were involved in rating the relevance of the aptitudes in the OAI. The fact that the aptitude ratings did not directly relate to specific jobs makes it very difficult to justify the use of these lists of aptitudes as constituting the job demand variables for use by SSA. These aptitudes along with Fleishman's ability taxonomy, however, may serve as prompts in the proposed methodology and/or as a basis for validating an independently derived list of job demand variables within the context of this project.

Harvey's CMQ is a job analysis system similar to the OAI in terms of its orientation and behavioral specificity. The psychometric assessment of CMQ was based on data generated from over 4500 positions involving more than 900 occupational titles. Job incumbents provided much of the data. Factor analysis of these data resulted in 80 dimensions. The dimension scores have proven to be highly predictive of mean aptitude scores reported in the DOT. Unlike PAQ and OAI, CMQ currently does not have any provision for aptitude ratings. This severely restricts the use of CMQ as the basis for generating job demand variables in making valid disability determinations. However, some of the experimental methods used for assessing the psychometric quality, as well as the establishment of a common metric, of CMQ may prove valuable in the proposed methodology.

The most recent of the job analysis systems reviewed in this chapter is O*NET. It was developed as replacement for the DOT. O*NET was developed as a means to identify, define, and classify occupations and provide a searchable database for exploring occupational potential. A major contribution of O*NET is the development of cross-job descriptors that offer a common

language to describe different jobs. This was achieved at the price of specificity, typically required in many applications of job analysis data (Peterson et al., 2001). An important consequence of this development is that the 12,000 job titles in the DOT are now classified into about 900 O*NET occupational units. While O*NET allows for gathering job specific information, it must be done at the occupational unit level. This transition from individual jobs to occupational units makes it very difficult for SSA to obtain detailed, specific information about jobs, especially those that have low physical/mental/skill requirements (Karman, 2002). Industrial/Organizational (I/O) and Rehabilitation Professionals have raised questions about the psychometric quality (the use of holistic rating scales for rating abilities and other constructs, the size and representativeness of jobs used for gathering psychometric data, and levels of inter-rater reliabilities) of O*NET (Harvey & Wilson, 1998). The reported reliability and other psychometric data were based on only 29 (out of 80 sampled) occupations (Peterson et al., 2001), raising questions about the stability and generalizability of these results. Suffice it to say, these limitations (especially the lack of specificity at the job level) have led to the current project for identifying optimal job demand variables for use in disability determinations.

The five instruments (F-JAS, PAQ, OAI, CMQ and O*NET) discussed thus far are job analysis systems. In addition, McCroskey's Vocational Quotient System (MVQS) is a computer program designed to provide job-person matching, transferable skills analysis, values, needs, vocational interest and personality reinforcer type indicator, and earning capacity estimation (McCroskey, 2001). Additional information about MVQS is provided in Appendix B. While MVQS is not a job analysis system in the traditional sense, some may look upon this as a mechanism for generating job demand variables. For example, the transferable skills component of MVQS provides ratings of jobs on a scale from 0% to 97% in terms of transferable skills. This implies that MVQS has information on the needed skills or abilities for each job and the extent to which these skills/abilities are transferable across jobs. The information that MVQS uses in making these transferable skill projections are the data from DOT, which are considered outdated, and the data on O*NET, occupational units, which are known to be unreliable. In addition, the transferable skill ratings are analytically derived, lacking empirical verification of these projections. While a recent study has offered support for the transferable skill projections (Grimley, Williams, Hahn, & Dennis, 2000), there is still a need for more empirical verification of the MVQS predictions, prior to seriously considering it (MVQS) as a mechanism for generating job demand variables.

In summary, there are several reasons for conducting a separate study for generating job demand variables for SSA's use in disability determinations. Some of the important reasons are: (a) Existing job analysis systems do not sufficiently address the needs of SSA in assessing the RFC of claimants for the purpose of determining disability, (b) with the exception of O*NET, the available job analysis inventories (and their derived job demand variables) may not adequately reflect the fast changing world of work, especially the dot-com industry; while O*NET is a new system, its serious deficiencies in meeting the needs of SSA are well known (Harvey & Wilson, 1998; Karman, 2002), and (c) recent advances in measurement technology (Muraki & Bock, 1996; Hambleton, Swaminathan, & Rogers, 1991; Lord, 1980; Wright & Master, 1982; Wright & Stone, 1979,) allow for a more precise assessment and simultaneous calibration of jobs and job demand variables on a common metric. This proposed study/methodology is described in the next chapter.

Chapter 3

A Methodology to Identify Optimal Job Demand Variables

The previous chapter has described some of the commonly used methodologies for conducting job analyses and identifying job demand variables across a wide range of job families. Also described are five well-known, structured systems/questionnaires for analyzing jobs and identifying essential human attribute requirements (e.g., physical, psychomotor, sensory, cognitive, and psychosocial) in a job or job family. In this section, we recommend a methodology for identifying job demand variables in a wide range of job families, with a special emphasis on the optimal job demand variables that SSA would be required to, or needs to, consider in articulating the residual functional capacity (RFC) of claimants for disability benefits.

Essential human attribute requirements, known from the extensive, well documented research by the five job analysis systems/inventories as well as from the FJA research (see Appendices A - F), appear to be quite comprehensive and may form the basis for the current project. Some may contend that this comprehensive list of human attributes or a subset of it be used as the list of essential job demand variables for the current project. While such a contention has merit, we recommend that a special survey be conducted for identifying optimal job demand variables. The underlying rationale for the current proposal is as follows.

The proposed methodology for conducting a special survey to identify essential job demand variables will consist of three major phases: (1) Survey Development, (2) Identifying Survey Participants, and (3) Survey Administration and Analysis. Each of these phases is briefly described below.

Survey Development

Subject matter experts (SMEs) should play a key role in defining the content of the survey. Among others, SMEs must include rehabilitation professionals and educators, vocational experts, professional job analysts, industrial/organizational (I/O) psychologists, professional experts in survey development (including measurement specialists), and representatives from SSA. Special focus groups may be required at various phases of survey development, including small groups of individuals to try out the survey prior to its administration.

Special attention should be given to the format of the survey questions/items. Both multiple-choice (including Likert-type) and open-ended or constructed-response formats should be considered in developing items for the survey. In the case of multiple choice formatting, we must also take time to create an appropriate rating scale.

The content coverage of the items/questions in the survey must be comprehensive enough to tap all major goals of the survey. For example, the survey should be capable of

gathering information on variables such as the following, in a wide range of jobs in the modern economy:

- Activities required
- Relationship between job tasks or sequence of actions
- Specific requirements of tasks (i.e., sitting, standing, walking, etc.)
- Job context (including environmental variables)
- Physical, psychomotor, sensory, cognitive, and psychosocial abilities

Survey developers should pay careful attention to what is currently known about the essential job demand variables in the world of work, so that survey items can be written to reflect and/or emphasize the special goals of the survey. The job demand variable information provided in Appendix E may prove very beneficial in this context. We recommend that this information be integrated and leveraged by first conducting a comparative content analysis of the most well researched standardized job analysis instruments with a focus on identifying those job demand variables that converge across the instruments. Next, we recommend an analysis of data from existing standardized job analysis questionnaires with the aim of identifying those job demand variables that are rated most highly in terms of frequency or importance across a range of job families. A list of job demand variables that is distilled from the content and frequency analysis of standardized questionnaires may then form the basis for either objective (multiple choice) survey items and/or prompts for open-ended questions, which ensure that participants make their responses as complete as possible.

Survey Participants

While it may be desirable to have job incumbents and their supervisors as survey participants, the logistics and the expense associated with such a scenario would probably argue against it. Therefore, we recommend the use of several thousand professionals, similar to the ones mentioned in survey development, as participants: Rehabilitation professionals and educators, vocational experts, professional job analysts, and I/O psychologists. In addition, representatives from the Interorganizational O*NET Task Force (IOTF) on the O*NET should be solicited for participation. Furthermore, we recommend that samples of members from the following professional organizations be contacted for participation in the survey: The American Association of Occupational Health Nurses, American Board of Vocational Experts, American Disability Representation Specialist Association, American Occupational Therapy Association, American Physical Therapy Association, American Rehabilitation Economics Association, California Association of Rehabilitation Professionals, Disability Management Employer Coalition, International Association of Rehabilitation Professionals, National Association of Private Providers in Rehabilitation, Society of Industrial/Organizational Psychologists, Vocational Rehabilitation Counselors, and Vocational Educators.

Whatever may be the source of the survey participants, the survey sample must be as representative as possible of the relevant professional groups and must be knowledgeable about the world of work, with a sufficient understanding of SSA's need for assessing the RFC of claimants for disability benefits. It is proposed that we work closely with SSA staff in establishing appropriate (and statistically defensible) parameters for selecting a representative sample of professionals. In addition, they must be given ample time to get familiar with the web-based system. Support should consist of training assistance, license to pilot the system, and any documentation needed for further clarity. All participants will be given the same survey irrespective of their professional affiliation or specialty.

Survey Administration and Analysis

We recommend that the survey be administered on the World Wide Web. That is, the participants would be asked to enter their responses to the survey questions using a Web portal connected to the project database. There are several advantages to using a Web-based administration over traditional paper-pencil administration: Cost effectiveness in terms of data collection; ease of keeping track of respondents, late respondents and non-respondents; and cost effectiveness in terms of initial data quality check, data transmission, and subsequent data analyses.

Automated Concept Mapping

For the analysis of survey data, we recommend the Automated Concept Mapping technique (ACM) that allows researchers to analyze input from a large sample of professionals regarding core job demands. Automating the mapping process using computers to link both multiple Web sites and multiple respondents expands the input for developing concept maps, increasing the probability of accurate knowledge representation (Anderson-Inman & Horney, 1996; Marshall & Haley, 2000). Literally thousands of stakeholders can potentially participate in the computerized data-collection process (Bryson & Anderson, 2000).

Concept mapping is a technique for graphically representing information to facilitate knowledge creation and problem solving (Jonassen, Beissner, & Yacci, 1993). This essentially deductive classification procedure develops concept maps or visual representations of knowledge (Alpert & Grueneberg, 2000). The objective of mapping ideas is to classify items into mutually exclusive groups after natural groupings based on item similarities are identified. The analysis is only descriptive and has no inferential properties, identifying interdependencies among terms without treating them as dependent or independent variables (Hair, Anderson, Tatham, & Black, 1992).

Traditional data collection methods use semi-quantitative techniques and reduce data to predetermined themes. ACM, on the other hand, incorporates a text-based method of content analysis that enables respondents to use their own language in providing responses to survey questions. Text clustering or free text analysis utilizes computing technology to produce "themes" from survey responses that can then be

checked and confirmed with smaller groups of experts and stakeholders. The formation of "themes" from natural language (free text) is a necessary preprocessing step that will transform a very large number of free text survey responses to clusters of like responses or "themes." This set of themes provides a more manageable dataset, that is, a dataset with less redundancy, for the various steps that experts will perform to categorize and rate the job demands.

Concepts resulting from an application of ACM can be tested for reliability and validity. This procedure allows researchers to access and analyze the expertise of a large sample of professionals in order to identify a hierarchy of optimal or core job demands. For the purposes of the job demands project, the professionals to be sampled will include vocational experts, certified rehabilitation counselors, occupational therapists, and industrial and organizational psychologists. The ACM process will involve a repeated iterative interaction between a small representative focus group and a large, geographically distributed group of respondents. The procedure is an analytical variant of traditional survey/focus group methodologies. It reduces potentially biasing factors, such as pre-selection of a limited number of participants, closed set item response options, and non-automated concept identification from textual information. The resulting concepts are expected to have a high degree of content validity. The ACM procedure consists of five major steps for the job demands project, which are described below.

Step 1: Data Collection from a Large Group.

Participants will be asked to enter their answers to the survey questions using a Web portal connected to the project database. Since an existing Internet infrastructure will be utilized, it is critical that systems be put in place to prevent break-ins and the transmission of bogus information to the server (Wen & Tarn, 2001; Erlanger, 2001). A secure Web site for collecting and archiving comments from the large group of geographically distributed respondents will be designed for the project.

Standard security practices available for Internet transactions will be used. The following measures will be implemented to insure that information is protected:

- User name and password authentication will be required for server and Web site access.

- Data encryption will be used for sending and receiving information between a client and the server.

- Client and server computer identity will be verified with a digital signature through the use of certification from a certificate authority.

- A firewall will be installed to prevent any break-ins and block unwanted information from getting to the server.

- Limitations will be set on the number of people that can access the server at one time to prevent the threat of denial of service attacks.

- Audit trials will be captured so that all access to the Web site and thus the database is documented.

Participants in the large group data collection will be asked to write their responses without pre-determined text limits or response constraints. Responses will be of no fixed length and will include some multiple-choice options. The Web interface will provide clear instructions and visual cues for effectively completing the information collection task. It is especially important for the automated mapping analysis to effectively guide the participants toward providing pertinent and succinct responses to specific queries. Ample space will be provided for the collection of general and/or non-task relevant comments so that responses to targeted queries remain as topic relevant as possible.

Step 2: Identification of Core Concepts from the Large Group Data.

Concept identification will utilize unsupervised clustering techniques (preprocessing) to group like responses. This approach will use a minimum of domain knowledge, i.e., expert opinion regarding core job demands, and is expected to provide a baseline for comparison of follow-on techniques. The purpose of this approach to concept identification is to preprocess a very large set of free text survey responses to discover a universe of job demand themes (text clusters) with a minimum of redundancy among the themes. Subject matter experts (SME) can screen, sort, and rate these themes, or potential job demand definitions, to provide a single list of non-redundant job demand variables for later analysis.

Step 3: Sorting and Prioritizing the Job Demand Variables.

Each participant will then sort the job demand variables on the single list (generated in the previous step) into non-overlapping categories using whatever category definition "makes sense" to the participant (Trochim, Cook, & Setze, 1994); that is, no specific definition of a category will be given to the participants.

The participants will also be asked to rate the importance (e.g., in terms of applicability to the world of work and/or in terms of making valid disability determinations) of each job demand variable, using a Likert-type scale.

Step 4: Identification of Dimensions of Job Demands.

The next phase of the ACM procedure would involve the determination of the underlying dimensionality of the sorted job demand variables using multidimensional scaling procedures (MDS; Trochim et al., 1994).

MDS is a technique for identifying and studying the structure of objects. In the present context, job demand variables will play the role of objects. Knowing how the participants sorted the job demand variables into the same or different categories will help determine the degree of similarity between the job demand variables. This then would help identify the underlying structure of the job demand variables. The end result of an MDS analysis in the present context would be to describe each job demand variable as a point in an n-dimensional space. For example, in a 2-dimensional space, each job demand variable (e.g., static strength-upper and lower body, oral expression) will have two coordinates, one for each of two dimensions (e.g., physical and cognitive)(see Figure 3-1). There are currently many procedures for performing an MDS analysis, and information about some of these procedures may be found in Davison (1983).

Figure 2.1: MDS Analysis

Physical — * (static strength)

* (oral expression)

Cognitive
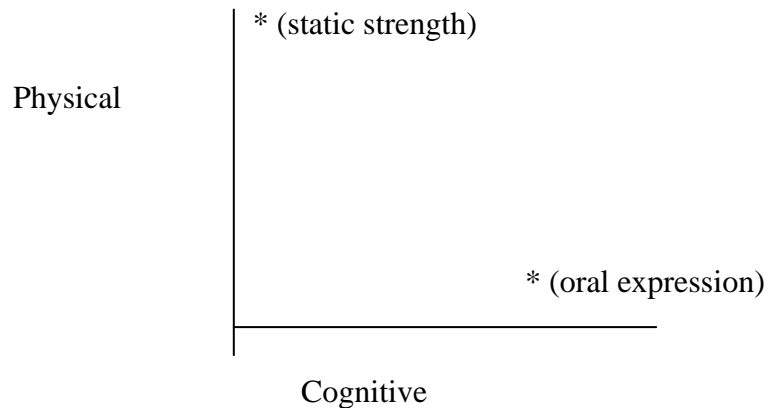
Step 5: Clustering of Job Demand Variables.

The multidimensional coordinates for each job demand variable would form the basis for a cluster analysis (Everitt, 1980) of the job demand variables in the final phase of ACM. Data clustering attempts to solve the following multivariate data analysis problem as described by Everitt:

> Given a sample of N objects or individuals, each of which is measured on each of p variables, devise a classification scheme for grouping the objects into a number of classes such that objects within classes are similar in some respect and unlike those from other classes. The number of classes and the characteristics of each class are to be determined. (Everitt, 1980, p. 1)

The data analysis will involve cluster analysis, an empirical procedure used to classify a sample of items into relatively homogeneous sets. In the clustering procedure,

individual response items are placed in groups or clusters with similar characteristics. The similarity or association between the items will be measured to determine group composition. This clustering will involve the calculation of a distance, such as the Euclidian straight-line distance, between cases with respect to certain pre-determined clustering variables. Cases that are closest to each other in distance will be assigned to the same cluster (Lorr, 1983; Romesburg, 1984).

Cluster formation techniques vary depending on the type and number of cases being analyzed (Anderberg, 1973). One of the most prevalent approaches uses a group of methods known as hierarchical clustering algorithms. In this application, cluster analysis could be used to group objects (jobs demands) in order to highlight relationships amongst the objects. For example, lifting is related to bending, grasping, and reaching. The classification process can be a top-down, "divide and conquer" approach or, alternatively, a bottom-up, agglomerative process. The type of cluster analysis that will be used for defining text concepts is an agglomerative (bottom-up) technique that models individual text items (job demand variables) in relationship to job demand dimensions (e.g., physical, cognitive, and psychosocial dimensions).

The agglomerative process will begin by placing each individual response in its own cluster and computing the similarity values for all possible cluster pairings. The two most similar clusters will then be combined and the process repeated until either a finite number of clusters are formed or the similarity between any two clusters does not rise above some threshold value.

The similarity between two items is not the same as the similarity between two clusters of items. In fact, there are several ways of computing the similarity between two clusters. One can measure the distance between the members of each cluster that are the closest (since link) or farthest (complete link) apart. The group average similarity between all pairs of items in the two groups will be calculated which recent research suggests is a more accurate approach.

In summary, we have described a multi-method approach that capitalizes on the best of existing approaches but that adds the advantages of state-of-art the approaches that will identify job demands that better meet SSA's needs in the disability determination process. We suggest that time and effort can be saved by capitalizing on it will be important to begin by identifying variables already existing in the literature. However, since there is a notable paucity of cognitive and psychosocial job demands within existing systems, we propose a method for identifying these job demands.

Vocational factors are a critical part of disability determination decisions and vital to all levels of the disability adjudication process. ACM and cluster analysis will identify these vocational factors in terms of core job demands and their hierarchical order. The use of experts knowledgeable in how the information will be used in disability determination is the strength of this method of concept identification and mapping.

Chapter 4

Procedures for Validating Job Demand Variables

A methodology for identifying optimal job demand variables was proposed and discussed in the previous chapter. This methodology consisted of three phases: Development of a survey questionnaire for administration on the Internet, identification of a sample of survey participants and administration of the survey, and use of a data analysis technique based on the automated concept mapping (ACM) procedure. Some of the factors influencing the results from these three phases are:

- The breadth and types of survey questions used,
- Subjectivity of response data (measurement error),
- Variation due to sampling error,
- Assumptions/limitations of the data analysis techniques employed.

While these factors are certainly not unique to the current situation (and are typically encountered in most investigations of this type), each of these factors could potentially limit the generalizability and/or the validity of the set of optimal job demand variables. Therefore, it is essential that this optimal list of job demand variables be verified from information generated from other independent sources before the list is considered valid. Indeed, multiple and independent confirmations of the list of optimal job demand variables are needed for assuring the validity and comprehensiveness of this list.

The purpose of this chapter is to describe the procedures needed for assessing the accuracy and completeness of the list of optimal job demand variables. This assessment is an essential component of the validation of the job demand variables previously identified. According to Anastasi and Urbina (1997), validity provides a check on how well a questionnaire or a list of optimal job demand variables fulfills its function. While the quality of the methods and procedures used in developing such a list of job demand variables is a necessary prerequisite to establishing the validity and comprehensiveness of such a list, this in itself may not be sufficient to assure the validity of the end product. These methods and procedures may be subject to certain practical and theoretical shortcomings as noted above, which may make the end result somewhat less than optimal.

Prior to describing this first phase of procedures for assessing the validity and comprehensiveness of the list of optimal job demand variables, it should be noted that the psychometric questions of validity and reliability might not be easily separable in the present context. For example, an independent confirmation of a list of optimal job demand variables may be viewed as reliability by some and as evidence of construct validation by others. While both interpretations are probably justifiable, our goal here is to describe methods for assessing the comprehensiveness of the list of optimal job

demand variables. That is, we want this list to be valid in the sense of being responsive to the needs of SSA in making valid disability determinations and being complete in that context.

This chapter describes several methods for demonstrating the validity and comprehensiveness of the list of optimal job demand variables. This is followed by a summary of the rationale for the methods, an analysis of the costs and benefits of the validation procedures, and an overall recommendation for SSA's consideration and comment.

Three initial procedures for verifying the relevance, appropriateness and comprehensiveness of the previously identified job demand variables are described in the following sections. However, before proceeding to these initial validation methods, we first present the broader context for this work.

Need for Verification/Initial Validation

Because ACM includes steps for both the generation and clustering of ideas, it provides the necessary building blocks for the validation of optimal job demand variables. Within this context, the ACM-generated ideas will be reviewed and evaluated for relevance and completeness as they relate to the disability determination needs of SSA. Subsequently, Likert-type scales will be developed for measuring jobs (and job incumbents) on the validated job demand variables. An important component of the scale development process is an empirical assessment of the psychometric quality of the newly developed scales using statistical techniques from classical test theory, item response theory (IRT), and factor analysis. Once the psychometric quality of these scales is considered sufficient, additional recommended strategies for assessing the validity of these scales in accurately describing jobs and job-incumbent profiles on relevant job demand variables will also be provided.

The first two ACM phases would involve judgment on the part of participants in generating job demand variables and later sorting them. The last two phases would also involve judgment in terms of how many dimensions and clusters to retain for accurately reflecting the final outcome. In view of this obvious potential for subjectivity in the generation of job demand variables, there is a definite need for validating the optimal job demand variables. Some initial validation procedures for consideration are as follows.

Replication/Cross-Validation:

Replication and cross-validation involves the generation of optimal job demand variables based on two independent, non-overlapping random samples of survey participants. If the two lists of job demand variables from two independent samples are very comparable or have a high degree of commonality, one can be fairly confident that future replications of the current procedures would result in similar lists of job demand variables. This type of a research design, referred to as cross-validation by some and reliability/ replication by others, was found to be very useful in many areas of statistical

estimation, especially in test validation (Guion, 1998) and structural equation modeling (Byrne, 1998).

SME Evaluation:

While the cross-validation/replication design would help determine the effects of subjectivity and idiosyncratic judgment on the final list of job demand variables, it may not be adequate in establishing the comprehensive or completeness of the final list. Different validation procedures may be needed for such an assessment. One such validation procedure is for content or subject matter experts (SMEs) to carefully review the ACM-generated list for completeness and relevance. SME panels comprised of professionals from human resources, rehabilitation counseling, and I/O psychology with experience in working with job families from discrete industries (as represented by standard occupational classification [SOC] codes) would be convened. On the basis of their shared knowledge of job demand variables required in their industries of focus, these panels will review the AMC-based list and discuss potential additions to, or deletions from, the list. Further, to ensure independent and objective validation, it is important that SME panel members would not have participated in the ACM survey. During this process, a trained moderator will facilitate consensus decisions that seek to fully justify any potential changes to the list of optimal job demand variables. Following the SME panels, the facilitators will meet to discuss and resolve any potential conflicts, which may develop from the independent SME panels.

Convergent/Content Validation:

Another validation procedure is to evaluate the ACM-generated list against existing lists of job demand variables from independent sources as identified in chapter 2 (e.g., PAQ, Fleishman Job Analysis Survey.) This approach to establishing convergent validity is analogous to establishing the construct validity of a new test (of intelligence, for example) by correlating it with a well-established test, also designed to measure the same construct (intelligence). Any additions to, or deletions from, the ACM-generated list of job demand variables based on this procedure will need to be justified. Again, trained facilitators will work with SME panels to reach consensus on any changes to the ACM generated list.

These three initial validation procedures (Replication/Cross-Validation, SME Evaluation, and Convergent/Content Validation) for assessing the relevance and completeness of job demand variables are described below in some detail as they apply to the current project. Also, the attached flow chart (Figure 1.2) highlights how each of these individual procedures fits into a coordinated whole, each contributing and building upon the prior steps in the process of validating job demand variables and shows their sequence with reference to the entire process used to identify and validate optimal job demand variables.

Procedure A. Replication/Cross-Validation

A sample of rehabilitation professionals and educators, vocational experts, vocational rehabilitation counselors, vocational educators, human resources professionals, job analysts and I/O psychologists will be selected on the basis of their experience and knowledge of job requirements in particular industry/job families. Given the number of job demand variables that may exist, a total sample of approximately 1,000-2,000 participants should provide adequate statistical power and appropriate representation of professional groups, stakeholders and industries. For purposes of increased buy-in and investment in the process by key groups that will be impacted by project outcome, an increased sample size may also be justified. We recommend that the entire sample of participants be split into two stratified, random sub-samples and that the ACM analysis is performed separately for each sub-sample. The samples will be stratified to ensure equal representation of occupational groups (e.g., rehabilitation professionals and educators, vocational experts, vocational rehabilitation counselors, vocational educators, human resources professionals, job analysts and I/O psychologists) and equal representation of expertise of important industries as defined by SOC codes. The resulting lists of job demand variables and their underlying clusters will then be evaluated for similarity and congruence. On this basis, a final list of job demand variables and clusters will be developed and proposed for operational use. This process represents the typical replication design.

An enhanced replication design, which is slightly more time consuming, involves a variation of the procedure described in the preceding paragraph (see Steps A1 & A2 on flow chart) and uses the list of job demand variables generated by one sub-sample with the second sub-sample in sorting and in the subsequent multidimensional scaling and cluster analyses. This variation would keep the initial list generation and the subsequent sorting independent of each other, thus potentially minimizing even further the effects of subjectivity in forming concept maps. Again, the two lists of job demand variables and the associated concept maps generated here will need to be carefully reviewed and merged into one for later use. This scenario may be viewed as reflecting both replication and cross-validation.

Procedure B: Evaluation by Subject Matter Experts

An additional important way to validate the job demand variables and clusters is to form panels of SMEs for the specific purpose of evaluating the completeness of the list of job demand variables generated in the Cross-Validation/Replication phase (Procedure A). The composition of SME panels should include, whenever possible, rehabilitation professionals and educators, vocational experts, vocational rehabilitation counselors, vocational educators, human resources professionals, job analysts and I/O psychologists. It will be necessary to convene multiple panels (approximately 10-20). Most panels would function with a discrete focus on jobs within a particular job family/industry, as represented by experience in working within a SOC group. We anticipate that each panel would have approximately eight participants, and we further recommend that these panels meet in face-to-face sessions to enhance the quality of the process.

Again, for this procedure to serve as an appropriate strategy for validation, members of these SME panels must be independent of the survey participants involved in ACM and Procedure A (above). SME panel members must have sufficient time to carefully review the job demand list and to freely discuss among themselves the adequacy and completeness of the job demand variables in the list. We expect that each SME panel will be convened, on average, for approximately 6-8 hours (one day). SME panel facilitators will have a crucial role to play in the outcome of this procedure and therefore should be carefully chosen and trained extensively in the areas of facilitation skills and job analysis. Facilitators will meet to discuss and resolve any potential conflicts, which may develop from the independent SME panels.

Procedure C: Convergent/Content Validation (Comparison with Existing Lists)

The previous chapter has shown the structure for major job demand variables identified in five job analysis systems (The Common Metric Questionnaire, Fleishman-Job Analysis Survey, Occupational Analysis Inventory, O*NET, and Position Analysis Questionnaire). We recommend that a single, non-overlapping list of job demand variables be generated with information from the five job analysis systems and be used as a basis for assessing the adequacy and completeness of the list generated in Procedures A/B. Given the current emphasis on disability determination, it is quite possible that the list from Procedures A/B may contain some variables that are absent in the five job analysis systems. Conversely, the list of job demand variables from the five job analysis systems may contain variables that are not reflected in the list from Procedures A/B. This approach to validation enables us to effectively build on previously validated systems while allowing flexibility to assure relevance to SSA's disability determination needs.

The major focus of this validation component should be to evaluate the degree of congruence between the two lists and clusters and to articulate possible reasons for any discrepancies. Results from this analysis may be viewed as evidence of the convergent validity of the list of job demand variables generated in Procedures A/B. Results from this exercise may also be used as evidence of construct validity of the list generated in Procedures A/B. Finally, this validation procedure will provide an additional basis on which to make decisions regarding adding to or deleting variables from previously established lists of job demand variables.

Two SME panels of six to eight participants would be convened in a face-to-face meeting of six to eight hours to compare lists. A trained facilitator would work to achieve consensus decisions among the SMEs regarding a clear rationale for any potential changes to the list of optimal job demand variables. Facilitators will meet to discuss and resolve any potential conflicts, which may develop from the two independent SME panels.

Summary and Recommendations

Three procedures were described in the preceding section for assessing the validity and completeness of the list of job demand variables described in Chapter 3. These procedures are designed to provide different types of reliability and validity evidence for the final list of job demand variables. As previously noted, each procedure provides an important and different piece of reliability and validity evidence. Therefore, we recommend that SSA seriously consider using all three procedures in assessing the validity of the final list of optimal job demand variables.

In terms of cost, Procedure B is probably the most expensive of the three procedures. Convening multiple SME panels and evaluating the panel members' input in preparing a final list of job demand variables can be very labor-intensive and costly. In contrast, Procedure A would mostly require additional data analyses, and the lists of job demand variables needed from the five job analysis systems for use in Procedure C are mostly in place. Therefore, the implementation of Procedure A or Procedure C is expected to be much less costly than the implementation of Procedure B. If cost is a major concern, we recommend that, at a minimum, Procedures A and C be used to assess the validity of the job demand variables.

Table 4-1 provides a summary of the three recommended procedures in terms of advantages and disadvantages, time and labor requirements. In addition, the flowchart (Figure 1.2) represents the sequence of the steps recommended for the validation of job demand variables and shows these steps with reference to the steps recommended in Chapter 3.

Table 4-1. Comparative Analysis of Recommended Validation Procedures

Procedure	Pros (+) /Cons (-)	Time Required	# of Participants
Procedure A: Replication/ Cross-Validation Design	+ powerful research design; relies on previously obtained data—efficient and cost effective	3 – 6 months	No additional sample required, will use data obtained from original 1000 – 2000 participants in ACM (see chapter 2)
Procedure B: Evaluation by SME Panels	+ interactive process among experts to facilitate creativity and critical thinking; + additional buy-in; - potentially expensive due to time and travel requirements	4 months	160

	for experts		
Procedure C: Comparison with Existing Lists	+ leverages best practices associated with current job analysis systems	2 months	16
A + C	+ Cost effective	5-8 months	16
A + B + C	+ multi-method approach reduces bias and delivers greatest evidence for validity of list of job demand variables - cost and time	9 – 12 months	176

Chapter 5

Procedures for Developing a Job Demands Questionnaire

The previous chapters described methodologies and procedures for generating and validating job demand variables. This chapter continues the process of validating the job demands identified in the previous chapter. In this chapter, the emphasis is on further content and constructs validation. Because one of the aims of this project is to propose how to develop a minimum data set, it is critical that the job demands selected are the best representatives of the constructs. This means the demands, as they are represented by data collection items, cover an appropriate range of content of the previously identified clusters and that the items cover the range of complexity of those demands seen in the work place. That is, the content of the job demand items should represent what is most commonly seen in jobs in the economy. For example, one of the frequently cited reasons for the obsolescence of the DOT is that the kinds of demands included are predominantly heavy manual labor. However, as technology has increasingly replaced heavy labor demands, more jobs require increased hand and finger dexterity. Thus any attempt to accurately capture the demands of current jobs should reflect these changes.

This goal of selecting items will be achieved by converting identified job demands in to survey items with rating scales. This chapter describes procedures for developing a questionnaire for rating jobs and job families on the job demand variables identified and validated in Chapters 3 and 4. The goal of this chapter is to develop a psychometrically sound mechanism for generating a description or profile for each job or job family using the relevant job demand variables previously identified. Such a description or profile should be capable of furnishing reliable information on what the relevant job demand variables are for each job or job family and the minimum level of proficiency required on these variables for successful job performance by an incumbent. This requires the following:

1. Development of a questionnaire with Likert-type items (or other appropriate type of format), covering all job demand variables from Chapters 3 and 4,

2. Use of the questionnaires and the different scales to rate a representative sample of jobs or job families and,

3. Establishment of minimum proficiency levels (or thresholds) for jobs or job families.

An assessment of the reliability, validity, and calibration of the questionnaire and its scales is an integral part of this chapter. These three major components are described below in detail.

Questionnaire Development

The measurement and calibration of job demand variables could be conducted using one of two methods. In the first method, ratings of job demand variables are made in global terms, whereby the questionnaire respondent is rating broadly defined variables (e.g., oral expression, physical strength). In the second method, ratings of job demand variables are made in terms of discrete behavioral manifestations through which a hierarchical scale of behaviors serve to define the job demand variable. We call this first method the "global approach" and the second method the "behaviorally-specific approach." For example, in defining oral expression, individual items might include "exchanges routine information," "initiates conversations," "presents information for the purpose of instruction or influence," and "coaches and counsels others." The advantages of the first option include a far briefer questionnaire and the ability to rate both job demand variables and jobs on a common metric within discrete dimensions (e.g., physical, cognitive, or social dimensions). With the second approach a common metric would be created within job demand scales, but not across scales. Because of the specificity with which items are written for each job demand variable, the second method has the potential to provide a direct means of translating job demands to worker proficiency. This feature would better meet SSA's disability determination needs. This second method would depend on being able to write a sufficient number of job demand items for each scale. A minimum of six to seven items is typically required by IRT to form scales with sufficient precision.

Regardless of the approach taken, the quality and interpretability of any measure of job demands relies largely on the care and quality with which job demand concepts are translated into items and rating scales. Carelessly developed questionnaires and rating scales will yield unsatisfactory data. This section discusses issues in the development of a quality job demand questionnaire.

The development of a questionnaire to evaluate job demands begins with the translation of job demands produced by the methodology outlined in Chapters 3 and 4, into items to which respondents (incumbents, supervisors, and job analysts) can provide quantifiable responses. Questionnaires in the behavioral sciences consist of items with a response format, typically multiple-choice, Likert-type, constructed-response format, or a combination of these. Both writing the item text and choosing the appropriate rating scale are critical to producing data that can actually be applied to the required task. In the sections that follow, we consider concerns for developing an effective rating scale and then consider how to write quality items.

Selecting Rating Scale Response Categories

The first issue to be considered in developing rating scales response categories is to be clear about the continuum to be described. For example, scales that capture human performance can be measured from the perspective of ability or from the perspective of need for assistance. The rating scale anchors would each capture a different aspect of

ability. For example, the first rating scale in Figure 5.1 could be used to illustrate frequency of performing a job demand such as heavy lifting. The second rating scale in Figure 5.1 could be used to illustrate the importance of heavy lifting.

Figure 5.1. Anchors for frequency and importance

Frequency anchors			
At least hourly	At least daily	At least weekly	At least monthly
O	O	O	O

Importance		
Essential	Important	Of minor importance
O	O	O

While these scales could be used to rate the identical items, they provide quite different perspectives on performance. Similarly, in the selection of rating scale anchors for capturing a continuum of job demands it is essential that rating scale anchors are chosen so as to define the appropriate continuum of measurement.

Commonly used rating scales in the job analyses literature include frequency, proficiency, effort, importance, and competence (U.S. Department of Labor, 1991; McCormick & Jeanneret, 1988; Harvey, 1998; Peterson et al., 2001, Fleishman & Mumford, 1991). Rating scales place both job demands and jobs on a continuum from less to more of the underlying trait. That is, jobs will vary in the number of job demands rated as frequent, in degree of proficiency needed, in amount of effort exerted, in importance of items performed, and so on. For example, for a proficiency scale, one end of the continuum would be defined by jobs that do not require performance of a job demand, independent of constant supervision, while the other end of the continuum would be defined by jobs that require not only performance of adequate speed and quality but also adaptability and supervision of others' performance. The former would describe unskilled jobs while the latter would describe highly skilled jobs. It can be seen then, that choosing the appropriate rating scale and stating clearly the underlying continuum it represents, is critical to designing an instrument that produces data which can be used for the intended purposes. Therefore, determining the necessary continuum needed to discriminate amongst jobs determining on what continuum discrimination amongst jobs is needed will be critical for SSA.

Selecting the appropriate range of response categories

The next issue to be considered in selecting an appropriate rating scale relates to ensuring that the range of variability that exists amongst jobs on the continuum of interest can be adequately detected by the anchors of the rating scale. For example, a 5-point frequency rating scales may have anchor extremes of "never" or "constantly". However, since few jobs have optimal job demands that are performed never or constantly, all

variability in jobs must be captured by the remaining three categories (anchors). Since it is more likely that jobs vary in their hourly or daily performance of job demands, scales like Harvey's CMQ, which includes hourly, hourly to daily, daily to weekly, and so forth, are likely to be more discriminating. This is not an argument for a large number of rating scale categories but rather that the categories chosen should reflect where most discrimination in the scale is needed. For example, it should be carefully considered if the discrimination between anchors such as "never" and "almost never", "very important and extremely important", and "sometimes critical to proficient performance" and "usually critical to proficient performance" are useful and necessary for the measurement task.

Additional considerations

Additional considerations in developing a rating scale is to clearly determine relevant parameters such as congruency of scales to be used by multiple raters, the time frame to be captured, the degree of precision with which a judgment can actually be made, and whether a neutral category is natural and necessary (Fink, 1995b). For SSA's needs, an additional consideration could be developing a rating scaling that could be calibrated with the abilities identified in the claimant's residual functional capacity.

Having several different groups of respondents, such as incumbents, supervisors, and job analysts, score a set of items can increase reliability and generalizability (Cascio, 1991). However, in order for such ratings amongst various types of respondents to be comparable, the continua of the rating scales must be the same. For example, in the development of the O*NET the authors developed questionnaires that were to be rated by both incumbents and job analysts. However, the rating scales for job analysts were not the same as those for incumbents and a series of messy and statistically suspect translations were undertaken. For example, in Table 5.1 below (Campbell, 2001), analysts rated the frequency of physical items on a 5-point, 0-4 scale, with text anchors of "never" to "always" while incumbents rated the same items on a 5-point 1-5 scale (originally a 6-point scale) with text anchors quantified by the approximate amount of time spent on the task.

Table 5.1. Rating Scales: Job Analysts versus Incumbents

For Ratings of Frequency of Physical Requirements* **(e.g., Walking, Running)**				
Analyst Questionnaire				Incumbent Questionnaire (revised)
Always	4	→	5	Continuously or almost continuously
Often	3	→	4	More than half the time
Sometimes	2	→	3	About half the time
Almost never	1	→	2	Less than half the time
Never	0	→	1	Never

In Table 5.1, in neither case (incumbent or job analyst) is a time period specified as a frame of reference, for example, during an average week, during the past year. Specifying a time frame for respondents helps encourage consistency amongst and between various types of raters (Fink, 1995b).

Consideration should also be given to creating a rating scale to which respondents can make informed responses rather than vague guesses. For example, the original version of the incumbents' rating scale of the O*NET for physical requirements (Campbell, 2001) required the incumbents to respond to a 6-point scale with the following anchors: Never, Under 10% of the time, 10-33%, 53-67%, Over 67%, and Almost continually. It seems unlikely that incumbents can really distinguish if they are spending 66% or 68% of their time walking.

The use of neutral or middle categories have for some time been shown to be problematic (Garland, 1991). Neutral categories often occur in the middle of a rating scale and include such phrases as "moderate," or "neither frequently nor infrequently." Neutral categories may discourage respondents from making decisions about where on the continuum their rating lies. Use of a neutral category should be made judiciously and its impact on responses evaluated.

In addition, recent work has shown that text-less anchors may not be used as frequently as those with text. For example, job analysis systems such as F-JAS and O*NET use up to 7-point rating scales with text descriptors provided for 3 anchors (generally each end and middle rater category). Recent literature has suggested that unlabeled categories are less frequently used than labeled categories because they have an ambiguous meaning (Lopez, 1996).

Types of Ratings

Earlier in this chapter we distinguished two methods for assessing job demand variables. For both methods frequency and importance ratings should be collected. These frequency and importance ratings are recommended for use in selecting the minimum number of job demands that describe a wide range of jobs in the economy and which are most frequently encountered for SSDI and SSI applicants. For the global approach, proficiency ratings will also be used. Proficiency ratings would be collected to establish thresholds for satisfactory job performance. Proficiency ratings will be needed due to a lack of behavioral specificity, while the frequency ratings alone could serve this purpose for the behaviorally-specific approach.

In this section, we describe how ratings of frequency, importance, and proficiency, can be applied to both job demand variables (for the global approach) and for items within a specific job demand (for the behavior-specific approach). We give examples for physical and psychosocial (communication) dimensions. These are only examples and such clusters/dimensions may or may not actually be identified from empirical data. We provide four examples of physical job demands and psychosocial job demands. We then use one of these job demands as an example in the physical and psychosocial, behaviorally-specific examples. These items are simply examples,

provided for illustrative purposes only. Careful writing of items and rating scales will be undertaken by SMEs using feedback from respondents of the web-based survey described in Chapter 3.

Frequency

The frequency anchors are designed to elicit information about how often a job incumbent would engage in a job demand for successful performance on the job. Gael (1983) has recommended frequency ratings as a valid basis for job analysis.

Figure 5.2. Frequency Ratings: Physical job demands (global)

Physical Job Demands:
In order to satisfactorily perform this job, how often does it require:
Physical Strength (e.g., lifting and/or moving objects)

At least hourly	At least daily	At least weekly	At least monthly
○	○	○	○

☐ *Not applicable to this job*

Figure 5.3. Frequency Ratings: Physical strength (behaviorally-specific)

Physical Strength:
In order to satisfactorily perform this job, how often does it require:
Moving light-weight objects (10-20 lbs) by hand for short distances (less than 50 feet)?

At least hourly	At least daily	At least weekly	At least monthly
○	○	○	○

☐ *Not applicable to this job*

In order to satisfactorily perform this job, how often does it require:
Moving light-weight objects (10-20 lbs) by hand for long distances (more than 50 feet)?

At least hourly	At least daily	At least weekly	At least monthly
○	○	○	○

☐ *Not applicable to this job*

In order to satisfactorily perform this job, how often does it require:
Moving heavy objects (over 50 lbs) by hand for short distances (less than 50 feet)?

At least hourly	At least daily	At least weekly	At least monthly
○	○	○	○

☐ *Not applicable to this job*

In order to satisfactorily perform this job, how often does it require:
Moving heavy objects (over 50 lbs) by hand for long distances (more than 50 feet)?

At least hourly	At least daily	At least weekly	At least monthly
○	○	○	○

☐ *Not applicable to this job*

Figure 5.4. Frequency Ratings: Psychosocial job demands (global)

Psychosocial Job Demands:

In order to satisfactorily perform this job, how often does it require:
Oral Communication
At least hourly   At least daily   At least weekly   At least monthly ○   ○   ○   ○ ☐ *Not applicable to this job*

Figure 5.5.   Frequency Ratings: Oral Communication (behaviorally-specific)

Oral Communication
In order to satisfactorily perform this job, how often does it require:
The ability to exchange routine information
At least hourly   At least daily   At least weekly   At least monthly ○   ○   ○   ○ ☐ *Not applicable to this job*
In order to satisfactorily perform this job, how often does it require:
The ability to provide complex information for purpose of instruction
At least hourly   At least daily   At least weekly   At least monthly ○   ○   ○   ○ ☐ *Not applicable to this job*
In order to satisfactorily perform this job, how often does it require:
The ability to facilitate a conversation for purpose of selling or influence
At least hourly   At least daily   At least weekly   At least monthly ○   ○   ○   ○ ☐ *Not applicable to this job*
In order to satisfactorily perform this job, how often does it require:
The ability to facilitate a conversation for purpose of advising, coaching or counseling
At least hourly   At least daily   At least weekly   At least monthly ○   ○   ○   ○ ☐ *Not applicable to this job*

Importance

Ratings of importance within this context typically represent the importance of the job demand variable to the accomplishment of the overall goals or objectives associated with the job. Sanchez and Levine (1989) have shown that importance ratings can yield valid and stable data for job analysis.

Figure 5.6. Importance Ratings: Physical demands (global)

Physical Job Demands:
In order to satisfactorily perform this job, how important is:
Physical strength (e.g., lifting and or moving objects)

Essential Job cannot be performed without this	Important Preferred but not essential for job performance	Of minor importance Job performance is unaffected without this
○	○	○

☐ *Not applicable to this job*

Figure 5.7. Importance Ratings: Physical strength (behaviorally-specific)

Physical Strength:		
In order to satisfactorily perform this job, how important is:		
Moving light-weight objects (10-20 lbs) by hand for short distances (less than 50 feet)?		
Essential Job cannot be performed without this	Important Preferred but not essential for job performance	Of minor importance Job performance is unaffected without this
○	○	○
☐ *Not applicable to this job*		
In order to satisfactorily perform this job, how important is:		
Moving light-weight objects (10-20 lbs) by hand for long distances (more than 50 feet)?		
Essential Job cannot be performed without this	Important Preferred but not essential for job performance	Of minor importance Job performance is unaffected without this
○	○	○
☐ *Not applicable to this job*		
In order to satisfactorily perform this job, how important is:		
Moving heavy objects (over 50 lbs) by hand for short distances (less than 50 feet)?		
Essential Job cannot be performed without this	Important Preferred but not essential for job performance	Of minor importance Job performance is unaffected without this
○	○	○
☐ *Not applicable to this job*		
In order to satisfactorily perform this job, how important is:		
Moving heavy objects (over 50 lbs) by hand for long distances (more than 50 feet)?		
Essential Job cannot be performed without this	Important Preferred but not essential for job performance	Of minor importance Job performance is unaffected without this
○	○	○
☐ *Not applicable to this job*		

Figure 5.8. Importance Ratings: Psychosocial demands (global)

Psychosocial Job Demands:		
In order to satisfactorily perform this job, how important is:		
Oral Communication		
Essential Job cannot be performed without this	Important Preferred but not essential for job performance	Of minor importance Job performance is unaffected without this
○	○	○
☐ *Not applicable to this job*		

Figure 5.9. Importance Ratings: Information exchange (behaviorally-specific)

Oral Communication:
In order to satisfactorily perform this job, how important is:
The ability to exchange routine information

Essential Job cannot be performed without this	Important Preferred but not essential for job performance	Of minor importance Job performance is unaffected without this
○	○	○

☐ *Not applicable to this job*

In order to satisfactorily perform this job, how important is:
The ability to provide complex information for purpose of instruction

Essential Job cannot be performed without this	Important Preferred but not essential for job performance	Of minor importance Job performance is unaffected without this
○	○	○

☐ *Not applicable to this job*

In order to satisfactorily perform this job, how important is:
The ability to facilitate a conversation for purpose of selling or influence

Essential Job cannot be performed without this	Important Preferred but not essential for job performance	Of minor importance Job performance is unaffected without this
○	○	○

☐ *Not applicable to this job*

In order to satisfactorily perform this job, how important is:
The ability to facilitate a conversation for purpose of advising, coaching or counseling

Essential Job cannot be performed without this	Important Preferred but not essential for job performance	Of minor importance Job performance is unaffected without this
○	○	○

☐ *Not applicable to this job*

Proficiency

Frequency and importance ratings provide very useful and relevant information regarding the centrality of job demands. For the global level of job demands however, these ratings do not automatically translate to a minimum level of competence needed for successful performance in a given job. Additional information may be required, most likely from a job supervisor, for specifying the minimum required level of proficiency for a given job. For the behaviorally-specific level of items, proficiency is implied within the item itself, so a separate rating of proficiency is not necessary. Proficiency information is critical for threshold determination. This approach is similar to that employed by Lopez, Kesselman, and Lopez (1981) in the validation of Threshold Traits Analysis.

Figure 5.10. Proficiency Ratings: Physical Job Demands (global)

Physical Job Demands:

What minimum level of proficiency in <u>physical strength</u> is required to satisfactorily perform the job?				
Ability to lift and move less than 10 pounds	Ability to lift and move 10 - 25 pounds	Ability to lift and move 26 - 50 pounds	Ability to lift and move 51 - 75 pounds	Ability to lift and move more than 75 pounds
○	○	○	○	○
☐ *Not applicable to this job*				

Figure 5.11. Proficiency Ratings: Psychosocial Job Demands (global)

Psychosocial Job Demands:			
What minimum level of proficiency in <u>oral communication</u> is required to satisfactorily perform the job?			
Ability to exchange routine information	Ability to provide complex information for purpose of instruction	Ability to facilitate a conversation for purpose of selling or influence	Ability to facilitate a conversation for purpose of advising, coaching or counseling
○	○	○	○
☐ *Not applicable to this job*			

Choosing the appropriate response format

Choosing an appropriate format for an item will be a function of its content and/or the type of measurement required. While Likert-type format may be the most popular item format for job analysis purposes, consideration should be given to a variety of formats in the proposed questionnaire.

The ACM analysis (see Chapter 3) will not only result in a set of validated job demand variables but also in a small number of clusters with several job demand variables in each. Since these clusters will be statistically derived, they may not necessarily correspond to the substantively derived clusters (or domains) such as physical, psychomotor, sensory, cognitive, and psychosocial. Both statistical and substantive cluster definitions may be considered in classifying job demand variables into groups. Statistical data from cluster analysis and SME input will form the basis for this classification. Items should be written for all job demand variables in a rating scale that meet the considerations outlined in this chapter.

Missing Data

It is very likely that some job demand variables may be irrelevant for certain jobs. Therefore, the proposed questionnaire will be designed so as to allow a job incumbent, supervisor, or a professional job analyst to indicate whether a given job demand variable is relevant or not for the job at hand and then require rating only when the job demand

variable is deemed relevant. While providing such a category as "not applicable" is pragmatic, it creates missing data.

Missing data are frequently encountered in the collection of behavioral data using surveys. In fact, opportunities for missing data are built into the survey with the use of a "Not Applicable" category. Categories such as "Unimportant" can also effectively operate as a "Not applicable" category (Harvey & Wilson, 1998). Missing data are problematic for approaches based on classical test theory (Nunnally & Bernstein, 1994). However, later in this document we propose the use of item response models for analysis of the survey data. These statistical models specify that available data are sufficient for estimation of job demand parameters (Wright, 1997). These estimation procedures have been shown to be extremely robust in dealing with missing data (Linacre, 1989; Linacre, 1994).

Observable Job Demand Items

Existing job analysis systems use a range of levels of analysis including skills, abilities, attributes, tasks, and general work activities (Fleishman, 1982). A number of approaches, particularly those that to some extent use what Fleishman (1982) describes as the ability requirements approach, often include items that reflect abilities that underlie performance.   Examples include: spatial orientation, selective attention, and oral comprehension. It is not possible to observe spatial orientation; instead one infers it if incumbents are observed to successfully align one object with another, or the lack of it if they fail to do so. However, various reasons could explain the failure to align objects, including poor vision and poor motor control. In the case of job performance, it is not clear that it is important how successfully the alignment of two objects is achieved, but rather is it achieved in an efficient manner. A lack of observable job demands is problematic for several reasons including the difficulty verifying ratings across independent respondents, the reliance on inferences and relationships to underlying causes that cannot be directly confirmed, and variation across respondents in their understanding of a job demand. Harvey & Wilson (1998) notes "the critical point is one of accuracy and verifiability: that is, which kinds of information can be reliably and validly rated by occupational analysts or job incumbents?" (p. 3). They go on to note that while observable activities can be related directly, abstract constructs must be inferred. A database of job demands used as part of the disability determination process be built on reproducible and comparable ratings across raters and jobs. Statistical estimations of reliability and validity are only as good as the data to which they are applied. Some job analysts have expressed concern that while physical demands can be easily observed, cognitive and psychosocial demands do not lend themselves to direct observation. Fortunately, this has been shown not to be the case. The work of Fisher and colleagues (2001) and Forsyth and colleagues (1999) has demonstrated that reliable and valid measures of *directly observable* cognitive (referred to a process) and communication/interaction skills can be developed. The task for the subject matter experts is to carefully and precisely translate job demand variables into observable statements. It will be important, as part of the web-based survey, to ask respondents to provide examples of observable job demands in their written responses.

Additional issues for items development

In item development, special attention will be paid to the reading level of an item in describing the job demand variable and the relevant anchors. The reading level for non-technical material will be kept at or below the 8th grade level. One of the major criticisms of a well-known job analysis system, the PAQ, is that its reading level is too high for incumbents in many jobs in the US economy. Job incumbents are an important source for information about jobs. Therefore, the proposed scale development will allow for an adequate review by professional item writers for clarity of expression and reading level.

Cognitive Interviewing

Despite even the most careful item writing, ideas as complex as those in job demands are open to misinterpretation. Accuracy amongst respondents means ensuring that they are interpreting items and rating scale anchors in the same way. Evaluating and correcting this particular source of error can be achieved through cognitive interviewing (Willis, 1999). Cognitive interviewing is a method of evaluating how respondents understand the question, recall relevant information, make choices between one response category and another (Willis, 1999). The steps involved in cognitive interviewing involve recruiting volunteers from appropriate sub-groups of potential respondents, conducting the cognitive interview, compiling and analyzing the data, and modifying/making revisions to the data collection instrument. Subjects are chosen for their representativeness of various sub-groups believed to be significant with respect to the content of the survey. For example, important sub-groups for the job demands project might include: type of respondent (incumbents, supervisors, job analysts) and type of industry (service, technology). Cognitive interviewing can help improve survey questions by informing developers about both the content of the items and rating scales and also about structural defects in the questionnaire such as logic of the questions or use of skip patterns. In addition, cognitive interviewing can point developers to ways in which respondents may answer in ways other than intended. For example, Willis (1999) cites an example from a study of work that asked respondents to report how much time they spent doing strenuous activities such as lifting, pushing and pulling. Response categories ranged from none to more than 4 hours. Cognitive interviewing revealed that respondents in sedentary occupations tended to use higher response categories because the categories provided did not match with their perceived time use.

Therefore, once items are written and reviewed by professional item writers, we recommend that cognitive interviewing be conducted with a small group of incumbents, their supervisors and also job analysts from a sample of jobs. This will enable data to be gathered about potential respondent perspectives on the quality of the items and their anchors with respect to clarity, potential for misinterpretation, and time for completing the questionnaire. Item and anchor rewrites may be necessary as a result of this process. Time estimates gathered in this tryout will be used in planning for a pilot of the questionnaire.

Pilot Test of the Questionnaire

A large scale pilot test of the job demands questionnaire is proposed for calibrating job demands on three scales (frequency, importance, and proficiency) in order to reduce the number of items to the most optimal demands across all jobs, ensuring the items selected adequately address the range of skills needed in the selected jobs, and for assessing the reliability and validity of job ratings. The data from this field test will also be used for establishing minimum proficiency levels (thresholds) for successful job performance of a representative sample of jobs. It is recommended that the 400 most frequently performed jobs in the national economy be considered for the pilot test. In addition, this sample of jobs should be compared and cross referenced to the frequency of jobs found in Social Security Disability Insurance (SSDI) and SSI case files. The final sample of selected jobs will include *either* the most frequent jobs in the economy or the most frequent jobs in SSDI and SSI case files. Thus the number of jobs in the sample is likely to exceed 400. For each job, it is recommended that a sample of five positions be obtained, with these positions stratified on the basis of rural versus urban location and size of employer. It is recommended that at least two job incumbents and one supervisor for each position respond to the questionnaire. In addition, one trained job analyst will rate one of the five positions. The rationale underlying these recommendations is described below.

Number of Jobs for the Field Test

It is essential that the sample of jobs for this pilot test be both representative of the world of work and relevant to the needs of SSA. Given the vast number of jobs in the US economy, it is desirable to start with those jobs that account for the greatest percentage of employment. Further, jobs should be considered for inclusion where they have been the focus of past SSA disability cases to ensure relevance to the needs of SSA. Finally, it is likely that job demands may vary somewhat within a job as a function of setting or context for the job; urban versus rural settings and size of employer are likely to be relevant moderator variables. In order to ensure that job demand variables are relevant across a range of manifestations of a given job, each group of job positions will be stratified on the basis of these variables with approximately five positions represented for each job.

Since a job is the unit of analysis in this investigation, the number of jobs for the field test must be several times greater than the number job demand variables. While it is difficult to predict exactly how many job demand variables will result from the methods described earlier and how many items will be needed for the proposed questionnaire, given our current knowledge of the world of work, the total number of job demand variables is unlikely to exceed 100. Assuming further that the questionnaire will consist of approximately the same number of items as the number of job demand variables, a stratified random sample of 400 jobs is acceptable for the field test (Guion, 1988) in the global approach. Since each job demand variable is analyzed separately in the behaviorally-specific approach, the sample of 400 jobs also appears to be adequate. If

adequate resources are available, it may be possible to increase the number of jobs for the field test. The sample of 400 jobs is also adequate for the proposed factor analyses and scale calibrations using techniques from item response theory (Mulaik, 1972; Linacre, 1994).

Number of Participants per Job

It is recommended that at least two incumbents and one supervisor from each job complete the job analysis questionnaire. Incumbents and supervisors should be selected based on experience (to the point that they have been judged to have gained essential job knowledge and skill), having shown an acceptable level of job performance.

In addition to the internal consistency estimates of reliability, the data from two incumbents and their supervisor may be used for determining inter-rater reliability as well as for establishing the degree of congruence between the incumbent and supervisor job ratings.

The inclusion of one supervisor per job is essential for gathering information about the minimum levels of proficiency needed for successful job performance on the relevant job demand variables. This provides an important check on the validity of self-report data, which could be biased by incumbents' desire to inflate their importance by way of overstating minimum proficiency levels (Guion, 19881998).

The inclusion of a trained job analyst also provides an important check on the validity of incumbent and supervisor ratings of job demands. Good inter-rater reliability between the job analyst, incumbents and supervisors would provide evidence that the system can be administered in the future with minimal involvement of a professional-level project staff.

Training of Questionnaire Participants

Chapter 6

Construct Validation: Dimensionality Assessment and Calibration of Job Demand Variables

This chapter begins by a discussion of procedures to select optimal job demands for a minimum data set. Next, the proposed psychometric analyses for the pilot data are described; these analyses consist of three major components: traditional item analysis, factor analysis, and IRT calibrations. We begin by providing a brief description of the magnitude and organization of the pilot data.

Information will be gathered about each of the job demand variables for 400 jobs. Within the global approach, each job will be rated on three qualities of job demands,

providing a rating for frequency, a rating for importance, and, as appropriate, a rating for proficiency level (minimum level of proficiency for successful job performance). In the behaviorally-specific approach, each job will be rated on frequency and importance only. These ratings will be in the form of Likert-type response scales. In addition, each job will be rated by four different individuals (two incumbents, one supervisor, and one trained job analyst). That is, for each job demand, there will be a total of 12 ratings (3 dimensions x 4 raters) in the global approach and a total of 12xn (where n is the number of items) ratings in the behaviorally-specific approach. Psychometric analyses of these data will be completed separately for frequency, importance, and proficiency. Since these procedures will be similar across the three scales, the proposed psychometric analyses are described below in detail only for the frequency rating, with any deviations in data analysis relevant for the other two rating types (importance and proficiency level) noted and described.

As previously noted, the validated job demand variables from Chapters 3 and 4 will be classified into a small number of mutually exclusive and substantively meaningful clusters. The proposed analyses are at this cluster level in the global approach and at the job demand variable level in the behaviorally-specific approach.

Figure 6.1 on the following page illustrates the structure of the data collection and analysis. The breakdown is shown for one position of one job but is replicated across positions and jobs throughout the sample.

Selecting Optimal Job Demands for a Minimum Data Set

In line with SSA goals for this project, this chapter proposes to begin by developing an exhaustive number of job demands from which to select the optimal but minimum number of job demands that effectively measure jobs in the national economy, particularly those encountered by SSDI applicants. Job demands from each cluster will be scored on three scales (frequency, importance, and proficiency) in the global approach, whereas items within a job demand variable will be scored on frequency and importance in the behaviorally-specific approach. In the behaviorally-specific approach, the ratings of frequency and importance will provide the necessary proficiency data. It is proposed that the proficiency ratings be utilized for developing thresholds for job performance on this minimum but optimal set of job demands.

Using frequency and importance to select optimal job demands variables can be achieved in several ways.

First, job demands that are rated as unimportant by all or most jobs can be set aside. Job demands set aside can be reviewed again later. Job demands that are essential to almost all jobs can also be set aside for inclusion later since their relevance is clear. Next, the frequency of the remaining job demand variables can be examined. Job demands performed daily or weekly can be set aside. The remaining job demands can

then be described in terms of importance and/or frequency ratings typically used in gathering information about jobs (Cascio, 1991). We should initially plan for gathering both types of ratings. As we get more specific information about job demand variables, we may decide to gather either the importance or frequency ratings but not both on some of the job demand variables.

It is likely that importance ratings are similar for some of the jobs (e.g., health care workers), but may be dissimilar amongst different types of jobs (e.g., health care workers and laborers).

In order to create a minimum data set, the goal will be to select those job demands that are most important to the greatest number of jobs. Importance ratings will also be used to ensure that job demand variables that might be removed during examination of the frequency scale were not also those that were very important to a large segment of jobs.

Figure 6.1

Analysis of Ratings of Job Demands

Each cluster will consist of a certain number of job demand variables, where each variable is operationalized by a Likert-type item in the global approach and by several Likert-type items in the behaviorally-specific approach. Using the frequency rating data, each cluster in the global approach or each job demand variable in the behaviorally-specific approach will be analyzed first with traditional item analysis techniques, then for dimensionality, and finally for IRT calibration by dimension. Each job is treated as the unit of analysis, and the frequency items (i.e., job demand) ratings as different measures for the job in question. Each job is treated as the unit of analysis, and the ratings of job demand frequency are the items used to describe each job. Each job will have 20 sets of ratings (five positions x four raters). Therefore, whenever possible, rater effects will be assessed and will be an integral part of subsequent data interpretation.

Traditional Item Analysis

Traditional item analysis techniques will be used to compute items means, standard deviations, proportion of jobs associated with each possible response on an item, and proportion of omits (proportion of jobs with no response whatsoever for the job demand in question). Mean and standard deviation of the total cluster score in the global approach and the job demand variable score in the behaviorally-specific approach, defined as the simple sum of the scores of items in the cluster or job demand variable, as well as the frequency distribution of total scores will be generated for each cluster or job demand variable. Item-cluster (or item-job demand variable) correlations and the Cronbach's alpha coefficient estimate of reliability will be computed.

The item analysis will be completed separately by rater source. That is, there will be four different sets of job demand analysis data, one for each rater source (two incumbents, one supervisor, and one trained job analyst). The statistical information from the four rater sources will be evaluated for similarity of item- and cluster-level (or job demand variable level) data using the appropriate ANOVA and MANOVA techniques (Tatsuoka, 1988; Winer, Brown, & Michels, 1991). We also propose to generate estimates of inter-rater reliabilities with the help of techniques from generalizability theory (Brennan, 1992).

Factor Analysis

An exploratory factor analysis of items in each cluster will be conducted to assess the underlying dimensionality (Byrne, 1998). That is, the question, "Do each of the clusters identified by cluster analysis, contain a single or multiple dimensions", will be addressed. For example, a cluster of physical job demands might contain dimensions of gross and fine motor items. Factor analysis has been used extensively in the development of job analysis systems (Fleishman & Mumford, 1991; Fleishman & Quaintance, 1984; McCormick, Jeanneret, & Mecham, 1972). This statistical approach examines the relationships among a large number of items (within a cluster in the global approach and within a job demand variable in the behaviorally-specific approach) in order to explain their common dimensions (factors). Factor analysis typically forms part of construct validation procedures since it can confirm that items do indeed group together in ways that would be expected from past literature and professional experience. Conversely, factor analysis can determine if items do not group together because they are independent and likely to form separate factors. Factor analysis provides a method to reduce many items to a smaller set of more parsimonious constructs with minimal loss of information. There is an important distinction between factors and components. Both are dimensions identified by sets of items. Principal factor analysis produces *factors* that represent the common variance, that is, the inter-correlation, among items and is therefore a correlation-focused approach. Principal components analysis identifies *components* that reflect both common and unique variance of the items and may be seen as a variance-focused approach. It is principal components analysis to which people typically refer when they say "factor analysis."

Factor analysis may precede or follow the conversion of raw scores (ratings scale data) to IRT calibrations. The proposed IRT calibrations (described below) assume that items in a cluster or a sub-cluster (or a job demand variable) are unidimensional. Several current IRT software programs allow for factor analysis to be carried out iteratively with calibration estimation. However, carrying out an initial factor analysis on the raw data may provide useful information about what to expect from the IRT analysis and serve as a useful comparison to later results. Information from raw score factor analysis may suggest whether IRT analysis should be done at the level of clusters or within clusters or at the level of a job demand variable. For example, if all items in a cluster are reasonably unidimensional, a cluster-level IRT calibration would be justified. However, if two factors explain the underlying dimensionality substantially better than a single factor, a given cluster of items may have to be broken up into two sub-clusters, with items in each

sub-cluster forming a unidimensional set. In this case, two separate IRT calibrations will need to be performed, one for each sub-cluster. Since job demand variables will be measured as ordinal level variables, the inter-correlation matrices in factor analysis will use polychoric correlations rather than Pearson correlations (Joreskog & Sorbom, 1996).

In either case, since there are four sets of rating data for each cluster in the global approach and for each job demand variable in the behaviorally-specific approach (one from each rater), a separate exploratory factor analysis will be needed for each cluster or job demand variable. If a single dominant factor emerges for each rater source, one can proceed with the proposed IRT calibrations. If two or more factors are required to adequately explain the underlying dimensionality, a confirmatory factor analysis approach is recommended to ensure that the number of factors and the specific items that load on each factor remain invariant across rater sources (Byrne, 1998). This information is essential for justifying the same sub-cluster (or job demand variable level) IRT analysis across rater sources. One may even consider a measurement equivalence analysis to assess the degree to which the factor loadings are similar across rater sources (Raju, Laffitte, & Byrne, 2002).

Item response theory – The Role of One Parameter and Two Parameter Models

Item response models are a relatively new method of analyzing rating scale data although the assumptions on which these models are based have been described since early in the last century. These models are used extensively in education and are increasingly utilized in health care and psychology. Item response theory (IRT) represents an alternative view of measurement to that provided by classical test theory (CTT). CTT views items as random replications of each other such that items on a test are simply a sample from a much larger domain of essentially equivalent items. A consequence of this assumption is that little attention can be given to the idea that items vary in difficulty, that is, some items are easy while others are more challenging. For example, we think about some jobs requiring more physical effort than others. When the goal of using a survey is to distinguish amongst jobs on some trait such as proficiency, a survey that includes a range of items from unskilled to highly skilled will be the most discriminating. The steps of the rating scale, for example proficiency of performing a demand, add a further level of discrimination. A job that requires performing several low skill demands is not as demanding as a job that requires performing several skilled demands. Because CTT is not able to discriminate the amount of skill in any particular demand, it does not offer a way to address this discrimination amongst job demands (McHorney, 1999). By contrast IRT models, by converting raw scores to probabilities, are able to evaluate the range of effort required across demands and rating steps and relate job demands to the same trait (e.g., physical effort).

Rating scale analysis is one method in the family of item response theories (IRT) (Bond & Fox, 2001; Rasch, 1960; Wright & Masters, 1982). It is also known as a one-parameter model since, in addition to estimating person ability, it estimates one parameter, the difficulty of the items. Two parameter models estimate an additional parameter, the slope (discrimination) of the items (Birnbaum, 1968; Hambleton & Swaminathan, 1984, Samejima, 1969). We begin by describing the 1-parameter approach

since all the basic assumptions of IRT are in this model. Later we describe the additional assumptions of the 2-parameter model and describe the pros and cons of each approach. We do not discuss the 3-parameter model since the additional parameter estimates guessing. This parameter can be relevant in multiple-choice tests but is not relevant for self-report and observational surveys. In the discussion below, we present information for dichotomous response models (e.g., Yes/No; Always/Never). Often though, surveys often have multiple steps in the rating scale (e.g., Superior, High, Moderate, Modest). Multi-step rating scales are referred to as polytomous scales. Although there are several approaches, the most general one extends the dichotomous case such that each step up in a rating scale (e.g., from Always to Frequently, from Frequently to Occasionally) is essentially treated as a dichotomy (Andrich, 1978; Masters, 1982). Therefore, for simplicity, we present only the dichotomous case.

Item response models are probabilistic (Rasch, 1969; Wright & Stone, 1979). That is, for every response to a survey item, there is a probability that it will be endorsed and a probability that it will not. This relationship is otherwise known as the odds ratio, the odds (likelihood) of an item being endorsed or not. For convenience, these probability ratios are linearized by a log transformation. This linearized unit is referred to as a calibration. In the simplest model, this probability ratio can be determined by the "ability" of the respondent and the "difficulty" of the item. (While we tend to use terms like "ability" and "difficulty" these concepts have shown to be appropriate in situations in which only objects are measured such as the number of traffic accidents at intersections and water pollution.) There are other components that might also affect the odds ratio, for example, steps of the rating scale. Other components include the difficulty of the task performed (Fisher, 1997) or the severity/leniency of a rater (Lunz & Stahl, 1993). Multiple components of a survey/assessment situation can be analyzed using the many-faceted Rasch model (Linacre, 1989). The results of a many-faceted analysis enable the investigator to examine not only hierarchical order of "items" (such as job demands) but also the ordering of other components such as jobs, positions, raters, incumbents, supervisors, and job analysts.

2-Parameter Models

In the 1-parameter model, each item is defined as having the same slope, representing its degree of discrimination. Deviations from this assumption are detected via chi-square fit statistics. By contrast, 2-parameter models account for differences in item discrimination by including a parameter that estimates the slope (discrimination) of each item. Item slopes are described by item response function curves (IRFs). Figure 6.2 and 6.3 below illustrate IRFs for 1 and 2 parameter models

Figure 6.2: 1-Parameter model IRFs   Figure 6.3: 2-Parameter model IRFs
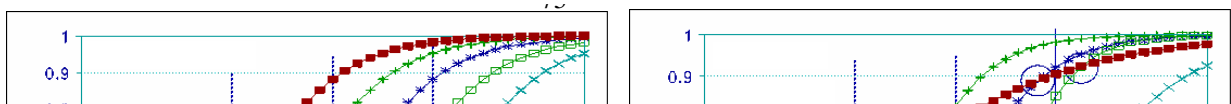
The difference between these two models is first and foremost a philosophical one. Proponents of 1-parameter models argue that, as in other scientific disciplines, data should fit the requirements of the measurement model. For proponents of the 2-parameter approach, the goal is, like most of social science, to fit the measurement model to the data. Proponents of the 1-parameter model find the crossing IRFs (see figure 6.3) problematic since the order of the items (that is the definition of the job demand construct) differs for jobs (or persons) at the low end (left side) from the order of items (construct definition) for high end (right side) jobs (or persons). 1-parameter proponents argue that that Item A above (see figure 6.3) is measuring a different construct than the other items and should be removed from the scale. If it is an important construct, a separate scale should be developed to measure that construct effectively. Proponents of the 2-parameter model argue that a set of items can be unidimensional while still containing items with different slopes (discriminations). This relates to a broader concern of whether the data should fit the model or whether the model should describe the data. Proponents of the 1-parameter model see the model as being inviolate and 2-parameter proponents view the data as inviolate. It is, as this paragraph began by asserting, essentially a philosophical difference. We adopt a pragmatic perspective on this debate and acknowledge the utility of using both models to learn more about a set of job demands and to what extent they define a unidimensional and sensible set of job demands. While we cannot resolve this philosophical debate, we can be informed by the tension created by these different perspectives.

Unidimensionality and Fit

The next step is to examine the "fit" of demands to the dimension. Fit statistics are based on the chi-squares since we have expectations (calibrations) about where certain jobs demands will be rated for certain jobs. Chi-square statistics can be used to examine how well the data match the expectations. Fit statistics are generally used in conjunction with a principal components analysis (which is based on the *calibrations* rather than raw scores) to establish the unidimensionality of the set of items (Smith, 1996). That is, all job demands reflect the same thing. Fit can be evaluated for each facet (i.e., job demands, cluster, position, job type). It will be particularly useful for determining which job demands reflect the cluster of interest across all job demands, and which are specific to particular jobs.

Application to the Validation of Job Demands

The discussion below describes an example of how IRT might be applied to the problem of validating job demands. Using a Likert-type rating scale, data is collected from surveys of incumbents, supervisors and via observation by job analysts. Job demands will be rated by each of these constituencies according to frequency, importance and proficiency. This process produces numerical data that are entered into a data matrix. Following the factor analysis to determine unidimensionality, data are then analyzed using one of the item-response approaches. Then items are examined by fit to the model. This is established through examination of fit statistics and principal components analysis. The acceptable range of fit statistics is determined by the size of the sample and number of items (Smith & Schumacker, 1998). For principal components analysis, the first factor should contain almost all the variance, with subsequent factors explaining little variance. The hierarchical order of the items is then examined from most to least frequently performed demands/items. Figure 6.4 shows the ordering of items from most to least frequent for physical and psychosocial job demands, both at the global level and the behaviorally-specific level. Job demands are on the right hand side of the line. Demands/items at the bottom are rated as those being most frequently performed across jobs. Those at the top are performed infrequently by most jobs. Jobs are shown on the left hand side of the line. The arrow beside each job name points to its position on the scale. In the case of the behaviorally-specific scale, this position is equivalent to the most challenging task that a particular job requires. In the example shown, the most challenging *physical strength* item for "truck driver" is "moving heavy objects long distances daily." The global level demonstrates how the frequency of "physical strength" relates to other physical job demands but cannot be used in the same way to examine specific level of job demands required. This is why a separate proficiency rating would be needed for use with the global approach.

It should be noted that the example provided is for illustrative purposes only and may not reflect the actual ordering of items or jobs. In addition, is should be expected that the ordering of demands/items will not form the same ordering for all job types. Using the behaviorally-specific items as an example, it is likely, that jobs with strong contrasts in the physical strength demands required will form a different hierarchy than those that are more sedentary. However, it is likely the number of different orderings of

items is quite small, and will result in like jobs being grouped together in meaningful ways. Appropriate hierarchies can be established by examining patterns of fit statistics and principal components analysis described above. In addition, jobs that may be related on physical strength may be dissimilar on other job demands. This approach allows jobs to be grouped in meaningful ways by a specific job demand. Finally, the behaviorally-specific items may have direct relevance to the disability adjudication process since, items that describe a job demand for a given job are to describe in terms that also can be related to a person's ability to perform that job demand.

Figure 6.4. Occupations can be described by their location in the hierarchical taxonomy of job demands.

Physical Demands
Global

Least frequently performed demand

Climbing (hourly)

Climbing (daily)

Sitting (monthly)

Fireman → Climbing (weekly)

Climbing (monthly)

Nursing → Physical Strength (hourly)

Truck driver → Standing (monthly)

Cashier → Physical Strength (daily)

Standing (weekly)

Physical Strength (weekly)

Physical Strength (monthly)

Sitting (hourly)

Standing (hourly)

Sitting (weekly)

Standing (daily)

Sitting (daily)

Most frequently performed demand

Physical Strength
Behaviorally-specific

Least frequently performed demand

Fireman → Moving heavy objects long distances (hourly)

Moving heavy objects long distances (daily)

Moving heavy objects short distances (hourly)

Moving heavy objects long distances (weekly)

Truck driver → Moving light objects long distances (hourly)

Moving heavy objects long distances (monthly)

Nursing → Moving heavy objects short distances (daily)

Moving heavy objects short distances (weekly)

Moving light objects long distances (weekly)

Cashier → Moving light objects short distances (hourly)

Moving light objects long distances (daily)

Moving heavy objects short distances (monthly)

Moving light objects long distances (monthly)

Moving light objects short distances (daily)

Moving light objects short distances (weekly)

Moving light objects short distances (monthly)

Most frequently performed demand

Establishing Proficiency Thresholds

Establishing proficiency thresholds will be different depending on whether the global or behaviorally-specific approach is used. In the case of the global approach, specific ratings of proficiency will be made for each job demand variable. In contrast, if the behaviorally-specific approach is used, the calibration of jobs and items using IRT automatically creates proficiency levels for each job on that job demand variable.

Having defined job demand clusters and created a hierarchy of job demands within clusters, the next task is to define proficiency thresholds for each job. We recommend using the supervisor ratings of minimally proficient performance of job demands to define thresholds. As outlined in the previous section, for each of the 400 jobs analyzed, relevant job demands would be selected by considering the frequency and importance ratings. For each retained job demand, we would recommend the use of the supervisory rating of the minimum level of proficiency for successful job performance. If more than one rating is available (from another supervisor, trained job analyst, or possibly incumbents), the average of all available ratings will be used to define the minimum proficiency level. A profile of minimum proficiency levels for each job will be defined using these proficiency ratings. Since the number of anchors for the proficiency item may vary from one job demand variable to the next, the average proficiency ratings will be placed on a common scale prior to developing the proficiency level profile for each job. If appropriate, IRT methodologies may also be used in deriving minimum proficiency levels.

Supervisors (and other appropriate raters) would need sufficient experience to make these judgments; both years of experience and range of incumbent performance would be needed to make reliable and valid ratings. The anchors used to define proficiency of each job demand variable would have to be written in an exquisitely careful manner. It may be that the rating scale or the number of anchors used to adequately define proficiency will vary by job demand variable, though we expect that the same rating scale would be used within a given cluster of job demands (e.g., physical, cognitive, psychosocial).

Chapter 7

SUMMARY

Conclusions of the Job Demands Project

A major focus of the project was to propose the methodologies needed to establish reliable, valid and easily measurable job demands. A critical review and evaluation of existing major job analysis approaches was undertaken. To the extent that all existing methodologies had some limitations for SSA's application, an additional approach (Automated Concept Mapping [ACM]) was considered as a complement to other recommended approaches. The project staff recommends a multi-faceted approach that takes advantage of recent advances in technology along with traditional data analytic techniques.

ACM, which allows researchers to analyze input from a large sample of professionals regarding core demands and incorporates a text-based method of content analysis that enables respondents to use their own language to respond to survey questions, will be useful in future phases of this project. ACM and cluster analysis identify vocational factors in terms of core job demands and their hierarchical order. The use of experts knowledgeable in disability determination is the strength of this method of concept identification and mapping.

Vocational factors are a critical part of disability determination decisions and vital to all levels of the disability adjudication process. ACM and cluster analysis will identify these vocational factors in terms of core job demands and their hierarchical order. The use of experts knowledgeable in how the information will be used in disability determination is the strength of this method of concept identification and mapping.

The recommended methodology for identifying job demand variables, then, consists of three phases: (1) development of a survey questionnaire for administration on the internet, (2) identification of a survey of sample participants and administration of the survey, and (3) the use of a data analysis technique based on ACM procedures.

An unresolved issue is whether this methodology produces results that may lead to changes in how the steps in the sequential evaluation process are operationalized. For example, will the new set of job demands cluster in ways that fit the current definitions of sedentary, light, and medium work? Could the new set give rise to a new grid that includes cluster variables for cognitive and job demands?

Optimal job demand variables should reflect the demands of a wide range of jobs so that a limitation resulting from a physical or mental impairment that precludes the ability to meet a particular job demand will result in the inability to perform a number of jobs or occupations. The rules and procedures associated with the SSA disability

adjudication process must provide the basis for all procedures associated with the identification and validation of job demand variables.

The goal of selecting items will be achieved by converting identified job demands into survey items with rating scales. The Job Demands Project describes procedures for developing a questionnaire for rating jobs and job families on the job demand variables. One goal of this project is to develop a psychometrically sound mechanism for generating a description or profile for each job or job family using the relevant job demand variables previously identified. Such a description or profile should be capable of furnishing reliable information on what the relevant job demand variables are for each job or job family and the minimum level of competence required on these variables for successful job performance by an incumbent. This would require the following:

- Development of a questionnaire with Likert-type items (or other appropriate type of format), covering all job demand variables.

- Use of the questionnaires and the different scales to rate a representative sample of jobs or job families and,

- Establishment of minimum competence levels (or thresholds) for jobs or job families.

In summary, the above methodology will result in the development of an instrument that will enable job analyses to accurately measure the critical job factors considered relevant for making determinations of disability. Once the job analysis method has been developed, the next steps are to: (a) determine what jobs should be analyzed; (b) determine who will collect this data; (c) determine what type of data base will result and how this data base will be integrated into the disability determination process; and (d) the continued investigation of the reliability, accuracy, and validity of the job analyses.

Other issues that arise from the Job Demands Project, which could be addressed in a pilot project of the methodology herein described, include:

1. defining anchors to be used for the scales

2. dealing with such issues as who would maintain the database,

3. how a system which requires observational data collection would be operationalized (e.g., SSA's current inferential system and the use of vocational experts' information in a system that relies on a functional analysis of measurable behavior),

4. the incorporation of a more contemporary view of job demands, from the perspective of person/environment fit, into the system of sequential evaluation,

5. the implications of training SSA staff and Vocational Experts in new job demands variables, and

6. Even the alteration of the evaluation process at both the DDS and OHA levels of adjudication may be addressed in a pilot study.

If this approach to defining job demands is piloted, a result could lead to change in the very way disability is defined in SSA from an "all-or-none" approach of disabled/not disabled to a more contemporary view of how a person can or cannot perform Substantial Gainful Activity in light of environmental limitations or obstacles.

Recommendations

1) It is recommended that SSA create a pilot project using the methodologies described herein to begin to create the job demand variables relevant to SSA's own adjudicative process. This work could go on parallel to continuing discussions with the Department of Labor, since it would not be a redundant activity to the work done in the creation of O*NET, and would more precisely meet the needs of SSA, than a simple disaggregation of the work already created in the construction of O*NET.

   • A pilot project building on the work of this Job Demands Project, would allow SSA to model for itself, the Department of Labor, and other interested parties, a valid and reliable method for identifying measurable job demands critical in the evaluation of the ability to engage in Substantial Gainful Activity.

   • The domain of variables for the pilot study could focus on non-exertional demands and would thus add a new dimension of review and investigation to the job demands arena. In focusing on an area such as cognitive ability, for example, the pilot project would unfold a new dimension that has never been precisely measured by the Department of Labor, and could bridge the needs of both SSA and DOL. Therefore, establishment of such a pilot project could become a bridge for SSA and DOL to continue working together on the creation of a macro system that truly evaluates the basic job demands in our national economy.

2) It is recommended that SSA consider using three procedures in assessing the validity of optimal job demand variables. In this document, three procedures were described for assessing the validity and completeness of job demand variables. The procedures provide different types of reliability and validity evidence for a list of job demand variables. The project team recommends that SSA consider using all three procedures in assessing the validity of optimal job demand variables. For complete discussion of the strengths and weaknesses of the three procedures, see Table 1, p. 256.

3) It is recommended that the methodology developed in the Job Demands Project be used to guide the accomplishment of a pilot project. The methodology recommended by the Job Demands Project will result in the development of a new instrument that will enable job analysts to accurately measure critical factors relevant for disability determination. Figure 1.2 describes a flow chart for this methodology based on an evaluation of criterion-related validity that will establish thresholds and evaluate the reliability of the final instrument. That triage process will facilitate the occurrence of redundancy in the analysis of data.

4) It is recommended that the DRI Job Demands Project team continue to participate in the development and implementation of the project. This would be a logical next step to the work accomplished in this first year of job demands activity. The energy created in this year's activities can be capitalized upon without a huge lag time in creating the next phase.

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Appendices

Appendix A:

RESEARCH APPROACHES TO VALIDATION OF SSA'S JOB DEMANDS JOB DEMANDS VALIDATION CRITERIA

This report provides a summary and critical review of pertinent literature on validation criteria, including those for validating job demands. This deliverable should inform the process of validating job demand variables and also the process of developing valid rating scales and thresholds that facilitate assessing the ability (or inability) to work. This report addresses the four major types of validity, but focuses particularly on content and construct validity procedures.

Introduction

The Social Security Administration (SSA) has determined that as part of the process of establishing that an individual is disabled and qualifies for benefits, there is a need for a method of assessing the demands of jobs currently in the national economy and that is also responsive to changing job demands in coming decades. Critical to any attempt to develop such an evaluation method is ensuring that the test actually does measure current job demands, that is, that the evaluation is valid. In her classic book on psychological testing, Anastasi asserted, "validity provides a direct check on how well the test fulfills its function" (Anastasi, 1988, p.28). The goal in validating job demands will be to determine how accurately each job is characterized by a particular set of job demands. Approaches to establishing the validity of an instrument can be qualitative or quantitative. Qualitative methods include face and content validity. Quantitative methods include construct validity and criterion-oriented validity (concurrent and predictive validity). This report briefly describes each of these validation methods, describes how they relate to job demands specifically, suggests criteria by which levels of validity might be established, and presents overviews of how each method has been used in validating job demands systems. Each section concludes with a recommended method for establishing validity of the job demands in the current work environment.

Current Approaches to the Evaluation of Job Demands

The evaluation of job demands has a long history, and there are many task inventories and taxonomies in use. Below is a brief description of the major evaluations in common use. The approaches utilized in establishing the reliability and validity of these methods are described in more detail in subsequent sections. This section serves to provide a brief overview of the main features of each approach. Table 1 summarizes the key features of these representative systems.

a.   Fleishman's Job Analysis Survey

Edwin A. Fleishman's Job Analysis Survey (F-JAS) evolved from the Manual for Ability Requirements Scales (MARS). It contains a taxonomy of abilities that is buttressed by four decades of research (c.f., Fleishman & Mumford, 1991; Fleishman & Quaintance, 1984). The taxonomy includes 52 cognitive, physical, psychomotor, and sensory abilities that have strong research support. A key feature is the use of level of ability rating scales that specify level of functioning requirements for jobs. F-JAS is a job analysis method; it has not been applied to a large number of jobs in the U.S. economy to produce an occupational database.

The F-JAS is the product of a longstanding program of research focused on identifying perceptual-motor abilities required in human task performance. The human capacities required to perform tasks serve as the basis of categorization. The objective of this work was "to define the fewest independent ability categories which might be most useful and meaningful in describing performance in the widest variety of tasks" (Fleishman, 1967, p. 352). Abilities are distinguished from skills in this taxonomy. Ability refers to a general trait or capacity of individuals to perform a variety of tasks. An ability is postulated to describe the pattern of performance across similar and different tasks. Both learning and genetic components are believed to underlie abilities. Skills refer to proficiency on a specific task or group of similar tasks. Proficiency on a given task reflects that an individual possesses relevant basic abilities. Factor analytic studies helped support the identification and description of various abilities. Domains of abilities include sensory, perceptual and cognitive domains; 52 discrete abilities domains are defined.

Fleishman and colleagues developed methods to define abilities carefully with a set of rating scales that contained empirically-derived task anchors that represent the amount of each ability represented at different points on the scales. A total of 52 scales were developed that cover cognitive, sensory-perceptual, psychomotor, and physical domains of human performance. It is these rating scales that comprise the F-JASurvey (Fleishman, 1992). A variety of respondents, including job incumbents, supervisors, and job analysts examined jobs and job tasks, then assigned scale values on each of the ability rating scales. The mean scores of these groups of raters provide the job's ability requirements profile. To date, several thousand jobs have been studied; interrater reliabilities are consistently high. High agreement between profiles obtained from incumbents, supervisors, and job analysts also supports the reliability of the F-JAS (c.f., Fleishman & Mumford, 1991).

Recently added to the F-JAS are domains related to interpersonal abilities. A taxonomy of ability definitions and behaviorally, task-anchored rating scales have been developed for 21 interpersonal abilities including social confidence, dependability, and social sensitivity.

b.   O*NET: Occupational Information Network

The United States Department of Labor (DOL) commissioned the American Institutes for Research (AIR) to develop O*NET, an Occupational Information Network in 1995. This endeavor was a collaboration between AIR and experts in related areas (e.g., database development, job analysis, industrial psychology).

The purpose of the project was to "develop a comprehensive yet flexible occupational information system that would have the capability to meet the needs of a diverse set of users in an efficient, timely manner" (Peterson, Mumford, Borman, Jeanneret, & Fleishman, 1999, p. ix). O*NET contains six domains; within each domain there are sets of occupational "descriptors" that describe the characteristics and requirements for the worker and the work. The descriptors are hierarchically arranged and are designed to be easily understood by all users regardless of background.

The content model was based on the recommendations of the Advisory Panel for the Dictionary of Occupational Titles (US DOL, 1993, p. 6). The six domains encompassed by O*NET are: experience requirements (training, experience, licensure), worker requirements (basic skills, cross-functional skills, knowledge, education), worker characteristics (abilities, occupational values and interests, work styles), occupation characteristics (wages, labor market information, occupational outlook), occupational requirements (generalized work activities, work context, organizational context), occupation-specific requirements (occupational knowledge, occupational skills, tasks, duties, machines, tools and equipment).

c.   Functional Job Analysis

The underlying assumption of Functional Job Analysis (FJA) is that "all work has a purpose in which something has to get done and meet certain standards"(Fine, 1988, p. 1019). For each job, a worker must possess three general kinds of skills: functional, specific content, and adaptive. These skills "have to be more or less in harmony for the worker to be able to function, get the work done satisfactorily, and feel satisfied that needs are being met" (p. 1019). The FJA distinguishes between what gets done on a job and what workers do to get the job done. It focuses directly on worker activities in accomplishing a job and provides information to consistently and reliably determine the complexity (level of difficulty) and orientation (worker involvement as a person) of job tasks and to develop performance standards and training content.

The FJA was developed by Sidney A. Fine to classify jobs found in the first (1939) and second (1949) editions of the Dictionary of Occupational Titles (DOT). The motivation for the system was to classify occupations and to allow transfer of workers from one occupation to another (i.e., transferable skills). These were the years of the Great Depression and World War II. During this period the Employment Service was faced with finding any relevant job for workers and meeting the personnel demands of the defense industry. The system that resulted was used to develop the third (1965) and fourth editions (1978) of the DOT. The most recent version of the FJA can be found in the *Revised Handbook for Analyzing Jobs* (US DOL, 1991a). FJA is also used in private industry for a variety of purposes, including test development, setting performance standards, developing training materials, job design, and personnel evaluation.

The FJA is divided into work performed (what gets done on a job) and worker characteristics (what the worker needs to be successful on the job.) In use, the system centers on identifying each task required for the job and developing a statement using sentence analysis about each task, for example, "Researchers market conditions in local, regional, or national are to determine potential sales."

The heart of the system is the careful description of elements and tasks using a sentence analysis format that considers what the worker does, what the purpose of the worker's actions are, and the final result of the action. Once the tasks have been identified, they are coded and classified as work performed components, worker functions (in terms of data, people, and things), and worker characteristics.

The procedures for conducting a job analysis include: determining the purpose of the job analysis; selecting the job; reviewing information on the employer, industry, and employer generated data on the job; visiting the work site; getting to know the worker and supervisor; collecting data using a variety of methods; writing the task statements using the sentence analysis format; and assigning work performed codes and worker characteristics ratings.

d.   Position Analysis Questionnaire

McCormick, Jeanneret, and Mecham (1972) developed the Position Analysis Questionnaire (PAQ) in 1972. It is a structured job analysis instrument to measure job characteristics and relate them to human characteristics. This tool consists of 195 job elements that represent, in a comprehensive approach, the realm of human behavior involved in work activities (McPhail, Jeanneret, McCormick, & Mecham, 1991). The items are classified in five areas: (1) information input (where and how the worker gets information); (2) mental processes (reasoning and other processes that workers use); (3) work output (physical activities and tools used on the job); (4) relationships with other persons; and (5) job context (the physical and social contexts of work).

Analyzing a job with the PAQ follows a highly structured process. Job analysts observe jobs and conduct interviews structured on the 187 work behaviors of which the PAQ consists. After the interview, analysts rate job characteristics on scales. This requires reference to the PAQ *Job Analysis Manual* and to the questionnaire itself (PAQ, 2001). The *Manual* defines each job element in behavioral terms and provides rating scale anchor points by listing jobs from the PAQ database that have been rated at each rating scale level. Analysts enter job data online at www.paq.com and run consistency checks to catch errors such as rating 40% sitting, 40% standing, and 40% walking, or rating computer use as high and no need for hand-arm steadiness that is necessary in using a mouse (PAQ, Inc., 2002).

Annually, PAQ Services, Inc. processes data from thousands of new job analyses. The incoming data are entered into a database that now represents 2,492 unique codes from the Dictionary of Occupational Titles. Depending on how common the job is, any given code may have been analyzed hundreds of times so database statistics are very stable. Each job is rated on the same 187 variables (PAQ, Inc., 2002).

The PAQ has several advantages. It provides a standardized means for collecting quantitative job data across a wide spectrum of jobs as well as providing reliable and valid job data. Several disadvantages are documented, too, including the recommendation that the questionnaire not be used with analysts having reading skills below the college level. In addition, the PAQ scores the basic work behaviors rather than specific tasks of the job, thus making it difficult to develop job descriptions.

e.   Common-Metric Questionnaire – CMQ

The Common-Metric Questionnaire (CMQ; Harvey, 1990; 1991) was developed by Robert J. Harvey to address the limitations of existing worker-oriented instruments such as the Job Element Inventory (Cornelius & Hakel, 1978) and PAQ. His objectives were to develop an instrument that would (1) be easier for raters to understand and complete, thus allowing non-experts to describe their own jobs and verify the ratings of other jobs; (2) describe more specific, observable aspects of jobs thereby enabling a higher potential accuracy and verifiability than most existing worker-oriented instruments; and (3) describe managerial, executive, and professional jobs using a common profile of work activities thus producing a tool that describes exempt and nonexempt jobs on a common metric.

The work dimensions of the CMQ were created by an integration of general-purpose work behavior constructs and managerial work dimensions. The general-purpose work behavior constructs were extracted from the PAQ and Job Element Inventory (i.e., from factor analysis of the entire pools of items); the managerial work dimensions were produced using factor analysis of work dimensions measured by managerially targeted instruments.

All work behavior factors are clustered into three dimensions: (1) interpersonal; (2) decision making/information processing activities; and (3) physical, mechanical, and contextual aspects of work.

The questionnaire is constructed so that workers can easily fill it in describing work they are currently engaged in or a different job that they are asked to evaluate. There are 15 sections in the questionnaire.

Reliability

Reliability assumes that the results from a test are consistent, that is, they are relatively free from error (Portney & Watkins, 1993). Error may be introduced from a variety of sources. The type of reliability estimate one chooses should be based on the source of error one believes is relevant to the tool being developed. For example, if one were concerned about error that is related to the passage of time, then test-retest reliability should be investigated (Cortina, 1993). If the error associated with selection of items from the sampling domain is of concern, then an estimate of internal consistency should be used (Nunnally & Bernstein, 1994). A prerequisite of instrument validity is freedom from error. "An instrument that is inconsistent or inaccurate cannot produce meaningful measurements." (Portney & Watkins, 1993, p. 69)

Reliability (or stability, consistency) refers to evidence that a job inventory possesses sufficiently trustworthy information. Reliability is usually established by studying the degree of agreement between at least two different views of the same inventory content. That is, that data collected at different times, by different raters, from different combinations of item subsets, or different forms of the test, produce essentially the same results. Task frequency and time required to perform tasks yield similar reliability estimates. These reliability estimates are higher than when respondents are asked to estimate the relative proportion of time spent on tasks and task difficulty. Relative scales yield higher reliability estimates than absolute scales (Gael, 1983).

Research conducted over several decades supports the conclusion that responses to questions about task frequency, task time, mental difficulty, physical difficulty, obtained for highly detailed and moderately detailed activity statements are about equally consistent, and are more consistent than are broadly written activity statements. Broadly written activity statements, however, result in more consistent responses than moderately detailed statements when the questions pertained to qualitative features, such as the type of training received or desired. The reliability of highly detailed statements fell between them but was not significantly different from either. Incumbents reporting more types of information about their tasks tended to provide more reliable information than those reporting fewer types of task information (Gael, 1983).

Internal Consistency

Definition: Internal consistency is most frequently established via Cronbach's (coefficient) alpha. Classical test theory (CTT), the traditional approach to test development, views items as random replications of each other; items on a test are simply a sample from a much larger domain of essentially equivalent items. CTT statistics are based on decomposing the sources of variance within and between individuals; thus, the choice of reliability estimate depends on the source of error one is interested in explaining. Coefficient alpha, the most ubiquitous estimate of reliability, "takes into account variance attributable to subjects and variance attributable to the interaction between subjects and items" (Cortina, 1993, p. 98). Coefficient alpha is "the estimated average correlation of a test with all possible tests of the same length obtained by domain sampling. Thus alpha is the expected correlation of one test with another test of the same length purportedly measuring the same thing" (Nunnally & Bernstein, 1994). It is often considered the "gold standard" by which the quality of a test is established. Standards by which the acceptability of the obtained alphas are judged vary depending on the usage of the test. When individuals will be assigned to a treatment or category based on test scores, reliability should be greater than .90 since even at this level, the standard error is one-third the size of the standard deviation (Nunnally & Bernstein, 1994). However, modern psychometricians emphasize that reliability is not the generalizable property of an assessment but rather of scores obtained by a particular set of persons (Guilford, 1996; McHorney, 1999; Nunnally & Bernstein, 1994). Consequently, coefficient alpha does not reference something enduring about a test but rather reflects conditions specific to a particular sample. The factors that influence coefficient alpha include: (1) test length (Nunnally & Bernstein, 1994), (2) test targeting (Thorndike & Hagen, 1977), (3) sample variance (Nunnally & Bernstein, 1994), (4) missing data (Nunnally & Bernstein, 1994), and (5) test homogeneity (Cortina, 1993).

Relation to Validation of Job Demands: Any new evaluation of job demands will most likely include multiple dimensions such as physical, cognitive, and psychosocial. The internal consistency should be established for each of these domains. Factors that influence estimates of internal consistency, such as targeting, will be important to address because it can have a significant effect on the obtained alpha. Ensuring that the range of job demands chosen adequately matches the jobs to be evaluated is critical when the goal is to establish a minimum set of items. Unfortunately, classical test theory offers few solutions for selecting on-target items (Mallinson, Stelmack, & Velozo, submitted). Modern psychometric approaches such as rating scale analysis (RSA), addressed below, can aid in the item selection process (Mallinson, Stelmack, & Velozo, submitted).

Strengths and Limitations of Previous Approaches: Developers of job inventory and job analysis systems recognize that high internal consistency is a necessary characteristic of their tools. Users of these systems may not appreciate that internal consistency is not an enduring quality of an instrument but rather reflects sample-specific characteristics as well as test length, test targeting, sample variance, and the extent of missing data. Contemporary psychometric approaches (described below under the heading *Hierarchical Order and Fit*) take into account these limitations and provide better means of estimating internal consistency.

Criteria: Internal consistency is most commonly determined by the value of coefficient alpha.

- Does the value of coefficient alpha equal or exceed a value of .90? A high degree of precision is required in order to assure a high degree of certainty that the demands of any job have been measured accurately (Nunnally & Bernstein, 1994; Thorndike & Hagen, 1977).

- Was a sufficiently wide range of job demands measured – from very demanding to very easy? Coefficient alpha is directly affected by the heterogeneity of job demands measured (Nunnally & Bernstein, 1994).

- Are the items comprising the evaluation well targeted to the job demands being evaluated? When tests are off-target (e.g., when jobs are rated as extremely challenging or easy on most items), coefficient alpha is distorted (Thorndike & Hagen, 1977).

- Are all items completed for all jobs evaluated? Coefficient alpha is particularly sensitive to missing data (Nunnally & Bernstein, 1994).

- Were coefficient alphas calculated for each domain of interest (e.g., physical, cognitive, psychosocial)? Coefficient alpha can be inflated when evaluations are multi-dimensional. It is appropriate in this case to calculate alpha for each dimension (Cortina, 1993).

Measurement Validity

Validity can be broadly defined as establishing that a test measures what it purports to measure (Portney & Watkins, 1993). Translational validity utilizes observation, expert opinion, input from critical stakeholders, and feedback from consumers to determine the extent to which the operationalization of that construct (vis-à-vis the assessment tool) reflects an accurate translation of the construct (Trochim, 2000). Criterion-related validation uses statistical methods to quantify the relationship between items within the new test, between the new tool and existing tools, or observable or measurable events. It assumes that there are theoretically predictable relationships between the new tool and other equivalent or distinct operationalizations of the construct (Trochim, 2000).

a.   Content-Related/Translational Approaches to Measurement Validity

Content-related or translational approaches to validity are primarily concerned with evaluating how well a group of test items represents the domain of interest (American

Educational Research Association [AERA], American Psychological Association [APA], National Council on Measurement in Education [NCME], 1999). Some groups focus on the role of expert opinion in this process while others argue that a range of stakeholders can contribute to the determination of content validity. This approach is predicated on there being a well-defined, or at least, well-accepted definition of the construct.

Face validity

Definition: A tool has face validity when it appears to measure the intended construct (Portney & Watkins, 1993), and when the tool is consistent with theoretical explanations of the construct (Trochim, 2000). Further, the tool contains elements that reflect what is perceived by experts, stakeholders, and consumers to be significant and relevant in measuring the construct. Some authorities do not consider face validity as distinct from other content-related forms of validity (AERA, APA, NCME, 1999). Others point out that stakeholder input can contribute to later acceptance and utilization of the tool (CARF, 2002).

Relation to Validation of Job Demands: Although face validity is often considered the weakest form of measurement validity, its importance in establishing the acceptability of the tool by end-users cannot be under-estimated. For example, a test that meets all forms of criterion-related validity but that is perceived to address the needs of one group of consumers at the expense of another may not be used by the disenfranchised group or receive much criticism or complaints. In the highly litigious environment of work disability determination, the "appearance" of a valid measure may be as important as statistical determination.

Strengths and Limitations of Previous Approaches: The development process of a typical job analysis entails creating task statements, verifying task statement accuracy and completeness, acquiring data (preparing, trying out, finalizing, distributing, collecting questionnaires), and using the data (analyzing the data, developing job descriptions, interpreting results, reporting results to client). Tasks are typically derived by interviewing job knowledgeable employees, reviewing documents about the job activities, and observing incumbents perform their work. Job inventories are typically developed as printed questionnaires with rating scales. Time spent performing tasks, difficulty, and judgments about their relative significance are typically rated (Gael, 1983). For example, the CMQ developers put strong emphasis on enabling incumbents to describe their own jobs (Harvey, 1990) so that "employees would be more involved in the process, and therefore more likely to accept the results of the job analysis" (p. 5).

However, existing methods have seldom sampled widely from all stakeholders for logistic reasons. The cost, time, and practicality involved in contacting and enlisting participation of all stakeholders, which could number thousands, is enormous. In addition, the analysis of qualitative data (text and verbal conversations) has been impractical. A cost-effective solution now available is Automated Concept Mapping (ACM). ACM begins by capitalizing on the widespread access to computer technology to provide a world wide web-based access to online surveys. Unlike traditional methods that use semi-quantitative methods such as Likert-type response scales to reduce data to predetermined themes, ACM is a text-based method of content analysis. This enables respondents to use their own language in providing responses to survey questions. Supercomputing technology enables the context-based analysis of content to produce richly saturated "themes" that can then be checked and confirmed with smaller groups of experts

and stakeholders. This enables the item content and rating scales that have meaning and value to the widest number of stakeholders to be more easily and efficiently identified.

Criteria: Determining face validity is at best a subjective process. However, it involves consideration both of the process by which the instrument development occurred and the process by which the data were collected and analyzed.

Criteria for validity of instrument development include:

- Were experts, practitioners, other stakeholders, and consumers adequately consulted at each stage of instrument development?

- Does the final instrument represent consensus on what stakeholders consider fundamental to work task completion?

Criteria for face validity of data collection and analysis include:

- Is the instrument user-friendly and relatively easy to complete?

- Are ratings scale categories clear and unambiguous for all items?

Content validity

Definition: Content validity is established by demonstrating that the "test items are a sample of a universe in which the investigator is interested" (Cronbach & Meehl, 1955, p.1). That is, the domain of interest is thoroughly specified and then items are evaluated for how well they cover this domain. In the current situation, the content of interest are optimal job demands, that is, those that represent essential functions of work. APA's *Standards for Educational and Psychological Testing* (1999) points out that the response format should also be considered for how well it maps to the "skills" of the intended universe.

Relation to Validation of Job Demands: Limitations in content validity have been one of the greatest criticisms of the Dictionary of Occupational Titles (US DOL, 1991). This method of job analysis was weighted heavily towards physical job demands and less towards cognitive, psychosocial, and communication demands. As occupations in the national economy have became more concentrated in technology and service industries, it became apparent that there was a disconnection between the content of the DOT and demands of current jobs.

Strengths and Limitations of Previous Approaches: Existing job analysis instruments have been criticized for a lack of adequate coverage of the activities and abilities that characterize current jobs (Harvey, 1993). In developing the CMQ, Harvey developed a complete list of all items and work dimensions covered by existing instruments from which to describe the domains that would contribute to the CMQ.

The F-JAS is the product of a longstanding program of research focused on identifying perceptual-motor abilities required in human task performance. The human capacities required to perform tasks serve as the basis of categorization. The objective of this work was "to define the fewest independent ability categories which might be most useful and meaningful in describing

performance in the widest variety of tasks" (Fleishman, 1967, p. 352). Generating the lists of abilities that would form the basis of this approach involved identifying the cognitive, perceptual, psychomotor, and physical abilities developed from previous analytic studies. Knowledgeable raters evaluated a wide range of work tasks on the identified items. Tasks that could not be adequately identified by items served as indicators that further content areas were needed. In addition, expert review of the items was used to clarify items and reduce ambiguity (Fleishman & Quaintance, 1984).

The O*NET is an example of an instrument with a strong theoretical background. The content model was based on the recommendations of the Advisory Panel for the Dictionary of Occupational Titles (APDOT, US DOL, 1993, p. 6). The six domains encompassed by O*NET are: (1) experience requirements (training , experience, licensure); (2) worker requirements (basic skills, cross-functional skills, knowledge, education); (3) worker characteristics (abilities, occupational values and interests, work styles); (4) occupation characteristics (wages, labor market information, occupational outlook); (5) occupational requirements (generalized work activities, work context, organizational context); and (6) occupation-specific requirements (occupational knowledge, occupational skills, tasks, duties, machines, tools and equipment).

Few systematic studies have been completed comparing various job analysis methods. One notable study was conducted by Rupe and associates for the United States Air Force (Rupe, 1956, as cited in McCormick, 1979). The criteria used to evaluate five job analysis methods (group interview, individual interview, observation interview, technical conference, questionnaire survey) were: (1) the number of job elements or work performed that was reported on job schedules, (2) the discrete tools and materials that were reported, and (3) time involved in analysis. Rupe concluded that the individual interview is the most effective and dependable because it yielded more job elements than the other methods with lower average cost in time. The technical conference method and observation interview are equivalent in producing information on work performed, though they are both costly in terms of time. Group interview and questionnaire survey methods were the least satisfactory methods in producing unique job elements (McCormick, 1979).

Criteria: Content validity requires that the content of the items match with skills that are important in defining the domain of interest. Relevance may be determined by on-the-job experience of workers and supervisor, and by theoretical explanations and empirical investigations of researchers. Relevant criteria include:

- Was an appropriately thorough conceptual model used to establish the domains of interest?

- Do the job demands thoroughly cover all relevant aspects of the conceptual domains they are intended to measure?

- Are the items identified optimal job demands? Are some items more important or central to the construct than others?

- Are the job demands applicable to the widest range of jobs in the economy?

- Do the ratings scales and scoring format capture the appropriate skills for which the test is intended?

- Was data collected from a representative sample of jobs?

- Were data triangulated from multiple stakeholders (e.g., supervisors, incumbents, vocational experts, and SSA evaluators)?

Potential stakeholders include: various offices of the SSA (Office of Policy, Office of Disability, Office of Research Evaluation and Statistics, Office of Hearings and Appeals), state Disability Determination Services, the Rehabilitation Services Administration, certified rehabilitation counselors, rehabilitation professionals (e.g. members of AOTA, APTA), employers, supervisors, job incumbents, and industrial/organizational psychologists.

b.   Construct-Related Validity

Construct validity refers to "the ability of an instrument to measure an abstract concept, or construct" (Portney & Watkins, 1993). It involves testing if the new assessment operates as one would expect from clinical or theoretical expectations. It focuses predominantly on the test score as a measure of the construct of interest. The conceptual model to which the test scores relate distinguishes the construct from other similar ones and shows how the test scores relate to test scores from measures of related constructs (AERA, APA, NCME, 1999). Construct validity may be established by factors inherent to the test itself, such as item intercorrelations (internal consistency), the hierarchical order of items from least to most challenging, and item "fit" or through the relationship to other tests that measure either the same construct (convergent validity) or a different construct (divergent validity). Examining item response is also an important feature when it informs or develops the underlying construct (AERA, APA, NCME, 1999).

Hierarchical Order and Fit

Definition: Rating scale analysis (RSA) reflects a significant advancement from classic test theory for instrument development (McHorney, 1999). The items comprising most job demand instruments are ratings of physical, cognitive or social demands recorded on an ordinal scale. RSA is a measurement procedure that can be used to develop interval-scaled measures from ordinal scores. RSA is one method in the family of item response theories (IRT) (Bond & Fox, 2001; Rasch, 1960; Wright & Masters, 1982). It is also known as a one-parameter model since, in addition to estimating person ability, it estimates one parameter, the difficulty of the items. Two parameter models estimate an additional parameter, the slope (discrimination) of the items (Hambleton & Swaminathan, 1984; Samejima, 1969). RSA produces measures in which the intervals between units of the scale are equal in size. Raw score totals obtained from rating scales do not exhibit this effect. This effect occurs because any test is a subset of possible items that do not reflect the full range of abilities of the population being measured. Thus, while the raw score can range from 0% to 100%, the actual range of abilities extends beyond these instrument limits. This has the effect of compressing the discrimination of scores at the ends of the distribution. The consequence of this effect is that a change of one raw score point at the ends

of the scale does not represent the same amount of change as one raw score point in the middle of the scale. This non-linearity of raw scores is most significant at the end of the scales, and therefore is most problematic when measuring individuals who are least or most able on the construct of interest. Equal-interval scales are necessary if one wants to accurately measure a job's demands or make quantitative comparisons within jobs, across time or between jobs, or across groups of jobs.

Producing an equal-interval scale through RSA involves estimating the difficulty measures of the items. Therefore, items should demonstrate a hierarchical order from most to least challenging and this order should make theoretical and clinical sense (Linacre, Heinemann, Wright, Granger, & Hamilton, 1994). If this task hierarchy is not as expected, then either the content of the items needs to be examined or the theory needs to be reevaluated. RSA further determines construct validity by evaluating the "fit" of individual tasks to the construct. Based on chi-square analysis, fit statistics indicate if all the items are measuring the same thing. If the tasks cohere to describe a single construct, "more demanding" jobs require performance of more difficult tasks and "less demanding" jobs require performance of less difficult tasks. In addition, harder tasks will be harder for everyone, and more able persons will be able to complete more tasks than less able persons. Thus, chi-square fit statistics examine the response (able or unable) and how expected (or unexpected) that response was. Misfit (highly unexpected "passes" or "failures") is an indication that the task may be measuring a construct other than the one being measured by rest of the tasks since the pattern of responses does not follow what would be expected.

Relation to Validation of Job Demands: Rating scale analysis identifies which demands define particular occupational taxonomies. Fit statistics indicate when items work in harmony to measure the same dimension of work demands. This method also determines the hierarchical order of job demands. This ordering quantifies both the amount of skill required to perform particular job demands and also determines which jobs are more challenging than others. In this way, occupations can be arranged in a continuum from least to most challenging. Particular occupations can be placed along the continuum at a position that corresponds to the ability needed to complete that occupation. The graphical representation below illustrates these points.

Figure 1. Hierarchical taxonomy of job demands.
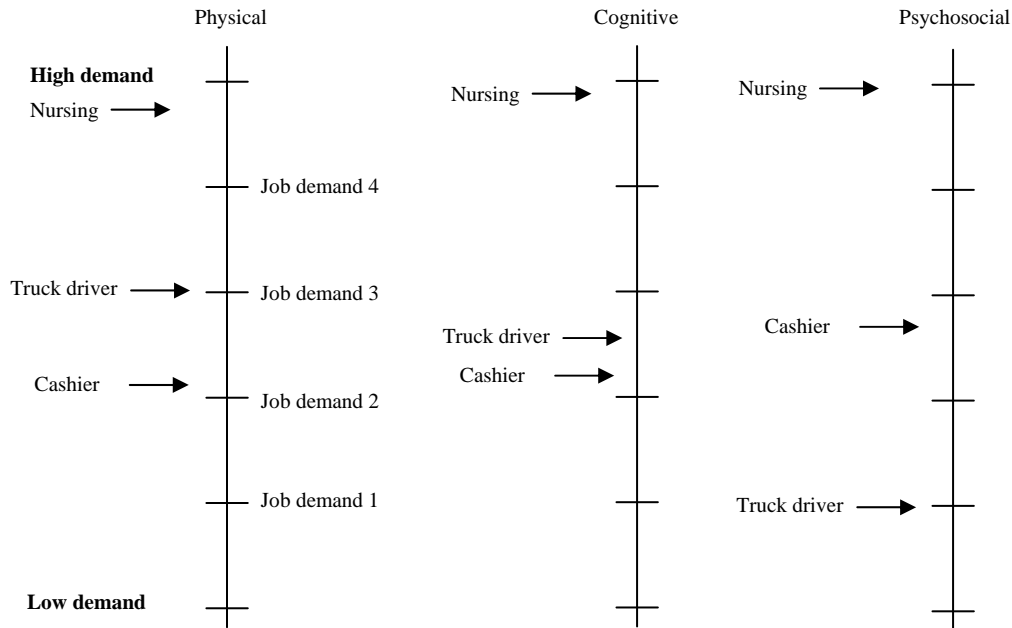
Strengths and Limitations of Previous Approaches: Rating scale analysis has been used widely in education and health care outcomes measures but has been recently utilized in vocational-related evaluations. For example, Ludlow (1999) utilized RSA to evaluate the Job Responsibilities Scale. He applied this method to the occupation of medical laboratory technician and demonstrated that a hierarchy of increasingly greater job responsibility tasks could describe this occupation. Davis (2000) utilized RSA to analyze the job demands of firefighters. He reports that 55 items reflecting regular duties of firefighters formed a hierarchical scale from dousing fire with rake or shovel (easiest) to locating hidden fire in ceilings or walls (most challenging). Three of the 55 items misfit, suggesting these were not strongly related to the construct. Spray and Huang (2000) utilized RSA in obtaining blueprint weights from job analysis surveys. Heinemann, Crown, and McMahon (2000) demonstrated that the Functional Assessment Inventory items define a unidimensional construct that is useful with vocational candidates who had sustained strokes.

Criteria: Rating scale analysis has several statistics for evaluating the psychometric properties of a test. Hierarchical order and fit statistics are two of these.

- Does the order of job demands, from least to most challenging, make clinical sense and correspond to the conceptual model?

- Does the ordering of actual jobs from least to most challenging make sense, relate to other systems that order job difficulty, and correspond with the order proposed by a conceptual model?

- Can deviations from expectations be explained in a rational way?

- Do the items "fit" with an underlying construct of job demands? That is, do the mean square fit statistics fall within appropriate ranges (based on test length and sample size) to avoid type II errors (Smith, 2000)?

Convergent and Discriminant (Divergent) Validity

Definition: Convergent validity is the degree to which the test is similar to other tests that purport to measure a similar construct (AERA, APA, NCME, 1999; Trochim, 2000). That is, there is a strong relationship (correlation) between the new test and existing tests. Jobs that show a high manifestation of the construct on one test should also demonstrate a high manifestation on the other test. Divergent (discriminant) validity is the degree to which a test is dissimilar to (divergent from) other tests that purport to measure conceptually distinct constructs (AERA, APA, NCME, 1999). This implies that statistical relationships between the tests should be weak. Both convergent and divergent validity should be demonstrated in order to have evidence of construct validity (Campbell & Fiske, 1959; Trochim, 2000). There is no absolute value of the correlation coefficient that demonstrates that convergent and divergent validity has been established. In general, the convergent correlations should be high, while the divergent correlations should be low (at least they should be lower than the convergent correlations). However, there should be a consistent and repeated pattern amongst the new test and existing tests.

Relation to Validation of Job Demands: An evaluation of job demands should be based on a sound theoretical (and empirically validated) model that proposes relationships between the construct of "job demands" and other related concepts such as "person ability." Job analysis has a long history, and there are numerous measures with which a new assessment of job demands would share a great deal of overlap. For example, the theoretical work of Fleishman and colleagues has a strong empirical background. While current instrumentation may be insufficient for evaluating job demands as part of the process of disability determination, the theoretical background may well provide a strong basis from which to begin new item development. There are also likely to be a good number of tests with which there should be convergent validity, such as those summarized in this report. While none of these tests specifically cover what is needed for evaluating job demands in a manner suitable for SSA, any new scale should co-vary with existing ones.

Establishing convergent and discriminant validity for an evaluation of job demands poses a unique set of concerns. Psychologists and education specialists who are primarily concerned with measuring traits in individuals and factors relevant to ensuring validity of measures of human performance have developed validity criteria. Their approaches may not be altogether relevant to measuring an abstract construct of "job demands" that does not consider the societal and cultural context in which job demands are defined. Relevant contextual factors include laws that mandate employer accommodation of workers' disabilities, developments in assistive technology, and a greater proportion of service-sector jobs that require cognitive and communication skills. Newer job inventory and job analysis systems recognize the importance of cognition, communication, and psychosocial dimensions of job demands. Consequently, evaluating convergent validity of a new job demands approach should consider how well a

particular dimension of the new evaluation correlates with an older evaluation (e.g., the physical "subtest" of the F-JAS correlates with the physical component of the O*NET).

Discriminant validity is particularly challenging to demonstrate since it requires that the new evaluation have a low correlation with another test that measures some unrelated job construct. The cost of collecting a considerable amount of information about a variety of jobs makes such an exercise impractical. To some extent, factor analytic studies that demonstrate various job factors are uncorrelated or correlated at only a low level would evaluate discriminant validity. One way to demonstrate discriminant validity might be to consider the physical, cognitive, and psychosocial subtests of a new evaluation as distinct "evaluations." It seems likely that the same jobs evaluated for psychosocial demands might look quite different evaluated from the perspective of physical demands. Thus, demonstrating that distinct dimensions of a job inventory of the same set of jobs provide distinct perspectives would help demonstrate discriminant validity of a job demands approach.

Strengths and Limitations of Previous Approaches: The most frequently employed method of convergent validation is to compare incumbents' responses about job requirements with those obtained from supervisors (Gael, 1983). The most desirable way to establish job inventory validity, however, is to compare inventory responses with actual job performance data, for example, clocked time on a task vs. self-report (Gael, 1983). This is rarely done because of the logistic difficulties and expense involved.

Discriminant validity may be much harder to demonstrate since it is not clear in what ways jobs might be measured that distinguishes them in conceptually new ways. This may be a limitation in the development of estimates of validity for any job demands project.

Criteria: As noted above, there are no absolute criteria for establishing convergent and discriminant validity. However, the following criteria may serve as guidelines:

- Is there a satisfactory (compelling) correlation between the new job demands evaluation tool and existing tools such as the F-JAS, CMQ, and PAQ?

- Are there correlations between dimension or sub-tests low? At least, are these correlations lower than those obtained between the new test and existing similar tests (those used to establish convergent validity)?

Factor Analysis

Definition: Factor analysis is a statistical method that provides evidence for an underlying latent conceptual structure by examining the correlation between the variable (item) and the factor. That is, do the items, together, represent a single factor or do items group together to form multiple factors. Factor analysis can aid investigators in understanding if items work together in the way in which they were intended. Factors are characterized by factor loadings and the percent of variance that is explained by the factor. The conceptual structure is elucidated by examining that variables load most strongly on which factors. While factor analysis has been widely utilized in the development of job analysis systems, it has also been criticized, since investigators using the same variables on different samples can (and do) obtain very different

factor loadings. This does not necessarily negate the usefulness of factor analysis in identifying conceptual structures, but it does point out the need for a thorough theoretical framework against which to compare the results of the analysis.

Relation to Validation of Job Demands: Earlier approaches to job analysis, such as those used in developing the Dictionary of Occupational Titles and initial studies of the F-JAS, focused heavily on the physical demands of jobs. More recently non-exertional demands such as cognition and communication have been incorporated in job inventory and job analysis systems. Recent tools such as O*NET address these demands explicitly. Several competing models of task demands reflect the multifaceted and multidimensional demands of jobs. Further empirical validation will help clarify the content of the dimensions of job demands.

Strengths and Limitations of Previous Approaches: Factor analysis has been used extensively in the study of job demands. For example, Fleishman and colleagues describe the objective of their work as being "to define the fewest independent ability categories which might be most useful and meaningful in describing performance in the widest variety of tasks (Fleishman, 1967, p. 352) Fleishman's initial program of research focused on identifying psychomotor abilities accounting for performance in a wide range of human tasks. He and his colleagues conducted a series of factor analytic studies that examined the correlations among proficiencies of hundreds of subjects who performed a wide range of tasks requiring different kinds of motor performance skills. They found that these tasks could be clustered into nine categories requiring common abilities. To date, several thousand jobs have been studied; high agreement between profiles obtained from incumbents, supervisors, and job analysts has been found (c.f., Fleishman & Mumford, 1991). The focus of these studies was predominantly on physical capacities; domains related to interpersonal abilities were recently added to the F-JAS. A taxonomy of ability definitions and behaviorally, task-anchored rating scales have been developed for 21 interpersonal abilities including social confidence, dependability, and social sensitivity. This developmental history of the F-JAS illustrates the strength of factor analysis in confirming ideas about underlying constructs, but shows the limitation of the method in identifying constructs that were not part of the initial instrument development and data collection.

As another example, the work dimensions of the CMQ were created by integrating general-purpose work behavior constructs with managerial work dimensions. The general-purpose work behavior "overall" factors were obtained by factor analyzing the items from the Job Element Inventory (Cornelius & Hakel, 1978) and the Position Analysis Questionnaire (Palmer & McCormick, 1961). Three factors were identified: 1) interpersonal dimensions, 2) decision making/information processing activities, and 3) physical, mechanical, and contextual aspects of work.

Criteria:

- Are the eigenvalues greater than 1.0? It is a general rule to focus only on factors that have eigenvalues greater than 1.0 because they explain a sufficient proportion of the variance in the factor structure (Trochim, 2000).

- Do the factor loadings make clinical or theoretical sense? Various types of rotations are employed to help enhance the interpretability of factors.

c.   Criterion-Related Validity

In criterion-related validity, the scores on a new instrument are related to a criterion of interest. The criterion is an outcome that is related to the construct measured by the new instrument. The relationship is such that the criterion may occur in close temporal proximity with the construct of the new measure, or the new measure may help predict how respondents will behave on the criterion at a future point in time. Both the choice of criterion and the manner in which the criterion is measured are important (AERA, APA, NCME, 1999). A determination is then made about how well the new evaluation predicts the criterion. This decision needs to take into account whether it is more important to avoid false positives (classifying someone as having or obtaining the criterion when they do not or will not) or to avoid false negatives (classifying someone as not having or not obtaining the criterion when in fact they do or will; AERA, APA, NCME, 1999). Because the new test can be related to a criterion that exists simultaneously with the test or is related to a future criterion, criterion-related validity may be concurrent or predictive.

Concurrent validity

Definition: Concurrent validity is established when the new test is related to or predicts a criterion that is measured simultaneously. This approach contrasts with convergent validity. In convergent validity the goal is to learn if the new test measures the *same* construct as the existing one. In concurrent validity, the new test should predict an outcome or performance that is related to the construct measured by the new test. In job analysis, it is not always clear what else job demands might be related to. In some cases, authors have argued that worker satisfaction might be utilized. To quote McCormick, "The requirements as stated should be possessed by job candidates selected for the job in order to provide reasonable assurance that they will become satisfactory workers on the job … Even the term satisfactory is fairly slippery, since in the case of most jobs the incumbents vary in degree of satisfactoriness." (McCormick, 1979, p. 241).

Predictive validity

Definition: Predictive validity is established when the new test predicts a future outcome on the criterion of interest. The amount of time in the future depends on the context and the construct being measured. Predictive validity does not imply that the construct underlying the new test is causally related to the criterion; in fact the criterion may occur so far in the future as to make causal inference unrealistic. However, it does suggest that knowing a score on the new tests gives one a strong indication of the outcome on the criterion.

Relation to Validation of Job Demands: Concurrent and predictive validity are not easily applied to job demands. Job demands are used to rate jobs or occupations rather than persons. Thus, jobs are not expected to "perform" in a particular way in other arenas or at a future time. In addition, the relationship between the job demands evaluation and the criterion are only as good as the validity of the criterion. Commonly used criteria are pay, tenure and FLSA exempt status

(Harvey, 1993). Validity can sometimes be inferred because of a logical relationship that should exist between inventory responses and a personal characteristic, such as job tenure because, up to a point, an incumbent's capability should correspond with job tenure. Problems with these criteria include vague definitions, no clear relationship with job demands, and short "shelf-life" (salaries quickly become dated). In addition, it is not clear what, in the case of an evaluation of job demands that is utilized in a disability determination process, the appropriate predictive criterion might be.

Strengths and Limitations of Previous Approaches: The CMQ makes extensive use of pay and FLSA exempt status as evidence of predictive validity. However, the author notes the difficulties with these measures including that wage predictions seldom match actual market wages, and that the criterion quickly becomes dated (Harvey, 1993).

Criteria: Generally considered one of the stronger forms of validity, criterion-related validity is the most problematic means of establishing validity of job analyses. Because the focus is on a "thing," job demands rather than a person, traditional concepts of criterion-related validity may not always apply. In this situation, it may be more important to establish translational, construct, and content-related validity.

Issues in Applying Validation Criteria

Reliability is frequently used to infer validity because reasonably high reliability is a necessary, but not sufficient, criterion to obtain acceptable validity. When incumbents' responses generally agree, a form of validity (consensual) can be considered to have been obtained. To quote Gael, "Because of the difficulty associated with establishing job inventory validity, validity is often assumed if the inventory data are reliable. While reliability is not a substitute of validity, high agreement between respondents is an indication that the job inventory data are valid." (Gael, 1983, p. 27).

McCormick notes that validity data "are difficult to come by, and there are very limited instances in which data have actually been obtained. (It would require some means of verifying the responses given by individuals). In most circumstances one must assume that if task inventory responses are reasonably reliable they are also reasonably valid." (1979, p. 133-4). "It is usually necessary to assume the validity of such data if they are reasonably reliable" (p. 134). A rare example of an attempted validity effort (Christal, 1969) is described in McCormick's text.

McCormick also notes: "The requirements as stated should be possessed by job candidates selected for the job in order to provide reasonable assurance that they will become satisfactory workers on the job. Validity, however, is not a clear-cut, unitary concept; rather, there are different varieties of validity; it is usually not feasible to refer to any given job requirement as *valid* or *not valid.* Instead, one needs to think in terms of the degree of validity or, perhaps more practically, to view validity in terms of the probabilities that those fulfilling a stated requirement will become satisfactory employees. Even the term *satisfactory* is fairly slippery, since in the case of most jobs the incumbents vary in degree of satisfactoriness." (McCormick, 1979, p. 241).

In summary, this report prepares us to begin work on subsequent deliverables, including: (6) a report that describes the methodology developed for identifying the optimal job demand variables and that includes exemplary variables produced by the methodology or methodologies developed, (7) a description of the procedures for validating the job demand variables, and (8) a report of the proposed scales, thresholds and rating methods for assessing job demand variables for the purpose of comparing the individual's residual physical and mental functional capacities with the minimum level of functioning for the job demand variable for any given job.

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TABLE 1: SUMMARY OF SELECTED JOB ANALYSIS SYSTEMS

System Name & Developer	Major Users	Purpose	Content	Database	Psychometric properties	Comments
Common Metric Questionnaire (CMQ): Robert J. Harvey (1991)	HR purposes in Government and private industry.	To develop a comprehensive yet standardized instrument that is easy to use by all and allows quantitative comparison among jobs.	Questions focus on the worker, the job, and the setting, organized in 15 sections and 5 areas: Background (41 questions), Contacts with people (62), Decision making (80), Physical and mechanical activities (53), and Work setting (47).	CMQ database is handled by Larsen & Associates, Personnel Systems & Technologies Corporation (PSTC): http://www.pstc.com/	The author addressed the issues of face, content, and criterion-related validity in the manual, and reported reasonably high internal consistency and reliabilities within and across scales.	Relatively new instrument. Was field-tested in on 4552 positions representing over 900 occupations in the DOT, including both exempt and nonexempt jobs.
Functional Job Analysis (FJA): Initially developed by Sidney A. Fine in 1939 and 1949 (1st & 2nd edition). The recent versions (3rd & 4th edition) were revised and endorsed by DOL (Fine & Cronshaw, 1999).	U.S. Department of Labor, SSA, vocational rehabilitation, educators, and private industry.	To classify occupations and to define job characteristics to facilitate transfer of workers from one job to another (to determine transferable skills).	Work characteristics (How the work gets done? What is acted upon? What actions are required?). 3 scales are defined: data, people and things. Worker characteristics: educational and vocational preparation, aptitude, temperament, interest, physical demands, etc. environmental conditions.	Dictionary of Occupational Titles and related documents. About 12,500 occupational definitions. Database not significantly revised in 10 years.	Early literature does not contain data on reliability. The 4th edition reports low to moderate range reliability estimates (Miller et al., 1980).	Probably the most widely used system in the US. Emphasis is on careful training of job analysts to assure consistency. Limited data on validation.

System Name & Developer	Major Users	Purpose	Content	Database	Psychometric properties	Comments
Position Analysis Questionnaire (PAQ): McCormick, E.J., Jeanneret, P.R., & Mecham, R.C, (1972).	Private industry.	To measure job characteristics and relate them to human characteristics (i.e., work behavior).	195 job elements that fall into 5 areas: (a) information input, (b) mental processes, (c) work output, (d) relationships with other persons, and (e) job context.	PAQ Services, Inc. Database is maintained at Purdue University (PAQ, 2002).	Criterion-related validity was reported by Schmidt & Hunter, 1977. Construct validity and reliability are reported in the Manual. Moderate correlations with GATB and SATB reported (McCormick, et. al. 1972; Mecham, McCormick & Jeanneret, 1977, PAQ, 2001).	First developed in the 1970s. 2492 jobs from DOT have been analyzed.
Fleishman Job Analysis Survey (F-JAS): Fleishman and colleagues (Fleishman, 1982; Fleishman & Quaintance, 1984; Fleishman & Mumford, 1991).	Military and private industry, researchers.	To use rating scales to determine job ability requirements. To establish a taxonomy of "functioning requirements" (e.g., ability, skills) for human (job) performance.	Initially, it consists 52 rating scales that cover cognitive, sensory-perceptual, psychomotor, and physical domains of human performance. Recently, 21 rating scales covering the domain of interpersonal abilities are added to the F-JAS.	It has not been applied to a large number of jobs in the U.S. economy to produce an occupational database.	Interrater reliabilities are consistently high for the ability ratings. Agreements between profiles obtained from incumbents, supervisors, and job analysts are also high.	Developed in 1984 based on 2 decades of research. To date, several thousand of jobs have been studied and provided "ability requirements profiles".
Occupational Information Network (O*NET): DOL (Peterson, Mumford, Borman, Jeanneret, & Fleishman, 1999).	U.S. Department of Labor, educators, manpower programs, vocational rehabilitation, and general public (job seekers, job providers, career counselors, researchers, etc.).	To develop a comprehensive yet flexible occupational information system that can be used by all users.	6 domains: worker characteristics, worker requirements, experience requirements, occupation characteristics, occupational requirements, and occupation-specific requirements.	On line database with links to other relevant information. Constantly updated. Occupational information on about 1200 jobs. Designed for ease of use by the general public.	Interrater reliabilities on descriptors are high in most cases. A large amount of research with various types of statistical analyses was conducted to examine the validity of the scales and the ratings.	Prototype was developed in the 1990s; national field testing was performed. Job descriptors for 1122 occupation units were completed by job analysts, and a small subset of such units were completed by job incumbents.

DEFINITIONS

In order to facilitate communication, the following definitions are used throughout this document to describe various features of work:

Aptitude: combination of abilities that is indicative of an individual's capacity to learn or develop a proficiency in some particular area if appropriate education and/or training are provided.[2]

Duty: usually used rather loosely to refer to a large segment of work performed by an individual.[3]

Element: sometimes considered to be the smallest step into which it is practical to subdivide any work activity without analyzing the separate motions, movements, and mental processes involved.[4]

Function: a broad subdivision of a job composed of a group of tasks that are somewhat related because of the nature of the work or the behavior involved, such as acquiring information.[5]

Job: a group of positions within an establishment that are identical with respect to major tasks.[6]

Job analysis: usually refers to a process whereby a job is dissected into its component parts and those parts are studied to decipher the nature of the work…breaking a job down into tasks performed by job incumbents, synthesizing those tasks into job functions, and obtaining data about and studying those tasks and functions.[7]

Job characteristics: the tasks, environmental, and psychosocial factors that constitute the performance of specific job tasks.

Job demands: the physical, cognitive, and psychosocial requirements for the performance of required tasks in a specific job.

Job description: typically consist of descriptions of the work activities that are performed in a job. They usually also include information about other job-related aspects such as working conditions and tools and equipment used.[8]

Job specification: sets forth the personnel requirements or personal qualifications that are specified for those who might be candidates for the job in question.[9]

Job inventory: a comprehensive list of the tasks that are performed to accomplish a job or set of jobs.[10]

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[2] Based on definition in Glossary of *Terminology for Vocational Assessment, Evaluation and Work Adjustment*
[3] Based on Edwin McCormick's definitions found in *Job analysis: Methods and applications*, 1979
[4] Based on Edwin McCormick's definitions found in *Job analysis: Methods and applications*, 1979
[5] Based on Sidney Gael's definitions found in *Job Analysis*, 1983
[6] Based on definition in *Revised Handbook for Analyzing Jobs*
[7] Based on Sidney Gael's definitions found in *Job Analysis*, 1983
[8] Based on Edwin McCormick's definitions found in *Job analysis: Methods and applications*, 1979
[9] Based on Edwin McCormick's definitions found in *Job analysis: Methods and applications*, 1979
[10] Based on Sidney Gael's definitions found in *Job Analysis*, 1983

Occupation: a group of jobs found at more then one establishment in which a common set of tasks are performed.[11]

Skill: the ability to use one's knowledge effectively and readily in the execution or performance of a task.[12]

Task: distinct activities that constitute logical and necessary steps in the performance of worker by the worker whenever physical and/or mental human effort is exerted to accomplish a specific purpose.[13]

Work activities: the physical and/or mental processes by which workers achieve an establishment's objectives.[14]

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[11] Based on definition in *Revised Handbook for Analyzing Jobs*
[12] Based on definition in Merriam-Webster's *Collegiate Dictionary*
[13] Based on definition in *Revised Handbook for Analyzing Jobs*
[14] Based on definition in *A Guide to Job Analysis*

Appendix B:

REPORT ON JOB ANALYSIS DATABASES, SYSTEMS AND SOFTWARE

Introduction

Identifying the best candidates to hire for specific jobs has long been the goal of employers and human resource personnel. Other professionals, such as vocational rehabilitation counselors, job placement counselors, and guidance counselors working in the field of career guidance and job development and placement, also strive to develop appropriate means to match particular individuals with specific occupations.

In the early 1930's, recognizing the need for a uniform classification of jobs, the United States Department of Labor understood the need to provide professionals working in the employment fields with information to assist in classifying and placing workers following the economic depression of this time (Miller, Treiman, Cain, & Roos, 1980). Following extensive occupational research, *the Dictionary of Occupational Titles* (*DOT*) was published in 1939. The first *DOT* offered definitions of a comprehensive range of occupations. Subsequent editions of the *DOT* added and refined definitions of jobs. In the 1977 edition, occupations were further defined by 46 specific worker traits and worker functions of each occupation. These traits included aptitudes, temperaments, interests, physical demands, working conditions, and training time necessary to perform satisfactorily in the occupation. The *DOT* therefore became a dictionary, which provided not only definitions of occupations, but also a classification system, and a source of data on job demands (Miller, Treiman, Cain, & Roos, 1980). Matching individuals to occupations was thus given a reference system.

When an individual's job prospects or potential are limited due to the impact of a disability or medical condition, appropriate job matching can become a complicated and involved process. The Social Security Administration (SSA), which bases decisions about eligibility for disability benefits in large part upon the individual's ability to work, requires a comprehensive and accurate means of determining the work potential of individuals with disabilities who are applying for disability benefits.

A reliable and valid system of matching the physical and mental abilities of these individuals with the requirements of jobs, therefore, is essential to providing a fair basis for decision making by SSA. With the advent of the computer, numerous job matching programs have been developed to assist in detailing the job demands of occupations and identifying appropriate occupations for particular individuals. The purpose of this paper is to provide a summary of job matching databases and other programs that utilize job demand data.

Background

The *DOT* is used by SSA as its authoritative source of occupational data. However, it has been over a decade since the last edition of the *DOT* was published in 1991. Furthermore, the U.S. Department of Labor has discontinued attempts to update the *DOT* and are implementing a replacement for the *DOT* known as O*NET, the Occupational Information Network. The O*NET program was made available to the general public in December 1998. This program was seen as an improvement to the *DOT* because its focus is on transferable skills, it uses a standard occupational classification system directly linked to labor market data, and it allows for a rapid updating of information (Mariana, 2001).

The O*NET, however, has not met the needs of the Social Security Administration in determining whether a person with certain physical and mental capacities has the ability to perform work related activities. According to Nibali (1999), SSA's Associate Commissioner for Disability, "The organization of the data...does not parallel SSA's disability determination process, as does the *DOT*. For example the O*NET's measures for exertional requirements of work, such as strength, are defined and rated differently than those in the *DOT*" (p.1). The O*NET does not categorize work according to the physical strength job demands of sedentary, light, medium, heavy, and very heavy. Therefore, SSA continues to rely upon the *DOT* when making disability decisions.

Discrepancies in the *DOT* or inadequately covered occupational information are clarified at the hearing level by the use of vocational experts, i.e., individuals with experience and training in the vocational rehabilitation and job placement of individuals with disabilities. Many of these experts are from the field of vocational rehabilitation and work as faculty members or as consultants for private companies. Generally, these vocational experts are not employed by state departments of vocational rehabilitation as these departments are often involved in the SSA disability determination process at the initial level.

It is a daunting task to remain abreast of occupational specific job demands in an ever-changing world of work (Wong, Chan, Gay, Ho & Hattori, 1992). Initial efforts to match specific job demands with an individual's abilities began as manual matching systems. Botterbusch (1986) states that the first efforts to develop a system to match specific job demands with individual abilities began in the mid-1950 when government Job Service personnel developed several manual systems to match job demands and requirements with aptitude test results, i.e. the General Aptitude Test Battery. In the late 1970's another manual system for job-person matching, the Vocational Diagnosis and Assessment of Residual Employability (VDARE), was developed. The VDARE became an effective tool in the hands of vocational rehabilitation experts to assess residual employability and transferable skills of individuals with disabilities (Botterbusch). In 1978 the first mainframe computer job-person matching system was developed (Wattenbarger & McCroskey, 1978). The first micro-computerized job-person matching program, the Datamaster Transferable Skills Analysis, was developed in 1982 at the University of Georgia (McCroskey & Dennis, 2000). In the two decades following the development of the first micro-computerized job-person matching system, many other similar programs have been developed.

The use of computerized job-matching programs offers a fast and consistent means of identifying an individual's employment potential considering his or her functional limitations

and transferable skills. These programs are designed to compare an individual's vocational strengths and weaknesses against the job demands of an occupation (Wong, Chan, Gay, Ho & Hattori, 1992). Vocational strengths could include transferable skills or advanced education. Potential weaknesses could include physical and mental limitations incurred as a result of physical or mental impairments, limited education or limited literacy.

The SSA disability determination process relies upon determining an individual's ability to be employed based upon his or her physical and mental limitations and transferable skills from prior education, training, and work history. Job-matching systems or software programs could prove beneficial in facilitating this process.

The purpose of this paper is to identify, describe and compare the programs or systems offered by public and private companies that collect data on job requirements and use or produce software or systems for identifying an individual's employment options through a structured analysis of job demand data. As appropriate, the following questions are addressed in examining these occupational data sources:

1.   What programs are available and what public and private companies collect data on job requirements in addition to using the job demands data for producing systems or software for delivery of the data?

2.   What are the salient physical and mental requirements for jobs identified by the programs or systems?

3.   What methodologies do the developers use in identifying the physical and mental requirements for work?

4.   What types of scales or ratings do the developers use for measuring each of the job demands?

5.   How do the developers approach the issues of validity and reliability?

6.   What methods do the developers use to collect, update, and provide the data?

Programs or Systems Offered by Public and Private Companies

There are basically three types of systems or programs offered by the public and private companies. These types include: job-matching programs, job analysis programs, and international programs.

Job-Matching Programs

This section will discuss the general methodology used by job-matching programs, the identification of specific programs, and the utilization of such programs for disability determination.

General Methodology Used By Job-Matching Programs

Job-matching programs were initially designed to assist the vocational expert and vocational rehabilitation provider in matching and comparing potential jobs for an individual with a disability (Bast, Williams, & Dunn, 2002). The computerization of these programs allowed quick, systematic, and comprehensive review of potential alternative occupations for the individual with a disability.

Job-matching programs and the *Dictionary of Occupational Titles* were not designed for forensic purposes. However, they are frequently used for this purpose. The job analysis programs presented rely heavily upon the *DOT*. Recognizing that the *DOT* is outdated, these job analysis programs often list undesirable or perhaps obsolete occupations for an individual. A rehabilitation or vocational expert input is necessary to identify and interpret the significance of the results. According to Bast, Williams, and Dunn (2002), "It is only after the rehabilitation expert has considered a full range of evidence appropriate to a case (i.e., job-seeking behaviors, decision-making about vocational and/or job options, work motivation, and trends of availability of work in a given geographical area) that a TSA [job-matching program] can to expected to generate defensible results" (p.3).

The most widely recognized methodology for conducting these job searches, also known as transferability of skills analyses, is based directly on the job demand data presented in the *Dictionary of Occupational Titles* and the Revised Handbook for Analyzing Jobs. The transferability or identification of alternative occupations is determined by comparing the relationships among the occupations listed in the DOT against three variables: Work Fields (WF), Materials, Products, Subject Matter, and Services (MPSMS), and Specific Vocational Preparation (SVP). The goal is to match job skills associated with past relevant work with work skills of alternative occupations, which remain possible for the individual (Bast, Williams, & Dunn, 2002). Some job-matching programs crosswalk occupational information derived from the Standard Occupational Classification (SOC) system, the National Compensation Survey (NCS) or the Occupational Employment Statistics (OES) survey. The federal government conducts the SOC, NCS, and OES surveys.

Work Fields. Work Fields is defined in the *Revised Handbook for Analyzing Jobs* as "categories of technologies that reflect how work gets done and what gets done as a result of the work activities of a job: the purpose of the job" (DOL, 1991, p.4-1). There are 96 work fields, which range from specific to general and are organized into homogeneous groups based on related technologies or objectives. The WF is identified by a three-digit code, a brief descriptive title, and a definition. The WF involves not only the overall objective or purpose of the job but also how the objective is attained. An example of a work field is as follows:

011   Material Moving

Conveying materials manually and by use of machines and equipment, such as cranes, hoists, conveyors, industrial trucks, elevators, winches, and hand trucks. Distinguish from Transporting (013), which involves conveyance of passengers, and material by common carrier.

Carrying	Forking	Relaying	Unloading
Dragging	Hanging	Shackling	Wheeling

Drawing	Hoisting	Shoveling	Dumping	Lifting	Skidding
Floating	Loading	Throwing			

Typical Occupations: Forklift Operator; Crane Operator: Stevedore: Freight-Elevator Operator: Hoist Operator: Conveyor Worker (DOL, 1991, p. 4-9).

Materials, Products, Subject Matter, and Services. The MPSMS component of work is defined in the Revised Handbook for Analyzing Jobs (1991) and includes Basic Materials processed, such as fabric, metal, or wood. Final Products made, such as automobiles; cultivated, such as field crops; harvested, such as sponges; or captured, such as wild animals. Subject Matter or data dealt with or applied, such as astronomy or journalism. Services rendered, such as bartending or janitorial (DOL, 1991a, p. 5-1).

There are 48 groups of MPSMS, which are subdivided into 336 categories. The MOSMS classification is generally based on the "overall purpose of the job, usually reflected by the primary knowledge required of the worker...When the primary knowledge is in terms of a product being made, the product is rated. When the primary knowledge is in terms of a specific material being processed, the material is rated." (DOL. 1991, p.5-2).

Specific Vocational Preparation. SVP is defined as the amount of "time required by a typical worker to learn the techniques, acquire the information, and develop the facility needed for average performance in a specific job-worker situation" (DOL, 1991, p. 8-1). The training may be acquired through vocational education, apprenticeships, on-the-job instruction, or essential experience in other jobs. There are nine levels of SVP, ranging from 1 (short demonstration only) to 9 (over 10 years). The Social Security Administration utilizes the SVP component of job analysis to classify jobs into unskilled, semi-skilled, and skilled categories. Jobs with an SVP of 1 or 2 are considered Unskilled; jobs with an SVP of 3 or 4 are considered Semi-Skilled, and jobs with an SVP or 5 or higher are considered Skilled.

Standard Occupational Classification. Effective in 1999, the SOC system is used by all federal statistical agencies to classify workers in occupational categories. Occupations are combined to form 23 major groups, 96 minor groups, and 449 broad occupations. The broad occupation category includes detailed occupations requiring similar job duties, education, skills, or experience (http://www.bls.gov/soc/home.htm). For example, material movers are classified as:

major group – Transportation and Material Moving Occupations,

minor group – Material Moving Workers, and broad occupation--Laborers and Freight, Stock, and Material Movers, Hand.

This broad occupation is further defined as an occupation that involves manually moving freight, stock, or other materials or performing general labor. It includes all unskilled manual laborers not elsewhere classified and excludes material moving workers who use power equipment (http://www.bls.gov/soc/soc-v7g2.htm).

National Compensation Survey. The NCS, conducted by the U. S. Department of Labor, provides information on occupational earnings, compensation cost trends, benefit incidence, and detailed plan provisions. Occupations are classified into 450 categories using the *1990 Occupational Classification System Manual (OCSM)*, which includes information on the level of difficulty and complexity of work (U.S. Income Surveys Branch-Census/DSD, 2000). The 1990

OCSM is based on the *1990 Census of Population and Housing Classified Index of Industries and Occupations* (1990 *OCSM*, 1993).

Identification of Job-Matching Programs

Through the literature review and contact with the companies in the public and private sectors, ten job-matching programs or systems were identified. These include:

- U.S. Publishing, Vocational Diagnosis and Assessment of Residual Employability (VDARE)(Sobush, Kuhne, & Harbers, 1985)

- McCroskey Vocational Quotient System (MVQS)(McCroskey, 2001)

- Job Browser Pro by Skill TRAN (Skill TRAN, 2001)

- WebTSA (VocRehab, n.d.)

- LIFECORP Transferable Skills Program (Grimley, et al. 2000)

- LifeStep® (Bast, n.d.)

- Valpar Pro3000 (Valpar International Corporation, n.d.)

- OASYS JOB-MATCH (Instructional Technologies, 2001)

- Labor Market Access Plus (LMA Plus)(Field, 2002).

Research on some of these and other programs has been conducted. Brown, McDaniel, Couch & McClanahan (1994) focused upon the ease of use and consumer satisfaction of job-matching programs. They found that CAPCO was rated as having highest overall satisfaction; RAVE was second; OASYS was third. Dennis & Dennis (1998) examined the computer programs listed by Brown et al. with an emphasis on the scientific attributes of the software. The authors concluded that the two programs with demonstrated reliability and validity relevant to vocational expert testimony were the McCroskey Transferable Skills Program and Job Quest. Some of these programs, e.g. RAVE (Brown, McDaniel, Couch, & McClanahan, 1994), CAPCO (Brown, McDaniel, Couch, & McClanahan), and Job Quest (Dennis & Dennis, 1998), are no longer in existence and are not described further in this document. The following is a summary of each currently available program or system. Two of the following programs, i.e. U. S. Publishing and VDARE, are programs that require the user to manually extricate the information and do not offer computerized search capabilities.

U. S. Publishing. U.S. Publishing produces the *Specific Occupation Selector Manual*, which is a crosswalk between Census Occupational Codes and the *DOT* (U.S. Publishing, 2002). This manual list includes an alphabetical list of occupations and gives the census code for each of the occupations. After locating the census code for an occupation, the consumer can review a second section of the manual that lists occupations by census code and outlines the physical demands, working conditions, general educational development, specific vocational preparation, aptitudes, and O*NET code for each occupation. The company also offers three quarterly

publications, the *Employment Statistics Quarterly*, the *Unskilled Employment Quarterly*, and the *Residual Access to Employment (RATE) Quarterly*. These quarterly publications do not list job demands of specific occupations, but focus on numbers of jobs in each occupational category according to census code or numbers of jobs by worker trait factors. The *Employment Statistics Quarterly* reports employment by occupation in specific geographical areas. The *Unskilled Employment Quarterly* provides analysis of unskilled work. Instead of an analysis by occupation, the *RATE* analysis is provided by worker traits and Labor Market Sectors.

Salient job demands are identified and rated based upon the Department of Labor's job analyses in developing the *DOT*. Validity and reliability issues are not addressed by the developers. Job demand data is updated according to updates of the *DOT*. Labor market information (i.e., numbers of occupations) is updated through Bureau of Census information.

VDARE. The Vocational Diagnosis and Assessment of Residual Employability (VDARE) process is a systematic manual method to analyze an individual's potential for work by comparing the individual's abilities to the job demands of occupations. Specific job demands used include physical demands, working conditions, specific vocational preparation, general educational development, aptitudes, interests, and temperaments. The VDARE was developed in the 1970's "to be used in conjunction with vocational expert courtroom testimony in disability adjudication cases" (Field, Choppa, & Shafer, 1984, p.3).

According to the developers, the VDARE process starts with determining the individual's Unadjusted Vocational Profile (UVP) by defining prior work history according to the salient job demand characteristics outlined in the *Dictionary of Occupational Titles* and its supplements. A Residual Employability Profile (REP) is developed to reflect the individual's current level of functioning with respect to physical, mental, and educational abilities. The REP is then matched (manually) with the worker trait requirements (job demands) of specific occupations (Field, 1979; Field, Choppa, & Shafer, 1984). The intent of the VDARE process is to determine the types of occupations that an individual can perform given physical and mental limitations. The basic VDARE process includes the following steps:

a) listing each of the individual's prior occupations by *DOT* title and number;

b) listing the specific vocational preparation, physical demands, environmental conditions, general educational development, aptitudes, interests, and temperaments associated with each of the individual's prior occupations according to the scales and ratings of the occupation outlined by the Department of Labor for occupations in the *DOT*;

c) collapsing the work history profiles of each of the occupations into a single profile (UVP), which represents the individual's highest demonstrated level of functioning in each of the job demand categories;

d) listing the individual's current level of functioning (REP) in each of these areas as derived from medical and psychological reports, testing, or professional judgment;

e) comparing the REP to past occupations and other occupations in similar clusters or arrangements to determine feasible alternative vocational possibilities (Field, Choppa, & Shafer, 1984).

The company that publishes the VDARE, Elliott & Fitzpatrick, Inc., uses the same physical and mental job demands as the *DOT*. Additional attempts to identify other physical and mental job demands are not made. The scales and ratings of the job demands are identical to the *DOT*. The job demand data is collected from the Department of Labor (as listed in the *DOT* and its supplements). Updates are dependent upon updates of the *DOT*. Three-way inter-rater reliability of the VDARE process was found to be extremely high at r=0.9944 (McCroskey, 1979). Validity studies by McCroskey (1979) revealed excellent predictive validity (93% without testing, 96% with testing).

MVQS. McCroskey's Vocational Quotient System is a computer program designed to provide job-person matching, transferable skills analysis, vocational interest and personality reinforcer type indicator and earning capacity estimation (McCroskey, 2001). The vocational analysis process used in the MVQS is similar to the VDARE process, but provides further expansion through the three components to this program: the McCroskey 5th edition Dictionary of Occupational Titles-Extended Dataset Edition (McDOT, 2000), the McCroskey Test Plot (McPLOT, 2000), and the McCroskey Transferable Skills Program (MTSP, 2000).

The McDOT2001 program includes 12,775 specific, unduplicated 9-digit *DOT*-coded jobs and 12,811, 9-digit *DOT*-coded jobs when duplicated jobs are included. Each job has a specific worker traits/job requirements profile with respect to 24 vocationally significant worker traits (job demands) and 3 aggregate variables (Vocational Quotient, Specific Vocational Preparation, and Zone). The Specific Vocational Preparation component, which was missing in the O*NET, has been reconstructed and added back to the McDOT job specific data. Further, the developers of the MVQS reconstituted 12 jobs which were classified with different 9-digit *DOT* codes by O*NET 98 researchers.

The McDOT2001 was modeled after the 1991 DOT and was last updated in 2000 for all profiles of job demands/worker trait requirements. Through data mining and data reduction techniques the developers pared the list of 483 worker trait elements listed in the O*NET down to the 75 most vocationally important O*NET-identified worker trait elements. This included 52 ability and 23 worker trait elements. In other words, the McDOT 2001 job demand profiles are presented in terms of job requirement scales from the 1991 Revised Handbook for Analyzing Jobs, which was used to structure the DOT published by the Department of labor. The O*NET provided 1,122 job demand group profiles for which means data were collected. The developers of the McDOT researched and developed an additional 52 job demand group profiles (McCroskey, 2002). Through use of the McDOT, the consumer can list the individual's past work history and develop a client profile.

The McPLOT is a computerizes system which computes a "Vocational Quotient" (VQ) from an analysis of the individual's ratings based upon test results and physical capacities and environmental conditions tolerances. A selection of more than 700 tests and measures from which to choose are available. The Vocational Quotient is defined as "the overall level of adaptive and accommodative behavior…required for people to accomplish meaningful work

adjustment and develop tenure for each of the 12,775 occupations listed in the McDOT." (McCroskey, 2000).

After computing the VQ, the consumer then uses the MTSP to determine transferable skills and potential job matches for the individual utilizing the information previously obtained through use of the McDOT and McPLOT. The 6th edition version of the MTSP, which should be released in 2003, will include more than 3,287 job bank databases. Detailed reports can be printed (McCroskey, 2002).

The MVQS identifies the following job demands/worker traits as salient and vocationally significant:

General Educational Development (GED)

    Reasoning

    Math development

    Language development

Aptitudes

    Spatial perception

    Form perception

    Clerical perception

    Motor coordination/bimanual dexterity

    Finger dexterity

    Manual dexterity

    Eye-hand-foot coordination

    Color discrimination

Physical demands

    Lifting, carrying, pushing, pulling, sitting, standing, walking

    Climbing, balancing

    Bending, stooping, crouching, squatting, kneeling, crawling

    Reaching, handling, fingering, feeling

    Talking, hearing, writing

    See up-close and see far away

Environmental tolerances

    Work location

    Extreme cold

    Extreme heat

    Dampness, wetness, humidity

Noise, vibration

Hazards

Adverse atmosphere

Numerous studies (Dennis & Tichauer, 1998; McCroskey, Dennis, & Dennis, 1998; McCroskey, & Hahn, 1995; McCroskey & Hahn, 1998; McCroskey & Lowe, 1986) have been conducted on the reliability and validity of the previous editions of the MVQS program. The program reported three-way inter-rater reliability to be very high ($R2 = 0.99$). Grimley et al (2000) found the MVQS to be a valid predictor of averaged vocational expert responses on a transferable skills evaluation test. The technical manual to the program contains statistical tables with standard errors of measurement, predictive validity coefficients, standard errors of estimates, frequency counts and percentages. The MVQS relies primarily upon the Department of Labor data for updated information.

Job Browser Pro by SkillTRAN. This computerized program was developed to assist with vocational counseling, planning rehabilitation services, identification of job information, and provision of a format for job analysis. It provides occupational information by job titles, assessment of competencies and training needed for jobs, and job outlook and earnings information (SkillTRAN, 2000). Job Browser Pro has data files, which include:

a) complete 1991 *DOT*;

b) alternate military and civilian titles (more than 30,000);

c) worker characteristics information for all *DOT* occupations, including physical demands, strength, working/environmental conditions, specific vocational preparation, general educational development, aptitudes, and temperaments;

d) cross references to all North American occupational classifications including Industry Designation (from the *DOT*), *Guide for Occupational Exploration* (GOE), Classification of Instructional Programs (CIP), CENSUS, Standard Occupational Classification (SOC), Occupational Employment Survey (OES), *Occupational Outlook Handbook* (2000-2001), Work Fields, Material, Product, Subject Matter & Services

e) (MPSMS), O*NET codes;

f) new, emerging occupations reported in *DOT* format;

g) skills and competency information for white collar occupations and skill checklists for blue collar occupations;

h) long term national job outlook by SIC industry; and

i) national wage information by CENSUS code and OES code (SkillTRAN, n.d.).

The salient physical and mental job demand data identified for occupations are the same as those listed in the *DOT* and its supplements. The company relies upon the analyses performed by the Department of Labor occupational analysts in developing the *DOT* to determine the

physical and mental job demands of each occupation. Scales and ratings of job demands are identical to those used in the *DOT*. Validity and reliability issues are not addressed by the developers (J. Truthan, personal communication, April 12, 2002). According to the literature (SkillTRAN, n.d.) the developers rely upon "original research" to describe new, emerging occupations and skills and competencies information for white-collar occupations. Further information and publication of this "original research" was not found.

WebTSA . This is a transferable skills computer program that processes and reports result over the Internet at http://www.vocrehab.com. Consumers are not required to purchase software. WebTSA by VocRehab attempts to provide job-person matching based on the individual's vocational history and limiting factors. Consumers enter up to 15 of an individual's previous occupations by *DOT* number. Then, the consumer enters (a) the physical abilities of the individual in the job demand areas of strength, climbing, balancing, stooping, kneeling, crouching, crawling, reaching, handling, fingering, feeling, talking, hearing, taste/smell, and vision, (b) the environmental conditions (weather, cold, heat, humidity, noise, vibration, atmospheric conditions, moving parts, electrical shock, heights, radiation, explosives, chemicals) which can be tolerated by the individual, (c) the highest aptitude levels (general learning, verbal reasoning, numerical, spatial, form perception, clerical, motor coordination, finger dexterity, manual dexterity, eye-hand-foot coordination, color discrimination) of the individual based upon current assessments, (d) the temperaments of the individual, (e) the level of data, people, and things which can be handled by the individual, and (f) the state of residence for the individual (to be used in wage calculations). The data entered is compared to the *DOT* to determine other occupations with the same or less job demands characteristics of those identified currently for the individual. Occupations can be reported by *DOT* number, job title, job description, and census code. An additional feature of the program allows the consumer to cross-reference these occupations with the yellow pages in a particular zip code to identify potential employers of these jobs.

The salient job demands that are included in the WebTSA are identical to those used in the *DOT*. The developer obtained all job demand information from the Department of Labor job analysts and did not develop alternative methodologies to identify job demands. The scales and ratings of the job demands are the same as those for the *DOT*. Validity and reliability issues are not addressed by the developer, except to state that Department of Labor information is not altered in any way. Data is collected and updated as it becomes available from the Bureau of Labor Statistics and other government sources. (T. Jazaitis, personal communication, April 18, 2002).

LIFECORP Transferable Skills Program. This computerized program is designed to match worker characteristics with job demands. Information found on this program was limited. Dennis and Dennis (1998) reported that the system was composed of 12 computerized job search and related modules. The developers were initially affiliated with Valpar Corporation. According to one of the developers, Donald Ross (personal communication, April 16, 2002), the computer program utilizes all of the salient job demands (i.e., aptitudes, general educational development, physical demands, etc.) defined in the *Handbook for Analyzing Jobs*, which was used to produce the *DOT*. The scales and ratings of the job demands are identical to those in the *DOT*. The developers do not address the issues of validity or reliability. Updates of data are purchased "from time to time"(D. Ross, personal communication, April 16, 2002) from the Department of Labor.

LifeStep®. LifeStep is a computerized job-matching system that matches a worker's capacities with specific job demands (e.g., general educational development, specific vocational preparation, strength, physical demands, aptitudes, temperaments, environmental factors, and worker functions). In addition, other search indexes are available and include: education level, certifications, licenses (by state), military-*DOT* crosswalk, *Guide to Occupational Exploration*, industry category, materials, products, subject matter, and services, Census codes, educational institutions (by state), zip codes, Standard Industry Classification codes, Occupational Employment Statistics, and wage data from various sources. The company is currently revising their program from Version 5 to Version 6 to include O*NET data, CPT codes, OSHA injury numbers, indexes from County Business Trends, and information from the National Compensation Survey and the North American Industrial Classification System (S. Bast, personal communication, April 13, 2002).

Salient job demands for occupations in the LifeStep® program are from the *DOT* and associated supplements. Methodology used to obtain these job demands was "modeled closely on the model described in the *Revised Handbook for Analyzing Jobs*…sometimes called the Classic Model, in that the Worker Traits associated with the *DOT*…are either adjusted or set to default." (S. Bast, personal communication, April 13, 2002). The scales and ratings used for the job demands are not discernable from the information reviewed and obtained through personal communication. Validity and reliability studies have not been conducted on the LifeStep® program. Plans for Version 6 of this program include alterations to allow the collection and updating of information through submission of labor market data and inter-user studies from consumers (S. Bast, personal communication).

Valpar Pro3000. Valpar Pro3000 is a computer program that includes the following modules: COMPASS (computerized assessment), wage and employment databases, O*NET information, Competencies Database, Work Sample Scorer (to score Valpar Component Work Samples), local job databases, Career Planner (explores occupational clusters based on over 500 Standard Occupational Classification codes, *DOT* database, *Occupational Outlook Handbook* database, plus additional aptitude, knowledge, interests, and skills tests. The company intends to offer the Military Occupation Code Database soon (Valpar International Corporation, n.d.).

COMPASS is the central module to the Pro3000 system. COMPASS is a computerized program that uses adaptive testing techniques for on-computer subtests, as well as several specialized Work Samples, to measure an individual's knowledge and skills. It measures the three General Educational Development (GED) factors and eleven aptitude factors of the *DOT*. In addition to the GED and aptitude factors, the COMPASS allows for entry of 20 physical demand factors, 11 interest factors, 13 environmental conditions, 11 temperaments, specific vocational preparation factors and worker functions (data, people, and things levels). The COMPASS scores from these factors (as determined by test results, review of medical data and reports, and professional judgment of an individual's level of functioning in these areas) can then be cross-referenced with the *DOT* to find potentially suitable occupations. Additional modules in the Valpar Pro3000 system allow the consumer to research resulting occupations through crosswalks to the O*NET, wage data, *Occupational Aptitude Handbook*, and other data (B.B. Christopherson, personal communication, April 22, 2002). In addition, the Valpar program includes a *competencies database,* that reportedly has complete competencies lists for 140 *DOT* jobs using over 15,000 competencies (Valpar, n.d.). The salient job demands and the methodology used to identify these demands for the Valpar Pro3000 are the same as those

outlined in the Department of Labor's *Revised Handbook for Analyzing Jobs*. The scales and ratings for each of the job demands are identical to the *DOT*. The developer reports that construct validity, temporal and internal consistency reliability studies have been conducted and results are outlined in the product manual. (NOTE: A product manual was not provided for review.) Dennis and Dennis (1998) report that the content validity of the previous version of the COMPASS (System 2000) was assessed and the level of exact and partial agreement between a panel of vocational experts (Certified Vocational Evaluators with doctoral degrees) was 88.7%.

OASYS JOB-MATCH. OASYS is a computerized job-match program that matches a job seeker's skills and abilities with occupations, employers, job openings, and training services. This program summarizes an individual's skills from past jobs and applies them to a work history profile. The profile can be modified, if necessary, by test results or other means that reflect a more accurate assessment of the individual's abilities. The profile is then compared to occupational requirements based upon job demands by decreasing levels of transferability of skills, ranging from occupations that closely match to occupations that may require additional training (Instructional Technologies, 2001).

OASYS uses the same salient job demands, methodology, and scales and ratings of job demands identified in the *Revised Handbook for Analyzing Jobs, which* was used to produce the *DOT*. The developers do not address the issue of validity or reliability. The developers do not collect data; they purchase updates of data from the Department of Labor and other government sources (G. Gibson, personal communication, April 12, 2002).

LMA Plus. Labor Market Access Plus is a computer program designed to process occupational and employment data to arrive at a reasonable level of transferability, and an analysis of employment and wage access or loss following an injury. "The program is based on an 'equal to or less than' search and match rationale following the input for the analysis with respect to occupational area, work fields, and worker trait factors (adjusted for restrictions)." (Field, 2002, p.11)

LMA Plus requires the consumer to assess the individual's Residual Functional Capacity (RFC) through the use of tests and information provided in medical and psychological reports or through demonstrated ability according to a manual analysis of the job demands required in past work utilizing a program such as VDARE. The job demands assessed include general educational development, specific vocational preparation, aptitudes, strength, physical demands, aptitudes, and temperaments. The consumer may enter either the current level of individual functioning in each of these job demands, or the past and current level of functioning (if an injury or increase/decrease in ability has occurred). Scales and ratings for each job demand are identical to those used in the development of the *DOT*. The computer then conducts a job search to match occupations in the *DOT* that have the same or less job demands than those entered for the individual. In addition to *DOT* job titles and *DOT* numbers, the program can report information on wages for potential occupations and can calculate the number of jobs an individual could perform prior to an injury (based upon the individual's vocational profile prior to an injury) and compare it with the number of jobs he or she can perform following an injury (based upon post-injury residual functional capacity data entered).

The manual for the LMA Plus program reports that the program is 100% reliable assuming the same search factors (job demand levels) are entered in the program on more than

one occasion. The validity of the program depends upon how well it predicts potential outcomes in the marketplace. The validity of the LMA Plus program is not considered, by the developers, to be inherent to the computer program itself, but relies upon the databases utilized in the program. In this instance, the primary database used is the *DOT*. Therefore, validity of the LMA Plus program is dependent upon the validity of the *DOT* (*Labor Market Access Plus*, 1999).

Utilization of Job-Matching Programs for Determining Disability

Job-matching programs were not designed to function in a disability determination capacity. However, they are often used by vocational experts and rehabilitation professionals to assist in examining occupational alternatives for individuals with disabilities. Although these programs can act as tools in a vocational rehabilitation endeavor, the fact that they rely heavily upon the outdated *Dictionary of Occupational Titles* negates their usefulness for Social Security disability purposes once the *DOT* is no longer used by SSA. Unless a decision is made by the Department of Labor to continue updating the *DOT*, any job-matching program based upon this reference will soon become obsolete.

Although the *DOT* is outdated, job-matching programs continue to be utilized by many rehabilitation professionals to assist in identifying alternative occupations. These professionals use information derived from such programs to assist in career counseling. Further, information in the *DOT* is used by agencies to record occupational statistics. For example, the state vocational rehabilitation agencies record successful return to work cases according to *DOT* occupational code and such statistics are collected by the federal Rehabilitation Services Administration.

Job-matching programs are also used by private and public agencies, such as workers compensation agencies and Long Term Disability insurance companies. The use of these programs is not directed toward actual disability determination. For example, the West Virginia Bureau of Employment Programs Worker Compensation Program refers injured workers to rehabilitation providers with specific instructions that a transferable skills analysis (job-matching) program, such as VDARE, be performed. The rehabilitation provider utilizes the information obtained in this analysis combined with an actual labor market analysis, medical, educational, and other claimant information to opine whether or not the individual has vocational potential with or without retraining.

With respect to the ten job-matching programs identified, all are proprietary in nature and, as such, customer lists are not readily available for contact. Attempts to obtain names of insurance companies utilizing particular programs were not very successful. According to one job-matching program developer, at least 50 Long Term Disability insurance companies use their program as a tool in determining vocational potential of individuals. The program is not, however, used by itself to determine disability.

Specific insurance carriers identified included Hartford, Reliance, and UNUM-Provident Insurance Companies. Attempts to contact Hartford and Reliance were not successful. However, contact was made with Kaye Sullivan-McDevitt, Assistant Vice President of Clinical and Vocational Resources with UNUM-Provident Insurance Company. According to Ms. McDevitt (personal communication, July 22, 2002), the job-matching program is not utilized in most of UNUM-Provident's disability contracts during the initial stage of disability determination,

because the individual only has to prove he or she cannot perform his or her regular occupation in order to receive Long Term Disability benefits for the first 24 months. After 24 months, in most cases, the person must be unable to perform any and all occupations in order to continue to receive disability benefits. Therefore, job-matching programs are not utilized until the "change of definition" evaluation is conducted, at approximately 18 months into the claim to prepare for the change of definition at 24 months. At this point, the following sequence of events occurs:

1) The insurance carrier requests additional updated medical information from the treating physician/medical professional;

2) A physician or nurse employed by the insurance carrier reviews the new medical information and the case to determine appropriate work restrictions for the individual;

3) If work is considered a possibility, the case is referred to a private rehabilitation
   i. provider, who performs a job-matching analysis.

4) The vocational expert or rehabilitation professional in the private rehabilitation company uses the results of this analysis along with other evaluation tools to determine if the individual is employable and in what occupations. If the individual accepts an offer of vocational rehabilitation services, the job-matching software may be used to identify vocational options to pursue in a return to work effort. The findings are reported to the insurance carrier.

5) If occupations are found to be feasible for the individual, a labor market analysis targeting the particular occupations may be performed by the rehabilitation provider to determine the availability and wages of the occupations if job availability and wages of the occupations are not known.

Members of the UNUM-Provident claims staff do not conduct or interpret the job-matching analysis. The job-matching program is considered only a tool in determining disability and is not used alone to make an actual determination of disability.

Rehabilitation professionals in the forensic arena also utilize job-matching programs as one of many tools to determine a person's residual vocational potential subsequent to an injury. The acceptance of these programs by courts has been mixed. In *Perez vs. IBP, Inc.* (1990), the Kansas Supreme Court stated:

> It is this court's opinion that a much more specific foundation, regarding the acceptance of this computer program within the field of vocational rehabilitation must be provided before the court will consider the program's output to have probative value. Just because something comes out of a computer does not mean that it has veracity. Unless the deponent understands how the computer program processes his inputs to read conclusions, and can explain that process to the Court's satisfaction, the computer's output will not be allowed as evidence (as cited in Field, 1993, p.38-39).

This case involved the use of the Labor Market Access software. In another case (*Hughes vs. Inland Container*), also involving the Labor Market Access program, the district court of Kansas utilized the Labor Market Access rationale presented by a rehabilitation consultant, Dr. Tim Johnson, to determine a percentage of permanent partial disability. However, the court modified the Labor Market Access rationale by further calculations deemed by the court to be appropriate (Field, 1993).

Job Analysis Programs

In addition to the ten job-matching programs outlined above, information was reviewed regarding other classification systems used as a basis for or resulting from job analyses. These classification systems include: the Functional Job Analysis Scales (FJA), Fleishman Job Analysis Survey (F-JAS), Common Metric Questionnaire (CMQ), Multipurpose Occupational Systems Analysis Inventory-Closed Ended (MOSAIC), Occupational Analysis Inventory (OAI), Position Analysis Questionnaire (PAQ), and Work Profiling System (WPS). These systems are described only briefly here because several of these are described in greater detail in chapter 2.

Functional Job Analysis Scales. FJA is a method of collecting job information. The FJA, beginning in the 1940's, was the system used by the U.S. Department of Labor to classify jobs for the *Dictionary of Occupational Titles*. The most recent version of the FJA uses seven scales to describe what workers do in jobs: (1) Things, (2) Data, (3) Things, (4) Worker Instructions, (5) Reasoning, (6) Math, and (7) Language. The scales used are the same as listed in the *DOT*. Other than the *DOT* and programs relying upon *DOT* information, a current database of jobs containing FJA data does not exist (Hr-Guide, n.d.).

Fleishman Job Analysis Survey. The F-JAS, formerly the Manual for Ability Requirements Scales, consists of 52 cognitive, physical, psychomotor, and sensory abilities. The F-JAS uses levels of ability rating scales to specify levels of functioning for occupations (HR-Guide, n.d.). This classification system was utilized in the development of the O*NET. The system is described as a holistic rating scale, defined as a "process that relies on a single-item...judgment to directly estimate a highly abstract characteristic (e.g., the amount of Inductive Reasoning, Oral Comprehension, or Truck Strength presumably required to perform a job or occupation." (Harvey & Wilson, 1998, p. 6).

Common Metric Questionnaire. The CMQ has five sections: (a) Background, (a) Contacts with People, (c) Decision Making, (d) Physical and Mechanical Activities, and (e) Work Setting. The Background section addresses work requirements, such as travel, seasonality, and licensure requirements. The Contacts with People section examines levels of supervision, degree of internal and external contacts, and meeting requirements. The Decision Making section focuses on relevant occupational knowledge and skills, language, sensory requirements, and managerial and business decision making requirements. The Physical and Mechanical section evaluates physical activities and equipment, machinery, and tools. The Work Setting section focuses upon environmental conditions and other job characteristics. Research with the CMQ has shown that "job dimension scores are strongly predictive of worker-trait levels of successful job incumbents" (Harvey & Wilson, 1998, p.59). The CAQ has been field tested on 4,552 positions representing over 900 occupations in the *DOT* and has yielded high reliabilities (Harvey, 1993, as cited in HR-Guide, n.d.).

MOSAIC. The MOSAIC is a job analysis program currently being used by the United States Office of Personnel Management (OPM) to develop a database of descriptions of federal jobs. Two primary types of descriptors are used, i.e., tasks and competencies. Tasks are rated on degree of importance and competencies are rated on several scales including requirement for entry and importance. The clerical, technical, and managerial job sections have been completed. Information on reliability has not been reported (HR-Guide, n.d.).

Occupational Analysis Inventory. The OAI is composed of 617 elements in five different categories: (a) Information Received, (b) Mental Activities, (c) Work Behavior, (d) Work Goals, and (e) Work Context. Each job element is rated on one of four scales: part-of-job, extent, applicability, or special scale designed for element. Data has been collected on 1,400 jobs that represent five occupation categories (HR-Guide, n.d.).

Position Analysis Questionnaire. The PAQ is a structured job analysis technique that measures job characteristics and relates them to human characteristics, rather than describing the tasks or duties of a job. There are 187 job elements that fall into five categories: (a) Information Input (how and where the worker gets information), (b) Mental Processes (reasoning and problem solving), (c) Work Output (physical activities and tools used), (d) Relationships with others, and (e) Job Context (the physical and social contexts of the job). Each work characteristic is rated on an 11-point scale. PAQ researchers have aggregated data for hundreds of jobs. The database is maintained by Purdue University. Several studies have revealed reasonably high reliability for the PAQ (Committee on Techniques, 1999; HR-Guide, n.d.). (Note: Attempts to contact Purdue University to obtain database information were not successful.)

Work Profiling System. The WPS is a job analysis system, which is targeted toward individual development planning, employee selection, and job description. Areas investigated include hearing skills, sight, taste, smell, touch, body coordination, verbal skills, number skills, complex management skills, personality and team role. The developers, Saville and Holdsworth, provide a database for users when users make data available (HR-Guide, n.d.).

International Systems

A global analysis would encounter the difficulties of assimilating far too vast systemic differences and significant divergences in the conceptual understanding reflected in national variations, therefore, this paper is confined to an overview of European concerns and practices.

Australian Standard Classification of Occupations (ASCO). The ASCO defines an occupation as a set of jobs with similar sets of tasks. It uses the concept of skill level and skill specialization and has eight major groups, 52 minor groups, 282 unit groups, and 1,079 occupations. The system classifies jobs according to skill level (the amount of education, training, or previous experience required to perform the job) and skill specification (the knowledge required, tools and equipment used, materials/goods/services) (Committee on Techniques for Enhancement of Human Performance, 1999; HR-Guide, n.d.).

Netherlands Standard Classification of Occupations 1992 (NSCO '92). This system classifies occupations by skill level and specialization related to designated educational sectors in the Netherlands. Skill level is coded with a 5-point scale that combines formal education with work experience. Skill specialization coding is made according to the educational sectors in the Netherlands, i.e., agricultural, mathematics and natural sciences, and language and culture. An additional 128 "task clusters" are used to further differentiate the occupation. Examples of "task clusters" include "navigate a ship" and "check, inspect, examine, verify, test, sort." An additional 11 specific skills can then be used to further differentiate the occupation. These specific skills are similar to the "generalized work activities" used in the O*NET. Through the classification

system, a total of 1,211 occupations are formed (Committee on Techniques for the Enhancement of Human Performance, 1999).

Canada's National Occupational Classification (NOC) and the Standard Occupational Classification (SOC). The NOC and SOC emerged from the *Canadian Classification and Dictionary of Occupations* (CCDO) originally developed by the Department of Manpower and Immigration based on the *DOT* (United States) as well as the *International Standard Classification of Occupations* (ISCO). The NOC is used to classify 25,000 job titles into 522 unit groups. The NOC contains characteristics including the education, training, or experience necessary to perform the occupation. The SOC is primarily used for the Canadian census coding of occupations. It is composed of 514 unit groups that are described in terms of the principal tasks and duties of the jobs in the unit group (Committee on Techniques for the Enhancement of Human Performance, 1999).

United Kingdom's Standard Occupational Classification. The SOC categorizes jobs into 9 major groups, 22 sub major groups, 77 minor groups, and 371 occupational groups (Committee on Techniques for the Enhancement of Human Performance, 1999). The earlier CODOT had been primarily used for employment policy planning and statistical purposes, while the new SOC is focused on fulfilling some of the employment objectives of the Labour government's New Deal for Communities program. Enhanced occupational guidance and improved placement strategies are seen as key elements in providing better job opportunities, especially for those at risk of long-term unemployment. The Institute of Employment Research (University of Warwick) has undertaken significant research in the area on behalf of the Office of National Statistics, among others, regarding job classifications, standards, and national and European employment trends (www.warwick.ac.uk/ier/).

Its "SOC Matching Project" looks at how the SOC is used in national *Jobcentres* for improved job matching for clients. An associated project, the "371 Database Project", is being undertaken with the London School of Economics on statistical aspects of the classification system employed.

Other European countries either have not developed extensive job classification systems (for a variety of reasons) or rely directly on systems like the DOT or ISCO-88 when necessary. Larger countries like Germany have extensive State involvement in labor market issues, strong employer/trade union consensus arrangements, specialist training and educational systems, and traditional craft demarcation structures that supersede standard job classification systems. In France, some 300 trades, mainly associated with craft based occupations, are covered by the national apprenticeship system. The system guidelines were traditionally agreed upon among employers, trade unions, and the State, and were given legislative underpinning and renewal in 1992. The system is financed by an apprenticeship tax levied on employers and linked to the right of employees to continuing vocational training and continuing professional development (Burgess, 1993).

In smaller European countries, government departments of labor are content to access external job classification systems when required, primarily ISCO-88 (or in some specialized contexts the DOT). For some, like Ireland, the absence of political autonomy historically or the absence of large-scale industrialization meant a significant underdevelopment in capacity to provide adequate labor market research and standards. This has been addressed by adapting

external models and techniques to local conditions. In the area of disability it has meant devolving job analysis responsibilities to the (primarily voluntary) specialist agencies in the field. These felt free, in the absence of indigenous systems, to import the classification systems they needed, primarily from the United States.

For countries like Ireland, Greece and Finland there has been the added necessity to adapt training and employment policies and structures to rapidly evolving labor market realities. Traditional job definitions and demarcations are either redundant or unhelpful in charting the socio-economic needs of a society in a time of significant change. The rapid expansion of such economies in recent years has meant the need to move far beyond traditional classifications and to embrace new and innovative ways of meeting employment needs.

Job analysis is seen, in this context, as less relevant than the need to plan for flexibility, skill-acquisition, adaptability, and enhanced problem solving among labor market aspirants. The rapid change in employment market terms and conditions means therefore a heightened emphasis on lateral thinking, newer forms of research and a pronounced emphasis on lifelong learning (Chapman & Aspin, 1997).

Occupational classification systems vary from European country to country – and in some countries do not exist in indigenous format. Industrial and employment traditions and standards vary greatly. There are no final agreed upon standardized European Union occupational classification systems applicable in all European Member States (but there has been an extraordinary amount of work done in establishing common norms and standards for vocational and academic qualifications to facilitate the free movement of labor). Job analysis and standards determination is frequently subcontracted to specialist consultancy firms with extensive experience in occupational psychology or human resource management. These firms frequently employ standards and tools developed in the United States.

The *International Standard Classification of Occupations* (ISCO-88), an international categorization of jobs developed by the International Labour Office, and various national job classification standards are based on systems originally developed in the United States, such as the *Standard Industrial Classification System* (SICS) and data from the Bureau of the Census. While there are many shared origins, the understanding and application of classification systems in individual European countries is significantly different from the United States. For example, with the exception of the Netherlands, European countries in general do not consistently utilize job standards at public or State levels to determine eligibility for rehabilitative benefits, allowances, or to determine capacity for return to work, rather the use of personal competencies and skills to determine job suitability is common practice.

ISCO88(COM). In the area of job standards and classifications, the European Union has produced its own variant of the ISCO-88. This version, known as ISCO88(COM) is based on a close liaison with the International Labour Office and its work in the field. It is also an outcome of the need to harmonize and coordinate the national occupational classifications in use in the various Member States of the European Union. ISCO88(COM) follows a series of lengthy and detailed investigations and analyses in the Member States. It combines the knowledge of occupational classification and labor market specialists in each country with the need to develop an European Union wide standard. Essentially, the ISCO88(COM) represents a statistical structure for census and survey-coding purposes.

ISCO88 (COM) represents the most detailed level of ISCO-88, which all European Union countries consider possible and feasible to relate to their own national classifications. It represents the area of common ground between varying systems. Even as such, its application beyond statistical analysis of labor market trends varies depending on national circumstances. Some countries have developed new or revised job standards and occupational classifications based directly on ISCO-88 (for example Denmark and Italy). As we have seen already, the United Kingdom bases its particular system on the basic structure of the ISCO-88. For Greece and Portugal, the national classification is simply the ISCO88(COM) itself. At the other end of the spectrum, France and Germany have developed their own national classification and standards systems that do not link directly with the ISCO-88 system at all.

Classification and analysis of job standards is frequently undertaken to determine levels of pay and remuneration, comparability ratios, benchmarking studies or job demarcation tasks in industrial relations settings. They are seldom if ever used in European countries to determine eligibility for welfare benefits in rehabilitation settings. This points to the significant differences between the United States and Europe in the understanding of social security systems, the role of the State, the nature of social responsibility, the nature of labor-management partnership, and the responsibilities of employers to meet social responsibilities.

Summary and Conclusions

The Social Security Administration relies upon the 1991 4th edition of the *Dictionary of Occupational Titles* to define occupations that exist in the national economy. This manual has not been updated since 1991 and over 80% of the jobs in the manual have not been updated since 1977. The O*NET is an attempt to replace the outdated *DOT*, but significant problems exist with this system that prevent SSA from implementing its use over the *DOT*.

This is a review of the public and private companies that collect data on job requirements and use or produce systems or software for delivering the data. Ten job-matching programs were identified and discussed. In addition, different types of job analysis and international occupational classification programs were identified.

The ten job-matching programs identified rely upon job analyses conducted primarily by the federal government. As outlined in Table 1, eight of the ten programs define the salient physical and mental job demands according to those given in the *DOT*. One of these eight programs, LifeStep, is in the process of developing a software program to include the work requirements outlined in the O*NET in addition to those found in the *DOT*. The Valpar Pro3000 program allows the user to research occupations based upon the *DOT*, the O*NET, the Occupational Outlook Handbook, federal Standard Occupational Classification, and a Competencies Database. The McCroskey program includes both *DOT worker traits* and O*NET 98 *trait elements* "fused into the 24 most vocationally significant worker traits" (Stein, 2002, p.10).

Table 1.

Summary of Job-Matching Systems and Programs

Program or system	Type of program or system	Salient job demand factors included	Methodology used to identify job demands	Scales and ratings used for job demands	Validity and reliability	Methods used to collect and update information
VDARE	Manual	Same as DOT	Same as DOT	Same as DOT	High validity and reliability per study	Not updated
MVQS	Computer software	Same as DOT	Fusion of data from O*NET and DOT	Same as DOT except order of highest to reversed for some scales	Over 50 studies conducted on past versions which show high validity and reliability, studies on current version underway	Research, DOT, government data
JobBrowser Pro	Computer software	Same as DOT	Same as DOT	Same as DOT	Unknown	Government sources
Valpar Pro3000	Computer software	Same as DOT plus competencies database for 140 occupations	Same as DOT	Same as DOT	Validity high per study	Government sources
OASYS	Computer software	Same as DOT	Same as DOT	Same as DOT	Unknown	Government sources
LMA Plus	Computer software, requires some manual calculations	Same as DOT	Same as DOT	Same as DOT	Reliability reported as high, actual studies not found	Government sources
U.S. Publishing	Paper print-outs	Same as DOT	Same as DOT	Same as DOT	Unknown	Government sources

Scales and ratings used by the ten job matching programs were identical to those outlined in *the Revised Handbook for Analyzing Jobs* (1991) used by the federal government in the development of the *DOT,* with one exception. The McCroskey program incorporates ascending versus descending Aptitude Scales (e.g., the higher the scale level, the greater the job demands).

The validity and reliability of the job demand data for all programs are primarily dependent upon the validity and reliability of job demand data in the *Dictionary of Occupational Titles*. Two of the programs (Valpar Pro3000 and MVQS) have been studied for validity and reliability in predicting employability and earning capacity and have shown promising results.

All of the companies rely upon federal government data to update their programs, primarily data from the Bureau of Labor Statistics, Bureau of Census, and Department of Labor. SkillTRAN is being revised to reportedly "capture labor market information (and other data) submitted from counselor/users around the country on an ongoing basis" (S. Bast, personal communication, April 13, 2002). The MVQS program is being updated to incorporate the NAICS Codes, which have replaced the SIC Codes, and the updated SOC Codes, which have replaced the OES Codes. The developers have reportedly also identified 275 new jobs in the national labor market and plan to include these in the McDOT 6th Edition *DOT* program (McCroskey, 2002). The developer states that data mining and data fusion techniques are used to generate the data for the new jobs that are defined and incorporated in the 6th Edition. Data posted on the Internet plays an important part in the updating. Regression analysis plays an important part in the data mining/data fusion of the data (B.J. McCroskey, personal communication, April 23, 2002).

Six of the programs require the purchase of software to analyze the data (see Table 1). Two programs are web-based and do not require purchase of software. Two programs are paper products that require manual searches to access data.

All of the job-matching programs are dependent upon the 1991 edition of the *DOT* and its supplements for identification of salient mental and physical demands of jobs, types of scales or ratings used, and validity and reliability, with the possible exception of the MVQS. This program purports to have continued updating the *DOT* every two years and has had several studies conducting regarding it. All of these systems and programs rely upon the job analysis methodology, that is, Functional Job Analysis Scales, used in the *Revised Handbook for Analyzing Jobs* in developing the *DOT*. McCroskey's program is an attempt to define the occupations in the O*NET according to the more recognizable job demands of the *DOT*.

Job-matching programs, as they currently exist, are not used to determine the extent of or eligibility for disability benefits. The programs are only one of several tools used by rehabilitation and vocational experts to assist in determining vocational potential and possible retraining needs. The programs could provide limited assistance to SSA claims personnel with rehabilitation or vocational expert backgrounds for determining transferable skills (as they are currently defined by SSA). However, these programs all rely upon the job demands data found in the *DOT* and its supplements. When the *DOT* is no longer used by SSA, these programs, unless modified would not be appropriate for SSA usage.

Bibliography

Systems & Software

The first step towards analyzing the methodologies employed in data collection and development of systems and software for job classification is identification of the programs that evaluate disability and return to work potential. This section identifies the public and private entities that collect data on job requirements or demands and the systems and software these entities use or produce based on the data collected.

ACT, Inc. (1999). *WorkKeys: Job aid series, job profiling guidelines*. **[Brochure]. (19088).**

ACT-authorized Work Keys job profilers who have been trained to use SkillPro and to conduct job profiling can advise employers about the best ways to complete profiling; but they should not attempt to advise employers on compliance with the laws and regulations governing personnel issues, or advise employers on integrating Work Keys into the employer's human resources practices. When deciding to use tests as part of a selection system, the employer is responsible for ensuring the validity of the tests used. The employer is also responsible for its employment practices and should not shift that responsibility to the profiler. While profilers can assist an employer with establishing validity by conducting profiling and advising on how best to do the profiling, the profilers are not responsible for making sure that the employers follow their advice. Their job profile reports should document the advice given to the company, and include information concerning how the skills are used on the job, examples of materials used, and examples explaining why particular levels of skill were chosen as appropriate for the profiled job. The following scenarios offer reasonable ways to respond when a client organization decides not to follow ACT's recommendations.

ACT, Inc. (2001a). *WorkKeys: Job aid series, comparing different approaches*. **[Brochure]. (1367).**

A number of job analysis systems on the market look easy when they are compared to the WorkKeys® job profiling system. This Job Aid describes some of the common characteristics of these systems and explains how and why WorkKeys does it differently—and better.

ACT, Inc. (2001b). *WorkKeys: Job aid series, when should a job be profiled again?* **[Brochure]. (1366).**

In the field of job analysis and employee selection, no single standard indicates how long the results of a job analysis can stand without being revisited. According to professional literature and practitioners consulted, the length of time passed is

irrelevant. What are relevant are changes in the work performed. So in a rapidly changing industry (e.g., computer), a job analysis can become obsolete rather quickly. However, in a stable industry (e.g., farming), years may pass before the nature of the work changes significantly. Because these considerations also apply to WorkKeys® job profiling, the following flowchart was designed to help determine if and when another job profile should be conducted.

ACT, Inc. (2001c). *Workkeystraining.com: Key Train***. [Electronic file]. Thinking Media: Author. Retrieved February 20, 2002, from http://www.workkeystraining.com/keytrain/ktn_over.asp.**

KeyTrain™ is a comprehensive, yet easy-to-use system for improving the basic skills measured by the WorkKeys® Employment System. Using KeyTrain, you can assess your potential WorkKeys score, review topics in each WorkKeys skill area, and practice problems similar to those on an actual WorkKeys assessment. The KeyTrain system includes targeted, self-paced instruction, pre- and post-assessments, a complete learning management system and an occupational job profiles database. These components can be used to help individuals learn, practice and demonstrate the skills they need to succeed in the jobs and careers they desire. KeyTrain is being used by One-Stops, WIA's, secondary schools, businesses, WorkKeys service centers, ACT Centers[SM], school-to-work consortiums and individuals. KeyTrain is available on CD-ROM's, print, or over the Internet. KeyTrain is the first computer-based training available which was specifically designed for WorkKeys. KeyTrain is also the first curriculum to be accepted as a Level 1 preferred curriculum provider for WorkKeys. This means that the KeyTrain system has been reviewed by ACT, which has determined that KeyTrain meets ACT's standards for WorkKeys training curriculum.

ACT, Inc. (2001d). *WorkKeystraining.com: What is WorkKeys?* **[Electronic file]. Thinking Media: Author. Retrieved February 20, 2002, from http://www.workkeystraining.com/wrk_over.asp**

Employment System is a comprehensive system for measuring, communicating and improving the common skills required for success in the workplace. It allows these skills to be quantitatively assessed in both individual persons and in actual jobs. Therefore WorkKeys can allow you to correctly identify individuals who have the basic skills required to be successful in a given position or career. ACT's rigorous approach has guaranteed that the WorkKeys assessment and job profiling systems are EEOC compliant and legally defensible. This means that, when properly used, businesses can make hiring and promotion decisions based on WorkKeys with confidence and security.

ACT, Inc. (2002). *WorkKeys: Job Profiles*. **[Electronic file]. ACT, Inc.: Author. Retrieved February 20, 2002, from http://www.act.org/workkeys/profiles/index.html.**

WorkKeys® job profiles accomplish the key task of job analysis, helping employers identify the levels of skills current and prospective employees need in order to be successful on the job. Job profiles also provide individuals with a clear picture of the skill levels they need to qualify for and be successful in the jobs they want.

Aerial Dynamics Worldwide. (2001). *The ARIEL Performance Analysis System (APAS): Simplicity, accuracy, flexibility***. [Electronic file]. Author: Gideon Ariel. Retrieved April 3, 2002 from** http://www.arielnet.com/Main/adw-04.html

Ariel Dynamics Inc. invented the First computerized Movement Analysis System, known as the Ariel Performance Analysis System (APAS) in 1968. The System's inventor, Dr. Gideon Ariel, developed the first on line electronic digitizing system for reducing each picture in a film sequence, and later from a video, into its kinematic components. Since 1971, Ariel Performance Analysis System has assisted medical professionals, sport scientists, and athletes, to understand and analyze movement using its advanced video and computer motion measurement technology. It surpasses all other video systems for quantitative accuracy and scientific excellence for the most cost effective choice in major medical and research institutions around the world. The Ariel Performance Analysis System (APAS) is the most advanced computer-based system for the measurement, analysis, and presentation of movement performance. The study of the motion of living things is known as "Biomechanics" and it has evolved from a fusion of the classic disciplines of anatomy, physiology, physics, and engineering. Biomechanical quantification is based on Newtonian equations and the APAS analytic technique models the human body as a mechanical system of moving segments upon which muscular, gravitational, inertial, and reaction forces are applied. Although the system has primarily been used for quantification of human activities, it has had some industrial, non-human applications. The computerized hardware/software technique provides a means to objectively quantify the dynamic components of movement and replaces mere observation and supposition.

Applied Personnel Research. (1997). Job analysis and competency software. A review of computer-assisted applicant screening tests and job analysis software (pp VII-1-VII-10). Newton, MA: Applied Personnel Research.

This chapter provides an outline of job analysis systems and software outlining the test category, name, publisher, job types, description, administration time, pricing information and computer administration. The systems included in this summary are as follows; Identifying Criteria for Success 5.0, Occupational Information Network (O*NET), Position Information and Classification Systems, SmartHire for Windows, Target Pro Production's Management and Supervisory CD, Work Profiling System, and WRIPAC Job Analysis System.

ASVAB career exploration. *Techniques, 77*(1), 13.

The Armed Services Vocational Aptitude Battery (ASVAB) was first offered to schools by the U.S. Department of Defense in 1968, and last year it was taken by more than 800,000 students in more than 12,000 high schools. The original ASVAB has been updated over the years in response to research studies that found ways to continue its improvement. Components of the ASVAB Career Exploration Program include a 10--part multiple-aptitude test, an interest assessment and a personal preference career assessment that yields career exploration matches through the ASVAB "Occu-Find" system. There are also support materials to assist counselors and educators in meeting the counseling needs of their students. The ASVAB Career Exploration Program is offered at no cost by the Department of Defense to students in secondary and postsecondary schools. The military services use the ASVAB scores to help determine the qualifications of young people for enlistment and to place them in occupational specialties. Career counselors use the program to help students explore potential careers-both civilian and military. Students and parents use it to help determine whether a high school graduate should go to college (and whether to go now or later), technical school, join the military or enter the workforce.

Botterbusch, K. F. (1975, April). *Tests and measurements for vocational evaluators*. Menomonie, WI: Department of Rehabilitation & Manpower, Materials Development Center, Stout Vocational Rehabilitation Institute.

Botterbusch, K. F. (1976). *A comparison of seven vocational evaluation systems.* Menomonie, WI: Department of Rehabilitation & Manpower, Materials Development Center, Stout Vocational Rehabilitation Institute.

This publication contains four sections. The first is a brief paper on how to select a commercial vocational evaluation system. The second is an explanation of the 14 major points contained in the outline including; development, organization, work evaluation process, administration, scoring and norms, observation of clients, reporting, utility, training in the system, technical considerations, reviewer's summary and comments, address, cost, and references. The third section is a table which presents a very brief comparison of the seven systems; McCarron-Dial Work Evaluation System, Philadelphia Jewish Employment and Vocational Service (JEVS), Singer Vocational Evaluation System, Talent Assessment Programs (TAP), The Tower System, Valpar Component Work Sample Series, and Wide Range Employment Sample Test (WREST), on the first ten points in the outline (Points 11 through 14 were not included due to redundancy or not being inappropriate to summarize). The fourth section contains a more detailed description of each vocational evaluation system, including reviewer's comments, address, cost, and references.

Botterbusch, K. F. (1977). *A comparison of four vocational evaluation systems.* Menomonie, WI: Department of Rehabilitation & Manpower, Materials Development Center, Stout Vocational Rehabilitation Institute.

This publication contains four sections. The first is an edited reprint of an article on how to select a commercial vocational evaluation system (Botterbusch & Sax, 1977); this article is based on the introduction to the earlier comparison publication. The second is an explanation of the 14 major points contained in the outline including; development, organization, work evaluation process, administration, scoring and norms, observation of clients, reporting, utility, training in the system, technical considerations, reviewer's summary and comments, address, cost, and references. The third section is a table which presents a very brief comparison of the four systems; Comprehensive Occupational Assessment and Training System (COATS), Hester Evaluation System, Micro-TOWER, and Vocational Information and Evaluation Work Samples (VIEW), on the first ten points in the outline (Points 11 through 14 were not included due to redundancy or being inappropriate to summarize). The fourth section contains a more detailed description of each vocational evaluation system, including reviewer's comments, address, cost, and references.

Botterbusch, K. F. (1982). *A comparison of commercial vocational evaluation systems*. **Menomonie, WI: Stout Vocational Rehabilitation Institute.**

This guide for potential purchasers of vocational evaluation systems begins with an edited reprint of an article on how to select a commercial vocational evaluation system. Section 2 explains the 15 major points contained in the outline of each system. They are development, organization, physical aspects, work evaluation reporting, utility, training in the system, technical considerations, reviewer's summary and comments, address, cost, and references. Section 3 is a table presenting a very brief comparison of the systems on the first 10 points in the outline. The fourth section contains a more detailed description of the 17 vocational evaluation systems: Career Evaluation System, McCarron-Dial Work Evaluation System, Micro-TOWER, Occupational Assessment/Evaluation System, Philadelphia Jewish Employment and Vocational Service Work Sample System, Prep Work Sample, Pre-Vocational Readiness Battery, System for Assessment and Group Evaluation, Talent Assessment Programs, The TOWER System, Valpar Component Work Sample Series, Vocational Evaluation System by Singer, Vocational Information and Evaluation Work Samples, Vocational Interest Temperament and System, Vocational Skills Assessment and Development Program, Wide Range Employability Sample Test, and Work Skill Development Package.

<u>Botterbusch, K. F.</u> (1986). *A comparison of computerized job matching systems*. **Menomonie, WI: Stout Vocational Rehabilitation Institute.**

This publication describes and compares 15 nationally available computerized job matching systems. The following job matching systems are reviewed: CHOICES, Computer Assisted Vocational Rehabilitation Counseling Techniques (VOCOMP); CompuJOBS, Computerized Career Assessment and Planning Program (CCAPP), DataMaster III, Isabel, Job Matching II, Job Opportunity Based Search (JOBS), Job-Person Matching System (JPMS), Labor Market Access (LMA), Occupational Access

System (OASYS), ValSEARCH Series, Vocational Adjudicative Rehabilitation System (VARS), Vocational Information Processing System (VIPS) or (AIS), and Work-Match.

Botterbusch, K. F. (1987). *Vocational assessment and evaluation systems: A comparison.* **Menomonie, WI: Stout Vocational Rehabilitation Institute.**

The first section considers factors for selecting commercial vocational evaluation systems based on two separate models. The first model focuses on the initial development of the evaluation unit and the second focuses on expansion of a pre-existing unit. The second section is a vocational evaluation system outline, which is used to analyze and compare the vocational evaluation systems. The outline includes; development, organization, physical aspects, vocational evaluation process, administration, scoring and norms, observation of clients, reporting, utility, training in the system, technical considerations, and reviewer's summary and comments. The vocational evaluation systems described are the Career Evaluation System, Key Educational Vocational Assessment System, McCarron-Dial Evaluation System, Microcomputer Evaluation and Screening Assessment, Microcomputer Evaluation of Career Areas, Micro-TOWER, Philadelphia Jewish Employment and Vocational Service Work Sample System, Prep Work Samples, Pre-Vocational Readiness Battery, Skills Assessment Module, System for Assessment and Group Evaluation, Talent Assessment Program, The TOWER System, Valpar Component Work Sample Series, Vocational Evaluation Systems by Singer, Vocational Information and Evaluation Work Samples, Vocational Interest Temperament and Aptitude System, Wide Range Employability Sample Test, Work Skills Development Package, and World of Work Inventory.

Brown, C., McDaniel, R., Couch, R., & McClanahan, M. (1994). *Vocational evaluation systems and software: A consumer's guide.* **Menomonie, WI: Materials Development Center, Stout Vocational Rehabilitation Institute.**

This publication is a consumer-oriented guide developed to aid those contemplating the purchase of vocational evaluation systems and software to assist in the assessment, vocational evaluation, and occupational exploration of individuals who benefit from alternative assessment modalities. The standard format chosen for review of each assessment system begins with an abbreviated summary of the system, followed by a description; administration procedures; scoring, interpreting, and reporting; measurement properties; and a summary and review. The opinions expressed in the reviews of evaluations systems and software, are those of the authors and are based on years of experience in practice and teaching of vocational evaluation and assessment.

Burbidge, J. (1994, January 18). Request for proposal: Development of prototype new occupational information/classification system to replace the current Dictionary of Occupational Titles. Utah Department of Employment Security.

The Utah Department of Employment Security's Occupational Analysis Field Center, as part of the U.S. Department of Labor's (DOL) Occupational Analysis Field Center (OAFC) system seeks a multi-phase contract for the development of a new occupational information/ classification system that will replace the current Dictionary of Occupational Titles (DOT). The first phase, expected to take 18-25 months, will be devoted to developing, testing and evaluating an operational prototype for an occupational data collection, analysis, and dissemination system that will demonstrate the feasibility of and provide the foundation for creating the new system. In subsequent years, the contract may continue to provide for development of the complete system.

Cannelongo, J. M. (2000, Spring). *O*NET Update*. IARP CM News. Retrieved on March 15, 2002, from http://www.rehabpro.org/onetupdates_onetprimer.html

The awareness of O*NET and its impact on vocational rehabilitation continues to grow. O*NET is designed to replace the Dictionary of Occupational Titles.

Cannelongo, J. M. (personal communication).[Electronic file]. Retrieved on March 15, 2002 from http://www.rehabpro.org/

In a letter to the Department of Labor, the IARP O*NET Committee writes that the O*NET Data Collection Proposal is too small in scope to adequately represent the concept of work in the national economy. The O*NET committee has been very busy gathering information and speaking with some of the other interested parties about a response to the request for proposals. We chose to address these specific issues knowing that other interested parties were addressing other issues. The letter that follows is the response of our committee. The committee is continuing to develop its relationship with the DOL who is receptive to our input. Our intent is to assure that O*NET is at least as viable tool as the DOT has been, for the rehabilitation profession. The letter addressed to James Wood, Chief of the Division of Evaluation and Skills Assessment at the Office of Policy and Research within the U.S. Department of Labor outlined three issues concerning the development of O*NET and provided recommendations based on these concerns.

Capodaglio, P., Capodaglio, E. M., Bazzini, G., Imbriani, M., & Ferrari, G. (1993). Physical workload demands: The combined use of 2 evaluation programs. [Article in Italian]. *G Ital Med Lav, 15*(5-6), 117-126.

A computerized methodology is presented for the "on-site" evaluation of work-related physical activities in industrial plant workers. Subjects were videotaped during the

activities while heart rate and subjective perception of effort were monitored. The video-recordings were then analyzed with two appropriate software, in order to identify activities at high risk for musculoskeletal injuries ("Vision 3000" program, Promatek Ltd., Montreal) and to evaluate energy expenditure ("Energy" program, University of Michigan). Validation of the energy expenditure indirect analysis system was done by monitoring oxygen consumption (VO2) with a portable telemetric oxygen uptake analyzer ("K2", Cosmed, Rome). No statistically significant differences were found between direct measurements of VO2 and laboratory-derived estimates of energy consumption. The utilization of the two programs provides a fast and reliable profile of job requirements and associated risks of musculoskeletal injury.

Career Interactive available from the Vocational Research Institute Career Planning Solutions. (1997). *Workforce Coach: The comprehensive multimedia job search skills program*. **[Brochure].**

Christopherson, B. B. (1996). Valpar's Learning Curve, Methods-Time Measurement, and the Worker Qualifications Profile. *Valpar Views and News, 1*(2).

In the last edition of *Views and News* (Christopherson, 1995) I discussed Methods-Time Measurement (MTM). In that piece, I wrote that the MTM standard represents the work rate that "well-trained employees in typical industrial contexts would be expected to maintain over the course of the eight-hour workday as they repeatedly performed the (work tasks)." MTM is one of the two criterion-referenced performance indices Valpar uses to help work sample users interpret client scores. MTM Rate of Work Percent scores are derived from raw time scores on work samples and may be used by themselves, if desired, as direct indications of clients' work-related capacities. This article will discuss a different issue: Valpar's use of MTM to help the user determine whether the client has succeeded in demonstrating the work sample's Work Qualifications Profile—the other criterion- references index.

Crosby, E. (n.d.) *U.S. Army civilian analysis and forecasting tools for workforce planning*. **SAMR-CPP-PSO. Retrieved on April 11, 2002 from** **http://www.opm/gov/workforceplanning/minisessions/sessionw/myopmchrts.ppt**

The presentation is an overview of the capabilities, validation, and evolution of the Workforce Analysis and Support System (WASS) and the Civilian Forecasting System (CIVFORS). The WASS consists of three databases cross-walked and examined to determine internal and external validity. Features of the WASS include selective merging data bases, longitudinal analysis, FNs & NGTs, duplicate SSN deletion option, counting by type of nature of actions, among other loaded data utilities. The system allows for a broad range of statistical analysis to be performed such as univariate statistics, correlation, chi-squares, means, T-test, paired T-test, analysis of variance, regression analysis, trend analysis, and developing graphics. The WASS, a mainframe

system has been updated to the WASS+ a web-based system. The CIVFORS is a projection system that analyzes life-cycle modeling of the civilian workforce including accessions, promotions, reassignments, retirements, voluntary separations, and involuntary separations. The time series forecasting computes probabilities of occurrence of the life cycle events and personnel characteristics become predictors of modeled behavior. Past and projected changes in these characteristics and behaviors from the workforce drive the forecasts. The current model reports 16 different strength dimensions in inventory from more then 700,000 records and projections, 6 additional manpower dimensions in authorizations, 5 years of historical data, and provides 7-year forecasts either with or without optimization. The new Flexible Forecasting System Version 3 can do even more.

Dennis, M. L., & Dennis, K. L. (1998). Job search software under Daubert: Will it withstand scrutiny as part of expert opinion. *Journal of Forensic Vocational Assessment, 1*(3), 19-28.

In the Daubert decision, the United States Supreme court established "scientific" knowledge as the standard for admissibility for expert testimony (Feldbaum, 1997). It is anticipated that this standard will have a significant impact on psychological rehabilitation, vocational, and economic experts. One general expectation is that the instruments used to assess disabilities and predict their consequences will need to be reliable (provide consistent results), valid (measure what is purported to measure), and exhibit acceptable error estimates (accuracy of predictions). In the context of the Daubert standards of acceptability, computer job search software programs used by exerts are surveyed.

Diffendal, J. (2001, August 6). Vocational assessments: Filling your vocational rehab toolbox-CareerScope may be all you need. *ADVANCE for Occupational Therapy Practitioners*.

Measuring Work: The Vocational Research Institute (VRI) funded by the U.S. departments of labor (DOL) and education (DOE), develops vocational assessment systems for people with disabilities. CareerScope, a vocational assessment system developed by the VRI, is a multiple choice interest inventory and aptitude test that can be self-administered by and to a number of clients at once. CareerScope has two main components: the interest inventory and the aptitude tests. The interest inventory asks the user a series of questions to identify career preferences that correspond to DOL interest areas. The aptitude section incorporates seven different tests, each measuring a different cognitive or perceptual ability. The first four tests measure spatial aptitude, form perception and clerical perception, which are the perceptual aptitudes in the DOL system. CareerScope does not offer tests for motor abilities; however, its format allows the administrator to input such scores from other assessments. These may include finger dexterity, manual dexterity and motor coordination. The administrator can generate three separate reports: the assessment profile provides the user with career recommendations based on their results; the counselor report summarizes the data into

a quick overview of the most pertinent results; and the summary report provides a one-page snapshot of the results, ideal for a counselor/user review session.

Dusik, L. A., Menard, M. R., Cooke, C., Fairburn, S. M., & Beach, G. N. (1993). Concurrent validity of the ERGOS work simulator versus conventional functional capacity evaluation techniques in a workers' compensation population. *Journal of Occupational Medicine, 35*(**8**), **759-767.**

A prospective blinded cohort study was performed in an interdisciplinary vocational evaluation program to investigate the concurrent validity of the ERGOS work simulator in comparison to current methods of evaluation. Seventy men and eight women, aged 22 to 64 years, who attended for a 2-week physical capacity assessment participated in the study. Physical activity factors as defined by the Canadian Classification and Dictionary of Occupations and the American Dictionary of Occupational Titles were assessed for all subjects under three evaluation conditions: the ERGOS work simulator, an exercise-oriented physical evaluation by a rehabilitation therapist, and performance of project-format industrial tasks. In addition, 17 men and 7 women were assessed with VALPAR standardized work sample tests. The statistical significance of the relationships between results obtained by the various evaluation methods was examined. There was a strong correlation between the ERGOS dynamometry and the clinical assessment of strength for all standard movements tested (P < .001). The Methods Time Measurement rating by the ERGOS for dexterity variables, according to industrial engineering standards, tended to rate subjects as more restricted than did the clinical evaluators. There was a significant relationship (P < .001) between the "overall physical activity rating" from ERGOS dynamometry, clinical evaluation, and performance in an industrial workshop setting. There was also a significant relationship (P < .001) between the "overall physical activity rating" for endurance of a full workday produced by the 4-hour ERGOS evaluation and by the 2-week functional capacity evaluation.

Edwards, M. (1992). AMAS: Activity Matching Ability System. In D. Saunders & P. Race, *Aspects of Educational and Training Technology Series, 25***, 155-57.**

Abstract: Activity Matching Ability System (AMAS) allows the activities of jobs to be matched to the abilities of people so that informed selection and placement decisions can be made. It gives greater opportunities for people with disabilities because they can be matched against a large selections of jobs which, if not systematically assessed might otherwise be considered unsuitable. The system is comprehensive in that the information provided by AMAS is relevant to the working environment and to specific jobs. It is relevant to people with a physical, mental or sensory impairment. AMAS focuses on abilities not disability and is used to identify appropriate solutions that will enable a person to do a job and not to be excluded from it.

Fishbain, D. A., Cutler, R. B., Rosomoff, H., Khalil, T., Abdel-Moty, E., & Steele-Rosomoff, R. (1999). Validity of the *Dictionary of Occupational Titles* residual functional capacity battery. *Clinical Journal of Pain, 15*(2), 102-110.

The Dictionary of Occupational Titles (DOT) is a U.S. government publication that defines each job in the United States according to 20 job factors. Fishbain et al. (Spine 1994;19:872-80) developed a DOT residual functional capacity (RFC) battery whose predictive validity for employment/unemployment had not been tested previously. OBJECTIVES: The purposes of this study were as follows: (a) to determine whether results of a DOT-RFC battery performed at completion of pain facility treatment predicted employment status at 30 months' follow-up and (b) to determine whether the DOT-RFC battery predicted employment capacity as determined by the DOT employment levels of the chronic pain patients' (CPPs) jobs. STUDY DESIGN: This is a prospective low back pain CPP pain facility treatment study using employment status and the DOT occupational levels as outcome measures. METHODS: One hundred eighty-five consecutive CPPs who fitted the selection criteria completed a DOT-RFC battery at the completion of pain facility treatment and were contacted at 1, 3, 6, 12, 18, 24, and 30 months for determination of their employment status and DOT employment level. Eight DOT job factors plus pain and worker compensation status were found to be significantly different between employed and unemployed CPPs and between those employed in different DOT employment levels. For the 10 variables, stepwise discriminant analysis was used to select final predictor variables. Sensitivity and specificity were calculated along with pain level cutpoints that separated the groups. RESULTS: The eight DOT job factors found to be statistically significant between groups were the following: stooping, climbing, balancing, crouching, feeling shapes, handling left and right, lifting, carrying, and pain and worker compensation status. In the discriminant analysis, these variables could discriminate between the employed and unemployed categories, with a sensitivity and specificity of approximately 75%. The pain level cutpoint between employed and unemployed was 5.4 on a 10-point scale. CONCLUSIONS: We cannot as yet predict DOT-RFC employment levels. However, if a CPP can pass the above eight DOT job factors and has a pain level less than the 5.4 cutpoint, that CPP will have a 75% chance of being employed at 30 months after treatment at the pain facility. Therefore, some DOT-RFC battery job factors demonstrate a predictive validity in the "real work world."

Fletcher, J. M, Friedman, L., & Pasnack, R. (1998). The validation of the Transition-to-Work Inventory: A job placement system for workers with severe disabilities. *Journal of Developmental and Physical Disabilities, 10*(1), 1-22.

The reliability and validity of the Transition-to-Work Inventory (TWI; Friedman et al., 1996), which is designed to diagnose worker/job fit problems for individuals with severe disabilities, was assessed. Worker/job analyses were conducted using the TWI for 64 workers with severe disabilities, in 35 jobs at 11 different organizations. These analyses were performed by supported employment staff members and other job-content experts. Worker's capabilities (as determined by the worker analysis) and the job's requirement's (as determined by the job analysis) were directly compared to each other to determine potential "target item" problems for the worker (i.e., items designating activities that he worker may have difficulties performing). Once target

items had been determined, their importance to task performance was rated, and correlations between the items' importance to tasks and actual performance were computed. Results indicated that TWI ratings of both worker capabilities and job requirements were reliable. In addition, TWI was determined to have predictive validity. The more important the worker's target items were rated for task performance, the greater were the decreases in the worker's performance appraisal ratings. Results indicate that specific problems for worker performance can be assessed using this instrument.

Halpern, M. (1996). A computerized medical standards system to help place impaired employees. *Methods Inf Med, 35*(4-5), 317-323.

The paper describes a knowledge-distribution system that supports decisions on placement of impaired employees. The knowledge base consists of job profiles and medical profiles. The job profiles list tasks and the physical abilities required to perform them. Twenty-one abilities describe the task demands. Active workers rated the exertion, frequency and importance of the physical ability required for each task. Thirty-nine work conditions were rated this way. Using identical scales, experts assessed the impact of impairments on the physical abilities of individuals and the tolerance of work conditions. The screening matches the job profile against the impairment profile. This process has been automated. The program lists tasks and work conditions that may compromise an impaired employee. This information can be used to accommodate employees, restrict duties or design a rehabilitation program. Also, the paper discusses the impact of the system on the operations of medical services within an organization.

Harvey, R. J. (n.d.) *Research monograph: The development of the Common-Metric Questionnaire (CMQ).* **[Electronic file]. Personnel Systems & Technologies Corporation and Virginia Polytechnic Institute & State University.**

The Common-Metric Questionnaire (CMQ), an incumbent-completable job analysis instrument targeted at both exempt and nonexempt jobs, was developed to address several limitations facing past worker-oriented instruments, including a) reading levels that are so high that they preclude incumbent completion; b) items and rating scales that are so behaviorally Summary that it is difficult to collect accurate and verifiable data; and c) deficiencies in content coverage, especially for managerial jobs. The CMQ's items and rating scales were written to be both more behaviorally specific (than the typical worker-oriented instrument) and easier to understand. The CMQ's matrix structure allows efficient data collection: approximately two-thirds of the 4,552 positions are used in a scoring system that describes job in terms of 80 work dimensions. CMQ work dimension scores are useful for functions that require an Summary view of work (e.g. compensation, job classification, synthetic validity); for addressing functions that require greater specificity (e.g., job descriptions, performance appraisals), CMQ item-level data can be used. The CMQ dimensions are highly predictive of external criteria: in the CMQ field-test, policy-capturing Rs predicting pay

rates were in the .80's and .90's, and hit rates predicting dichotomous FLSA exempt status were in the 80-90% range.

IARP O*NET Committee. (2001, February 16). *DOT occupations in the SOCr O*NET: SVP/Job Zone Matrix.* **[Electronic file]. Retrieved March 13, 2002, from http://rehabpro.org/onetupdates_onetprimer.html**

The lack of congruence between Job Zones (as described in O*NET documentation) and Specific Vocational Preparation (SVP) is confusing and makes the terms ambiguous. If the term "Unskilled" is defined as "short demonstration (SVP 1), up to including one month (SVP 2)" and Semi-Skilled as "over one month up to and including six months (SVP 3 and 4), O*Net Job Zones can not be used to differentiate between Unskilled and Semi-Skilled Occupations. Either O*NET Job Zones do not accurately reflect the Education, Training or Experience claimed by O*NET, or the DOT does not accurately reflect the SVP required- they cannot both be correct.

IARP O*NET Committee. (2001, February 26). *The revised Standard Occupational Classification System and O*NET 3.0.* **[Electronic file]. Retrieved March 13, 2002, from http://rehabpro.org/onetupdates_onetprimer.html**

The Bureau of Labor Statistics has now retired the Occupational Employment Statistics (OES) database and uses the Standard Occupational Classification System (SOCr) to report national, state, MSA, and balance of state wage and employment estimates. The 2002-2003 Occupational Outlook Handbook will reflect the SOCr titles, rather than the OES-based titles it currently uses. BLS employment projections and wage data will be reported at the SOCr level, not at the occupational unit (OU) level of the O*NET database. O*NET 3.0 utilized 751 of the 821 SOCr "Detailed Occupations" but contains 900 O*NET OUs- the O*NET is an extension of the SOCr occupational classification system. O*NET will add 74 OUs to its database at some point in the future, bringing the total OU count to 974. One safe conclusion is that there will be lots of changes over the next few years. The SOCr-Based O*NET subsumes 9, 564 DOT occupations. Some DOTs crosswalk to more than one O*NET OU (57 DOT occupations are contained in more than one OU). The net effect of such duplication ends up crosswalking 9,480 unique DOTs (duplicates excluded) to the current O*NET. O*NET eliminates 3, 281 DOT occupations from its database. Five O*NET OUs contain no crosswalk to any DOT occupation. An example of the SOCr Classification System Drill-Down is provided in table form including occupation codes, occupational information titles, and the level in the hierarchy.

IARP O*NET Committee. (2001, March 12). *Understanding homogeneity- Two examples.* **[Electronic file]. Retrieved March 13, 2002, from http://rehabpro.org/onetupdates_onetprimer.html**

The two examples below can be used to illustrate the term "homogeneity" as it relates O*NET Occupational Units and the DOT occupations subsumed within them. The examples are based on a combination of the revised SOC O*NET and the DOT databases.

IARP O*NET Committee. (2001, April 3). *O*NET and the DOT: Which is more up-to-date?* [Electronic file]. Retrieved March 13, 2002, from http://rehabpro.org/onetupdates_onetprimer.html

The U.S. Department of Labor (DOL) urges us to switch from the Dictionary of Occupational Titles (DOT) to O*NET. "While still available," DOL says, "the DOT is becoming more and more outdated. Users should plan to transition to O*NET as soon as possible, " (O*NET Web Page). Thus, DOL infers that O*NET is up to date, while the DOT is outdated. The purpose of this document is to examine whether O*NET is really more up-to-date than the DOT.

IARP O*NET Committee. (2001, April 8). *Extending O*NET to its occupational roots.* [Electronic file]. Retrieved March 13, 2002, from http://rehabpro.org/onetupdates_onetprimer.html

O*NET reports employment and performance descriptors for groups of occupations. However, working with a national occupational database at the group level leaves insurers, courts, disability managers, case managers, expert witnesses, claimants, claim managers, and others with the inability to identify, describe and discriminate among occupations and, therefore, weakens the credibility of our findings and opinions. We suggest that DOT occupations could be quickly appended to O*NET Occupational Units in a way that partially answers the need for more detailed occupational information. Moreover, we recommend that IARP take the lead in organizing an interdisciplinary task force that will address this issue. O*NET is here to stay. O*NET replaces the Dictionary of Occupational Titles (DOT). O*NET is the future and it's here now! Switch to O*NET, because the DOT is no longer maintained." Thus, the US Department of Labor advises to rely on O*NET, but forget the DOT. Can we? O*NET reports employment and performance descriptors for groups for occupations—a level above information describing occupations themselves. Working with the nation's occupational information database at the group level leaves us with the inability to identify, describe and discriminate amongst occupations and, therefore, weakens the credibility of our findings and opinions. We, therefore, take the position that the current O*NET does not provide sufficiently detailed information for use by professions who require it at a deeper, more detailed occupational level. These professionals are insurers, courts, disability managers, case managers, expert witnesses, claimants, claim managers, and others. The primary weakness these kinds of professionals cite is based on the lack of occupationally specific information contained in O*NET. If O*NET falls short of meeting our needs and the DOT is no longer available, where do we turn?

IARP O*NET Committee. (2002, January 10). *O*NET: What is really going on?* **[Electronic file]. Retrieved on March 13, 2002, from http://rehabpro.org/onetupdates_onetprimer.html**

The IOC summarizes results of the first meetings of the IOTF (Inter-organizational O*NET Task Force) with the SSA (Social Security Administration) and DOL-ETA (Department of Labor, Employment and Training Administration). At these meetings, held October 30-31, 2001 in Baltimore, DOL-ETA agreed in concept with SSA/IOTF requests for the development of an additional database for disability/vocational rehabilitation purposes to be connect to the O*NET. Development of this O*NET extension, if implemented, will require the work of many additional volunteers from the rehabilitation professions.

Innes, E., & Straker, L. (1999). *Work assessments in Australia: A review*. **Australian Association of Occupational Therapists 20th National Conference, Canberra, 25-28 April. Paper presented on April 26, 1999.**

"Occupational therapists and other health professionals conduct work-related assessment for many and varied reasons. The purposes of work-related assessments include: to diagnose, determine need for intervention, and plan treatment; determine an individual's ability to perform work roles, activities, tasks & skills; determine sincerity and consistency of effort; document outcome, achievement of goals; and develop treatment resources and research. A number of assessment approaches are used to achieve these purposes. They include observing the worker in the workplace, and may be combined with the use of commercial work samples and evaluation devices used in clinic-based situations (Innes, 1997; Innes & Straker, 1998). These assessments commonly assess skills and performance components, and extrapolate this information to the ability to perform a specific work role (Innes & Straker, 1998). Most commercial work samples and evaluation devices currently used in Australia, however, have limited research-based literature on which to support their use (Innes & Straker, in press-a; in press-b). The implications of basing return to work recommendations on systems with a minimal research base is of concern to many in the profession. To address this concern, I conducted this study with the purpose of: 1. Examining the current research and documentation regarding work-related assessments used in Australia, particularly with regard to reliability and validity, and 2. Identifying critical features of the assessments, including the physical demands covered, testing approach used and how the end-point of assessment is determined, and the existence of norms and criterion-referenced data."

Instructional Technologies, Inc. (2001). *Enhanced job analyzer*. **[Electronic file]. Vertek Inc.: Author. Retrieved March 6, 2002, from http://www.vertekinc.com/VERTEKWEB/NewFiles/eja.html**

Enhanced Job Analyzer (EJA) is an exceptionally fast and versatile occupational exploration tool. Access to occupational and employment information has never been easier, or quicker. When people explore careers, they want job descriptions, work requirements, wages, employment outlook, names and locations of any local employers

likely to offer employment in their career path and more. And they want it instantly! Once a career goal has been selected, EJA can report the local post-secondary schools that provide appropriate training. Cutting through volumes of data to get at useful information is only part of what EJA does well. Things you can do with EJA in a few seconds and quick ways to find an occupation: Ever had a problem finding a specific occupation and all the information that goes with it? p*oint-and-click* your way through the occupational information database in a hurry! *Click* on occupational titles, descriptions, or both, then enter key words and *click* to search for occupation matches. Find occupations within occupational groups. C*lick* to select any of ten indexes to the information database (O*NET, SOC, GOE, OAP, Work Fields, MPSMS, O*NET and others). *Click* on the major, minor and base title levels to narrow your selection, then *Click* to display the occupational titles within the occupational group. It's called a "drill-down" and you will be surprised how easy it is to access occupations within groups. Civilian equivalents to military occupations work the same way. *Click* to select the branch of service you wish to access. *Click* to highlight the military occupation you wish to investigate and the civilian equivalents will be displayed.

Instructional Technologies, Inc. (2001a, May). *OASYS Job Match for Windows*. **[Electronic file]. Vertek Inc.: Author. Retrieved March 6, 2002, from http://ww.vertekinc.com/VERTEKWEB/NewFiles/oasysjm.html**

OASYS Job Match for Windows is a dynamic software program that matches a job seeker's skills and abilities with occupations, potential employers, job openings and training services. This software is an incredibly powerful tool for use by those who operate and manage the labor exchange service delivery process – placement specialists, job developers, career counselors and support staff. Whether conducting specific job matching and placement functions, transferable skills analysis, building "what if" scenarios for a job seeker, or merely exploring occupations, OASYS JOB-MATCH software gives you quick, sure access to useful information. OASYS JOB-MATCH saves you valuable time and ensures results are accurately and professionally reported. Elegant "point and click" operation makes OASYS JOB-MATCH the most easily learned system of its kind.

Instructional Technologies, Inc. (2001b, May). *OASYS JobMatch Job Seeker's Workstation*. **[Electronic file]. Vertek Inc.: Author. Retrieved March 6, 2002, from http://www.intecinc.net/oasys.htm**

OASYS JobMatch Job Seeker's Workstation - enables job seekers (clients/customers) to use parts of OASYS without the assistance of a counselor. It is intended for use by organizations that want job seekers to play a greater role in employment activities. It contains personal data entry, occupational exploration, career path development and job searching functions. This component can also be used by technicians who could be responsible for entering some of the above data. Job Seekers can access training information (schools), employers in the employer bank, open job orders in the job bank, and record their work history, personal and work preferences, and discover jobs that

match to their transferable skills and requirements. VERTEK's peerless training files incorporate information from both the U.S. Department of Education and the State SOICC. The Information a Job Seeker enters on this workstation is saved in the database. The data is then accessible to counselors working on their own workstations. The payoff is that staff effectiveness is improved with less time expended on individual cases.

Instructional Technologies, Inc. (2001, July). *Enhanced job analyzer*. **[Electronic file]. Vertek Inc.: Author. Retrieved March 6, 2002, from www.intecinc.net/enhanced.htm**

Enhanced Job Analyzer is the perfect companion to CareerScope. This is the most complete and easy to access job specific information available. It contains the entire Dictionary of Occupational Titles -all 12,760 descriptions, and you can access them from any direction: key word in title or description, or by any clustering system such as interest, aptitude pattern, industry code, etc. It also shows job requirements, wage data, and outlook - nationally and by state with projections by industry. Industry projections tell you who is hiring and who is laying off. For job seekers this is most important. We can add an employer list so you can print local employers likely to hire any job title. All jobs requiring training are linked to local post secondary programs and, of course, the schools, businesses, or apprenticeships that offer them. You can go directly to America's Job Bank to look for actual openings for any job you're examining.

Instructional Technologies, Inc. (2001, December). *OPAC*. **[Electronic file]. Vertek Inc.: Author. Retrieved March 6, 2002, from http://www.intecinc.net/prod13.htm**

The OPAC System contains over 30 tests to assess the knowledge, skills, and abilities of job candidates. Skills such as word processing, spreadsheets, databases, Microsoft® Windows, 10-Key, data entry, keyboarding, filing, and personality assessment. The built-in Validation Wizard will allow you to establish criteria and data specific to your organization, and you can create your own custom tests with Test Writer 2000.

International Personnel Management Association. (n.d.) *The computer-based testing system: Breakthrough in the Philippine civil service examination system*. **Retrieved April1, 2002 from http://www.ipma-hr.org/public/federal_template.cfm?ID=50**

One of the most important and visible functions of the Philippine Civil Service Commission (PCSC) is the conduct of examinations- the first step in the process of selecting prospective civil servants. The exams are conducted in accordance of a constitutional mandate requiring civil service appointments, excluding specific positions noted in the law, to be based on merit and fitness determined by competitive examinations. Examinations are viewed as the most objective means to distinguish

qualified applicants from hundreds of applicants and are the basic requirement for entry into a government position.

Johnson, J.W., Carter, G.W., & Dorsey, D.W. (2002, April). Development of an occupational strength requirement measure from O*NET descriptors. In F.L. Oswald (Chair), *It's new and it's used: Applications of O*NET*. **Practitioner forum conducted at the 17th Annual Conference of the Society for Industrial and Organizational Psychology, Toronto, April 2, 2002.**

There is no single overall strength variable within O*NET that is comparable to the DOT strength factor. There are many physical ability descriptors in the O*NET content model, however, and a number of these descriptors are conceptually similar to DOT variables that were used in making overall DOT strength judgments. The primary purpose of this study was to examine the extent to which O*NET occupations could be classified into DOT strength categories using weighted linear combinations of sources on O*NET descriptors. Assuming occupations can be sorted into DOT strength categories on the basis of O*NET descriptors with an acceptable level of correspondence, an algorithm could be developed to place occupations other than those included in this study in DOT strength categories. Although the goal was to make the O*NET strength classification system as similar as possible to the DOT strength classification system, we did not expect perfect agreement between them. Because DOT strength ratings were based on holistic judgments of job analysts regarding strength requirements, we simply tried to model those judgments as closely as possible with a weighted linear combination of O*NET descriptor scores.

Kaiser, H., Kersting, M., & Schian, H. M. (2000). Value of the ERGOS work simulator as a component of functional capacity assessment in disability evaluation. [Article in German]. *Rehabilitation (Stuttg), 39*(3), 175-184.

The use of assessment instruments in evaluating functional capacity is an important element in the process of social-medical judgment of whether a person will likely be able to reintegrate into working life. Standardized work processes are used in simulating occupational reality over several hours, with all the requirements involved, and the performance found is contrasted with the requirements to be expected at a workplace. Time-tested in the U.S. for more than 20 years and applied throughout Germany for some two years now, the ERGOS work simulation system is presented in the article, using a case example for more detailed description. Using five different work stations, performance data are collected for job tasks such as carrying, working in kneeling position or overhead, and subjected to computer-based comparison with the job requirements information contained in relevant databases. This enables computerized identification of excessive demands, and hence may point to a need for further rehabilitative action. An important feature is objective assessment, as subjective information on the basis of observation or reports of painfulness are raised separately, hence do not influence the findings of the work simulation performed.

Laham, D., Bennett, Jr., & Winston, L. T. (2000). An LSA-based software tool for matching jobs, people, and instruction. *Interactive Learning Environments, 8*(3), 171-185.

New LSA-based agent software helps to identify required job knowledge, determine which members of the workforce have the knowledge, pinpoint needed retraining content, and maximize training and retraining efficiency. The LSA-based technology extracts semantic information about people, occupations, and task-experience contained in natural-text databases. The various kinds of information are all represented in the same way in a common semantic space. As a result, the system can match or compare any of these objects with any one or more of the others. To demonstrate and evaluate the system, we analyzed tasks and personnel in three Air Force occupations. We measured the similarity of each airman to each task and estimated how well each airman could replace another. We also demonstrated the potential to match knowledge sub-components needed for new systems with ones contained in training materials and with those possessed by individual airmen. It appears that LSA can successfully characterize tasks, occupations and personnel and measure the overlap in content between instructional courses covering the full range of tasks performed in many different occupations. Such analyses may suggest where training for different occupations might be combined, where training is lacking, and identify components that may not be needed at all. In some instances it may suggest ways in which occupations might be reorganized to increase training efficiency, improve division of labor efficiencies, or redefine specialties to produce personnel capable of a wider set of tasks and easier reassignment.

Lightfoot, M. A., & Ramsberger, P. F. (2000). Matching soldiers to jobs: The Enlisted Personnel Allocation System (EPAS).

This U.S. Army Institute (ARI) special report on the EPAS presents the history and current status of the Army's enlisted personnel selection and classification system. It is written for policy makers, managers, and human resources personnel. The report includes a discussion of theoretical and practical aspects of selection and classification testing in the context of Army operations dating back to World War I. EPAS, the optimal person-job-matching software developed by the ARI, is described along with its potential to improve the effectiveness of the Army's classification system.

Mariani, M. (2001). O*Net update. *Occupational outlook quarterly, 45*(3), 26-27.

Since its introduction to the public in December 1998, the Occupational Information Network (O*Net) has evolved. The O*NET database is a flexible, skills-based system that describes job requirements and worker attributes, as well as the content and context of work using over 400 variables. This update on the status of O*Net has three parts. First comes a look at its realignment and plans for future data collection. Next, the spotlight shines on the new Web-based version of O*Net. Finally, the self-directed career exploration and assessment tools developed by Team O*Net receive special

attention.

Mayall, D. (1994). The worker traits data book: Specific details on the 12,741 jobs listed in the Dictionary of Occupational Titles. Indianapolis, IN: JIST Works, Inc.

A database of worker traits including over 75 separate details for each occupation including: training time, aptitudes, physical demands, environmental conditions, temperaments, work fields, and materials, products, subject matter and services, and cross-walks to SOC, CIP, and OES data bases.

McArthur, D. L., Cohen, M. J., & Gottlieb, H. J. (1987). Treating chronic low back pain II. Long-term follow-up. *Pain, 29*, **23-38.**

Appraisal of chronic low back pain (CLBP) treatment outcome is incomplete unless results can be shown to be stable over an extended follow-up period. This paper concentrates on methods by which the long-term trends of objective outcome assessments can be studied and predictions developed given incomplete data. Employment and litigation status, self-rating of pain, activities, medications, and hospitalizations related to pain were periodically assessed in up to 210 graduates of a CLBP treatment program, over a period of 6 months to 5 years following treatment. Favorable outcomes were achieved by many of the respondents, and a good degree of stability in outcomes was observed in several of the measures. Few indicators were found which adequately predicted long-term outcomes however. Attrition in the sample and other possible systematic sources of bias are discussed.

McCroskey, B. J. (2001). *MVQS2001 summary description of programs: The McCroskey Vocational Quotient System 2001 (Version 1.1) Edition***. Retrieved March 19, 2002 from http://www.vocationology.com**

MVQS2001 (Version 1.1) is the most comprehensive, up-to-date and powerful Job-Person Matching, Transferable Skills Analysis, Values Needs, Vocational Interest & Personality Reinforcer (VIPR) Type Indicator, and Earning Capacity Estimation System available in the U.S. and Canada. The MVQS McPLOT 2001 (Version 1.1) Edition Evaluative Data Profiles reflect general education development/intellectual aptitudes, perceptual aptitudes, dexterity aptitudes, other aptitudes, physical demands, and environmental tolerances.

Miller, A. R., Treiman, D. J., Cain, P. S., & Roos, P. A. (Eds). (1980). *Work, jobs, and occupations: A critical review of the Dictionary of Occupational Titles.* **Washington, DC: National Academy Press.**

In 1977 the U.S. Department of Labor published the 4th. Edition of the DOT. This book is a detailed report on the DOT, its foundations, and development. Presented in nine chapters and several appendices, this report covers use of the DOT, DOL occupational

analysis program, occupational information, classification of occupations, and reliability and validity. "...the committee's concerns ...centered on the reliability and validity of the occupational data collected and analyzed by the occupational analysis program of the Employment Service, the usefulness of the classification structure of the current edition, and the potential for improvement in the document through revisions in the kinds of data collected and data collection procedures" (page. 3). The report concludes with 17 specific recommendations, ranging from improvements in data collection to defining "occupations".

Nibali, K. D. (1999, June 30). Current status of the Dictionary of Occupational Titles (DOT) and the Occupational Information Network (O*NET)—information. Letter (no. 503) distributed to Disability Determination Services administrators by Social Security Administration Office of Disability.

In response to numerous questions from adjudicators, we have prepared the attached letter which provides the Disability Determination Services (DDSs) with status on the Department of Labor's (DOL's) DOT, and it's proposed replacement, O*NET. The letter summarizes the development of the current O*NET prototype, as well as a few of our key concerns.

Nibali, K. D. (1999, June 30). Current status of the Dictionary of Occupational Titles (DOT) and the Occupational Information Network (O*NET)—information. Letter (no. 507) distributed to Disability Determination Services administrators by Social Security Administration Office of Disability (attachment).

This letter addresses questions about the current status about the Department of Labor's (DOL's) Dictionary of Occupational Titles (DOT), and its proposed replacement, the Occupational Information Network (O*NET).

***O*NET Abilities Questionnaire*. (n.d.) [Electronic file]. Retrieved on March 13, 2002, from http://harvey.psyc.bt.edu/JobAnalysis/resources.html**

This survey is designed to capture the diversity of American workers. This questionnaire will be administered to a large number of workers with differing amounts of job experience in many different jobs. Your answers to these questions will help us to know if the goal of diversity is being achieved. Therefore, it is very important that you give accurate answers to these questions. These questions are about job-related abilities. An ability is an enduring talent that can help a person do a job. You will be asked about a series of different abilities and how they relate to your current job- that is, the job you hold now.

***O*NET Education and Training Questionnaire*. (n.d.) [Electronic file]. Retrieved March 13, 2002, from http://harvey.psyc.bt.edu/JobAnalysis/resources.html**

This survey is designed to capture the diversity of American workers. This questionnaire will be administered to a large number of workers with differing amounts of job experience in many different jobs. Your answers to these questions will help us to know if the goal of diversity is being achieved. Therefore, it is very important that you give accurate answers to these questions. In these questions, you are asked about the education and experience requirements for this job. Please read each question carefully and mark your answer by putting an X in the box beside your answer.

*O*NET Generalized Work Activities Questionnaire*. (n.d.) [Electronic file]. Retrieved March 13, 2002, from http://harvey.psyc.bt.edu/JobAnalysis/resources.html

This survey is designed to capture the diversity of American workers. This questionnaire will be administered to a large number of workers with differing amounts of job experience in many different jobs. Your answers to these questions will help us to know if the goal of diversity is being achieved. Therefore, it is very important that you give accurate answers to these questions. These questions are about work activities. A work activity is a set of similar actions that are performed together in many different jobs. You will be asked about a series of different work activities and how they relate to your current job- that is, the job you hold now.

*O*NET Knowledge Questionnaire*. (n.d) [Electronic file]. Retrieved March 13, 2002, from http://harvey.psyc.bt.edu/JobAnalysis/resources.html

This survey designed to capture the diversity of American workers. This questionnaire will be administered to a large number of workers with differing amounts of job experience in many different jobs. Your answers to these questions will help us to know if the goal of diversity is being achieved. Therefore, it is very important that you give accurate answers to these questions. These questions are about work related areas of knowledge. Knowledge areas are sets of fact and principles needed to deal with problems and issues that are part of a job. You will be asked about a series of different areas of knowledge and how they relate to your current job- that is, the job you hold now.

*O*NET Work Context Questionnaire*. (n.d.) [Electronic file]. Retrieved March 13, 2002, from http://harvey.psyc.bt.edu/JobAnalysis/resources.html

This survey is designed to capture the diversity of American workers. This questionnaire will be administered to a large number of workers with differing amounts of job experience in many different jobs. Your answers to these questions will help us to know if the goal of diversity is being achieved. Therefore, it is very important that you give accurate answers to these questions. In this questionnaire you will be asked about your working conditions. These conditions are about your work setting and its possible hazards, the pace of your work, and your dealings with other people.

*O*NET Work Styles Questionnaire*. (n.d.) [Electronic file]. Retrieved March 13, 2002, from http://harvey.psyc.bt.edu/JobAnalysis/resources.html

This survey is designed to capture the diversity of American workers. This questionnaire will be administered to a large number of workers with differing amounts of job experience in many different jobs. Your answers to these questions will help us to know if the goal of diversity is being achieved. Therefore, it is very important that you give accurate answers to these questions. These questions are about work styles. A Work Style is a personal characteristic that can affect how well someone does a job. You will be asked about a series of different work styles and how they relate to your current job- that is, the job you hold now.

Paterson, D.G., Gerken, C.d'A., & Hahan, M. E. (1953). *Revised Minnesota occupational rating scales***. Minneapolis, MI: University of Minnesota Press.**

The Revised Minnesota Occupational Rating Scales (M.O.R.S.) consists of ratings for seven abilities or aptitudes; academic ability, mechanical ability, social intelligence, clerical ability, musical talent, artistic ability, and physical agility, for each of 432 occupations yielding an occupational pattern or profile for each of the 432 occupations. The Individual Counseling Record is a convenient device for recording an individual's occupational choices and the Revised M.O.R.S. occupational patterns for each, the counselee's self-estimated pattern and corrected ability pattern, a list of occupations which correspond to the corrected ability pattern, and information regarding the counselee's abilities and interests. The Revised M.O.R.S. and Individual Counseling Record is designed to not only support vocational professionals in service counseling, but also to train counselors and provide a supplement to guidance courses in high schools and colleges. The scales and record may also be used in business and industrial personnel work to aid in the selection, training, promotion, and vocational counseling of employees.

Peterson, N. G., Mumford, M. D., Borman, W. C., Jeanneret, P. R. & Fleishman, E. A. (Eds). (1999). *An occupational information system for the 21st century: The development of O*NET***. Washington, DC: American Psychological Association.**

This book describes a 2-year effort to develop a comprehensive occupational information system, suitable for many purposes that would primarily reside in electronic media. The product of this effort is a prototype of the national occupational information system intended to replace the Dictionary of Occupational Titles (U.S. Department of Labor, 1991) and its supporting technology (as documented in the *Revised Handbook for Analyzing Jobs*, U.S. Department of Labor). The new system has come to be called the *Occupational Information Network* or *O*NET*.

Reeves, J. F. (1999, updated 2001). *O*NET versus DOT: You have to admit this is getting interesting***.**

True to the 1991 mission of the Advisory Panel on the Dictionary of Occupational Titles (APDOT), the Department of Labor finally released Version 1.0 of O*NET in late 1998. You can download this prototype of the DOL's planned replacement for the Dictionary of Occupational Titles for free at www.doelta.gov.programs/onet. Or go

directly to the on-line version at http://online.onetcetner.org My opinions and some objective analysis follows.

Shin-Chin, L., & Nathan, B. R. (1997, June). *Obtaining reliable job analysis information: A progress report from the Work Keys System: ACT's nationwide program for improving workplace skills*. **Presented at the International Personnel Management Association Assessment Council Annual Meeting, Newport Beach, CA.**

The reliability of job profiles collected for ACT's Work Keys system, which was first introduced to IPMAAC in 1993, is reviewed. The Work Keys job profiling system, the job analysis system used to establish content validity of the Work Keys assessments, is discussed. Profiles showed strong interrater agreement, with skill levels differing depending on the job and company in which the data was collected. Implications for selection, training, and educational skill standards are discussed.

SkillTRAN. (2001, January). *Software review by Dr. Joseph Havranek*. **[Electronic file]. Retrieved March 22, 2002, from http://www.skilltran.com/iarpreview.htm**

This software review outlines the hardware requirements, purposes of the program, installation, documentation, operation/interface, ouput/goal achievement, and then a summary of the *Job Browser Pro 1.2* by SkillTRAN (2000). Dr. Havranek describes the new version of Job Browser as a "quantum leap forward" and testifies the Job Browser Pro 1.2 is "light years ahead of any similar program Dr. Havranek has had the opportunity to review in both the information available and ease of operation."

SkillTRAN. (2001). *Job Browser Pro version 1.2*. **[Electronic file]. Retrieved March 6, 2002, from http://www.skilltran.com/jb_overview.htm**

A Budget-Friendly Windows Tool for Career Exploration & Planning, Expert Testimony, Labor Market Info., Resume Preparation, and ADA Job Descriptions. JOB BROWSER *Pro* is a remarkable professional-strength WINDOWS software tool for career exploration and planning, testimony, labor market information, resume preparation and ADA conforming job descriptions. JOB BROWSER *Pro* is a dramatic expansion of the very popular DOS-based EZ-*DOT*. Simple, straight-forward, affordable access to the information you need every day. JOB BROWSER *Pro* even includes the complete occupational text and images from the *Occupational Outlook Handbook* (OOH). Developed for career transition and disability management professionals and their clients, JOB BROWSER *Pro* enables quick access to an enormous amount occupational information. JOB BROWSER *Pro* provides comprehensive data for more than 12,700 unique occupations, *plus* new and emerging occupations. Specific information is easily retrieved by job title or partial title. Any list of matching titles can be narrowed to light and sedentary strength only. This feature helps identify alternate, light duty jobs for corporate disability management (early return to work) and rehabilitation or transitional career planning.

SkillTRAN. (2001). *Software for career counselors and rehabilitation professionals: SOS-SkillTRAN online services*. **[Electronic file]. Retrieved March 6, 2002, from http://www.skilltran.com/online.htm#PPS**

SkillTRAN is delighted to restore the most powerful suite of online products ever assembled for rehabilitation, forensic, and career professionals. Former customers of CAPCO® / JobQuest® will quickly recognize these familiar reports and user interface. These are time-tested, defensible, and sensible reports, like none other. Many data files are being rebuilt for fresh labor market information and will be maintained. SkillTRAN is also restoring the level of service and customer care that you deserve. SkillTRAN has four online services - PPS, PREPOST, CCS, and JSS. Products differ by intended users of the product (both data entry and report interpretation). The Placement Planning Service is SkillTRAN's most powerful all-purpose product. It is designed for complete vocational planning and job placement solutions of all kinds of clients, particularly persons with disabilities. It is the workhorse product most often used by vocational rehabilitation and case management professionals. Placement Planning Service (PPS) can identify feasible occupations for an individual using residual post-injury capacities, transferable skills and past training and experience, preferences, and/or interests. PPS supplements this analysis with optional labor market information. PPS also has built-in support for storage of client data, job analyses, and live job orders. Pre-injury/Post-injury analysis (PREPOST) is used by vocational experts and attorneys in litigated cases including: worker compensation, personal injury, medical malpractice, and product liability. The PREPOST analysis quickly documents critical vocational issues in a clear, defensible report. PREPOST analysis is based on true transferable skills and is appropriate for individuals with a significant work history and/or a clear cut career path. Local labor market information estimates differences in pre-injury vs. post-injury wages. Career Consulting Service (CSS) identifies occupations a non-disabled person can do using transferable skills and interests from past work experience and training. The report generated by CSS is easily interpreted by the client. The report encourages active, self-directed client decision making. It is best when followed up with the Job Search Service (JSS) report after the client has narrowed vocational choices down to a few realistic possibilities. CCS is designed for high volume processing of cases in outplacement, transition assistance, welfare return-to-work, schools, military, civilian transition, etc. If a client has a disabling condition, use PPS instead for career planning purposes. The PPS report will require professional input and interpretation. Job Search Service(JSS) prepares information helpful to self-assessment of skills and resume writing. It generates a self-directed report with local labor market information for targeted job search. This product is useful for all client populations.

Simkiss, P., & Floyd, M. (1995). Developing a computerized information system for visually disabled people to assist with job placement. *International Journal of Rehabilitation Research, 18*(2), 133-141.

Unlike several other countries, the UK does not have a national occupational database describing jobs in terms of skill and other factors. Neither is there a nationally recognized method for assessing the functional skills that job seekers have to offer. If these two types of assessment were based on the same criteria, individuals could accurately match their profile to occupations or vacancies. Assistance with job placement is one of the most popular services offered by Royal National Institute for the Blind (RNIB) Employment Network to visually disabled people. Yet resources are stretched and the Network is considering computerizing its occupational information

and job-matching activity to increase efficiency. By drawing upon a comparison of existing systems and recommendations in the literature this paper offers suggestions for the development of this system. Factors for consideration at the design stage are discussed, and the paper concludes with a program for development, evaluation and implementation. The need to ensure quality standards through staff training and appropriate procedures is stressed.

U.S. Department of Labor. (1991). *The Revised handbook for analyzing jobs.* **Washington, DC: U.S. Department of Labor, Employment and Training.**

Job analysis: what it is and its uses -- Concepts and principles of job analysis -- Worker functions -- Work fields -- Materials, products, subject matter, and services -- Sentence analysis technique -- General educational development -- Specific vocational preparation -- Aptitudes -- Temperaments -- Guide for occupational exploration -- Physical demands and environmental conditions -- Writing job summaries and descriptions of tasks -- The job analysis report -- Procedure for preparing for and conducting a job analysis study -- Plant control card and staffing table -- Organization and workflow charts -- The narrative report.

U.S. Department of Labor (1993, December). *1990 OCSM: Occupational Classification System Manual.* **Washington, DC: Author.**

U.S. Department of Labor: Advisory Panel for the Dictionary of Occupational Titles(APDOT). (1992, March). *Interim Report.* **Washington, DC: U.S. Employment Service, U.S. Department of Labor.**

The DOT review is a Secretarial Initiative designed to ensure that the Dictionary of Occupational Titles (DOT) becomes an effective tool for meeting the workforce challenges of the 1990's and beyond. As the nation's single most comprehensive source of occupational information, the DOT is uniquely positioned to help the Department of Labor shape its response to the issues of workplace changes and skills development. A revised DOT has the potential to serve as a centerpiece of the Department of Labor's strategy to improve the competitiveness of the American workforce. The Secretary of Labor has appointed the Advisory Panel for the Dictionary of Occupational Titles (APDOT) and charged the panel with recommending strategies for developing, producing, and disseminating a new DOT. Final recommendations are expected in February 1993. The Interim report was developed by APDOT to clarify the approach and status of activities in the DOT Review and to solicit comments from interested persons and organizations on critical issues currently under discussion. The report describes activities undertaken to date, tentative findings, and potential options for recommendations. To encourage response, specific questions for comment are listed at the conclusion of the report.

U.S. Department of Labor: Advisory Panel for the Dictionary of Occupational Titles (APDOT). (1993). *The new DOT: A database of occupational titles for the twenty first century.* **Washington, DC: U.S. Government Printing Office.**

Historically, the DOT was developed during the economic crisis of the 1930's as a tool to help the new public employment system improve linkages between skill supply and skill demand. The Panel believes that it is particularly appropriate for the DOT to be reinvented in the 1990's to serve the nation's current and future efforts to foster economic growth and competitiveness through skill acquisition and workforce investment. (p. 6)

U.S. Department of Labor, Bureau of Labor Statistics. (2002-03 ed.). *Occupational Outlook Handbook*. **Washington, DC: The Bureau.**

The *Occupational Outlook Handbook* is a nationally recognized source of career information, designed to provide valuable assistance to individuals making decisions about their future work lives. Revised every two years, the *Handbook* describes what workers do on the job, working conditions, the training and education needed, earnings, and expected job prospects in a wide range of occupations.

U.S. Publishing. (n.d.). *Data sources references*. **Retrieved March 20, 2002, from http://www.uspublishing.net/references-main_body.html**

U.S. Publishing combined data from the U.S. Department of Labor, U.S. Department of Commerce (Census Bureau), and the Bureau of Labor Statistics to create new reference materials that are more practical and useful than those available directly from the above government agencies. This data is intended to be used in conjunction with local labor market expertise and research. Included in this data is information on the Census Occupational Format, the Dictionary of Occupational Titles (DOT), and the Specific Occupation Selector (SOS) manual, a crosswalk for the Census and the DOT displaying all DOT codes and titles grouped by Census Code. Three quarterly publications were created following the combining of DOT information and census data, the *Employment Statistics Quarterly*, *Unskilled Employment Quarterly*, and the *Residual Access to Employment (RATE) Quarterly*.

Valpar International Corporation. (n.d.) *Pro3000 Modular Assessment System: Introduction*. **[Electronic file]. Retrieved March 19, 2002 from http://www.valparint.com/**

The Pro3000 is described as "the new Windows version of our best selling, widely used and highly successful system 2000 software." The Pro3000 allows on-computer, self-directed testing and transferable skills analysis using a client's work history information. Work sample scores can be imported for in-depth physical skills assessment and popular paper/pencil tests such as VTES, TABE, ABLE, DAT, and CAAT, can also be imported.

Valpar International Corporation. (n.d.) *Pro3000: Valpar's new Windows version of our best selling, widely used and highly successful system 2000 software*. **[Electronic file]. Retrieved March 19, 2002 from http://www.valparint.com/**

Pro3000 is Valpar's latest generation of computer software. It features a high degree of integration, a modern Windows interface and a modular design. The modules can be purchased individually to build the exact system you want, and new modules can be added at any time. Pro3000 modules are self-contained, producing useful information on their own, and each module is part of the overall system with access to data from other modules. Current modules available are as follows; The Wage and Employment Database, O*NET, The Competencies Database, The Work Sample Scorer, the Local Job Database (Revised Handbook for Analyzing Jobs), The System Manager, The Career Planner, COMPASS, COMPASS Lite, The DOT Database, The DOT Job Descriptions, The OOH Database, PET, Spatial/Nonverbal, TECO, Work History, The Pictorial Interest Survey, and SUS. A module that will soon be available is the Military Occupation Code Database, which provides access to the Army, Navy, Air Force, Marines, and Coast guard.

Valpar's New Joule FCE Combines Pragmatic Therapy Experience with Perspectives from Vocational Evaluation. (1999, March/April). *Work Injury Management*.

Valpar International combined its experience in vocational evaluation with a design team of therapists to develop its newly-released Joule functional capacity evaluation (FCE) system. Like other FCEs, Joule can be adapted to various work injury management (WIM) needs of industrial clients such as: pre-placement screening, return-to-work testing, work hardening, and software support for job analysis. The company's line of component work samples was launched in 1973 and now includes more than 20 samples. Work samples focus on capabilities needed for common tasks in specific job categories, and they have been used by vocational evaluators and therapists to evaluate and treat workers in transition. Of the more than 20 work samples, two focus on range of motion, one on dynamic physical capacities, and nearly all are oriented to objective measurable function. With content and uses similar to the work samples, the Joule FCE also has the same cover-the-waterfront approach: it includes specific testing protocols for 20 job categories. The categories are based on definitions in the Dictionary of Occupational Titles (DOT), Bureau of Labor Statistics and other sources. This could shorten the learning curve for providers that must bring expertise on-line quickly. In addition, the Joule testing format imitates the work samples in their attempt to build in procedures or basic formats that are engaging to clients. The FCE's rack system is adjusted to fit the anatomical dimensions of clients, and clients adjust the color-coded weights as they move through weight-lifting progressions. Such things help build trust and a sense of ownership. These and other family ties to vocational rehabilitation may be important in serving SSA disability clients in the near future. Pending legislation posed to pass in Congress (the Work Incentives Improvement Act, see cover article) will make alliances with vocational rehab providers a key element in accessing these disability markets.

Valpar International Corporation. (1999, May). *Interrater reliability of Joule: An FCE system by Valpar*. **[Electronic]. Retrieved February 13, 2002 from http://www.valparint.com/**

Joule is a new functional capacity evaluation system (FCE) by Valpar International Corporation. "(FCEs) are supposed to define an individual's functional abilities or

limitations in the context of safe, productive work tasks" (King, Tuckwell, & Barrett, 1998). This report will not describe FCEs generally; readers unfamiliar with FCEs should refer to the article by King, Tuckwell, and Barrett (1998). That article not only described existing FCE systems, it also calls attention to several shortcomings among those systems and makes recommendations for the development of well-designed FCEs. A recent article published by Valpar International Corporation (Christopherson & Ruprecht, 1999), introduced Joule, described several of its unique features, and made a preliminary report on Joule's effectiveness and client satisfaction. The article previewed several planned studies that would assess Joule's interrater reliability and validity, and this article reports on the interrater reliability study. Those who desire more detail on the specifics of Joule, should refer to the article by Christopherson and Ruprecht (1999) or contact Valpar. Several key elements of Joule were analyzed for the purposes of this study. All of the data was gathered from the two Joule forms reproduced in Appendix A of this report, "Summary of Functional Abilities," and " FCE Participation Index." Those elements are: Subjective client input, Participation Index, Terminating factors, Last Safe Weight, Job Frequency Recommendations. This report will discuss each of the several analyzed elements of Joule separately, and will describe the manner in which each element's "agreement index" was calculated.

Valpar International Corporation. (1999-2002). *Meca (Microcomputer evaluation of careers & academics): A technology-based career exploration and assessment system linked to applied academic skills*. **[Electronic Brochure]. Retrieved February 1, 2002 from http://www.valparint.com/**

MECA is a unique microcomputer "hands-on" career exploration and assessment program linked to basic academic skills. This system utilizes work simulations and is built around common occupational clusters. Each cluster, or career area, consists of hands-on Work Samples that provide a variety of career exploration and assessment experiences along with Learning Activity Packets (LAPs). The LAPs integrate basic academic skills into the career planning and placement process. It is the lack of basic skills that prevents many people from achieving their career goals. The Learning Activity Packets provide a very powerful representation of why basic skills are essential for success in the workplace. Both Work Samples and Learning Activity Packets use the latest technology in multimedia software development.

Valpar International Corporation. (1999-2002). *TPAL- Therapists' Portable Assessment Lab*. **[Electronic Brochure].**

T/PAL contains 12 work modules designed to assess cognitive and psychomotor abilities. The modules aid in formulating treatment plans by providing valuable insight into the skills that a patient possesses. T/PAL provides a standardized screening assessment system, tied to both the DOT Worker Qualification Profile factors and to MTM industrial performance standards. Norms are also included. It is not necessary to administer all modules in order to obtain meaningful results. The entire assessment requires about two hours. T/PAL is easily portable so the modules can be administered in a variety of settings, including bedside. All modules are contained in a compact, sturdy wooden case that is mounted on wheels.

Valpar International Corporation. (2002). *Joule: An FCE system by Valpar*. [Electronic Brochure]. Retrieved February 13, 2002 from http://www.valparint.com/

> When designing a new Functional Capacity Evaluation (FCE) system, a number of basic decisions were made that formed the foundation of the product. *Joule* systematically integrates objective data and subjective findings to help evaluators fairly and accurately draw meaningful conclusions. Standardized protocols, procedures and proper body mechanics are utilized to ensure repeatability and inter-rater reliability. Multiple predefined FCE plans are included to accommodate a wider range of uses. Valpar's *Joule* is flexible, offering the evaluator the ability to create custom protocols from Joule's standard protocols when designing FCE plans. *Joule* is complete, providing a full set of protocols, hardware, software, training, quality assurance and support systems. *Joule* is a function-focused system that does not utilize overly precise, client intimidating, biomechanical measuring devices. The result of this philosophy is an innovative FCE system that is safe, accurate and both client and evaluator friendly.

Vocational Research Institute. (n.d.) *Vocational Interest, Temperament and Aptitude System (VITAS): Efficient work sample vocational assessment*. [Brochure]

> VITAS was developed under a U.S. Department of Labor contract. The project's goal was new work sample technology for short-term evaluation of large numbers of clients. Expansion of manpower programs and new legislation mandating individualized education and rehabilitation plans had created this demand. VITAS' wide applicability is evident from the variety of settings in which it is used- rehabilitation centers, psychiatric hospitals, vocational schools, government employment offices and others. The 21 VITAS tasks were originally designed to relate to 15 Worker Train Group Arrangements in the U.S. Department of Labor's Guide for Occupational Exploration in 1979, they were analyzed again and found to be representative of 16 Work Groups in the Guide. VITAS is the only integrated work sample system related to the Guide.

Vocational Research Institute, Philadelphia Jewish Employment & Vocational Service (JEVS). (1992). *The APTICOM report*. [Brochure].

> For every individual tested on APTICOM, APTICOM will generate the APTICOM Report-a unique personalized printout containing an array of valuable vocational information. The APTICOM Report consists of five parts: the Aptitude Test Battery Report, the Occupational Interest Inventory Report, the Educational Skills Development Report, the Vocational Recommendations Report and Legend.

Vocational Research Institute, Philadelphia Jewish Employment & Vocational Service (JEVS). (1993). *APTICOM: Vocational & career assessment that works*. [Brochure].

Vocational Research Institute, Division of Jewish Employment & Vocational Service (JEVS). (2001a). *Careerscope: The premier career assessment and reporting system*. [Brochure].

Vocational Research Institute, Division of Jewish Employment & Vocational Service (JEVS). (2001b). *The Careerscope reporting system*. [Brochure].

Vocational Research Institute, Division of Jewish Employment & Vocational Service (JEVS). (2002). *Help build brighter futures with WorkPlace Mentor: The situational assessment and employment tool that gets consumers working today… and keeps them working tomorrow*. **[Brochure].**

> Developed under grants from the U.S. Department of Education's National Institute on Disability and Rehabilitation Research and Rehabilitations Services Administration, WorkPlace Mentor is a comprehensive system for designing and conducting effective community-based assessments and planning the employment of individuals with special needs or limited work histories. The process relies upon intelligent database software that facilitates the objective and targeted evaluation, the matching of critical consumer characteristics with job demands, and systematic collaboration between practitioner and consumer.

West Coast Educational Systems. *Understanding OASYS & transferable skills analysis*. **Handouts provided at the California Association of Rehabilitation and Reemployment Professionals Conference. Fullerton, CA.**

> There are a lot of ways to define 'skills' but how to transfer those skills to job possibilities is not always easy. People can relate skills as a very vague statement such as "I am good with my hands," or "I like dealing with people," to highly specific such as "I can program an IBM PC in Visual Basic" or "I can prepare French pastries." Transferable Skills occurs when we take a person's job history, factor in other data such as an aptitude and achievement tests or physical restrictions and come up with jobs that use the same or similar job skill and job knowledge factors.

Job Analysis & Classification Methodologies

This section explores the methodologies behind job analysis and occupational classification systems utilized by public and private entities including the military and government agencies.

Agen, R. (1996). *Construct validation of a worker characteristic-based job analysis system*. **Thesis, Roosevelt University.**

American Occupational Therapy Association & American Physical Therapy Association. *Physical Demand Variables*. **(presented to DOL & SSA on March 22, 2002)**

> A list of physical demand variables organized under the following headings; psychomotor abilities, dynamic strength abilities, positional abilities, ambulatory abilities, and repetitive movements.

Bennett, W., & Mitchell, J. L. (1995). *Military occupational analysis: Issues and advances in research and application*. **[microform]. Brooks Air Force Base, TX: Armstrong Laboratory, Air Force Material Command.**

This report highlights recent research advances and applications of military occupational analysis (OA) technology. It is designed to bring military psychologists u to date concerning the OA technology for military applications and the impact that military occupational analysis is having on civilian practice. First, the history of occupation analysis research and development (R&D) and application in military organization is reviewed, to establish the context for ensuing chapters covering current military OA R&D results and applications. The various chapters address OA both in U.S. and allied nations' service organizations. In addition, civilian applications of military OA technology are discussed. Finally, future directions for OA are highlighted. The potential use of OA methods for modeling organizational structure, and of informing organizational intervention (e.g. job enlargement, training, and technostructural change), is also discussed. The final chapter includes a proposed research agenda for future military occupational analysis R&D based on comments received from symposium discussants.

Botterbusch, K .F. (1978). *A guide to job site evaluation***. Menomonie, WI: Department of Rehabilitation & Manpower, Materials Development Center, Stout Vocational Rehabilitation Institute.**

Vocational evaluation is a process of assessing a person to determine the specific nature of his aptitudes, skills, interests, and work related behaviors. Most writers in the field of vocational evaluation list four major methods for assessing human potential: (1) psychological testing, (2) work samples, (3) situational assessment, and (4) job site evaluation. Presently, many evaluation units depend heavily on a combination of psychological testing and work sample assessment. Although each assessment technique has its advantages and disadvantages, the advantages of job site evaluation have been largely ignored by the field. The purpose of this publication is to provide the evaluator who chooses to use job site evaluation with procedures, ideas, and examples that will insure the successful use of job sites. The result will be an accurate method for assessing client potential. Finally, it is hoped that his publication will help facilities to make job site evaluation a part of their evaluation process. The first part of this publication describes the specific uses of job sites and ways that the evaluator can use job sites for planning client evaluation. It also contains places where job sites can be found. The second part provides information on how to set up a job site; the third tells how to evaluation the client on the job site. The wage and hour regulations are described and examples of job site evaluation forms are given in the appendices.

Christal, R. E., & Weissmuller, J. J. (1983). Job-task inventory analysis. In *Activity-based psychological job analysis methods* **(pp. 1036-1050).**

The job-task inventory approach to job analysis is a systematic method of collecting job information from incumbents and supervisory personnel, coupled with a flexible set of computer programs for analyzing, organizing, and reporting this information to management. A job-task inventory is basically a questionnaire, generally composed of two major sections. These sections are called the "background information section" and the "task inventory section." Each section plays an important role in obtaining information needed by management. The background information section contains two

kinds of questions: identification-classification questions and checklist questions. The identification-classification questions may ask an incumbent of this or her name, employee number, sex, years of service, position title, organization, education level, attitude toward job, career intentions, desire for transfer—indeed, any information that might allow management to classify people into categories of interest. Checklist questions are similar to identification-classification questions except that the incumbent is presented with lists of things that may apply to his or her job, prior training, or job attitudes. These lists may include tools used, equipment worked on, courses taken, or attitudes toward various aspects of the job. Questions in the background section of a job-task inventory generally appear in one of three formats: "Fill in the blank" (name, employee Id, etc); "Check ONE that BEST describes…"; or "Check all that apply."

Committee on Techniques for the Enhancement of Human Performance: Occupational Analysis: National Research Council. (1999). *The changing nature of work: Implications for occupational analysis*. **Washington, D.C.: National Academy Press. [Electronic file]. Retrieved on January 30, 2002, from http://books.nap.edu/html/occup_analysis/index.html**

The committee's current topic and the subject of this book are the changing nature of work and the implications for occupational analysis. The charge to the committee from the Army Research Institute was (1) to review and analyze the research on the environmental forces, organizational factors, and the content of work; (2) to identify key issues in the changing context and content of work that affect the design of occupations in the civilian and military sectors; (3) to evaluate the changes in tools for analyzing the nature of the work environment and developing occupational classification systems that are responsive to current and future needs of the workplace; and (4) to assess the application of methods and tools developed in the civilian sector to occupational classification and analysis in the Army. The current composition of the committee includes experts in the areas of sociology, economics, management, occupational analysis, and industrial and organizational psychology and training. This book is intended to provide decision makers in both public and private organizations, as well as in both the civilian and military sectors, with guidance on how to assess and respond to contemporary debates about changes in work. Our audience extends far beyond the boundaries of social scientists and human resource specialists who have a professional interest in understanding changes in work and the adequacy of occupational analysis systems for charting and managing the changes. In particular, we hope that decision makers whose choices influence the nature of work--who include senior executives, line mangers, military officers, and designers of technology--will find valuable information in this volume.

Davis, E. W. (1942). *A functional pattern technique for classification of jobs*. **New York, Teachers College, Columbia University.**

The problem of this dissertation was to investigate the relationship between job titles and the functions performed by men in the advertising profession in order to devise and demonstrate a technique for setting up typical "function patters" as a basis for classifying positions in an occupations. Some of the subordinate problems that were

met are as follows: (1) To demonstrate the limitations of the structural or logical method traditionally used in classifying jobs. (2) To devise a statistical method of grouping all of the function performed by individuals in various positions into characteristic function patterns by means of simple and unique numerical codes which would replace the inexact, structural method of classifying jobs. (3) To compare the results obtained by using the two methods—"structural" and "functional pattern."

De Zwart, B.C., Broersen, J. P., Van Der Beek, A. J., Frings-Dresen, M. H., & Van Dijk, F. J. (1997). Occupational classification according to work demands: An evaluation study. *International Journal of Occupational Medicine and Environmental Health, 10*(3), 283-295.

The use of job title as crude exposure measure in epidemiological studies is often inevitable when the available exposure data is scarce. In this study, an existing classification scheme of all job titles in the Netherlands into six categories of physical and mental work demands, constructed by expert judgment, was evaluated. Furthermore, a revision of this classification scheme for a research project on the relation between age, physical work demands, and musculoskeletal complaints was proposed and evaluated as well. For the evaluation, self-reported work demands, derived from questionnaire data of 38,921 employees and quantified by a scale of physical work demands and mental work demands, were used. Based on comparison of the mean scale scores of the several categories of work demands at group level, both classification schemes showed construct validity. Notwithstanding several limitations, the use of the presented classification schemes in epidemiological studies seems particularly challenging and rewarding when analyzing data at group level from large and heterogeneous occupational populations. These kind of exploratory studies may generate new hypothesis on the basic patterns concerning work-related disorders, and can also be informative from a policy making perspective.

Ferello, A. S. (1982). Job sample evaluation methodology. *American Archives of Rehabilitation Therapy, 30*(2), 15-24.

This article is intended to serve as a guide for vocational rehabilitation specialists team members involved with hands-on performance evaluation of clients to determine occupational potential. The performance evaluation is based upon a demonstrated knowledge of the required job skills and an understanding of the abilities and personal characteristics required for general employability. The job samples detailed in Part II have been selected as representative of most prevalent industrial and occupational jobs available in a typical community of an industrialized country.

Field, T. F. (2002). *Transferable skills analysis: A common sense approach.* **Unpublished manuscript.**

Fine, S. A., & Cronshaw, S. F. (1999). *Functional job analysis: A foundation for human resources management.* **Manwah, NJ: Lawrence Erlbaum.**

This book will be of special interest to industrial and organization psychologists, human resource management practitioners, counselors, and to researchers and teachers in these areas. Along with this companion book (Benchmark Tasks for Job Analysis: A Guide for Functional Job Analysis Scales) in this Series, it provides a comprehensive understanding of an important approach to the analysis and understanding of work behavior and performance. This approach is the Functional Job Analysis (FJA) system developed by Sidney Fine. The FJA is a holistic approach to job analysis, which focuses on individual tasks rather than the job and describes human skills using three components: functional, specific content, and adaptive skills. Fine and Cronshaw define and explore the FJA in three organized sections. Part I is learning and understanding the FJA model, Part II is generating the FJA data, and Part III is using FJA in human resource management (HRM) applications.

Fleishman, E. A., & Reilly, M. E. (1992). *Handbook of human abilities: Definitions, measurements, and job task requirements***. Palo Alto, CA: Consulting Psychologists Press.**

This Handbook brings together, for the first time, comprehensive definitions of human abilities spanning the cognitive, psychomotor, physical, and sensory/perceptual domains of human performance. A major objective of the book is to integrate these ability definitions with information about the kinds of tasks and jobs that require each ability and the tests that can be used to measure each ability.

Fleishman, E. A. (1974). *Model procedures for job analysis, test development and validation: Final report***. Washington, DC: American Institutes for Research.**

Gael, S. (Ed.). (1988). *The job analysis handbook for business, industry, and government: Vol. & 21***. New York: Wiley and Sons.**

The opening section contains conceptual underpinnings, job analysis history, the legal basis for job analysis, and a discussion of majority job analysis issues and research. Two sections follow with presentations about sues for job analysis results, one from an organization administration viewpoint and the other from a human resource management viewpoint. The Handbook then moves into a section on planning for job analysis, which is followed by a section that covers several techniques practitioners can use to obtain job information. The 6th, 7th, 8th, and 9th sections are devoted to industrial engineering, human factors engineering,, worker-oriented and work-oriented approaches to obtaining information about work activities and jobs. The concluding section covers a variety of job and work process analyses.

Gael, S. (1983). *Job analysis: A guide to assessing work activities***. San Francisco, CA: Jossey-Bass Inc., Publishers.**

Each chapter in the book begins with a brief introduction and a list of objectives that he reader should be able to accomplish after studying the chapter. The material has been written and organized so that users can zero in on topics of interest. Part One contains eight chapters; Chapter One describes the job inventory approach to job analysis and introduces readers to WPSS. Chapter Two presents a brief history of the job inventory approach, focusing on the reliability and validity of job inventory data and relative

percent time spent performing tasks. Chapter Three is a detailed overview of the WPSS approach written especially for WPSS planners. Chapter Four shows how to write task statements for inclusion in a WPSS questionnaire and describes methods for analyzing and documenting job content and for observing job incumbents in order to obtain job information and derive task statements. Chapter Five describes how to plan and conduct interviews with job incumbents and supervisors to obtain job task information. Chapter Six covers the development, production, and distribution of WPSS questionnaires. Chapter Seven considers the interpretation and use of results obtained by analyzing WPSS questionnaire data. Chapter Eight discusses the shortcut procedures for obtaining job task information that can be applied in small organizations and under special circumstances. Part Two is a guide to using WPSS computer programs to enter questionnaire data in the computer, analyze the data, and obtain computer printouts that summarize the results. WPSS interactive computer printouts have been designed to enable inexperienced computer users to carry out WPSS analyses. The computer system is "user friendly" and prompts the user step-by-step throughout computer terminal sessions. All prompts and responses are in English and no special computer language is required.

Green, B. F., & Wing, H. (1988). *Analysis of job performance measurement data: Report of a workshop***. Washington, DC: National Academy Press.**

In 1980 it was determined that the Armed Services Vocational Aptitude Battery (ASVAB), the major military entrance test, had been misnormed resulting in approximately 250,000 men and women entering the military service over a 4 year period who would have been unable to meet the entrance standards. In response, each of the four military services began to address the complexities of evaluation of job performance and as a result, the Department of Defense (DOD) in conjunction with Congress, developed the Joint-Service Job Performance Measurement/ Enlistment Standards Project. This project includes two phases. First, to determine if technically adequate criterion measures can be developed that are representative of job performance and second, to determine how well the current enlistment procedures, including the ASVAB, predict these approximations and then to develop methodologies that link the job performance measure to enlistment standards. This report describes a workshop, focused on data analysis, held December 12-13, 1986 in Baltimore, Maryland. Part I presents the preliminary results of the Army's Project A research and Part II consists of a series of recommendations to the Job Performance Measurement Working Group for a core set of analyses of the job performance data collected by the Services over the past several years.

Harvey, R. J., & Wilson, M. A. (2000). Yes Virginia, there is an objective reality in job analysis. *Journal of Organizational Behavior, 21***, 829-854.**

We fundamentally disagree with the Sanchez and Levine (this issue) on several issues. Terminologically, we are troubled by their failure to differentiate between the descriptive process of rating verifiable work characteristics (i.e., *job analysis*) versus the subjective process of inferring worker ability and 'other' (AO) requirements (i.e.,

job specification). Although 'consequential validity' is crucial for evaluating job specifications, it is largely irrelevant for assessing properly conducted job analyses. Ontologically, we reject their relativist view that an objective reality does not exist when describing work activities. When verifiable descriptors are rated using sound rating scales, independent judges can definitively assess position rating accuracy; such a review constitutes all the 'validity' evidence needed for the job analysis *per se*. We discuss a number of additional concerns, including the way in which practitioners deal with true cross-position ratings variability, and the role of holistic inferences.

Harvey, R. J., & Wilson, M. A. (1998). *Occupational analysis at the crossroads*. **Paper presented at the 1998 Annual Conference of the Society for Industrial and Organizational Psychology.**

HR-Guide. (2000). *Job-analysis*. **Retrieved April 10, 2002, from www.job-analysis.net/**

This web site provides a general definition of job analysis and provides many links to related information on job analysis including an overview, methods, law/legal issues, job descriptions, uses of job analysis, and general links. Specific information about three job analysis methods, interview, observation, and questionnaire, is displayed under the corresponding links. The advantages, disadvantages, methodologies, and outcomes for each method of job analysis are explored individually.

Hunter, J. E. (1983). *Test validation for 12,000 jobs*: *An application of job classification and validity generalization analysis to the general aptitude test battery*. **Washington, DC: Division of Counseling and Test Development, Employment and Training Administration, U.S. Department. of Labor.**

This report cumulates the results of 515 validation studies carried out over a 45-year period by the U.S. Employment Service, and relates these findings to five systems of job classification and job analysis. Correction for sampling error shows that general cognitive, perceptual, and psychomotor ability are valid predictors of job proficiency for all jobs, though there is considerable variation in validity across jobs. Correction for sampling error shows that cognitive and perceptual ability are valid predictors of training success for all jobs and that psychomotor ability is a valid predictor for all but a few high-complexity jobs. The relevant information in each of the five job analysis systems turned out to be the same dimension: job complexity. This dimension has been assessed for all 12,000 jobs in the Dictionary of Occupational Titles (DOT; U.S. Department of Labor, 1977) and the validity of generalization analysis performed here thus extends to all jobs in the current volume. Cognitive ability increases in validity as job complexity increases while psychomotor ability increases in validity as complexity decreases. Thus a shift in weight from cognitive ability to psychomotor ability across categories of job complexity produces average multivariate validity ranging from .49 to .59 for job proficiency and from .59 to .65 for training success.

International Personnel Management Association Ad Hoc Committee on Use of the Personnel Assessment Specialist Job Analysis. (1995). *Personnel assessment specialist job analysis: Interpretation and use report*. **International Personnel Management Association Assessment Council.**

In the 1980's, IPMAAC conducted a comprehensive Personnel Assessment Specialist job analysis in order to develop information about the variety of tasks we perform and the competencies needed in our profession. Many different applications and uses were envisioned for the resulting report. In a subsequent survey, the IPMAAC membership reported their belief that the job-analysis results would be useful to organizations for a variety of personnel activities including job design, job classification, employee selection, employee training and development, and employee performance appraisal. The purpose of the project hat led to this report has been to provide the IPMAAC membership with as much information from the job analysis as possible, in as user-friendly a format as possible, for such organizational use. To facilitate use of these materials, examples of application for three different personnel activities have been developed and are included in this report. Applications of the job analysis results are presented for job description/classification, for employee selection, and for employee performance appraisal. The job analysis project approach and research results are also summarized.

Knapp, D. J., Campbell, J. P., & Russell, T. L. (1995). *Building a joint-service classification research roadmap: Job analysis methodologies*. **[microform]. Brooks Air Force Base, TX: Armstrong Laboratory.**

The Armstrong Laboratory, the Army Research Institute, the Navy Personnel Research and Development Center, and the center for Naval Analysis are committed to enhancing the overall efficiency of the Services' selection and classification research agenda. This means reducing the redundancy or research efforts across Services and improving inter-Service research planning, while ensuring that each services' priority needs are served. The Roadmap project is composed of six tasks. This report documents the third task, a review and discussion of job analysis methodologies as they relate to joint service selection and classification goals. The review is structured around a framework that provides for two major categories of job descriptive information: Situation-oriented and person-oriented. Situation-oriented information describes the nature of work and/or environment where the work is to be performed. Person-oriented information describes the individual characteristics of people who are able to successfully perform various types of work in different contexts. In this report, the types of situation-oriented and person-oriented job descriptive information that can be collected is outlined. Projects that have attempted to establish linkages between these two domains are described.

Levine, C., & Salmon, L. (1999). The 1998 SOC: Bridge to occupational classification in the 21st century. *Occupational Outlook Quarterly*, **27-33.**

Daguerreotypist was one of about 320 occupations included in the Nation's first occupational classification system, the 1850 Census of Population. Much has changed since then. Today, photographers have replaced daguerreotypists, the Federal Government defines nearly three times as many occupations today as it did 150 years ago, and the Census Bureau is only one of several agencies collecting occupational information. In the late 1970s, Government economists produced the Standard Occupational Classification (SOC) for Federal agencies collecting occupational data. A 1998 revision to the SOC includes a number of improvements to the original system.

This article discusses the need for a universal classification system, creation of the 1998 SOC, its implementation schedule, and plans for ongoing development.

Levine, E. L., & Sanches, J. I. (2000). Accuracy or consequential validity: Which is the better standard for job analysis data? *Journal of Organizational Behavior, 21*(7), **809-818.**

The value of research on the accuracy of job analysis is questioned. It is argued that the traditional criteria employed to evaluate job analysis accuracy (i.e., interrater agreement and deviations from proxy true scores) provide information of little practical value. Alternative criteria focusing on the consequences of job analysis data are suggested. Consequence-oriented criteria are clarified through a review of the various inferential leaps or decision points that job analysis supports. In addition, the consequences of job analysis are also thought to be a function of the rules governing the making of job-analysis-based inferences which, unfortunately, are sometimes unspecified in even the most molecular job analysis methodologies.

McCormick, E. J. (1979). *Job analysis: Methods and applications*. **New York: Amacon.**

This book deals with at least some aspects of the study of human work or job analysis. In particular it covers various methods of job analysis including both conventional, or more descriptive, methods and some of the more recently developed systematic, or structured, methods. In addition, the bases and methods for job interrelationships and classifications are described and examples are provided. Then the application of the data obtained by such methods to certain practical objectives, such as vocational choice, work adjustment, establishing job requirements, and job evaluation, are addressed.

Morgeson, F. P., & Campion, M. A. (2000). Accuracy in job analysis: Toward an inference-based model. *Journal of Organizational Behavior, 21*(7), **819-827.**

Although the accuracy of job analysis information is critically important, standards for accuracy are not clear. Researchers have recently begun to address various aspects of job analysis accuracy by investigating such things as potential sources of inaccuracy in job analysis as well as attempting to reconceptualize our notions of job analysis accuracy. This article adds to the debate by first discussing how job analysis accuracy has been conceptualized. This points to difficulties in the prevalent 'true score' model upon which many of these discussions have been based. We suggest that discussions of job analysis accuracy would benefit from a consideration of the validity of job analysis *inferences*, as a complement to the more traditional focus on the validity of job analysis *data*. Toward this end, we develop a model of the inferences made in the job analysis process, outline some of the ways these inference could be tested, and discuss implications of this perspective.

Paskey, E. IT job profile pilot: Building the next generation workforce. Office of Personnel Management, Washington, DC. Retrieved on April 11, 2002 from http://www.opm.gov/compconf/Postconf00/it/paskey/htm

A multimedia presentation on human resource management applications including training and development, compensation, selection, succession planning, career planning, classification, performance appraisal, and organizational alignment. The Multipurpose Occupational Systems Analysis Inventory-Closed Ended (MOSAIC) is outlined. The objectives, features, and qualification standards of the job profiling system are provided along with an overview of the validation of assessment measures. Current options in IT assessment including crediting plan, computer assisted interview, structured interview, work sample, interest inventory, objective assessment, assessment center, and online portfolio are described. Finally, the competency-based job profile pilot's strengths, areas of improvement, quality of hires, diversity, and overall satisfaction with the process are evaluated.

Peterson, N. G. (1987, May). *Development and field test of the trial battery for Project A.* **U.S. Army Research Institute for the Behavioral and Social Sciences: Alexandria, VA.**

This research was performed under Project A, the U.S. Army's large-scale manpower effort to improve selection, classification, and utilization of enlisted personnel. This report deals with development and field test of a battery of experimental tests to complement the Armed Services Vocational Aptitude Test Battery in predicting soldiers' job performance. Findings from an extensive literature review, expert judgments on validity of measures identified in the review, and administration of a preliminary battery of "off-the-shelf" measures guided the development of new tests. Three major types were prepared: paper-and-pencil tests of cognitive ability; computer-administered test of perceptual/psychomotor abilities; and paper-and-pencil inventories measuring temperament, biographical data, and vocational interests. After iterative pilot tests and revisions, the measures were field tested. Analysis indicated the new tests had adequate to excellent psychometric qualities, were relatively unique, and were not unduly affected by practice or by faking an applicant setting. The resulting Trial Battery contains six cognitive paper-and-pencil tests, 10 computer-administered perceptual/psychomotor tests, and two paper-and-pencil inventories measuring temperament, biodata, and interests. It is being used in the next Project A phase, concurrent validation executed with FY83/84 accessions to evaluate the predictor measures against subsequent job performance.

Rayson, M. P. (2000). Fitness for work: The need for conducting a job analysis. *Occupational Medicine (Lond), 50*(6), 434-436.

Ensuring that employees are both physically fit for work by matching their capabilities with the physical requirements of their job, and physically fit for life by promoting health-related physical activities, are important and under-utilized tools in a company's arsenal for reducing absence and ill-health retirement (IHR). Both the Health and Safety at Work Act (1974) and the Disability Discrimination Act (1995) require evidence-based approaches to setting physical and medical employment standards. Proven fitness-related strategies include redesigning the most demanding tasks, selecting and training personnel who possess the necessary physical attributes, and assessing and redeploying personnel to jobs within their capability. An essential precursor to pursuing these strategies is to conduct a job analysis to quantify the

physical demands of the job.

Spirn, S., & Solomon, L. (1976). A key element in EDP personnel management: Functional job analysis. *Personnel Journal, 55*(11), 552-556, 567.

Spector, P. E., & Jex, S. M. (1991). Relations of job characteristics from multiple data sources with employee affect, absence, turnover intentions, and health. *Journal of Applied Psychology, 76*(1), 46-53.

Much of the evidence in support of job characteristics theory is limited to incumbent reports of job characteristics. In this study, job characteristics data from three independent sources--incumbents, ratings from job descriptions, and the Dictionary of Occupational Titles--were used. Convergent validities of incumbent reports with other sources were quite modest. Although incumbent reports of job characteristics correlated significantly with several employee outcomes (job satisfaction, work frustration, anxiety on the job, turnover intentions, and number of doctor visits), the other sources showed few significant correlations, except for number of doctor visits. Caution is urged in the use of incumbent self-reports of job characteristics as indicators of actual work environments. New methods for studying job characteristics are suggested.

Toeppen-Sprigg, B. (2000). Importance of job analysis with functional capacity matching in medical case management: A physician's perspective. *Work, 15*(2), 133-137.

Medical case management of musculoskeletal injuries can be facilitated when objective testing of the physical demands of the job can be compared to the functional capabilities of the individual. When the job analysis is appropriately sectioned into the separate physical demands, the physician can use information about specific job demands to maximize the likelihood of a safe return to regular duties. The response in the physical abilities in the worker can then be again functionally evaluated, leading to increased confidence in process.

United States Bureau of Labor Statistics. (1991). *Occupational compensation survey: Definitions of occupations*. Washington, DC: U.S. Department of Labor, Bureau of Labor Statistics.

U.S. Bureau of Manpower Utilization. (1946). *Physical demands analysis and physical capacities appraisal*. Washington, DC

A manual describing the concepts of the physical demands and capacities technique and presenting instructions for the preparation and matching of physical demands and capacities information. Does not present a complete description of the selective placement process.

Werwie, D. M. (1987). *Sex and pay in the federal government: Using job evaluation systems to implement comparable worth*. New York: Greenwood Press.

Three major questions are addressed in this research. First, is the new Factor Evaluation System (FES) more beneficial to female-dominated jobs than the old narrative classification system? Second, would changing the weights assigned to the various job factors delineated in the new system alter the pay relationship between male- and female-dominated jobs? Third, do the factors, dimensions, and operational indicators of the FES and other major job evaluation systems adequately define and measure the job content of female-dominated jobs? The results provide insights that will be useful to other researchers who are interested in moving current job evaluation systems closer toward the goal of a bias-free job evaluation system.

West Coast Educational Systems. (n.d.) *TSA Checklist*. **Handouts provided at the California Association of Rehabilitation and Reemployment Professionals Conference. Fullerton, CA.**

Outlines issues related to transferable skills analysis in order to compare OAYS and other analysis systems. Topics included in the outline are data, process/methodology, and technical issues and other considerations. Questions regarding data encompass data collection, credibility of the source providing the data, arrangement, utilization of data in analysis, limitations on factors, and any modifications of the data provided. Process/methodology issues include work history, adjusting skill and ability profile, searches, output, and employment projections/placement. Other considerations outline placement and tracking, career ladder development, occupational exploration, employer listings, and proprietary crosswalk from DOT to industry SIC. Technical issues addressed in the checklist include manager defined multi-level access, restricted access, ability to evaluate TSA lists from other sources to evaluate TSA, and ability to export the file to other programs.

West Coast Educational Systems. (n.d.) *TSA Questions*. **Handouts provided at the California Association of Rehabilitation and Reemployment Professionals Conference. Fullerton, CA.**

To adequately meet a Daubert challenge, an expert witness must be able to demonstrate full command and understanding of the process he uses to arrive at his conclusions. The credentials of the witness and even the Daubert factors are not the issue: methodology and reliability are. A list of recommended questions for professionals to consider regarding the transferable skills software they currently use or when selecting a new system.

Woodward, M. M. (1998). *The validation and reliability testing of the functional job analysis questionnaire as a tool for compliance with the Americans with Disabilities Act*. **Springfield College: Thesis.**

The purpose of this study was to examine the validity and reliability of the Functional Job Analysis Questionnaire (FJAQ) as a job analysis tool for determining the essential functions of a job as well as the physical and mental aspects, which contribute to the accomplishment of a job. The study was broken down into two phases. The first phase

examined the content validity of the instrument through the evaluations of a panel of six experts selected for their relevant expertise. The second phase examined the test-retest reliability of the instrument. A percent agreement analysis was used to examine the responses of 25 raters on two separate test trials administered to each of the raters individually. Overall, the results indicated that the FJAQ is a content valid instrument with moderate reliability.

Zeidner, J., Johnson, C., & Vladimirksy, Y. (1997). *The substitutability of criteria in the development and evaluation of ASVAB classification procedures.* **Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.**

Job Matching Methodology

The job requirement data is utilized by public and private entities to match individuals to jobs, which correspond to their abilities. This section examines the methodologies and techniques for job matching.

Anderson, P., & Burgess, S. (2000). Empirical matching functions: Estimation and interpretation using state-level data. *The Review of Economics and Statistics, 82*(**1**). **93-102.**

Becker, H. (1987). Monitoring and tracking clients and helpers: A system for matching disabled students with adult services. *Education of the Visually Handicapped, 19(2),* **53-63.**

Bell, H. M. (1940). *Matching youth and jobs: A study of occupational adjustment.* **Washington, DC: American Council on Education American Youth Commission.**

Berman, E. (1997). Help wanted, job needed: Estimates of a matching function from employment service data. *Journal of Labor Economics, 15*(**1**)*,* **S251-292.**

I estimate a function that matches vacant jobs and unemployed workers to produce new hires. Israeli law requiring vacancy registration yields unique data quality. The literature underestimates matching function coefficients because of a simultaneity bias, as the outflow of hires depletes stocks of unemployed and vacancies. Instruments and a new stimulation method address this bias. A new test reveals strong evidence of heterogeneity in unemployed and vacancies. Estimates imply labor market dynamics that absorb shocks completely within only 2 months. Reductions in the hire rate of referrals can explain a 2.1 percentage point increase in unemployment between 1978 and 1990.

Den Haan, W. J., Haefke, C., & Ramey, G. (2001). *Shocks and institutions in a job matching model.* **London: Centre for Economic Policy Research.**

This Paper explains the divergent behavior of European and US unemployment rates using a job market-matching model of the labor market with an interaction between shocks and institutions. It shows that a reduction in TFP growth rates, an increase in real interest rates, and an increase in tax rates leads to a permanent increase in unemployment rates when the replacement rates or initial tax rates are high, while no increase in unemployment occurs when institutions are 'employment friendly.' The Paper also shows that an increase in turbulence, modeled as an increase probability of skill loss, is not a robust explanation for the European unemployment puzzle in the context of a matching model with both endogenous job creation and job destruction.

Dortch, C. T. (1989). Job-person-match person-job-match: A case study. *Personnel Journal, 68*(6), 48-61.

All organizations are made up of 2 things—people and jobs. This is true of sole proprietorships, small companies, public agencies and large multinational organizations. As organizations grow, they add systems, technologies, policies, procedure, organization charts and titles, but the basis is always the relationship of the person and the job. If Drucker's comment is anywhere close to the truth, we're spending a lot of time, effort and money creating a lot of miserable and unproductive people. Organizations have been around for decades. They've been studied, written about, modified and legislated, and yet, from an organizational perspective, we still have a terrible success rate matching people with jobs, and we aren't much better when it comes to managing our own careers.

Field, H. S., & Gatewood, R. D. (1987). Matching talent with the task. *Personnel Administrator, 32*(4), 113-126.

Fry, R. R. (1989, March). *The issues papers.* Papers presented at the National Forum on Issues in Vocational Assessment, St. Louis, MO.

This compilation of papers represents the presentations made at the 4th National Forum on the Issues in Vocational Assessment held in St. Louis, Match 9-11, 1989. This was the biggest forum ever—six general sessions involving 21 presenters and 55 papers sessions with 75 presenters. There were approximately 260 people present, representing evaluation and assessment from the disciplines of education, rehabilitation, and allied health professionals. Of the 50 papers, selected titles include "Redefining the Client, Expanding the Evaluator's Role" (Weldon, Gibson); "Professional Contacts for Evaluator's Expanding Roles" (Dowd); "Vocational Evaluators and the Law" (Kass); "Ethics in Vocational Evaluation" (Early); "Professional Advocacy in Vocational Evaluation and Assessment" (Bowers et al.); "Pre-Employment Placement Screening" (Taylor); "Career Assessment to Facilitate Adult Life Transitions" (Mullins); "On-the-Job Evaluations" (Kell); "Considerations for Job Selection and Placement of Persons with Cumulative Trauma Disorder" (Lopez); "Forensic Vocational Evaluation" (McDaniel); "Marketing Plan Development" (Grissom, Nelson); "Understanding the Unique Contributions of Occupational Therapy within Vocational Assessment" (McCracken); "Rehabilitation Counseling and Occupational Therapy Working Hand in Hand" (Fryman, Melickian); "Non-Relational Databases in Rehabilitation Facilities" (Prachyl); "New Gameplan for Vocational Evaluators" (Williamson); "What WAT Is and

What WAT Is Not" (Ayella); "Four Perspectives of Vocational Evaluation" (Nolte); "Marketing the Non-Profit Evaluation Service to Private Industry" (Vohlken); "Model for Vocational Evaluation in Community-Based Employment" (Botterbusch); "Toward Consensus" (Ayella et al.); "Job Matching Systems" (Truthan); "The Trial and Tribulations of a First Time Vocational Expert" (Magrega); "Vocational Evaluation of Closed Head Trauma" (May, Wilkins); "Vocational Assessment for the Severely Physically Challenged" (Peterson, Oliveira); "Illinois Vocational Interest Survey and Assessment" (Sprengel, Moradian); "Vocational Evaluation of Persons with Combined Hearing and Visual Impairments" (Kaskel); "Integrating Vocational Assessments with Special Education Triennial Reevaluations" (Levinson); "Role of School Psychology in Vocational Assessment" (Levinson); "Curriculum Based Vocational Assessment at the Middle and Secondary School" (Swisher); "Role of Assessment in the Transition/Education Process" (Schmitz); "Concurrent Validation of the Abbreviated McCarron-Dial System for Students with Mental Retardation and Learning Disabilities" (Kimmel); "Use of a Robotic System in Vocational Assessment" (Robbins et al.); "Analysis of Private Sector Rehabilitation Case Managers' Opinions Regarding Work Hardening and Work Capacity Evaluation Programs" (May); "Vocational Patterns and Work Concepts of Recovering Alcoholics" (Ridlehoover); "Correlates of Consumer Satisfaction with Vocational Evaluation Services" (Early, Bordieri); and "Comparison of Rehabilitation Clients Tested and Self-Estimated Vocational Aptitudes and Interests" (Bond et al.).

Gallant, J. (1984). Job-matching firms ride boom/programmers top wanted list in '84. *Computerworld, 18*(4), 14.

Gates, W. R., & Nissen, M. E. (2001). Designing agent-based electronic employment markets. *Electronic Commerce Research, 1*(3), 239-263.

Two modes of matching people with jobs prevail at present: 1) hierarchical planning and 2) distributed markets. Each has strengths and limitations, but few systems have been designed to take advantage of strengths corresponding to both. With evolving information technology, however, the job-matching process could be accomplished far more equitably and efficiently using web-based markets within the firm, and intelligent agents offer excellent potential to help both potential employees and employers find one another in a distributed, electronic marketplace. But realizing this potential goes well beyond simply changing the rules of internal job matching or making agent technology available to job searchers. Rather, the corresponding markets and technologies must be designed, together, to mutually accomplish the desired results (e.g., efficient and effective matching) and conform to necessary properties (e.g., market clearing). Through the research described in this paper, we draw from Game Theory results to assess the feasibility of using two-sided matching algorithms to address this market-design problem. We also draw from current agent research to address the information technology dimension of the problem by implementing a proof-of-concept multi-agent system to enact, automate and support the corresponding market solution. This paper integrates the key economic and technological elements required to design robust electronic employment markets. And the corresponding research provides

new knowledge and insight into co-development of the requisite economic markets and agent technologies.

Gill, I. S., Fluitman, F., & Dar, A. (2000). *Vocational education and training reform: Matching skills to markets and budgets.* **Geneva, Switzerland: International Labor Office.**

This book builds on the 1991 policy paper on Vocational Education and Training (VET) published by the Work Bank in conjunction with the International Labour Office (ILO). The four-part book divides the nations included into transition economies (e.g., Hungary, Poland, Czech Republic), high-growth economies (e.g., China, Indonesia, Malaysia), low-growth economies (e.g., South Africa, Tanzania, Jordan), and two special studies (Australia and Germany). Each chapter focuses on an individual nation and examines entities such as education and VET finance, enrollment in vocational and education programs, organization and management of vocational and educational programs, wage data, distribution of the working population, employment status, labor force profiles, government roles, and issues surround system reform.

Gill, M.E. (1972). *Matching the qualifications to the job semi professionals.* **Cave Hill, West Indies: University of the West Indies.**

Green, H. (1987). Matching people to jobs: An expert system approach. *Personnel Management, 19(9)***, 42-45.**

Heflich, D. L. (1981). Matching people and jobs: Value systems and employee selection. *Personnel Administrator, 26*(3)**, 77-85.**

When deciding whether or not to hire an applicant, most manager do an adequate job of assessing the prospective employee's education, skills and experience, which are usually easy to obtain and verify. The problem area involves dimensions that are more difficult to assess. A person's beliefs, assumptions, ways of coping with tasks, responsibility training, other people, and physical conditions all affect whether or not the candidate will be successful in a particular job. The key to improving the matching process is for interviewers to develop their capacity to assess these dimensions, which we all call value systems. Rather than hire in their own image, interviewers should hire people whose value systems are appropriate to the particular jobs.

Human resources: How to strike a perfect match. (1988). *Business Software Review, 7*(6)**, 11-12.**

The Occupational Skills Analysis System (OSAS) is a job placement, job match and task analysis system designed to eliminate guesswork involved in getting jobs for personnel and getting personnel for jobs. It is used by businesses, vocational centers and state governments to perform that function. The system was created by Educational Data Systems, Inc. (EDSI) in Dearborn, Michigan and targeted human resource professionals, employee placement and staff directors, training directors and vocational and technical educations however the program filtered out into state governments as well as research firms. The program features a data base that includes 220 common

occupations and allows the user to assess job skills, analyze jobs, assist in dislocated worker programs, identify skill deficiencies, match people to jobs, transfer skills to new occupations and track and develop resumes. OSAS is also utilized as a tool for counseling individuals who are making occupational decisions. In addition, Kennedy Research, a research firm focusing on labor market information, uses the program to research the labor market for other companies. Kennedy Research uses OSAS to develop reports and design labor market information systems for a variety of organizations including education institutions and commercial real estate developers. The individuals who utilize the program attest OSAS is a very helpful, user-friendly tool that manages job evaluation and job analyses information effectively.

Leach, S. (2002). *A supported employment workbook: Using individual profiling and job matching.* **London: Jessica Kingsley.**

Lightfoot, M. A., & Ramsberger, P. F. (2000, August). *Matching soldiers to jobs: The Enlisted Allocation System (EPAS)***. U.S. Army Research Institute.**

This U.S. Army Institute (ARI) special report on the EPAS presents the history and current status of the Army's enlisted personnel selection and classification system. It is written for policy makers, managers, and human resources personnel. The report includes a discussion of theoretical and practical aspects of selection and classification testing in the context of Army operations dating back to World War I. EPAS, the optimal person-job-matching software developed by the ARI, is described along with its potential to improve the effectiveness of the Army's classification system.

Lynch, B. (1987). Job matching by computer. *Best's Review (Prop/Casualty), 87***(12), 84, 86.**

Maurice, S. J. (1990). Matching people and jobs. *Executive Excellence, 7***(5), 15-17.**

Mayer, L. L. (2000). Annotated Bibliography of Topics in Forensic Vocational Knowledge and Applications Related to the 1998 3rd Edition ABVE Examination. *Journal of Forensic Vocational Assessment, 3***(1), 15-22.**

This particular bibliography has been updated and sectionalized to cover basic knowledge areas that are apropos to the 3rd edition of the ABVE certifying examination. Areas noted are Measurement Reference and Research Tools; Expert Testimony foundations: Vocational Assessment, VE Testimony, Research and Precedent-Setting Cases, Expert Witness Qualifications and Testimony; Selected Government or government-Related References; Psychological Assessment, Achievement, and Aptitude; Specialized Resources: Testing and Rating Guides, Pain Measurement, Computerized Job-Person Matching Systems and Related Tools Used to Evaluate Cases for Social Security, Workers Compensation,, Personal Injury, General Disability, Wrongful Death, Divorce and Similar Types of Cases; Pain Assessment and Measurement, Selected Computerized Job-Person Matching, Labor Market Access and Pre/Post Injury Earning Capacity Prediction.

McCall, B. P. (1988). *Occupational matching: A test of sorts***. Princeton Industrial Relations Section Working Paper, 237.**

This paper develops a model of occupational matching where, within an occupation, information at one job may be useful for predicting the match at other jobs. Recent developments in the theory of super processes are used to derive the optimal sampling policy that predicts that those currently working their second job within an occupation are less likely to separate from this job then those working their first job. Also, this difference should increase with tenure in the previous job since, for those with long tenures, it is more likely that occupational sorting has taken place. These predictions are tested using weekly tenure data from the National Longitudinal Survey: Youth cohort. Controlling for unobserved heterogeneity and employing semi-parametric estimation techniques, it is found that one's previous job tenure significantly lowers the likelihood of leaving the current job only if both jobs are of the same occupation. However, overall, occupational switchers are more likely to leave the current job if the tenure in the previous job is greater than one year. Similar results are found for job quitters when the data is analyzed using a competing risks framework.

Melendez, E., & Harrison, B. (1998). Matching the disadvantaged to job opportunities: Structural explanations for past successes of the center of employment training. *Economic Development Quarterly, 12*(1), 3-11.

Illustrates the case study conducted by the Center for Employment Training (CET) to explain for the success of employment training and workforce *development* programs in matching disadvantaged populations to job opportunities. Importance of social networks to the design of training programs; Discussion of various studies made about this subject.

Mondy, R. W., Noe, R. M., & Edwards, R. E. (1987). Successful recruitment: Matching sources and methods. *Personnel, 64*(9), 42-46.

This article outlines the recruitment process, including utilization of internal and external resources, and provides examples of how three unique firms find the best sources and methods for recruiting. A firm's future is no better than the quality of people who make up the organization. The effectiveness of employee selection depends on the number and quality of available applicants. An appropriate number of alternatives must exist for the manager to make the correct hiring decision. Each organization is unique in many ways; the types and qualifications of workers needed to fill various positions vary. To ensure that the best possible people seek employment with a firm, whether it's large or small, recruitment sources and methods must be carefully matched. Human resource (HR) recruiters must be able to locate potential employees and persuade individuals at the targeted sources to apply to the firm.

Rubin, S. S. (1993). *Job matching in supported employment: Variables related to transitional planning for students with moderate and severe disabilities***. In T. Dais,(1993). (Vol Ed.), Selected readings in transition: Vol. 2. Cultural differences, chronic illness, and job matching.**

Smith, T. E., & Zenou, Y. (2001). *A discrete-time stochastic model of job-matching.* **London: Centre for Economic Policy Research.**

In this Paper, an explicit micro scenario is developed which yields a well-defined aggregate job-matching function. In particular, a stochastic model of job-matching behavior is constructed in which the system steady state is shown to be approximated by an exponential-type matching function, as the population becomes large. This steady-state approximation is first derived for fixed levels of both wages and search intensities, where it is shown (without using a free-entry condition) that there exists a unique equilibrium. It is then shown that if job searchers are allowed to choose their search intensities optimally, then this model is again consistent with a unique steady state. Finally, the assumption of a fixed wage is relaxed, and an optimal 'offer wage' is derived for employers.

Sommers, P., & Heg, D. (2000). *Matching community and technical college professional/ technical education capacity to employer demand.* **Seattle, WA: Northwest Policy Center.**

This project provides the Washington State community/technical college system with an improved occupational forecasting system so that it can do a better and faster job of meeting employer training/education needs. The system has two parts: the first matches long term occupational forecast data from the Employment Security Department with education program completion numbers to identify occupations where demand is not being met (or where oversupply exists). The second part of the forecasting system verifies this information through extensive interviews with local employers, preferably using college faculty or staff as a means of building longer term relationships with area firms. These interviews collect detailed and up to date labor market information about occupational demand, wages, skill requirements, hiring processes, and preferred forms of training/education that enable the colleges to tailor programs responsive to current employer needs.

Uffelman, E. (1995). **Empowering students: An effective job matching strategy.** *Journal for Vocational Special Needs Education, 17*(3), 123-125.

When students with severe disabilities are of high school age, the primary focus of their education should be on the transition from school to work. Appropriate education at the high school level must encompass life-career development and transition education (Clark & Kolstoe, 1993). One vehicle commonly used in preparing for transition is job training. In many high school settings for student with disabilities, job training becomes the focus of individual education plan goals and objectives (Wehman, Moon, Everson, Wood, & Barcus, 1988). Typically, in monitoring students' progress, data are collected on specific elements of their job performance. However, one key element is often overlooked when collecting data on students on the job site: job preference assessment (Snell, 1993). Assessment of student preference may provide the bridge that connects a student to a long-term job match.

Van Ours, J. C. (1994). **Matching unemployed and vacancies at the public employment office.** *Empirical Economics, 19*(1), 37-54.

Public employment offices match job seekers and vacancies. The effectiveness of this matching process depends on the way these offices handle the job vacancies. This article studies the matching process by analyzing the effect of different mediation methods on the duration of job vacancies. The results suggest that intensive mediation reduces average vacancy duration, indicating that public employment offices can improve the matching process.

Vandenberg, R. J. (1990). The matching model: An examination of the processes underlying realistic job previews. *Journal of Applied Psychology, 75*(1), 60-67.

Using information systems and data processing personnel in 9 major insurance companies, this research assessed the validity of J. P. Wanous's (1980) matching model as a framework of the processes linking realistic job previews (RJPs) to employee adjustment and employment stability. Because the matching model is an adaptation of the Theory of Work Adjustment (TWA), this study also assessed the TWA's applicability to RJP and turnover research. Structural equation methodology tested the fit of the matching model to the data of newcomers and of more tenured employees. Also, two-group structural analysis was performed to determine differences between groups. Support for the matching model was obtained with newcomer data but not with data from tenured employees. Results also supported the applicability of the TWA to RJP and turnover research. Implications of the findings to work adjustment and RJP research are discussed.

Williams, J. M. (1998). Transferability of skills methodologies used in computerized matching systems: Sufficient or insufficient control of methodologically induced error variance? *Journal of Forensic Vocational Assessment, 1*(3), 29-41.

This article focuses on the reasons for differences that sometimes occur in the results of transferability-of-skills computer software when such software is provided with identical search criteria. The article also addresses the implications the differences may have with regard to the use of the software as the basis for scientific expert opinions given in civil and administrative law hearings. Included within this article are quotations from representatives of the Department of Labor commenting on the correct methodology to be employed in a transferability of skills analysis.

Wong, D. W., Chan, F., Gay, D. A., Ho, C., & Hattori, K. (1992). Toward the development of a second generation computerized job-matching system for persons with disabilities: A conceptual framework. *Journal of Rehabilitation, 58*(1), 70-77.

Recently, rehabilitation researchers have identified a number of problems with the current Dictionary of Occupational Titles (DOT) based computerized job-matching systems. These DOT based systems tend to utilize a straight-line search and employ rigid cut off scores in job selection for people with disabilities. This method provides profiles without considering the adaptability of individual clients and the possibilities of job modification and accommodation. Consequently, these systems do not take advantage of the wealth of knowledge developed by experienced rehabilitation professionals over years of clinical practice. Most of these systems are overly

concerned with the "person-job requirement fit" aspects and basically overlook the "person-job environment fit" needs. As an alternative, this paper presents a conceptual framework for developing a second-generation computerized job-matching system. Utilizing some common elements from the current literature on artificial intelligence, the authors conceptualized the development of a knowledge-based (expert) job-matching system capable of reasoning, making decisions as would a vocational expert, learning from cumulative job matching experience, and handling ambiguous data commonly found in real live job-matching situations. The conceptualized system uses a "fuzzy set" of mechanisms to maximize the amount of information available for a successful job search.

Yuan, Y., & Kochen, M. (1987). Matching support systems: Information systems for supporting matching processes. *Human Systems Management, 7*(2), 129-141.

Guidelines and principles for the design of information systems to support general matching processes are presented. These are based on a new model of matching processes and an analysis of key decision issues. Thus, a fruitful new avenue of inquiry into assignment problems that do not assume perfect information by match participants is opened.

Zeidner, J., Scholarios, D., & Johnson, C. D. (2001). Classification techniques for person-job matching: An illustration using the US Army. *Kybernetes: The International Journal of Systems & Cybernetics, 30*(7/8), 984-1005.

This paper presents the case for personnel systems based on maximizing the differential information gathered about individual abilities and their match to jobs. In the context of assignment to multiple jobs, such systems are shown to be more effective than those based on the currently dominant paradigm of maximizing predictive validity. The latter paradigm favors the measurement of general cognitive ability over multiple specific aptitudes. Recent differential approaches use computer simulation modeling of alternative hypothetical systems to evaluate potential efficiency. The paper reviews the theoretical background on the structure of human abilities that has led to these contrasting approaches to personnel system design, and presents evidence, based on the US Army selection and classification system, in support of the alternative approach. Individual test/aptitude profiles improve the efficiency of personnel selection and classification as well as academic, vocational and career counseling. They also provide a broader, potentially fairer definition of talent than a unidimensional indicator of cognitive ability, and a foundation for the design of learning and decision environments around learner and user profiles.

Vocational Evaluation

Vocational evaluation helps to determine the skill level of individuals relative to the physical and psychosocial demands of work. This section identifies and analyzes evaluation tools and methods that determine the functional working capacity.

Andresen, E. M. (2000). Criteria for assessing the tools of disability outcomes research. *Archives of Physical Medicine and Rehabilitation, 81*(12*)*, 15-20.

> To recommend instrument assessment criteria, deriving from psychometric textbooks and articles and disability and research experts, for reviewing and assessing surveys and questionnaires for disability outcomes research. Traditional criteria are recommended, including psychometric properties of validity, reliability, and sensitivity to change, as are newer statistical methods for assessing scaling properties, such as Rasch analysis. Special consideration is needed for generic instruments that may be poorly scaled for disability research. Pragmatic aspects of data collection, including acceptability and disability accommodation, are also recommended.

Avolio, B. J., & Waldman, D. A. (1990). An examination of age and cognitive test performance across job complexity and occupational types. *Journal of Applied Psychology, 75*(1), 43-50.

> In this study, job complexity and occupational type were examined as potential moderators of the relationship between age and cognitive ability. Data included general, verbal, and numerical ability scores for 21,646 individuals in the General Aptitude Test Battery (GATB) database. These individuals comprised 102 unique samples and 10 major occupational groups. Differences in the relationship between age and cognitive ability test scores were observed across occupational types but not for different levels of job complexity. Findings were discussed in terms of a need for research that examines specific life and work experiences and how such experiences may influence an individual's cognitive abilities across the life span.

Bemis, S. E., Bonner, R. L., Kearney, T., & Goppold von Lobsdorf, K. (1974). The new occupational aptitude pattern structure for the GATB. *Vocational Guidance Quarterly, 22 (3)*, 189-194.

> Describes the final developmental work and the resulting structure of the new occupational aptitude scales of the General Aptitude Test Battery (GATB). The primary goal was to develop a rationale for relating occupational aptitude patterns to worker trait groups. The new structure is comprehensive from the standpoint of using available research data because 90% of the specific occupational batteries are included. The structure is limiting, however, from the standpoint of reference to all occupations in the economy. Reports from counselors using the new structure have been favorable.

Bemis, S. E. (1971). Use of aptitude scores as predictors of success in occupational training under the MDTA. *Journal of Employment Counseling, 8*(1), 11-18.

> Summarizes results from studies utilizing the general aptitude test battery to predict success in specific vocational training programs authorized by the 1962 manpower development and training act. Over 1,200 trainees from a number of states in a variety of occupational areas were involved. Trainees from all included studies were combined and then subgrouped on the basis of number of years of formal education claimed. Good prediction was obtained for the 0-7, 8, 9, 10, 11, and 12 years-of-education

groupings. The prediction obtained with the 13-16 years-of-education grouping is not at an acceptable level of significance, but this may be a result of the small sample available for this grouping. Results are seen as supporting manpower administration efforts to devise ways in which aptitude tests can be used to help match applicants with low levels of reported educational attainment with suitable vocational or training opportunities.

Bemis, S. E. (1968). Occupational validity of the General Aptitude Test Battery. *Journal of Applied Psychology, 52*(3), 240-244.

Summarizes 20 years of occupational validation on the General Aptitude Test Battery (GATB) in terms of average validity with job proficiency and training criteria, and concurrent and longitudinal studies. These 4 categories are studies from the standpoint of single and multiaptitude prediction. The relative efficiency of many of the 9 GATB aptitudes in predicting criteria is dependent on whether job proficiency or training criteria are used. Longitudinal studies tend to have higher-aptitude criterion correlations than concurrent. The median validity of batteries of GATB aptitudes tends to be higher with studies using training criteria or the longitudinal design than job-proficiency criteria or the concurrent design. The summary is based upon 424 studies involving over 25,000 employees, applicants, trainees, and students.

Botterbusch, K. F. (1978). *Psychological testing in vocational evaluation***. US; Wisconsin, 101.**

The purpose of this publication is to help the evaluator wisely select and use tests within the context of the referral questions and the individualized evaluation plan. Part I will contain information on why tests are used in evaluation, problems with tests, and how to select tests. Part II is a careful review of specific tests that either have been found to be successfully within vocation evaluation or have this potential. The types of tests included in Part II are achievement batteries and reading tests (e.g., Adult Basic Learning Examination), character and personality (e.g., Edwards Personality Inventory), intelligence (e.g., Peabody Picture Vocabulary Test), multi-aptitude batteries (e.g., Differential Aptitude Test), vocations-clerical (e.g., General Clerical Test), vocations-interests (e.g., AAMD-Becker Reading-Free Vocational Interest Inventory), vocations-manual dexterity (e.g., Crawford Small Parts Dexterity Test), and vocations-mechanical ability (e.g., Bennett Mechanical Comprehension Test).

Botterbusch, K. F. (1983). *Short-term vocational evaluation***. Menomonie, WI: Department of Rehabilitation & Manpower, Materials Development Center, Stout Vocational Rehabilitation Institute.**

This publication describes how to plan and conduct a thorough vocational evaluation within a one-week time period. No magic processes and no shortcuts are involved in this procedure. Rather, each evaluator must carefully plan how to best answer the client's referral questions by using the most appropriate assessment techniques. Thus, the theme of this publication is careful planning with flexibility. The first part of the monograph contains planning strategies and an example of their use. The second part is

a detailed description of the three model programs that evaluate clients in one week or less. One caution is necessary. While most clients can be accurately evaluated in a shorter time period than formerly believed possible, some severely disabled persons, and especially those without a significant work history, may require additional time.

Botterbusch, K. F., & Michael, N. L. (1985). *Testing and test modification in vocational evaluation***. Menomonie, WI: Department of Rehabilitation & Manpower, Materials Development Center, Stout Vocational Rehabilitation Institute.**

This publication contains three major sections: Part I presents general information on testing, their selection, and use within evaluation programs. Part II discusses the modification of tests for 3 special disability groups: visually disabled, hearing impaired, and mentally retarded. Part III reviews tests commonly used in evaluation including the following types: achievement, aptitude, intelligence, interest, work attitude and behavior, and dexterity. Information about each individual test under the previous types includes the purpose, subtests, test format, administration, scoring, norms, reliability and validity, population specified, skills needed, usefulness with individuals who are blind, deaf, or mentally retarded, possible modifications to adapt the test to individuals who are blind, deaf, or mentally retarded, subjective comments, and ordering information.

Davison, M. L., Gasser, M., & Ding, S. (1996). Identifying major profile patterns in a population: An exploratory study of WAIS and GATB patterns. *Psychological Assessment, 8*(1), 26.

Profile analysis via multidimensional scaling (PAMS) is described. It is a technique for studying the most prominent profiles of a battery of measures in a given population. Results of PAMS are reported for 2 well-known test batteries: the Wechsler Adult Intelligence Scale--Revised and the General Aptitude Test Battery. For each inventory, the profiles found in the PAMS analysis are discussed in light of major profiles used in the interpretation of that inventory. Finally, methodological features of the PAMS approach are discussed.

Drasgow, F., & Olson-Buchanan, J. B. (1999). *Innovations in computerized assessment***. Mahwah, NJ: Lawrence Erlbaum.**

For professionals in educational measurement, psychometrics, and I/O psychology. Computerized assessment offers many opportunities for innovations in measurement. In contrast to static paper-and-pencil instruments, computerized assessment can capitalize on the dynamic capabilities of the computer. For example, the difficulty of administered items can be adopted to the ability of the examinee, thus eliminating items that are too hard or too easy. Multimedia computers provide the opportunity to revolutionize assessment. Stereo sound, animation, and full-motion video can be incorporated into assessment tools and aid in the measurement of individual differences ranging from musical skills to interpersonal abilities. *Innovations in Computerized Assessment* presents the experiences of leading researchers in computerized assessment. The book places particular emphasis on the dilemmas that were faced by the researchers. Questions addressed include: What problems did they confront? What were the pros and cons of various options? How were dilemmas resolved? Were the solutions

good ones?

Droege, R. C. (1967). Effects of aptitude-score adjustments by age curves on prediction of job performance. *Journal of Applied Psychology, 51*(2), 181-186.

A study to determine the relative validity of unadjusted and age-adjusted General Aptitude Test Battery (GATB) aptitude scores for predicting occupational success. Eleven longitudinal occupational validation studies, conducted on samples varying in size from 56 to 124 cases, were selected for the analysis. For each sample the validities of unadjusted and age-adjusted aptitude scores for predicting occupational success were compared for the 9 GATB aptitude measures. Differences between validities tended to be small.

Field, T. F. (1979). VDARE: The vocational diagnosis and assessment of residual employability. *Vocational Evaluation and Work Adjustment Bulletin, 12*(3), 28-29.

According to the developers, the VDARE Process was designed as a tool for vocational professionals to use in translating client case data into meaningful terms that can in turn be used to accurately predict functional vocational potential. Initial research with the process suggests that it has utility beyond vocational rehabilitation settings including guidance and counseling services in schools and personnel screening in business and industry. The foundation of the VDARE Process is job analysis. The defined variables and measurement scales of job analysis provide the vocationally-meaningful terminology into which client data are translated. The VDARE Process user must have a functional understanding of job analysis and the *Dictionary of Occupational Titles* (DOT). The validity of VDARE rests on the validity of the database with which it is used.

Field, T. F. (1993). *Strategies for the rehabilitation consultant*. **Athens, GA: Elliott & Fitzpatrick.**

Field, T. F., Choppa, T., & Shafer, L. K. (1984). *Labor market access*. **Athens, GA: VSB.**

Labor Market Access (LMA) establishes a system by which a vocational expert can objectively show an individual's loss of access to the local labor market generally. The ability of an individual to procure employment is an important consideration in loss of earning capacity and industrial disability. The LMA process presumes a working knowledge of the Vocational Diagnosis and Assessment of Residual Employability (VDARE) process (1982), as well as the Dictionary of Occupational Titles (1977, 1982). LMA is a method of adding objectivity to the work of the vocational expert. The process requires a knowledge of the local labor market and a broad knowledge of work in general.

Grimley, C. P., Williams, J. M., Hahn, S. J., & Dennis, K. (2000). A scientific approach to transferable skills. *Journal of Forensic Vocational Assessment, 3*(1), 47-54.

The McCroskey Transferable Skills Program (MTSP 2000) Transferable Skills Percent (TSP) scale was found to be a valid predictor of the average responses of 93 vocational experts tested using the ABVE Transferable Skills Evaluation Test instrument. The predictive validity coefficient between the MTSP 2000 TSP rankings and the criterion-reference prediction estates of the vocational experts (N=93) was extremely high (RXY + 0.96). Correspondingly, the coefficient of determination (R2 = 0.92) was extremely high. Finally, the standard error of estimate (SEE = 0.357) was found to be very reasonable.

Hattori, K., & Chan F. (1989). Determining vocational levels of people with disabilities in Japan: A statistical prediction approach. *The Journal of Rehabilitation, 55*(3), 56.

The purpose of this paper was to determine the appropriateness of statistical techniques in predicting vocational placement levels of people with physical disabilities in Japan. Two hundred and fifty-three rehabilitation clients were administered the Japanese version of the General Aptitude Test Battery (GATB) and the Wechsler Adult Intelligence Test (WAIS). The data were analyzed by multiple discriminant analysis using GATB and WAIS scores as predictors and actual vocational placement levels as criterion. Using the discriminant function derived, 79.5% of the clients in the validation sample were accurately classified, representing a significant improvement over the base rate prediction of 62.2%. It can be concluded that predicting formulas are moderately successful in predicting work performance levels of people with disabilities. Also, a substantive interpretation of the discriminant function suggested the existence of different vocational ability requirements for different vocational placement levels. Implications for vocational evaluation were discussed.

Johansson, B. H. (1999). Serious shortages of working capacity evaluation. [Article in Swedish]. *Lakartidningen, 96*(35), 3641-3644, 3646.

Makowiec-Dabrowska, T., Sprusinska, E., Bazylewicz-Walczak, B., Radwan-Wlodarczyk, Z., & Koszada-Wlodarczyk, W. (2000). Ability to work: New approach to evaluation methods. [Article in Polish]. *Medycyna pracy, 51*(4), 319-33.

In Poland, the assessment of work ability has thus far been almost entirely objective, which means that it was based on the evaluation of the individual's health state. That is why a subjective method of work ability assessment with work ability index (WAI), developed by the Occupational Health Institute in Helsinki, was used in our present study. This method allows to indicate other possible factors which modify work ability. The study covered 189 men employed in five metallurgical plants, located in the region of Lodz. In the study population, WAI and workload on the basis of the expenditure of energy were measured, the health condition was evaluated, and information on life styles and non-occupational responsibilities was gathered. It was found that WAI values were inversely proportional to age and workload. They were also modified by individual characteristics, such as life style, body mass, and activities at leisure. It was found that the correlation between the general index of work ability and the objective health indicators was low with the concomitant considerably higher correlation with the

values of the components that reflect subjective work abilities. In view of the results obtained, WAI can be recommended as a tool for assessing work ability. Due to this method it is possible to present conclusively all elements of individual characteristics and to identify at the same time links with working conditions.

Malinskii, D. M., & Dyskin, A. A. (1980). Complex evaluation of occupational work capacity. [Article in Russian]. *Gigiena truda i professional'nye zabolevaniia, 12*, 48-50.

Malzahn, D. E., Fernandez, J. E., & Kattel, B. P. (1996). Design-oriented functional capacity evaluation: the available motions inventory. [Review]. *Disability and Rehabilitation, 18*(8), 382-95.

The accommodation of a task to the unique abilities of an individual with a disability is becoming increasingly the responsibility of the employer. Functional capacity evaluation (FCE) provides the information necessary for rational design decisions when modifying work stations. The currently used FCE systems have been designed to assess an individual's performance for a range of reasons other than industrial task accommodation. The Available Motions Inventory (AMI) is a system that has been developed specifically to address the design issues raised when accommodating an industrial task to a person with a neuromuscular impairment. This system has a unique scoring system that allows intra-individual ability comparisons that support task allocation decisions. Some general principles of task design are developed for persons with cerebral palsy, but the strength of assessment lies in its application to a specific individual performing a specific task.

Mazanec, D. J. (1996). The injured worker: Assessing "return-to-work" status. *Cleveland Clinic Journal of Medicine, 63*(3), 166-71.

In workers injured on the job, the physical findings tell only part of the story. Physicians must also consider psychological, economic, social, and legal factors when performing a return-to-work assessment.

McCroskey, B. J., Streater, S. E., Wattenbarger, W. E., Feldbaum, C., & Dennis, K. (1997). Analyzing employability using worker trait factors: Past, present and future. *The Journal of Forensic Vocational Assessment, 1*(1), 3-39.

The evolution of vocational assessment and worker-trait factor technologies is reviewed, as well as the conclusions to be drawn regarding vocational. Indices of import to vocational experts, from its origins to it current state including the proliferation of software programs based on worker-trait factor methods. Organized historically and by topic, the article presents VDARE as the precursor model from which subsequent systems have emerged. Included is a rare history of the published research and landmark presentations contributing to the reawakening of worker-trait-factor methodology in light of recent innovations in computer technology. The article concludes with a call for vocational experts to join in the research and refinement of an empirically valid worker-trait factor methodology predictive of wage earning capacity and various measures of employment potential.

Menard, M., & Gorman, D. (2000). Work capacity evaluation. *New Zealand Medical Journal, 113*(1115), 335.

Miller, A. M. (1984). Vocational evaluations. *Florida Bar Journal, 58*(1), 49-52.

Muche, R., Rosch, M., Flierl, S., Alt, B., Jacobi, E., & Gaus, W. (2000). Development and validation of a prognosis model for predicting work capacity after rehabilitation based on routinely collected parameters. [Article in German]. *Rehabilitation (Stuttg), 39*(5), 262-2677.

For efficient rehabilitation it is important to identify, as early as possible, the patients likely to be successfully returned to work after rehabilitation. The aim of this pilot study was to develop a statistical model for predicting this return as reliably as possible. The model uses only information readily available at the beginning of rehabilitation. A multiple regression analysis with backward elimination was used from a routine data base and identified 8 variables of prognostic value. The model offers a comfortable possibility to predict the probability of return to work of a patient on the basis of routinely registered data. The prognosis was found correct in 68% of those returning to work after rehabilitation (sensitivity) and in 80% of those who did not (specificity). Further work to improve the model for prognosis in rehabilitation research is considered reasonable.

Prozonic, D. B., Kosciulek, J. F., & Linda, A. (1995). On the congruence of evaluation, training, and placement. *The Journal of Rehabilitation, 61*(4), 20.

The purpose of this study was to assess the congruence between vocational evaluation job recommendations, vocational skills training, and jobs obtained by vocational rehabilitation (VR) clients. Subjects were 78 former clients of one state rehabilitation agency who had received vocational evaluations, participated in training, and were closed successfully rehabilitated (status 26) during fiscal year (FY) 1993. Results suggest low to moderate rates of congruence between evaluation, training, and placement. Implications for VR service provision and suggestions for future research are discussed.

Randolph, D. C. (2000). Use of functional employment testing to facilitate safe job placement. *Occupational Medicine, 15*(4), 813-21.

Functional testing has evolved to a new sophistication, and is currently used in a variety of situations to assist the employer and physician in safely placing an individual at the job site. The functional capacity evaluation can be employed in several ways, not only to place individuals safely in jobs, but also to monitor their progress throughout recovery from an injury or illness and aid in the establishment of vocational counseling and planning. Many legal issues now alter employer techniques for hiring and assigning people to jobs. This state of affairs places increasing importance on functional testing.

Roessler, R. T., & Rubin, S. E. (1982). *Case management and rehabilitation counseling.* Baltimore: University: Park Press.

Rusiak, I. G., Leshchinskii, L. A., Farkhutdinov, A. F., Logacheva, I. V., Ponomarev, S. B., & Sufiianov, V. G. (1999). Mathematical model for prognostication of work capacity recovery in patients with myocardial infarct. [Article in Russian]. *Meditsinskaia tekhnika, 4***, 6-10.**

> The impact of clinical and instrumental findings on prognosis was evaluated in patients with myocardial infarction and a mathematical model was proposed to predict their recovered working ability. The developed predictive index for prediction of recovered working ability is of high informative value and accuracy. It may be practically used by a cardiologist to choose a protocol of medical and rehabilitative measures in myocardial infarction.

Sheikh, K. (1987). Occupational injury, chronic low back pain and return to work. *Public Health, 101***, 417-425.**

Skoien, D. Report reveals worker motivation, commitment, skills. Retrieved on April 1, 2002 from http://www.ipma-hr.org/public/federal_template.cfm?ID=64

> Workers are largely unmotivated, unrecognized and unrewarded, according to the results of a recent survey by Kepner-Tregoe, Inc. The report entitled "People and Their Jobs: What's Real, What's Rhetoric," examines the structure of organizations to determine how effectively their employees are motivated and managed in order to facilitate success within the organization.

Sobush, D. C., Kuhne, K., & Harbers, T. (1985). Resources for vocational planning applied to the job title of physical therapist. *Physical Therapy, 65***(10), 1524-1528.**

> Industrial rehabilitation is a rapidly developing area of health care. As a result, physical therapists need to become functionally familiar with common vocational planning processes and resources. Therefore, the purpose of this article is to describe a process called Vocational Diagnosis and Assessment of Residual Employability (VDARE), which is based on the Dictionary of Occupational Titles (DOT) and Classification of Jobs (COJ) resources. We have provided the DOT and COJ classifications for the job title of PHYSICAL THERAPIST as an example of their terminology. A critique of the DOT and COJ, applied to several occupational examples, suggests these resources be used with supplemental task analyses for a given job. The physical therapist, however, can use the VDARE process and the DOT and COJ resources to identify specific and achievable job targets for clients rather than relying solely on traditional trial and error, on-the-job evaluation.

Stein, D. B. (2002). *The scientific method is the standard for vocational evaluation and vocational expert testimony***. Paper presented at the 2002 International Association of Rehabilitation Professionals.**

> Ever since the United States Supreme Court decisions in the cases of *Daubert v. Merrell Dow Pharmaceuticals* (No. 113 S. Ct. 2786, 1993), *General Electric Company v. Joiner* (No. 94-9131, 1996) and *Carmichael v. Kumho Tire* (*No. 97–1709*, 1999)

regarding the admissibility of expert testimony, controversy has been disparate among *Vocational Experts (VEs)* regarding what is and is not an acceptable methodology for assessment in vocational evaluation. This includes such issues as individual employability, wage earning capacity, transferability of job skills and other important vocational issues. While debate among *VEs* has had wide variance between *scientific* and *non-scientific* methods, the US Supreme Court decisions were not ambiguous: *The Scientific Method is the Standard for Vocational Evaluation and Vocational Expert Testimony.*

Strauser, D. R., & Ketz, K. (2002). The relationship between self-efficacy, locus of control and work personality. *Journal of Rehabilitation, 68*(1), 20-26.

The purpose of this study was to examine Hershenson's theory of work adjustment by examining the relationship between work personality and work competencies. Specifically, this study examined the theoretical link and the reciprocal effect between the domains of work personality and work competencies. Participants included 104 job placement service recipients in a large Southern urban area. Findings showed that higher levels of work personality predicted an internal locus of control and higher job-related self-efficacy. The number of jobs a personal had held was correlated with work personality and work persistence was correlated with education. Findings also indicated that individuals whose parents/guardians worked while they were growing up had more internalized locus of control. Results are discussed in light of current literature.

U.S. Department of Labor Employment and Training Administration. (1999, March). *Testing and assessment: An employer's guide to good practices*.

In today's competitive marketplace and complex legal environment, employers face the challenge of attracting, developing, and retaining the best employees. Michael Eisner, CEO of the Disney Corporation, recognized the impact of personnel decisions on a business' bottom-line when he remarked, "My inventory goes home every night." This guide is to help managers and human resource professionals use assessment practices that are the right choices for reaching their organizations' human resource goals. It conveys the essential concepts of employment testing in easy-to-understand terms so that managers and human resource professionals can: 1) evaluate and select assessment tools/procedure that maximize chances for getting the right fit between jobs and employees 2) administer and score assessment tools that are the most efficient and effective for their particular needs 3) interpret assessment results in an accurate manner 4) understand the professional and legal standards to be followed when conducting personnel assessment.

Velozo, C. A. (1993). Work evaluations: Critique of the state of the art of functional assessment of work. *American Journal of Occupational Therapy, 47*(3), 203-209.

The area of work evaluation is fertile ground for future research and development by occupational therapists. Current evaluations of work range from standardized work evaluations associated with vocational rehabilitation to highly technical physical capacity and work capacity instrumentation and equipment often associated with sports medicine. In addition, methods used to identify pain and abnormal illness behavior ad

the psychosocial component of work evaluation. The limitations of most of the traditional approaches to work evaluations are their lack of focus on the actual work environments and on the meaning of work to persons. Occupational therapy can play an important and unique role in linking work evaluations to psychosocial and environmental variables and in formulating comprehensive theoretical models of work that should improve and refine present work evaluations.

Weinberg, J. (1995). Understanding the limitations of vocational tests. *The Pennsylvania Nurse, 50, 23.*

Williams, B. (1999). Vocational assessment: Evaluating multi-cultural consumers with disabilities. *Journal of Forensic Vocational Assessment, 2*(1), 39-52.

The demographics of the United States are changing and vocational evaluators are assessing more consumers who identify themselves as being of minority status. If current trends hold and demographic projections pan out, with the next 20 years individuals who identify themselves as being members of a minority group will become the statistical majority of the U.S. population. Vocational evaluators, indeed all rehabilitation professionals, must closely examine these trends and develop an understanding of how diverse cultural beliefs and values may impact their vocational evaluation process. The level of acculturation identification, language fluency of the consumer and the biases inherent in standardized test are typically the most pervasive challenges encountered by vocational evaluators. Despite these challenges, it is the vocational evaluator's task to understand and work with cultural diversity rather than against it. Although initially more time consuming ad expensive, thorough and accurate multicultural vocational evaluations are both more efficacious and economical in the long-run. This article discusses the problematic issues in the vocational evaluation of consumers to identify themselves as being of minority status as well as possible solutions and recommendations for future practice.

Wyman, D. O. (1999). Evaluating patients for return to work. *American Family Physician, 59*(4), 844-848.

The family physician is often instrumental in the process of returning a patient to the workplace after injury or illness. Initially, the physician must gain an understanding of the job's demands through detailed discussions with the patient, the patient's work supervisor or the occupational medicine staff at the patient's place of employment. Other helpful sources of information include job demand analysis evaluations and the Dictionary of Occupational Titles. With an adequate knowledge of job requirements and patient limitations, the physician should document specific workplace restrictions, ensuring a safe and progressive reentry to work. Occupational rehabilitation programs such as work hardening may be prescribed, if necessary. If the physician is unsure of the patient's status, a functional capacity evaluation should be considered. The family physician should also be familiar with the Americans with Disabilities Act as it applies to the patient's "fitness" to perform the "essential tasks" of the patient's job.

Changing Nature of the Work Environment

Workplace demands encompass not only physical and cognitive abilities, but also psychosocial and emotional strains created on the job. This section investigates the extent to which these psychosocial and emotional factors affect the overall job demand and identifies methods and tools used to analyze their existence in the workplace including the individual's ability to adapt or cope with these factors.

Bose, J. L., Lam, C S., Geist, G. O., & Chan, F. (1991). Occupational information in social security disability cases: A follow-up. *Rehabilitation Counseling Bulletin, 34*(3), 274-282.

Surveyed 668 manufacturing and service industries to determine existence of sedentary and light unskilled jobs. More light than sedentary jobs were found to exist but the availability of each was minimal. Results support the conclusion by J. L. Bose et al (1986) that the Social Security Administration should refrain from using the Dictionary of Occupational Titles and its supplements in its decision-making regarding sedentary work and extends this conclusion to light jobs.

Brown, L., Halpern, A. S., Hasazi, S. B., & Wehman, P. (1987). From school to adult living: A forum on issues and trends. [An interview with Lou Brown, Andrew S. Halpern, Susan Brody Hasazi and Paul Wehman. Interview by Gary M. Clark and H. Earle Knowlton]. *Exceptional Children, 53*(6), 546-554.

This article presents a forum for the personal views of four significant contributors to the conceptualization and implementation of transition programming as it exists in this country today. These individuals were selected from among a number of active contributors to the transition movement as representative spokespersons for the field. The questions posed by the guest editors were developed from ideas and concerns that surfaced in the many manuscripts submitted for consideration in this special issue. Some of the issues raised in the questions reflect concerns expressed openly by professionals in the field, while others were inferred from more subtle or cautious statements. Each contributor received a set of questions to address. Each question was given to at least two contributors. They were encouraged to respond not only to their own set, but to any question of interest contained in other contributors' sets as well. As a result, a few questions were addressed by all four contributors. Their responses appear to reflect some consensus regarding the importance of the issues and trends suggested in the questions. Even so, the substance of their responses reflects a range of positions that would provoke keen consideration by readers.

Cheng, Y., Guo, Y. L., & Yeh, W. Y. (2001). A national survey of psychosocial job stressors and their implications for health among working people in Taiwan. *International Archives of Occupational Environmental Health, 74*(7), 495-504.

OBJECTIVES: The prevalence of job stress, distributions of major job stressors, and the associations of job stress with multiple self-reported health complaints were examined in a national survey conducted in 1994 in Taiwan. METHODS: A total of 9,746 men and 5,599 women who were employed at the time of the survey and aged between 25 and 65-years were studied. Information on employment status, perceived level of job stress, major job stressors, and health complaints were obtained by a self-administered questionnaire. RESULTS: Overall, 7.6% of men and 6.5% of women reported often or always feeling very stressed at work. Higher levels of perceived job stress were found among subjects who were younger, with higher education level, working in a larger firm, working for longer hours per week, and who were administrators or managers. Problems with individual job content were ranked as the most important job stressor in men across all employment categories and in most women. Other major job stressors included problems with monetary rewards and lack of career prospects. The patterns of major job stressors appear to vary by employment grade and by gender. After adjustment for age and education, employees who perceived higher levels of job stress had significantly increased risks of multiple health problems, including strained eyes, ringing ears, chronic cough with phlegm, chest tightness, stomach problems, headache, and musculoskeletal discomfort. CONCLUSIONS: These results suggest that psychosocial stress in the workplace has profound impacts on health. This study identified high-risk groups and major types of job stressors for further investigation.

Dane, D., Feuerstein, M., Huang, G. D., Dimberg, L., Ali, D., & Lincoln, A. (2002). Measurement properties of a self-report index of ergonomic exposures for use in an office work environment. *Journal of Occupational Environmental Medicine, 44*(1), **73-81.**

Office work-related upper extremity symptoms and disorders have been associated with static work posture, repetition, and inadequate recovery in the anatomic structures of the neck and upper extremities. Despite these associations, relatively little research has been conducted on the development of practical measures of these ergonomic exposures. The present study examines the measurement properties of an upper-extremity-specific self-report index of ergonomic exposures. Ninety-two symptomatic office workers completed a Web-based questionnaire measuring demographic variables, ergonomic exposures, pain, job stress, and functional limitations. Comparisons of internal consistency, construct validity, and discriminative and predictive abilities were made between the self-report index and an observational exposure assessment checklist. Results indicated that the self-report index had acceptable measurement properties. Furthermore, higher levels of self-reported ergonomic exposures were associated with upper extremity pain, symptom severity, and functional limitations. In contrast, higher levels of observed exposure were related only to lower levels of general physical function. The self-report measure has potential for use in occupational health surveillance programs for office work environments and as an outcome measure of ergonomic exposure in intervention trials. These results also suggest the need for using multiple methods when assessing ergonomic exposures.

Hogan, J. (1998). *Personality and job performance*, **11**(2,3). **Mahwah, NJ: Erlbaum.**

Professionals in human factors, industrial/organizational psychology, and applied psychology. The papers contained in this special issue of Human Performance present the current ideas of researchers who have led the revival of personality assessment in industrial-organizational psychology. Contents: J. Hogan, Introduction. R. Hogan, D. Shelton, A Socioanalytic Perspective on Job Performance. M.K. Mount, M.R. Barrick, G.L. Stewart, Five-Factor Model of Personality and Performance in Jobs Involving Interpersonal Interaction. T.A. Judge, A. Erez, J.E. Bono, The Power of Being Positive: The Relationship Between Positive Self-Concept and Job Performance. J. Hogan, S.L. Rybicki, S.J. Motowidlo, W.C. Borman, Relations Between Contextual Performance, Personality, and Occupational Advancement. L.M. Hough, Effects of Intentional Distortion in Personality Measurement and Evaluation of Suggested Palliatives. D.S. Ones, C. Viswesvaran, The Effects of Social Desirability and Faking on Personality and Integrity Assessment for Personnel Selection. J.F. Salgado, Big Five Personality Dimensions and Job Performance in Army and Civil Occupations: A European Perspective. H. Mabon, Utility Aspects of Personality and Performance.

Hurrell, J. J., Nelson, D. L., & Simmons, B. L. (1998). Measuring job stressors and strains: Where we have been, where we are, and where we need to go. *Journal of Occupational Health and Psychology, 3(4)*, **368-389.**

This article examines assessment approaches and specific measures used by job-stress researchers to characterize aspects of work and the working environment (potential job stressors) and workers' reactions to these working conditions (strains). Self-report instruments, observational approaches, and physiological indicators are described. Problematic areas (e.g., the use of overlapping stressor and strain measures) and contemporary issues affecting job stress assessment (e.g., negative affectivity) are discussed. Recommendations regarding instrument selection and measurement improvements are offered. It is concluded that closer attention to measurement-related issues is critical to the advancement of knowledge in the field. Important needs include the identification and more frequent use of objective measures, the increased use of triangulation strategies, and a careful examination of the adequacy of existing constructs and measures for capturing the demands of contemporary work.

Karasek, R., Brisson, C., Kawakami, N., Houtman, I., Bongers, P., & Amick, B. (1998). The Job Content Questionnaire (JCQ): An instrument for internationally comparative assessments of psychosocial job characteristics. *Journal of Occupational Health and Psychology, 3*(4), **322-355.**

Part I discusses the Job Content Questionnaire (JCQ), designed to measure scales assessing psychological demands, decision latitude, social support, physical demands, and job insecurity. Part II describes the reliability of the JCQ scales in a cross-national context using 10,288 men and 6,313 women from 6 studies conducted in 4 countries. Substantial similarity in means, standard deviations, and correlations among the scales, and in correlations between scales and demographic variables, is found for both men and women in all studies. Reliability is good for most scales. Results suggest that

psychological job characteristics are more similar across national boundaries than across occupations.

Lees-Haley, P. R. (1990). Vocational neuropsychological requirements of U.S. occupations. *Perceptual and Motor Skills, 70*(3), 1383-1386.

Aptitude levels required to perform occupations listed in the U.S. Department of Labor Dictionary of Occupational Titles are indicated. Numbers and percentages of jobs requiring each level of each aptitude are presented in a tabular format. These data can be useful in assisting vocational neuropsychologists in evaluating brain-injury disability cases.

Lerner, D., Amick, B. C., Rogers, W. H., Malspeis, S., Bungay, K., & Cynn, D. (2001). The Work Limitations Questionnaire. *Medical Care, 39*(1), 72-85.

OBJECTIVE. The objective of this work was to develop a psychometrically sound questionnaire for measuring the on-the-job impact of chronic health problems and/or treatment ("work limitations"). RESEARCH DESIGN. Three pilot studies (focus groups, cognitive interviews, and an alternate forms test) generated candidate items, dimensions, and response scales. Two field trials tested the psychometric performance of the questionnaire (studies 1 and 2). To test recall error, study 1 subjects were randomly assigned to 2 different questionnaire groups, a questionnaire with a 4-week reporting period completed once or a 2-week version completed twice. Responses were compared with data from concurrent work limitation diaries (the gold standard). To test construct validity, we compared questionnaire scores of patients with those of healthy job-matched control subjects. Study 2 was a cross-sectional mail survey testing scale reliability and construct validity. SUBJECTS. The study subjects were employed individuals (18–64 years of age) from several chronic condition groups (study 1, n 5 48; study 2, n 5 121) and, in study 1, 17 healthy matched control subjects. MEASURES. Study 1 included the assigned questionnaires and weekly diaries. Study 2 included the new questionnaire, SF-36, and work productivity loss items. RESULTS. In study 1, questionnaire responses were consistent with diary data but were most highly correlated with the most recent week. Patients had significantly higher (worse) limitation scores than control subjects. In study 2, 4 scales from a 25-item questionnaire achieved Cronbach alphas of >0.90 and correlated with health status and self-reported work productivity in the hypothesized manner (P <0.05). CONCLUSIONS. With 25 items, 4 dimensions (limitations handling time, physical, mental/interpersonal, and output demands), and a 2-week reporting period, the Work Limitations Questionnaire demonstrated high reliability and validity.

Mayer, L. L. (1998). The U.S. Labor Force: Present and future status and implications. *Journal of Forensic Vocational Assessment, 1*(2), 51-89.

This article frames the implications of technological advancement vis a vis the American labor market. Taking note of shifts and trends in employment, the author offers scenarios and data relative to the U.S. labor market, its recent status, and implications for the future of work and workers. Statistical data of the various group

participants in the world of work are presented inclusive of gender, race, age and disability. Additionally, within the framework of this article, general limitations and implications of data that are encountered in many of the resources unutilized for projecting labor market scenarios are presented.

Muller, C. (1986). Health and health care of employed adults: Occupation and gender. *Women Health, 11*(1), 27-45.

This paper reports on a study of health and health care of employed women and men that used the National Health Interview Survey of 1975-1977 as the data source. Materials from the Dictionary of Occupational Titles and other government sources were used to develop scales for psychosocial and physical health features of individual occupations. Multiple regressions were then used to study the relation of occupational factors and gender along with family factors, to health status, chronic limitations, and use of physician and hospital services. The study shows a correlation of the jobs that are more complex and challenging and offer more autonomy with better health status. The current job structure shows more variation in psychological level of occupations than in physical healthiness; women are concentrated in the less desirable occupations. The study also examines gender differences in illness-day measures and health care utilization in 36 occupations with substantial employment of both sexes, and finds considerable variability among occupations in the extent of gender differences.

Muntaner, C., & Schoenbach, C. (1994). Psychosocial work environment and health in U.S. metropolitan areas: A test of the demand-control and demand-control-support models. *International Journal of Health Services, 24*(2), 337-53.

The authors use confirmatory factor analysis to investigate the psychosocial dimensions of work environments relevant to health outcomes, in a representative sample of five U.S. metropolitan areas. Through an aggregated inference system, scales from Schwartz and associates' job scoring system and from the Dictionary of Occupational Titles (DOT) were employed to examine two alternative models: the demand-control model of Karasek and Theorell and Johnson's demand-control-support model. Confirmatory factor analysis was used to test the two models. The two multidimensional models yielded better fits than an unstructured model. After allowing for the measurement error variance due to the method of assessment (Schwartz and associates' system or DOT), both models yielded acceptable goodness-of-fit indices, but the fit of the demand-control-support model was significantly better. Overall these results indicate that the dimensions of Control (substantive complexity of work, skill discretion, decision authority), Demands (physical exertion, physical demands and hazards), and Social Support (coworker and supervisor social supports) provide an acceptable account of the psychosocial dimensions of work associated with health outcomes.

Ostry, A. S., Marion, S. A., Demers, P. A., Hershler, R., Kelly, S., Teschke, K., & Hertzman, C. (2001). Measuring psychosocial job strain with the job content

questionnaire using experienced job evaluators. *American Journal of Ind Med, 39*(4), 397-401.

BACKGROUND: A union/ management system of job evaluation has been in place in the British Columbia (BC) sawmill industry since the late 1960s. This system uses an instrument, very similar to the job content questionnaire (JCQ) to evaluate psychosocial work conditions for sawmill jobs. METHODS: Four experienced evaluators, one from the union and three from industry, independently estimated psychosocial work conditions for 54 current job titles in a "typical" coastal sawmill using a shortened, 18-question version of the JCQ questionnaire. RESULTS: Inter-rater reliability was acceptable for control but not for co-worker social support, physical demand, or psychological demand. Reliability was least for psychological demand. CONCLUSIONS: Experienced job evaluators in the sawmill industry were able to reliably estimate only the control dimension of the JCQ. The observed lowest reliability for psychological job demand may be due to the imprecise construct definition in the domain of the JCQ instrument.

Ostry, A. S., Marion, S. A., Demers, P. A., Hershler, R., Kelly, S., Teschke, K., Mustard, C., & Hertzman, C. (2001). Comparison of expert-rater methods for assessing psychosocial job strain. *Scandinavian Journal of Work and Environmental Health, 27*(1), 70-75.

OBJECTIVES: This study tested the reliability and validity of industry- and mill-level expert methods for measuring psychosocial work conditions in British Columbia sawmills using the demand-control model. METHODS: In the industry-level method 4 sawmill job evaluators estimated psychosocial work conditions at a generic sawmill. In the mill-level method panels of experienced sawmill workers estimated psychosocial work conditions at 3 sawmills. Scores for psychosocial work conditions were developed using both expert methods and applied to job titles in a sawmill worker database containing self-reported health status and heart disease. The interrater reliability and the concurrent and predictive validity of the expert rater methods were assessed. RESULTS: The interrater reliability and concurrent reliability were higher for the mill-level method than for the industry-level method. For all the psychosocial variables the reliability for the mill-level method was greater than 0.90. The predictive validity results were inconclusive. CONCLUSIONS: The greater reliability and concurrent validity of the mill-level method indicates that panels of experienced workers should be considered as potential experts in future studies measuring psychosocial work conditions.

Pope, D. P., Silman, A. J., Cherry, N. M., Pritchard, C., & Macfarlane, G.J. (1998). Validity of a self-completed questionnaire measuring the physical demands of work. *Scandinavian Journal of Work and Environmental Health, 24*(5), 376-385.

OBJECTIVES: This study determined the accuracy of workers in quantifying occupational physical demands on a self-administered questionnaire. METHODS: First, a self-administered questionnaire on work postures, manual materials-handling, and repetitive upper-limb movements was validated using direct simultaneous observations for 123 randomly selected employees from 6 occupational settings. Second, weight estimation accuracy was assessed on visual analogue scales for 6 manual materials-handling activities using 20 randomly selected employees from 1 occupational setting. RESULTS: At a dichotomous level (ever-never), the accuracy of most of the self-reported physical demands was good (sensitivity 60-100%; specificity 56-100%). A more-detailed analysis of the dimensions studied (frequency, duration and amplitude) also showed that the accuracy of the self-reported estimates was satisfactory. Full agreement between the estimated and observed frequency was >60% for most of the manual materials-handling activities. In addition the average difference between the estimated and observed duration of the physical demands was found to be small. Finally the average difference between the self-reported and actual weights of various loads was found to be modest. CONCLUSIONS: The self-reported questionnaire used in this study would provide a useful instrument for estimating occupational physical demands and the frequency, duration, and amplitude of these demands in future epidemiologic studies associated with musculoskeletal pain.

Quick, J. C. (1998). Introduction to the measurement of stress at work. *Journal of Occupational Health and Psychology, 3*(4), 291-293.

This article introduces a special section on the measurement of stress in occupational and work environments. It discusses stress as a creatively ambiguous term that, nonetheless, has important medical, behavioral, and psychological health consequences for people at work as well as away from work. The article discusses the importance of multiple medical and psychological measures for occupational stress assessments and offers an abbreviated conceptual framework for such measures. The 5 articles and 1 commentary that compose the section are briefly introduced.

Ryzhov, A. I., Kremleva, T. G., & Stepanenkova, N. P. (1994). Physiologic characteristics of work capacity using models of nervous and high tension job. [Article in Russian]. *Meditsina truda i promyshlennaia ekologiia, 11*, 27-29.

The experiments enabled to design a physiologic curve showing sensorimotor performance and therefore functional state of the examinees' central nervous system in all periods of performing the tasks. Considering correlations between the periods and phases, quantitative analysis of the curve defines physiologic features and mechanisms underlying performance changes during work associated with mental strain.

Vagg, P. R., & Spielberger, C. D. (1998). Occupational stress: Measuring job pressure and organizational support in the workplace. *Journal of Occupational Health and Psychology, 3*(4), 294-305.

Person-environment fit and demand-control theoretical models developed to explain stress and strain in the workplace have guided the construction of most measures of occupational stress. The strengths and limitations of 8 job stress measures are briefly reviewed, and the Job Stress Survey (JSS), designed to assess the severity and frequency of occurrence of 30 specific sources of occupational stress, is described in some detail. Factor analyses of responses to the JSS items identified Job Pressure and Lack of Organizational Support as major dimensions of occupational stress for male and female employees in a wide variety of work settings. JSS Index, scale, subscale, and item scores assess general and specific aspects of the work environment that are most distressing for individual workers and that adversely affect groups of employees.

Widerszal-Bazyl, M., & Cieslak, R. (2000). Monitoring psychosocial stress at work: Development of the Psychosocial Working Conditions Questionnaire. *International Journal of Occupational Safety and Ergonomics*, 59-70.

Many studies on the impact of psychosocial working conditions on health prove that psychosocial stress at work is an important risk factor endangering workers' health. Thus it should be constantly monitored like other work hazards. The paper presents a newly developed instrument for stress monitoring called the Psychosocial Working Conditions Questionnaire (PWC). Its structure is based on Robert Karasek's model of job stress (Karasek, 1979; Karasek & Theorell, 1990). It consists of 3 main scales Job Demands, Job Control, Social Support and 2 additional scales adapted from the Occupational Stress Questionnaire (Elo, Leppanen, Lindstrom, & Ropponen, 1992), Well-Being and Desired Changes. The study of 8 occupational groups (bank and insurance specialists, middle medical personnel, construction workers, shop assistants, government and self-government administration officers, computer scientists, public transport drivers, teachers, N = 3,669) indicates that PWC has satisfactory psychometrics parameters. Norms for the 8 groups were developed.

World Health Organization. (1993). Aging and working capacity. *World Health Organization Technical Report Series, 835*, 1-49.

Explores the large number of factors that influence both the health of aging workers and their performance on the job. Citing global demographic trends that point to an increasingly aged workforce, the report emphasizes specific measures that can help prevent a premature decline in work capacity and thus contribute to economic productivity. Fundamental questions considered include the nature of age-related changes in mental and physical abilities and the extent to which these changes are compatible with work demands. Factors that can help protect workers against disability

are also considered. The opening section reviews what is known about age-related changes that may impair performance and thus call for adjustments in either the workplace or the assignment of responsibilities and job tasks. Changes considered include a decline in muscular, cardiovascular, and respiratory functions and in vision and hearing. Readers are also reminded of certain areas in which older workers continue to perform at a very high level. Other sections summarize data on the health problems of aging workers and discuss different working conditions of special concern to older workers. Stressful work environments, such as shiftwork and conditions of heat and cold, are considered in a separate section, which concentrates on differences in the adaptive capacity of younger and older workers. The remaining sections outline different health promotion strategies for aging workers and describe measures that can support work capacity as workers age.

Appendix C:

ANNOTATED BIBLIOGRAPHY

Introduction

The Social Security Administration uses the Dictionary of Occupational Titles (DOT) and its companion volume, Selected Characteristics of Occupations, as a primary source in the sequential evaluation of disability determinations. Because the Department of Labor (DOL) discontinued the DOT and replaced it with the Occupational Information Network (O*NET), a transition from DOT to O*NET would result in major changes in how SSA evaluates disability cases at Steps 4 and 5 of the sequential evaluation process. SSA is concerned that the way in which occupations are aggregated with O*NET will result in a loss of specificity that is needed in its disability decision process. The DOT contains over 12,000 job titles; some of these no longer exist in the national economy while other jobs have evolved and are not included in the DOT. The O*NET taxonomy clusters nearly 9,500 DOT job titles into approximately 900 occupational units (OUs). Many of the OUs contain a large, heterogeneous mix of jobs with a wide range of requirements. About 50 of the more than 200 O*NET occupational demand descriptors are relevant to the medical-vocational process. Unfortunately, the manner in which the descriptors were developed and measured limits ready adoption for disability determinations. SSA is concerned about the extent to which the descriptors validly and accurately reflect the type and level of functioning required in an occupation. Also, it is uncertain how or if adjudicators could use the descriptors reliably to assess claimants' ability to perform work.

Given these concerns, this deliverable of the Job Demands project is designed to help SSA investigate recent research regarding non-medical factors SSA applies in its medical-vocational assessment. The results of this project could help SSA develop a range of options for policy changes. The prospect of losing the DOT along with problems regarding the use of O*NET have significant legal and program impact for SSA. The literature analyzed here will be used in this project to develop methodologies that could describe job demands for SSA's disability determination needs.

Establishing the demands of jobs for the Social Security Administration requires a detailed understanding of a large and diverse literature. Functional assessment, vocational rehabilitation, and job analysis are salient components to consider in the development of these demands. These components need to be viewed in the context of today's changing work environment, the legal arena, and with special awareness of the needs of persons with disabilities.

This document provides an overview of relevant literature to facilitate the development of the process and eventual criteria leading to the identification of key job demands. The range of

references was honed to provide a succinct and current overview of the most important issues. The literature reflects the diverse expertise required to understand job demands, garnering its strength from Industrial/Organizational Psychology, Medicine, Law, Policy, Disabilities Studies, Mental Health, Rehabilitation Counseling, and Vocational Rehabilitation. The intent of the following bibliography is to provide a foundation upon which to root future deliverables for the project entitled "Job Demands."

This literature review is structured to reflect the topics that are relevant to the scope of work in this proposal. The major headings are: (1) The changing nature of the work environment, (2) Defining human performance, (3) Describing job demands, (4) Methods of identifying and validating job demands, and (5) Current applications. Searches were undertaken using online databases including CINAHL, PubMed, PsycINFO, ArticleFirst, NARIC, and ERIC. The search terms included: career guidance, disability, employment, employment forecasting, functional assessment, job analysis, job standards, occupational demands, residual functional capacity, and work. Criteria for selecting the articles included in this review were both theoretical and pragmatic. They were as follows:

- The article must provide clear evidence that it relates in a compelling and immediate way to job demands.

- If there were many articles on a particular area of job demands, not all have been included as the aim is to provide a comprehensive review rather than an exhaustive list of all articles.

- Articles that are current and relevant to jobs in the modern economy (mostly from the mid 1980s forward) unless the article is considered seminal in the field.

- Articles that could be easily accessed or were publicly available.

1. THE CHANGING NATURE OF THE WORK ENVIRONMENT

The references contained in this section review the environmental, organizational, and content of work resulting from the shift of focus within the work environment from manufacturing to service through the last century (Johnston, 1987). Concomitantly, as the century drew to a close, the legal aspects of work, particularly for those with disabilities, gained enhanced visibility as the Americans with Disabilities Act began to be applied, pursuing equal rights under the law for people with disabilities. This act also caused a shift in the work environment; its provision included the "guarantee that all test and assessment devices be valid for all examinees" (Fisher, 1994). These changes contributed to a new context for assessment, rehabilitation, placement, and employment for individuals with disabilities (National Research Council, 1999).

Danek, M. M, Conyers, L. M., Enright, M. S., Munson, M., Brodwin, M., Hanley-Maxwell, C., & Gugerty, J. (1996). Legislation concerning career counseling and job placement for people with disabilities. In E.M. Szymanski & R.M. Parker (Eds.). *Work and disability: Issues and strategies in career development and job placement.* **Austin, TX: Pro-Ed.**

Chapter Three: This chapter reviews how legislation impacts on vocational rehabilitation counseling and job placement for people with disabilities. Although it is somewhat dated, it provides a useful overview of the Americans with Disabilities Act of 1990 (ADA), Social Security work incentives, the Job Training Partnership Act, Veterans vocational rehabilitation, and workers' compensation. The intent is to focus on those with disabilities and how such pieces of legislation impact their ability to work.

Fischer, R. J. (1994). The Americans with Disabilities Act: Implications for measurement. *Educational Measurement: Issues and Practice, 13*(3), 17-26.

This article reviews the Americans with Disabilities Act (ADA), guidelines for employers to use when seeking to act within the compliance process, and the implications for the field of rehabilitation counseling. The author recommends that employers demonstrate a good faith effort, patience, common sense and a true need to assist those with disabilities. The ADA sets forth parameters that require that all tests and assessment devices be valid for all examinees. The author also recommends that all modifications be implemented. Such implementation may require a great deal of time and expense given the fact that adapting testing procedures and tests to fit any disability may not be simple or inexpensive. Furthering the need for time and considerations is that all disabilities do not require the same type of testing adaptations, and all adaptations do not fit all types of disabilities. The author points out that the intent of the ADA is to guarantee that workers with disabilities are given equal rights under the law. The author concludes that there are no simple answers to these issues and no set standards that employers have to follow to achieve equality for people with disabilities. This article provides a helpful background.

Harvey, R. J. (1991). The Americans with Disabilities Act: Using job analysis to meet new challenges. Paper presented at IIPMAAC Conference, Baltimore, MD.

The intent of this paper was to provide personnel specialists with an overview of the Americans with Disabilities Act (ADA) and a description of the implications. Harvey asserts that accommodations within job analysis was beyond the scope of traditional job analysis and that it would take the judicial system to clearly demarcate the implications in this area. Nonetheless, the results of job analysis will form the basis for setting specifications that may result in the denial or acceptance of employment opportunity for disabled job applicants. This paper states that the need for each item on the job analysis instrument to be verifiable is paramount.

Judy, R. W. & D'Amico, C. (1997). *Workforce 2020: Work and workers in the 21st century*. **Indianapolis, IN: Hudson Institute.**

This book represents an update of the text produced ten years ago by Hudson Institute. The first study demonstrated the changing demographics of the American workforce and identified a gap between the skills likely to be required for entry-level jobs and the skills that new workers would have on entry to the workforce. The study examined how the face of the work force will gradually become older, more female, and more disadvantaged, and that the new jobs in service industries will require much higher skill levels than current jobs. This revised version looks at forces that impact the economy and workforce. The book also examines how the global economy will impact the US workforce, how technology is changing work, and how education, training, and employment services need to change in order to effectively prepare workers for jobs in the new workplace. The purpose of this document is to furnish the basic intelligence on the job market that can be used in evaluating current public policies and in undertaking new policy initiatives.

National Research Counsel. (1999). *The changing nature of work: Implications for occupational analysis*. **Washington DC: National Academy Press.**

Although this project was initiated by the Department of the Army, it is a review of civilian approaches to job analysis taking into account how employment has changed for the workforce. Themes

throughout the study are: the changing demographics of the workforce and the changing organization of work leading to changes in what kinds of personnel perform what tasks. In particular, this report reviews existing approaches to job analysis, what they are, and how they might fit in this changing work environment. They conclude that further research is needed about changes in the images of work and occupations, more study is needed into what it is workers actually do, and that there is a need for a national database on work.

Ryan, C. P. (1995) Work isn't what it used to be: Implications, recommendations, and strategies for vocational rehabilitation. *Journal of Rehabilitation, 61*(4), 8-15.

This article discusses how the nature of work is rapidly changing and what the implications are for the delivery of vocational rehabilitation services. Factors such as technology, global economy, population trends, and characteristics of post-industrial work are reviewed. The author outlines the skills needed for the labor force of the twenty-first century and a summary of thirteen work trends. Implications and recommendations are presented for both vocational rehabilitation service delivery and vocational counseling and guidance.

DEFINING HUMAN PERFORMANCE

The following literature reviews functional assessment within a broad context of vocational assessment. Fleishman (1982, 1984) sets the theoretical framework for functional assessment with his in-depth work on taxonomies of human performance and classification of those taxonomies. Abdel-Moty and colleagues (1996) state that functional capacity testing encompasses statistical, procedural, behavioral, technological, as well as legal issues that are frequently addressed in the literature. In fact, the field is continually reevaluating assessment tools to ensure reliability and validity (Clark, 1988). Regardless, predictive ability of these tools in this area is inconsistent. For example, Fishbain (1999) found some limited predictive ability with DOT – RFC for chronic low back pain, but Mather (1993) warns that assessment of people with disabilities requires special approaches. Despite the awareness of the need for validity, reliability, and consideration for special circumstances, Matheson and colleagues (2000) point out that the American Medical Association's *Guides to the Evaluation of Permanent Impairment* is "the most widely used set of procedures for rating permanent medical impairments" even though the *Guides*' authors did not intend for the *Guides* to be used as impairment ratings for disability determination. Thus, the universal use of the *Guides* is negated by the unintended use affecting the validity of the measures.

In addition, this section also addresses the measurement of functional status more broadly as it relates to human performance in general (both underlying capacity and functional status). There is a long tradition of considering the issues and problems related to measuring human performance; this section samples some of these writings.

Vocational Evaluation

Abdel-Moty, E., Compton, R., Steel-Rosomoff, R., Rosomoff, H. L., & Khalil, T. M. (1996). Process analysis of functional capacity assessment. *Journal of Back and Musculoskeletal Rehabilitation, 6*, 223-236.

Academic and clinical communities have placed much emphasis on what constitutes a functional capacity assessment (FCA) battery. This article reports on the issues surrounding this type of human performance evaluation. Concerns revolve around the accurate description of the FCA process to

determine whether the objective of the test was to evaluate functional abilities, support the use of multiple measures, ensure sufficient statistical power of the FCA, and to assure that client-centered issues are not occurring including secondary gain, fatigue, depression, pain, or psychological factors. Additionally, the article supports the role of a trained professional in designing, performing, and analyzing the FCA. These authors believe that each component of the FCA process is as important as the actual testing; awareness of these issues is key in the performance of an FCA.

Cathey, M. A., Wolfe, F., & Kleinheksel, S. M. (1988). Functional ability and work status in patients with fibromyalgia. *Arthritis Care and Research, 1*, 85-98.

This study sought to investigate the kind and amount of work tasks that fibromyalgia (FB) patients could do, as well as document the ability of an established disability instrument to predict work performance. The authors examined 28 fibromyalgia patients during the performance of 5 standardized work tasks, and compared their performance to 26 rheumatoid arthritis (RA) patients and 11 healthy controls. The patients with FB patients performed 58.6% and RA patients 62.1% of the work done by controls. The authors found that work performance was strongly associated with pretest scores on the disability scale of the Stanford Health Assessment Questionnaire, but also with pain, global severity, and psychological status in both RA and FB groups. Further investigation of results reviewed work status in 176 FB patients was also examined. 60% were employed, 9.6% considered themselves disabled, but only 6.2% received disability payments (none for the specific diagnosis of FB). Twenty-nine percent of patients had changed jobs because of their condition. This data show that the fibromyalgia patients had significant impairment in their ability to perform work tasks when compared normal controls.

Chan, F., Torkelson-Lynch, R., Dial, J. G., Wong, D. W., & Kates, D. (1993). Applications of the McCarron-Dial system in vocational evaluation: An overview of its operational framework and empirical findings. *Vocational Evaluation and Work Adjustment Bulletin, 26*, 57-65.

This paper provides an overview of the McCarron-Dial System (MDS) and its uses as a tool to predict vocational and independent living for people with disabilities. The MDS, introduced in 1973, is one of the most widely validated vocational evaluation systems in the field of rehabilitation. This system is based on a neuropsychological model and Functional System Theory that view the brain as being comprised of functional systems that mediate all behavior, including work-related behaviors. The system provides an assessment of the three major constructs of behavior (Verbal-Spatial-Cognitive, Sensory-Motor, and Emotional-Coping). The article references the more than 20 years of research conducted on this instrument demonstrating its validity (factorial and concurrent). Even the abbreviated version evidences high predictive validity. In conclusion, the authors state that while the MDS is a validated vocational tool, further work is needed to demonstrate its effectiveness for people with neuropsychological disabilities.

Clark, W. L., Haldeman, S., & Johnson, P. (1988). Back impairment and disability determination: Another attempt at objective, reliable rating. *Spine, 13*, 332-341.

This paper outlines a new impairment schedule that has been developed based on a comprehensive review of the medical literature and from expert opinions of back specialists. The authors believe that current disability evaluation schedules for the low back are not scientifically based and produce large inter-examiner differences. Piloting of the new schedule showed a marked decrease in inter-examiner differences compared to the prior California disability rating schedule. The goal of the new disability rating system is to create a system that is more objective, more scientifically valid, and more consistent, thereby, decreasing litigation.

Colledge, A. L., Johns, Jr., R. E., & Thomas, M. H. (1999) Functional ability assessment: Guidelines for the workplace. *Journal of Occupational & Environmental Medicine, 41,* 172-180.

Discusses how the ADA impacts the certification process for short and long-term disability. The authors purpose a uniform methodology for physicians and employers to determine the performance capabilities of individuals with disabilities based on the terminology of essential job functions. The authors suggest that physicians should document fitness-for-duty using an established, objective measure such as the Workplace Functional Ability Guidelines (WFAGs). The WFAGs format is reviewed and examples of report forms are provided.

Droege, R. C., & Padgett, A. (1979). Development of an interest-oriented occupational classification System. *The Vocational Guidance Quarterly, 27,* **303-311.**

The U.S. Employment Service (USES) in 1977 developed a link between the psychological measurement of employees and occupational classifications. This allowed them to use the new Guide for Occupational Exploration as a supplement to the Dictionary of Occupational Titles. This article outlines the steps that they took to develop a tool that relates measurable capabilities, interests and adaptabilities of individuals to the requirements of occupational groups.

Fishbain, D. A., Cutler, R. B., Rosomoff, H., Khalil, T., Abdel-Moty, E., & Steele-Rosomoff, R. (1999). Validity of the Dictionary of Occupational Titles Residual Functional Capacity Battery. *The Clinical Journal of Pain, 15,* **102-110.**

The purpose of this study was to determine whether the results of a DOT-RFC battery performed at completion of a pain treatment predicted employment status at 10 month follow-up, and if the DOT-RFC battery predicted employment capacity of chronic pain patients' (CPPs). Employment status and the DOT occupational levels were primary outcome measures for a sample of 185 consecutive CPP's who completed a DOT-RFC battery at discharge from a pain facility treatment. Patients were contacted at 1, 3, 6, 12, 18, 24, and 30 months for determination of their employment status and DOT employment level. Eight DOT job factors plus pain and worker compensation status were significantly different between employed and unemployed CPPs and between those employed in different DOT employment levels. Stepwise discriminant analysis was used to identify the final predictor variables. Sensitivity and specificity were calculated along with pain level cut points that separated the groups. The authors found that the eight DOT job factors found to be statistically significant between groups were stooping, climbing, balancing, crouching, feeling shapes, handling left and right, carrying, and pain and worker compensation status. Discriminant analysis variables could differentiate between the employed and unemployed categories, with a sensitivity and specificity of approximately 75%. The pain level cut point between employed and unemployed was 5.5 on a 10-point scale. The DOT-RFC employment levels could not be predicted, but some DOT-RFC battery job factors demonstrate predictive validity.

Fishbain, D. A., Abdel-Moty, E. A., Cutler, R., Khalil, T. M., Sadek, S., Rosomoff, R. S., & Rosomoff, H. L. (1994). Measuring residual functional capacity in chronic low back pain patients based on the Dictionary of Occupational Titles. *Spine, 19,* **872-880.**

This paper reports the development and piloting of a functional battery based on the DOT to measure residual functional capacity in chronic low back pain patients. Outcome included results of the Residual Functional Capacity battery based on the degree of medical impairment. Physicians have difficulty in estimating functional limitations and establishing residual functional capacity. This battery was tested on 67 consecutive chronic pain patients to determine if they could perform DOT job factors and had the necessary RFC to be placed in a DOT job. DOT categories were divided into occupational categories as sedentary, light, medium, heavy or very heavy. This study found that the majority of patients with chronic pain could not pass the full battery. In fact, the presence of pain and original job classification predicted whether the individual could perform a job factor at all.

Geyer, P. D., Johnson, V. A., & Hunter, J. E. (1998). Empowering career decision-making: A practical strategy for using occupational information. *Journal of Rehabilitation, 64*(4), 23-27.

Meeting the challenges of the current work environment requires reliable, accurate and current occupational information. These authors hold that the DOT analysis, which is widely used and easy to access, does not provide the needed information. This article reviews a tactic to take full advantage of the most effective and efficient use of the DOT. The authors state that despite the lack of currency, the DOT is "far too valuable of a tool to set aside or refuse to use." Therefore they propose using the standard error of measurement (SEM) coefficient to construct error bands around an estimate DOT occupational rating. The authors suggest this procedure facilitates the determination of a range of values for a characteristic. By using the error bands, the counselor can use the DOT with the SEM adjustments to allow the continued use of the DOT for case management.

Gottfredson, L. S. (1986). Occupational Aptitude Patterns map: Development and implications for a theory of job aptitude requirements. *Journal of Vocational Behavior, 29*, 254-291.

This paper presented an aptitude-based, occupational classification. It was created from the United States Employment Service's Occupational Aptitude Pattern (OAP) Work Groups into a smaller number of clusters to identifying the aptitudes that are the most predictive of good job performance and to determine the minimum levels of those aptitudes required in different families of work. The resulting OAP map consists of 13 job clusters arranged according to major differences in overall intellectual difficulty level and in functional focus of work activities. The paper then illustrates how, when combined with previous evidence about patterns of job aptitude demands, the OAP map laid the foundation for a theory of job aptitude requirements. The author was able to support her hypotheses that general intelligence is the key variable by which aptitude demands have become organized across jobs; within the range of work types, the aptitude demands of different fields of work differ primarily in the shape of their cognitive profiles, and that different aptitude demand patterns arise in large part from variations in actual work tasks.

Klein, M. A., Wheaton, J. E., & Wilson, K. B. (1997). The career assessment of persons with disabilities: A review. *Journal of Career Assessment, 5*(2), 203-211.

This purpose of this article is to present a comprehensive career assessment model for persons with disabilities. This model includes the use of a comprehensive assessment of aptitudes, achievement, vocational interests, career maturity, and career-related, self-efficacy, in addition to vocationally relevant medical, psychological, and vocational information. The authors draw from a theoretical foundation citing numerous works on vocational assessment including vocational interests, vocational aptitudes and intelligence factors, career-related personality factors career maturity, achievement level, work evaluation, self-effacing of the career assessment of persons, and physical disabilities. The authors propose a system to utilize the theoretical information reviewed, integrated into a computerized skills program for job matching.

Lerner, D., Amick, B. C., Rogers, W. H., Malspeis, S., Bungay, K., & Cynn, D. (2001). The Work Limitations Questionnaire. *Medical Care, 39,* 72-85.

This work was conducted to create a measure of work limitations, i.e., the impact of chronic health problems on work performance. The researchers used focus groups, cognitive interviews, and an alternate forms test to identify the items and rating scales. Study subjects were working age adults with chronic conditions who were currently employed. The study found that the 25 item, 4 dimension Work Limitations Questionnaire (limitations handling time, physical, mental interpersonal, and output demands), and a 2-week reporting period, demonstrated high reliability and validity.

Mather, J. H. (1993). The problem of functional assessment: Political and economic perspectives. *American Journal of Occupational Therapy, 47*, 240-246.

This article acknowledges the political and economic approaches that have been taken to meet the needs of people with disabilities, especially workers and their dependents. The author asserts that there are no consistently agreed upon, valid and reliable approaches to functional assessment. The intent of this article is to assist occupational therapists select assessments to people with disabilities. An overview of disability classification systems, national and international programs, is provided to increase awareness of the issues and the differences between the programs. The author suggests research opportunities within the National Institute of Disability and Rehabilitation Research, the Public Health Service, and the National Center for Medical Rehabilitation Research at the National Institutes of Health. In summary, this article provides an organized presentation of policy information for clinicians.

Matheson, L. N., Gaudine, E., Mael, F., & Hesse, B. W. (2000). Improving the validity of the impairment evaluation process: A proposed theoretical framework. *Journal of Occupational Rehabilitation, 10*, 311-320.

This paper examines the American Medical Association's *Guides to the Evaluation of Permanent Impairment.* They note that there are several limitations with the guides, including that they are now currently being used as part of the disability determination process that was not a use for which the Guides were originally developed. The authors suggest that one solution to this problem might be to "adopt a model of work disability to specify the context of the Guides so that the different levels of measurement of each chapter can be explicated."

Power, P. (2000). A Guide to vocational assessment. (3rd ed.). Austin, TX: Pro-Ed. [On-line] www.proedinc.com/store

This work serves as a guide to understanding the different types of vocational assessments, particularly as they are used with clients with physical or cognitive disabilities. It is often used as a textbook for undergraduate and graduate students. The author provides general information and advice for those who work with people with disabilities. Case studies are used to illustrate points made by the author. Its recent publication allows it to provide the most up-to-date information on testing and policy.

Toeppen-Sprigg, B. (2000). Importance of job analysis with functional capacity matching in medical case management: A physician's perspective. *Work, 15*, 133-137.

This article describes how the use of a job analysis system can help facilitate matching to job demands. The author describes how job analysis increases the probability of return to regular job tasks. Job analysis assists medical case managers with return to work planning. The job analysis becomes increasingly more effective when it is matched with functional capacity testing.

Zarate, R., Liberman, R. P., Mintz, J., & Massel, H. K. (1998). Validation of a work capacity evaluation for individuals with psychiatric disorders. *Journal of Rehabilitation, 64*(4), 28-34.

The authors discuss the use of the Work Capacity Evaluation (WCE) instrument to measure the relationship between psychiatric symptoms and the capacity to perform entry-level work. The WCE is a collection of work related assembly tasks judged to be valid indicators of ability to engage in entry-level work. Social validity and construct validity of the WCE tasks are presented. The authors state that the WCE is a cost-effective tool for assessing the work capacity of individuals with psychiatric impairments.

Evaluation of Human Performance

Brandt, E. N., & Pope, A. M. (Eds.). (1997). *Enabling America: Assessing the role of rehabilitation science and engineering***. Committee on Assessing Rehabilitation Science & Engineering, Division of Health Sciences Policy, Institute of Medicine. Washington, DC: National Academy Press.**

This landmark document reflected a growing concern with the progress of research in rehabilitation and engineering sciences, and specifically with the translation of research into practice. This document reflects a concern to improve research and interventions for the increasing number of Americans who are living with chronic illness and disability. One of the major concerns was how disability is conceptualized. This report presents the enabling/disabling process, a model for explaining how a person with physical, psychological, and social impairments becomes "disabled" when interacting with environments that limit that person's ability to engage effectively in everyday activities and roles. The report points out that disability is not inherent within the person but rather results from an interaction of the individual with the environment. The report extends these ideas to broad research agendas in the areas of pathology and impairment, functional limitations, disability, and health services research.

Fisher, A. G. (1993). The assessment of IADL motor skills: An application of many-faceted Rasch analysis. *American Journal of Occupational Therapy, 47***, 319-329.**

Fisher, A. G. (1996). A study to examine the relationship of the Assessment of Motor and Process Skills (AMPS) to other tests of cognition and function. *British Journal of Occupational Therapy, 59***, 260-263.**

These are two articles from a body of literature of over fifty articles evaluating this unique approach to performance evaluation. The Assessment of Motor and Process Skills (AMPS) evaluates observable skills rather than the traditional approaches that evaluate either underlying impairment (e.g., grip strength, range of motion) or global functional status (e.g., FIM, Katz ADL, Lawton IADL). Rather than inferring how or if limitations in strength, posture, mobility and coordination translate into functional disability, clinicians can observe directly whether there are "skill" deficits that effect ADL and IADL performance. To achieve this, the AMPS consists of 16 motor and 20 process (organizational/adaptive) "skills" that form two taxonomies of observable actions that a person uses when performing a task. These skills, which can be observed in all tasks, become more challenging as the task performed becomes more difficult. These studies demonstrate that performance of a task cannot be adequately inferred from underlying capacity. For example, they demonstrated that persons with cognitive impairments, while having no demonstrable motor impairments, nonetheless had significant motor skill deficits during task performance.

Mathiowetz, N., & Wunderlich, G. (2000). *Survey measurement of work disability***. National Research Council. Washington, DC: National Academy Press.**

This study, commissioned by the Social Security Administration, is part of an ongoing effort by SSA to revise the disability determination process. The paper considers how disability can be conceptualized, methodological issues in measuring work disability (with a particular focus on sources of measurement error), the implications for research such as sampling issues, the development of appropriate questionnaires, and the role of the environment in evaluating disability.

World Health Organization. (2001). ICF: The International Classification of Impairments, Disabilities, and Health. Classification Assessment Surveys & Terminology Group. Geneva, Switzerland: WHO. www. who.int/classification/icf

This document replaces the ICIDH that for many years was one of the most widely used conceptualizations and classifications of disability. The goal of the ICF is "to provide a unified and standard language and framework for the description of health and health-related states." The ICF includes both a conceptual model of ability/disability and also an extensive classification system based on this model. Like other models, the ICF considers disability as an interaction between the person and the environment. Person-related components of the model include Functioning and Disability (body functions, structures, and impairments, and activities and participation) and Context-related factors including environmental factors and personal factors. This serves as the basic framework for the classification system that further divides each of these four components into domains; the domains are broken down to constructs, which are finally distinguished into positive and negative aspects such as functional integrity and impairment, activity limitation, and participation restriction. Concepts from the ICF have been translated into an assessment of function and disability called the WHODAS-II, which is currently in field trials.

Wunderlich, G. (1999). *Measuring functional capacity and work requirements: Summary of a workshop.* National Research Council. Washington, DC: National Academy Press.

This study, commissioned by SSA as part of an effort to revise the disability determination process, considers state of the art approaches to the measurement of functional status and how this can be utilized in the process of determining a person's capability to engage in substantial gainful employment. In considering the impact of the changing nature of work on what and how functional capacity could be measured, the study notes the lack of comprehensive data on workers with disabilities, the increasing role of cognition in worker performance, and the need to consider how disability occurs as an interaction between the person and the environment. In considering how functional capacity can be linked to work demands, the committee suggested there may be work demands that are inherent to almost all jobs but also suggested that this may result in oversimplification that makes application of such an instrument unhelpful. They also note that the disability determination process that continues to focus on disability as lying solely within the individual fails to recognize peoples' ability to adapt and the role of accommodations in enabling those with disabilities to participate in the workforce. The report also provides a thorough discussion on the desired qualities of a functional capacity measurement including establishing reliability and validity, socially acceptable, pragmatic, exhibits qualities of a real measure (including unidimensionality, equal intervals, well targeted), and is sufficiently sensitive to detect differences in performance.

DESCRIBING JOB DEMANDS

The array of literature contained in this section suggests the interconnections between functional assessment and job analysis. Specifically, building upon the foundation of work created through functional assessment, Fleishman and Reilly (1995) bridge the taxonomies of human performance to specific job tasks evidenced in job analysis. Harvey (1986) discusses the variety of job classification systems, revealing that job classification decisions underlie nearly all personnel functions. A properly performed job analysis needs to include a clear, well-written job description, an indication of how specific task measures should be evaluated, and an accurate evaluation of the job specifications (Moss, 2000; Rayson, 2000). Harvey also emphasizes the importance of identifying specific job clusters and the issues that may arise as a result of these clusters. All of these issues need to be considered with respect to people with disabilities. This may influence how the job analysis unfolds (Murphy, 1991). This body of literature also reflects the field's continued reliance on the Dictionary of Occupational Titles in job analysis and placement (Pines, et al., 2002).

This section is organized in two major sections: First, a general discussion about issues related to job analysis and job classification (e.g., theories, methods of development, measurement issues), and secondly, specific job analysis models and systems. We provide a brief overview of several major systems followed by a bibliography.

Job Analysis

Colihan, J., & Burger, G. K. (1995). Constructing job families: An analysis of quantitative techniques used for grouping jobs. *Personnel Psychology, 48*, 563-586.

In order to study job classification (or grouping of jobs into families), this study was designed to compare and contrast various strategies with respect to correctly identifying the number of job families and groups jobs into those families. Grouping was completed under several conditions of measurement error and job family overlap. The authors sought to reduce measurement error and to create more accurate hybrid procedures rather than use the traditional clustering methods. A data set with 300 profiles (i.e., employees) with ratings on 240 job analysis items was studied. The 300 profiles were reduced to six job families with 50 profiles per family for the basis of this simulation. The results showed that measurement error and overlap between job families might be an area of concern for some researchers. The authors concluded that this result reflects the training of the individuals conducting the job analysis. Also, overlap between jobs in different job families might also be an issue that must be considered as well. The authors concluded that the hybrid techniques were a preferable methodology for job analysis over traditional cluster analysis as it allows more robust grouping strategies.

Cornelius, E.T., Carron, T. J., & Collins, M. N. (1979). Job analysis models and job classification. *Personnel Psychology, 32*, 693-708.

The ability to analyze similarities and differences among jobs has captured much research interest. The purpose of this study was to see the effect of the type of job analysis on the resulting job classification decisions. The authors set forth three types of job analysis data (task-oriented, worker-oriented, and abilities-oriented). A study was constructed using these three data types whereby they collected data to describe seven nominally different foreman jobs in a chemical processing plant. A hierarchical clustering algorithm was used to analyze the data. The results demonstrated that the number of clusters varied based on the type of job analysis data that were analyzed with ability data producing three clusters, task data producing three to five clusters and worker-oriented data producing one cluster. The authors conclude that in selecting a job analysis method consideration should be given to how the results will be used.

Cunningham, J. W., Boese, R. R., Neeb, R. W., & Pass, J. J. (1983). Systematically derived work dimensions: Factor analysis of the Occupation Analysis Inventory. *Journal of Applied Psychology, 68*, 232-252.

This article is intended to address the proliferation of work taxonomies in the literature. The emphasis of this work is on the development of a taxonomy that can be applied for use in occupational education and guidance, with a particular focus on occupational exploration. The work reported in this article involved the development of a structured job analysis questionnaire (the Occupational Analysis Inventory OAI) for use as a taxonomic tool, the derivation of a broad set of human work dimensions (factors) based on that questionnaire, and an attempt to establish some degree of construct validity for the resultant dimensions. This work builds upon McCormick's work documented elsewhere in this bibliography. Factor analysis was used on a total of 602 OAI work elements (items) based on two data sets: a) ratings of 1,414 jobs on the elements and b) ratings of the elements on their requirements for 102

defined human attributes. The author states that the results were favorable and were "intuitively meaningful" and proved to be significantly related to the tested abilities of relevant job holders. Job-rating factors should be fairly reflective of the various kinds of work activities and conditions in the world of work and unique in their coverage of information relevant to occupational education and career decision-making. The authors believe that further work is needed to develop the more quantitative side of the taxonomy work.

Fine, S. A., & Getkate, M. (1995). Benchmark tasks for job analysis: A guide for Functional Job Analysis (FJA) scales. Hillsdale, NJ: Erlbaum.

This work is by a pioneer in the field of industrial/organizational psychology. The purpose of this book was to provide a single source of information on job analysis presented within the framework of human abilities and the tasks performed within the workplace. The book is organized around Functional Job Analysis (FJA). The main thrust of FJA is to achieve objective, reliable, and valid information on job analysis. The book discusses how to establish benchmarks for the seven scales within the FJA (Things Functions Scale, Data Functions Scale, People Functions Scale, Worker Instruction Scale, Reasoning Development Scale, Mathematical Development Scale and Language Development Scale). An appendix provides as an example an application of FJA to job evaluation. It is well-organized and a useful reference for those completing FJA-type activities.

Fine, S. A., & Wiley, W. W. (1971). An introduction to functional job analysis: A scaling of selected tasks from the social welfare field. *Methods for Manpower Analyses, 4*, 1-87.

This monograph provides an updated and expanded version of the Functional Job Analysis manual. It is also part of a series of papers on functional job analysis and career design. It contains detailed information about how to conduct a functional job analysis. It is a useful primer on the required components. The authors apply the concepts with an example from the field of social welfare to illustrate their points.

Fleishman, E. A., & Reilly, M. E. (1995). *Handbook of human abilities: Definitions, measurements, and job task requirements*. Bethesda, MD: Management Research Institute.

This is an important monograph in the field of measuring human abilities. The book provides a guide to the instruments used to measure cognitive, psychomotor, physical, and sensory/perceptual abilities as defined by Fleishman's theory of classifying tasks. The book contains definitions for each of 52 abilities. The authors have included explicit examples of how these definitions apply in the world of work. Then, they provide examples of jobs that require the defined ability; match specific tests to measure that ability; and describe how these approaches are applied. This book provides a wealth of information. Beyond the application of tests to abilities, they also provide a comprehensive list of tests and citations relevant to these tests. It is a valuable document to help match tasks and jobs with their ability requirements and the tests that measure these abilities.

Fleishman, E. A. (1982). Systems for describing human tasks. *American Psychologist, 37*, 821-834.

This article provides a useful historical overview of the role of taxonomic development in the biological and behavioral sciences. The author articulates links between the evolution of taxonomies in other sciences and the need for taxonomies in psychology. Foundation issues and guidelines for the development of such systems are reviewed, in addition to criteria for their evaluation. Alternative systems are discussed as a means of comparison. He concludes by acknowledging that recent (as of 1982) empirical work shows that the most utilitarian basic categories with current taxonomies seem to revolve around large and growing database categories. He states that whereas more categories may appear to be

complicating, but when working with human performance, it is better to define more specifically then step back to organize the categories into something more manageable.

Fleishman, E. A., & Quaintance, M. K. (1984). *Taxonomies of human performance*. **Orlando, FL: Academic Press.**

This chapter identifies the need for taxonomic development in the field of human performance. It also discusses problems in human performance research and application as well as the implications of taxonomy of human performance. It gives the reader areas of human performance in which taxonomy are useful. These areas include job definition and job analysis; human-machine system design; personnel selection, placement, and human resource planning; training; performance measurement and enhancement; development of retrieval systems and databases. An overview of the Taxonomy Project was also provided in this chapter.

Chapter 2 provides an intensive look at the role of taxonomies in scientific development. The reader is given a review of the issues in the science of classification, including a discussion of the objectives, processes, and subject matter of classification. The role of classification in the development of other sciences is described, and the status of taxonomic development in biology is used as a prototype for comparison to highlight the issues faced in psychology. Early taxonomic efforts in psychology are described, with emphasis on concepts developed in the field of learning. The changing nature of categories used in the field of learning is instructive and has implications for general human performance taxonomies.

Chapters 3 and 4 deal with specific issues in classifying human performance. Past efforts are reviewed and the state of the art is assessed to provide procedural guidelines for future taxonomic efforts. Approaches to and dilemmas encountered in developing systems of classifying human task performance are discussed. Chapter 3 emphasizes conceptual issues of purpose and descriptive bases in terms of available alternatives. Different ways of defining and conceptualizing human tasks are described, with each way leading to different models and rationales for describing and classifying tasks. Chapter 4 emphasizes methodological issues in developing classificatory systems and presents criteria for evaluating the utility and validity of such systems.

Chapters 5 through 7 examine specific task or job descriptive systems developed by earlier investigators. Included in these reviews are schemes that employed such conceptual units as overt behaviors, functions, abilities, and task characteristics. These schemes are evaluated in terms of the criteria specified in earlier parts of the book.

Chapter 8 is concerned with both the role and the use of human performance databases in taxonomic development. Such problems as indexing and classifying, formatting, search vocabulary, cross-referencing, and the needed technology are discussed. A prototype attempt to build a database of previous research findings in several areas of human performance is described. The use of the database for evaluating taxonomic systems is illustrated by such questions as: Are generalizations improved when the data on factors affecting human performance are reorganized according to different classes of tasks? Are new relations uncovered? Are better descriptions of functional relations provided?

The next several chapters describe newer attempts at developing taxonomic systems for describing tasks.

Chapter 9 briefly describes a criterion measures approach that categorizes tasks in terms of dependent operator response measures. For example, one class of task performance called switching is defined by measures indicating the latency or reaction time of the operator's responses; another called coding is defined by the percentage of correct responses made; and a searching category is defined by probability of detection. There are subcategories for these types of broader categories.

Chapter 10 describes an information-theoretic approach based on a theoretical model that provides for a systems language common to tasks. Information processing is seen as the common denominator, in which a task is defined in terms of types of information transferred between sources and receivers. The types of descriptors used include classes of constraints on stimulus and response events, amount of redundancy, and types of relations between input and output.

Chapter 11 describes a task strategy approach that characterizes tasks in terms of discriminable task functions, task content, task context, task environment, and level of learning. The approach lays out the terminology needed to interrelate these activities in accomplishing task goals. The emphasis is on categories that characterize the sequence of goal directed transactions between the operator and the task environment. The types of terms used include search, interpret, transmit, plan, and test.

Chapter 12 describes the approach that has received the most development and most extensive evaluation. This is the ability requirement approach, in which tasks are described in terms of the human capacities required to perform them effectively. The abilities on which the system is based were derived from empirical studies on the interrelationships among performances on a wide variety of tasks, including those in the sensory, cognitive, perceptual, motor, and physical performance areas.

Chapter 13 describes the task characteristics approach. The approach classifies tasks in terms of descriptors that are independent of the characteristics of the human operator. The model developed characterizes tasks in terms of general components of goal, stimuli, responses, and their relations. Within these components, major components of a task are identified and treated as categories within which to devise task characteristic descriptors.

Chapter 14 provides a brief review of recent efforts at taxonomic development in other fields of psychology, including personality, social, clinical, and educational psychology. Chapter 15 concludes with an overview and some implications for future research.

Fleishman, E. A., & Mumford, M. D. (1991). Evaluating classifications of job behavior: A construct validation of the ability requirement scales. *Personnel Psychology, 440,* **523-575.**

Understanding people's behavior in the work place is a salient issue for industrial and occupational psychologists. Job analysis techniques seek to create a coherent framework for these job behaviors. This allows job analysis to serve as a foundation for work in personnel selection, performance appraisal, training, job design, and wage and salary administration. This article discusses the major issues arising in the development of behavioral classification systems. The authors review the ramifications of these issues as in the evaluation of construct validity of systems designed to assess the requirements of human task performance. Fleishman's ability requirement taxonomy and its associated job analysis system, the Manual for the Ability Requirement Scales (MARS), were then evaluated based on these criteria. These authors found that the ability requirement taxonomy and the associated measurement system provided a meaningful description of job activities. The article concludes with the argument that applying construct validity principles might contribute much to our understanding job task behaviors.

Gael, S. (1988). The Job analysis handbook for business, industry, and government (Vols. 1-2). White Plains, NY: John Wiley & Sons.

The importance of correct and exact job information is paramount; without this information, the decisions that flow from these initial data will be flawed. This handbook was developed to provide job analysts with a background of theory, history, and the legal basis for job analysis. It also includes a discussion of major job analysis issues and research. The Handbook contains job analysis methods and related topics in ten sections. The Handbook is comprised of 83 chapters. Sections covered include presentations about uses for job analysis results, one from an organization administration viewpoint and the other from a human resource management viewpoint, planning for job analysis, techniques

practitioners can use to obtain job information, and industrial engineering, human factors engineering, worker-oriented and work-oriented approaches to obtaining information about work activities and jobs. The final section covers a variety of job and work process analyses. The Handbook is well organized and provides a wealth of information for practitioners.

Geyer, P.D, Hice, J., Hawk, J., Boese, R., & Brannon, Y. (1989). Reliabilities of ratings available from the Dictionary of Occupational Titles. *Personnel Psychology, 42*, 547-560.

This article evaluates the reliability of the Dictionary of Occupational Titles. The authors observed and interviewed job incumbents representing 20 different occupations. They evaluated each occupation on many characteristics using the United States Employment Services. The results of their analyses found that, based on four ratings, the large majority of 70 scales were found to have coefficient alpha (or KR-20) reliabilities in excess of .80 and 25 scales had reliabilities ranging from.90 to .98. They also found that reliabilities were nearly the same as those found in a previous study using different procedures. The authors note that the raters (the job analysts) were "atypically good" in this study as these individuals' sole work responsibility is job analysis so the reliability estimates obtained may reflect the skill of the analysts themselves. They also found that higher reliabilities were obtained for scales representing broad, abstract job characteristics compared to scales representing more concrete job characteristics.

Harvey, R. J. (1986). Quantitative approaches to job classifications: A review and critique. *Personnel Psychology, 39*, 267-289.

Decisions about job classification are a part of nearly all personnel functions (e.g., grouping for test validity generalization, compensation, performance appraisal, training needs analysis, career path and succession planning). This author provides a review and critique of quantitative job-classification procedures, with a focus on decision-making tasks. For example, he asserts that hierarchical cluster analysis is the most widely used job classification method. He comments on rotated, exploratory factor analysis, but found that the results of such analyses are difficult to understand. He concludes that continued research in this area is necessary. The application should determine the analysis. This work is thoughtful and well organized.

Harvey, R. J. (1993). Research monograph: The development of the Common-Metric Questionnaire (CMQ). [On-Line] Available: 05/29/96;

http://harvey.psyc.vt.edu.
Through the use of a metric or a common profile, work activities can be compared. Existing worker-oriented tools have numerous limitations according to the author. The limitations result from both the psychometric properties of the instruments as well as their utility for everyday personnel problem solving. Other limitations include: (a) reading levels that are so high that they preclude incumbent completion; (b) items and rating scales that are so behaviorally abstract that it is difficult to collect accurate and verifiable data; and (c) deficiencies in content coverage, especially for managerial jobs. The Common-Metric Questionnaire (CMQ) was developed to address some of these limitations. The CMQ is completed by the incumbent. This paper describes the development process of the CMQ and the results of a field test conducted to validate it. The field test included 4,552 positions evaluated between 1989 and 1991. These positions were standardized on the CMQ and then they were classified into 904 separate occupational titles according to the DOT. Over 1,200 CMQ rating are used in a scoring system that describes jobs in terms of 80 work dimensions. The median scale coefficient alpha was .86. Given these results, the authors conclude that their tool addresses some of the stated limitations and was actually more cost-effective than other job analysis systems.

Harvey, R. J. (1994a). *Methodologies, objectives and issues involved in identifying occupational clusters using skills-based data*. **A report submitted to DTI, Government and Commercial Services Group.**

Harvey, R. J. (1994b). *Methodologies, objectives and issues in identifying occupational clusters using skills-based data*. **Blacksburg, VA: Virginia Polytechnic Institute & State University.**

These two papers address the questions: 1) What kind of "occupational/skill clusters" would be expected to find when such clusters are formed by clustering occupations or job families using a criterion of commonality and worker skills required to perform each occupation; and 2) What kinds of statistical and data-collection methodologies might be useful in constructing such occupation/skill clusters? The author reports that these questions are key in the efforts that are being funded by the Departments of Labor and Education in order to develop voluntary national skills standards that can be used when selecting, placing, training, and otherwise managing the high-performance workforce of the future. The second paper is an elaboration in which the author (1) makes a clear differentiation between abstract versus specific worker attributes and abstract versus specific work activities, (2) identifies the "occupational/skill clusters" that would result after using a criterion of commonality of worker skills required to perform each occupation, and (3) identifies the issues and problems that might arise as a result of such occupational/skill clusters.

Harvey, R. J., & Wilson, M. A. (1998). *Occupational analysis at the crossroads*. **Paper presented at the Annual Conference of the Society for Industrial and Organizational Psychology, Dallas, TX.**

This paper provides a critical review of the O*NET. Several weakness are illuminated, including the absence of a traditional verifiable job analysis (JA) rating; reliance on a single item to estimate highly abstract characteristics (e.g., the amount of Inductive Reasoning); the lack of empirical data to verify the job-relatedness and "consequential validity"; the use of cross-rater correlations to justify claims of reliability and validity; an oversimplified occupational title system containing 90% fewer titles than the DOT; and a loose standard for assessing cross-rater reliabilities. The authors state that they view the field of occupational analysis as being at a "crossroads." They recommend that the field should use a national occupational information system with verifiable JA data, excluding current work that relies on "faith" (i.e., that holistic ratings of hypothetical constructs will be accurate) and raters' "expert" credentials.

Havranek, J. E., Brodwin, M. G., & Kontosh, L. G. (1999). O*NET job analysis and vocational evaluation for the 21st century. *Journal of Applied Rehabilitation Counseling, 30*(3), 42-46

This article briefly discusses functional job analysis and lists the seven categories in the DOT that are the current focus of job analysis. It also reviews the O*NET in terms of its development, components, potential uses, limitations, and the importance of the O*NET for job analysis and to vocational evaluation. It also lists fifteen ways the O*NET will influence job analysis and the vocational profession.

Karasek, R., Brisson, C., Kawakami, N., Houtman, I., Bongers, P., & Amick, B. (1998). The Job Content Questionnaire (JCQ): An instrument for internationally comparative assessments of psychosocial job characteristics. *Journal of Occupational Health Psychology, 3*(4), 322-355.

This article provides a comprehensive description of the Job Content Questionnaire (JCQ). The first section discusses the JCQ that was designed to measure psychosocial demands, decision latitude, social support, physical demands, and job insecurity. The second section describes the reliability of the JCQ scales in a cross-national context using 10,288 men and 6,313 women from 6 studies conducted in 4 countries (United States, Japan, the Netherlands, and Canada). Reliability is reported as good for most scales, as well as correlations amongst the scales, and in correlations between scales and demographic

variables. The authors also found minimal gender differences. The final portion of the paper reports on the similarities of psychologically based job characteristics. The JCQ demonstrates more similar results on individuals between countries and less similarity between occupations. This is a detailed study looking at the international applications for the JCQ. The authors note that limitations exist with respect to the self-report nature of the JCQ. They reflect on how international views of work may impact how individuals respond to the questionnaire. However, despite this weakness, the article clearly describes the need to think more globally about the work place in today's vocational environment.

Lees-Haley, P. R. (1990). Vocational neuropsychological requirements of U.S. occupations. *Perceptual and Motor Skills, 70*(3), 1383-1386.

Aptitude levels required to perform occupations listed in the U.S. Department of Labor Dictionary of Occupational Titles are identified. Numbers and percentages of jobs requiring each level of each aptitude are presented in a tabular format. These data can be useful in assisting vocational neuropsychologists in evaluating persons with brain-injury.

Lytel, R. B., & Botterbusch, K. F. (1981). Physical demands job analysis: A new approach. Menomonee, WI: Materials Development Center, Stout Vocational Rehabilitation Institute.

The goal of this monograph is to help the reader understand what to look for in job stations and work environments to then facilitate the work of vocation development specialists in focusing on what is relevant and crucial in any given employment situation. The authors present a thorough and detailed discussion of job analysis procedures and tools which permit creative job development for difficult to place persons. It is broken into two sections: Part I discusses the physical demands analysis and how to conduct a job analysis and Part II contains information about environmental conditions and details on how to analyze each job task. While the work may be dated, it still appears to have some applicable portions.

McCormick, E. J. (1979). Job analysis: Methods and applications. New York: Amacom.

This author is a leader in the field of job analysis. This work looks at the study of human work and with practical applications of such of study. This is a detailed work. It is an excellent resource. The book covers job analysis (JA) methodology and the use of this information. It also reviews job interrelationships and job classification systems and applications of job-related information such as job placement, adaptation, and vocational choice.

McCormick, E., Mecham, R. C., & Jeanneret, P. R. (2001). Technical manual for the Position Analysis Questionnaire (PAQ). North Logan, UT: PAZ Services.

This is a manual for clinicians to use to administer the Position Analysis Questionnaire (PAQ) to analyze jobs. The book provides an overview of the PAQ structure, a description of the job analysis process, and descriptions and examples for each of the PAQ "job elements" (i.e., job activities, behaviors, and features of the work environment). The manual also includes: Collecting Job Information, Job Analysis Documentation Using the PAQ Answer Sheet, PAQ Rating Scales, PAQ Items, Verifying the Reliability Ratings, and Processing PAQ Data. This reference is the foundation work on the PAQ published by the three original authors of the instrument.

Murphy, L. R. (1991). Job dimensions associated with severe disability due to cardiovascular disease. *Journal of Clinical Epidemiology, 44*, 155-166.

Job stress has been identified as a critical occupational safety and health problem in the past several decades. This article looks at the relationship between job activities and disability due to cardiovascular disease. The author used national disability data (1978 US Health Interview Survey) as well as a job analysis database. The databases were merged and odds ratios were calculated across 32

different job dimensions. Results of this analysis found four job dimensions associated with cardiovascular disability. These dimensions included hazardous situations, detail-oriented work and supervisor's responsibilities for others, the communication of job-related information, and the careful use of equipment. Positions that illustrate this type of high scoring across the four dimensions include jobs such as air traffic controller, bus drivers, teachers, and machinists. The high stress on these jobs clearly impacts stress-related physical and emotional symptoms including cardiovascular disease.

Pearlman, K. (1980). Job families: A review and discussion of their implications for personnel selection. *Psychological Bulletin, 87*, **1-28.**

In order to address the absence of a thorough system for classifying performance-related variables within the area of human work performance, these authors have reviewed the personnel literature on the history of job families and discuss the ramifications of these families with respect to theoretical and practical problems in the hiring of personnel. This review is rich with references on the development of taxonomies within the area of human work performance. The author begins by defining *job family* and its objectives to focus the article. Job family is seen the core of behavior classification in vocational endeavors. A discussion on how job families are clusters follows. Finally, reflecting on the paper itself, the author then discusses implications for personnel selection using these concepts. The author concludes asserting that personnel selection is more of a "science" than a "technology." The world of personnel selection, according to the author and given this paper, is not as subjective as the field has long characterized it.

Pines, S., Dickerson, V., & Cates, L. (Eds.). (2002). Dictionary of occupational titles (2nd ed.). Indianapolis, IN: JIST Publishing.

This is a current publication that lists descriptions of over 1,000 jobs that are contained in the O*NET database. The organization of the listings follows the O*NET arrangement. It is a handbook for accessing elements of positions, such as job tasks, educational requirements, earnings, skills, abilities, personality type, and work environment. It is a valuable resource for field of vocational rehabilitation.

Pope, D. P., Silman, A. J., Cherry, N. M., Pritchard, C., & MacFarlane, G. J. (1998). Validity of a self-completed questionnaire measuring the physical demands of work. *Scandinavian Journal of Work and Environmental Health, 24*(5), **376-385.**

This study examined how accurate workers could be in quantifying physical demands of jobs on a self-administered questionnaire. Following validation of the questionnaire via direct observation of job performance, employees rated performance on physical demand items. For dichotomous scoring, employees were fairly accurate. Employees were also accurate in rating frequency, duration and amplitude of performance. The authors concluded that this self-report questionnaire could be a useful instrument for estimating occupational physical demands in epidemiologic studies associated with musculoskeletal pain.

Rodgers, S. H. (1992). A functional job analysis technique. *Occupational Medicine, 7*, **679-711.**

This article addressed fundamental decisions about a person's' ability to work within the context of the need to be more objective following the implementation of the Americans with Disabilities Act (ADA) legislation. Prior to the ADA, health professionals could rely on their own judgment; however, the use of the functional job analysis to define activities more clearly has become the tool of choice. This article describes a method to analyze jobs in a way that does not require extensive training while still meeting ADA and OSHA requirements. The article continues by suggesting ergonomic solutions to vocational issues. Finally, a case study is used to illustrate the technique described. This article is a useful

resource for practitioners and researchers to better understand the Job Analysis process. It highlights how a job can be modified to improve a person's ability to work with minimal adaptations.

Schippman, J. S., Prien, E. P., & Hughes, G. L. (1991). The content of management work: Formation of task and jobs skill composite classifications. *Journal of Business and Psychology, 5,* **325-354.**

The absence of an inclusive method for classifying the interrelating performance related variable is a known issue in the study of human work performance. The purpose of the study reported here was to access and interrelate classifications of managerial tasks and job skills using job analysis techniques. Twenty-one published and unpublished studies were used to address task content of management work for this study. An additional ten studies examining job skills involved in management work were also reviewed. Detailed definitions for every task and job skill category were developed. A questionnaire was then developed by combining all the triads of task and job skill statements. The Delphi method was used elucidating twenty-one task categories and twenty-two job skill categories of management work. The results of this study were used to develop and evaluate a comprehensive set of management tasks and job categories based on expert input. The author recommends that the next steps include the creation of a taxonomy that applies these tasks.

Job Classification Systems

Peterson, N.G., Mumford, M. D., Borman, W. C., Jeanneret, P. R., & Fleishman, E. A. (Eds.). (1999). *An Occupational Information System for the 21st century: The development of O*NET.* **Washington, DC: American Psychological Association.**

U.S. Department of Labor, Employment and Training Administration. (1991). Dictionary of Occupational Titles (Rev. 4th Ed.), Revised). Indianapolis, IN: JIST.

U.S. Department of Labor, Employment and Training Administration (1993). *The new DOT: A Database of Occupational Titles for the twenty first century.* **Advisory Panel for the Dictionary of Occupational Titles Final Report. Washington, DC: U.S. Government Printing Office.**

The DOT was originally developed by the DOL to match people with jobs. However, the DOT has become outdated and a replacement was sought which eventually was called the O*NET. The O*NET is substantially more condensed than the DOT (about 1,200 jobs compared to 12,000 in the DOT) and this has raised questions about the utility of O*NET for job placement. Refinement and development of O*NET continues.

Elias, P. & Birch, M. (1994). ISCO 88 (COM): A guide to users.

http://www.warwick.ac.uk/ier/isco/brit/intro.html

International Labour Office (1990). ISCO-88: International Standard Classification of Occupations. Geneva: ILO

http://www.ilo.org/public/english/support/publ/pindex.htm

McLennan, W. (1997). ASCO: Australian Standard Classification of Occupations. Australian Bureau of Statistics.

http://www.abs.gov.au/Ausstats/abs@.nsf/Lookup/NT000120BE

Standard Occupational Classification (SOC) User Guide. (2001). US Bureau of Labor Statistics.

www.bls.gov/soc/socguide.htm

National Occupational Classification. (2000). Human Resources Development Canada. www.worklogic.com:81/noc

Standard Occupational Classification 2000, Volume I. (2000). Occupational Information Unit, Office for National Statistics. London, England: The Stationery Office.

www.statistics.gov.uk/nsbase/methods_quality/ns_sec/soc2000.asp

These documents represent the major international occupational classification systems. The format of each is approximately similar. Each provides broad occupational categories that are further divided into various subdivisions of jobs and skills. The systems generally classify jobs by the type of work performed although the means of determining this varies across systems. Methods of data collection vary by system from being part of the national census data to specific data collection projects.

METHODS OF IDENTIFYING AND VALIDATING JOB DEMANDS

This section deals with several methodological approaches that could be used to identify and validate job demands. The first group of articles addresses concept mapping, an essentially deductive technique for graphically representing information to facilitate knowledge creation and problem solving. The mapping process provides a visual representation of the conceptual relationships between and among key ideas in job demands. The objective of mapping ideas is to classify items into mutually exclusive groups after natural groupings based on item similarities are identified. The analysis is only descriptive and has no inferential properties. The second group of articles provides references to several of the fundamental monographs on reliability and validity of tests. Included are the official standards of some of the major professional organizations whose members are involved in the development and utilization of performance and psychological measures. Anastasi (1988) and Nunnally and Bernstein (1994) are two of the most widely referenced texts on classical test theory. The next section provides introductory references on rating scale (or Rasch Analysis, a method of creating interval level measures from ordinal level data. Equal-interval scales are necessary if one wants to accurately measure a job's demands or make quantitative comparisons within jobs across time or between jobs or across groups of jobs.

Identifying Job Demands
Alpert, S. R. & Grueneberg, K. (2000). Concept mapping with multimedia on the Web. *Journal of Educational Multimedia and Hypermedia, 9*, 313-331.

Anderson-Inman, L. & Horney, M. (1996). Computer-based concept mapping: Enhancing literacy with tools for visual thinking. *Journal of Adolescent and Adult Literacy, 4,* 302-306.

Bryson, J. M. & Anderson, S. R. (2000). Applying large-group interaction methods in the planning and implementation of major change efforts. *Public Administration Review, 60*(2), 143-162.

Hair, J. F., Jr., Anderson, R. D., Tatham, R. L., & Black, W. C. (1992). Multivariate data analysis with readings (3rd Ed.). New York: MacMillan.

Jonassen, D. H., Beissner, K., & Yacci, M. A. (1993). *Structural knowledge: techniques for conveying, assessing, and acquiring structural knowledge.* Hillsdale, NJ: Lawrence Erlbaum.

Marshall, W. W., & Haley, R. W. (2000). Use of a secure Internet Web site for collaborative medical research. *Journal of the American Medical Association, 284*, 1843-1852.

Concept mapping is a technique for graphically representing information to facilitate knowledge creation and problem solving (Jonassen, Beissner, & Yacci, 1993). The mapping process provides a visual representation of the conceptual relationships between and among key ideas in job demands. This essentially deductive classification procedure develops concept maps or visual representations of knowledge (Alpert & Grueneberg, 2000). The objective of mapping ideas is to classify items into mutually exclusive groups after natural groupings based on item similarities are identified. The analysis is only descriptive and has no inferential properties, identifying interdependencies among terms without treating them as dependent or independent variables (Hair, Anderson, Tatham, & Black, 1992). Concept maps use a system of nodes representing concepts and links representing relationships between concepts. Automating the mapping process using computers to link multiple Web sites and respondents has revolutionized the way concept maps are developed, facilitating accurate knowledge representation (Anderson-Inman & Horney, 1996). Such large group interaction methods allow researchers to involve large numbers of people in planning and implementing major change efforts. Literally thousands of stakeholders can potentially be involved in the computerized data-collection process (Bryson & Anderson, 2000).

Automated Concept Mapping (ACM) is a cost-effective way of contacting and enlisting participation of all stakeholders in the job analysis process. ACM begins by capitalizing on the widespread availability of computer technology that provides World Wide Web-based access to online surveys. The Internet enables participants with different types of computers and operating systems anywhere in the world to participate in data collection through a common Web-based interface (Marshall & Haley, 2000). Traditional data collection methods use semi-quantitative techniques, such as Likert-type response scales, and reduce data to predetermined themes. ACM, on the other hand, is a text-based method of content analysis that enables respondents to use their own language in providing responses to survey questions. Context-based analysis utilizes supercomputing technology to produce richly saturated "themes" that can then be checked and confirmed with smaller groups of experts and stakeholders. This allows for easier and more efficient identification of item content that has meaning and value to the widest number of stakeholders.

Trochim, W. M. K, Cook, J. A., & Setze, R. J. (1994). Using concept mapping to develop a conceptual framework of staff's views of a supported employment program for individuals with severe mental illness. *Journal of Consulting & Clinical Psychology, 62*, 766-775.

This article describes an application of concept mapping to develop a conceptual framework of staff views of a program of supported employment (SE) for individuals with severe mental illness. Fourteen staff members brainstormed 96 program activity statements, sorted and rated the statements, and then interpreted the map that was produced through multidimensional scaling and hierarchical cluster

analysis. This map helped staff identify the important issues to consider when developing and implementing a supported employment program.

Michalski, G. V. & Cousins, J. B. (2000). Differences in stakeholder perceptions about training evaluation: A concept mapping/pattern matching investigation. *Evaluation & Program Planning, 23*, **211-230.**

This paper demonstrates how concept mapping and pattern matching can be used to examine how stakeholders differ in their perceptions about training evaluation. The study involved line managers, product developers, and training professionals. Each participant rated statements of what they thought constituted the best outcomes of training programs. The stakeholder groups generally agreed about what was important to the organization but differed in terms of the importance of these for evaluating training.

Wiener, R. L., Wiley, D., Huelsman, T., & Hilgemann, A. (1994). Needs assessment: Combining qualitative interviews and concept mapping methodology. *Evaluation Review, 18*, **227-240.**

Although not directly related to job demands, this study demonstrates the use of concept mapping in identifying relevant dimensions and variables from a group of stakeholders. The study used "a naturalistic model of research, open-ended qualitative interviews, and a social science research model, concept mapping (CMP)." Stakeholders were interviewed about their views of how the agency operated, how it ought to operate, and needs of the both the agency and the clients they serve. Cards with these need statements written on were given to a smaller subgroup to sort and assign importance weights. Concept mapping technology was used to identify categories of need from this sorted data. Results address the following goals: to clarify services offered to the community, to clarify the clients that are targeted for services, and to improve communication with other agencies.

Validating Job Demands

American Educational Research Association, American Psychological Association, National Council on Measurement in Education (1999). *Standards for educational and psychological testing***. American Psychological Association.**

Anastasi, A. (1988). *Psychological testing***. New York: Macmillan.**

Campbell, D. T., & Fiske, D. W. (1959). Convergent and discriminant validation by the multitrait multimethod matrix. *Psychological Bulletin, 56*, **81-105.**

Cronbach, L. J., & Meehl, P. E. (1955). Construct validity in psychological tests. *Psychological Bulletin, 52*, **281-302.**

Nunnally, J., & Bernstein, I. (1994). *Psychometric theory***. New York: McGraw-Hill.**

These five documents are fundamental sources on test reliability and validity. The first are the official standards of some of the major professional organizations whose members are involved in the development and utilization of performance and psychological measures. Anastasi (1988) and Nunnally and Bernstein (1994) are two of the most widely referenced texts on classical test theory as it relates to establishing the reliability and validity of tests. The articles by Campbell and by Cronbach represent seminal articles in the field and form the basis for current approaches psychometric analysis.

Innes, E.,. & Straker, L. (1999). Reliability of work-related assessments. *Work, 13*, **107-124.**

Innes, E., & Straker, L. (1999). Validity of work-related assessments. *Work, 13*, 125-152.

These two articles review evidence of the reliability and validity of 28 work-related assessments. The authors report that most of the instruments cited do not have psychometric properties sufficient for clinical or legal situations. The authors note the paucity of broad validation studies.

Zarate, R., Liberman, R. P., Mintz, J., & Massel, H. K. (1998). Validation of a work capacity evaluation for individuals with psychiatric disorders. *Journal of Rehabilitation, 68*, **28-34.**

This study evaluated the validity of an observational measure of work capacity, the Work Capacity Evaluation (WCE) for a group of persons with psychiatric disorders. The authors used several expert panels to select 4 tasks that clients would perform as part of the evaluation. Tasks were selected that a) reflected skills required for entry-level work, and b) were relevant to work in the current economy. The four tasks selected were: filing index cards, assembling toilet tank flush mechanisms, folding and packaging hand towels, and circuit board assembly. The study found that the scores on the WCE adequately distinguished between those with disabling psychiatric disorders, those with non-disabling psychiatric disorders, and those without psychiatric impairment. The study also considered the duration of time needed in order to make valid assessments. They found that 78% of the variance in Work Performance Index scores could be accounted for by the end of day 1 and 94% could be accounted for by the end of day 2. Thus valid empirically-based assessments can be completed in a relatively short period of time.

Davis, B. (2000). Job analysis rating analysis via item response theory. 24th Annual IPMA Assessment Council Conference, June, 2000. http://www.ipmaac. org/conf00/davis.pdf

Fisher, W. (1993). Measurement-related problems in functional assessment. American Journal of Occupational Therapy, 47, 331-338.

Linacre, J. M., Heinemann, A. W., Wright, B. D., Granger, C. V., & Hamilton, B. B. (1994). The structure and stability of the Functional Independence Measure. *Archives of Physical Medicine and Rehabilitation, 75*, **127-132.**

Ludlow, L. H. (1999). The structure of the Job Responsibilities Scale: A multi-method analysis. *Educational and Psychological Measurement, 59*, **962-975.**

Lunz, M., & Stahl, J. (1993). The effect of rater severity on person ability measure: A Rasch model analysis. *American Journal of Occupational Therapy, 47*, **311-317.**

Nibali U.S. Department of Labor (1993). *1990 OSCM: Occupational Classification System Manual.* Washington, DC: Author.

Nunnally, J. C., & Bernstein, I. H. (1994). *Psychometric theory (3rd ed.).* New York: McGraw-Hill.

Rasch, G. (1960). *Probabilistic models for some intelligence and attainment tests.* **Copenhagen: Danmarks Paedogogiske Institut, (Chicago: University of Chicago Press, 1980).**

Spray, J., & Huang, C. (2000). Obtaining test blueprint weights from job analysis surveys. *Journal of Educational Measurement, 37*, **187-201.**

Wright, B. D. & Stone, M. H. (1979). *Best test design: Rasch measurement.* **Chicago: MESA Press.**

Wright, B. D. & Masters, G. N. (1982). *Rating scale analysis: Rasch measurement.* **Chicago: MESA Press.**

These articles all outline the use of Rasch Analysis (RA), a method of creating interval level measures from ordinal level survey data. RA produces measures in which the intervals between units of the scale are equal in size. Raw score totals obtained from rating scales are not equal interval (Fisher, 1983). This is because any test is a subset of possible items that do not reflect the full range of abilities of the population being measured. Thus, while the raw score can range from 0% to 100%, the actual range of abilities extends beyond the abilities tapped by the instruments. This has the effect of compressing the discrimination of scores of persons at the ends of the distribution. The consequence of this effect is that a change of one raw score point at the ends of the scale does not represent the same amount of change as one raw score point in the middle of the scale. This non-linearity of raw scores is most significant at the end of the scales, and therefore is most problematic when measuring individuals who are least or most able on the construct of interest. Equal-interval scales are necessary if one wants to accurately measure a job's demands or make quantitative comparisons within jobs across time or between jobs or across groups of jobs. Producing an equal-interval scale through RA involves estimating the difficulty measures of the items. Therefore, items should demonstrate a hierarchical order from most to least challenging and this order should make theoretical and clinical sense (Linacre et al., 1994). If this task hierarchy is not as expected, then either the content of the items needs to be examined or the theory needs to be reevaluated (Davis, 2000; Ludlow, 1999). RA further determines construct validity by evaluating the "fit" of individual tasks to the construct (Wright & Stone, 1979). Fit statistics indicate if all the items are measuring the same thing; they are based on chi-square analysis. If the tasks cohere to describe a single construct, "more demanding" jobs require performance of more difficult tasks and "less demanding" jobs require performance of less difficult tasks. In addition, harder tasks will be harder for everyone, and more able persons will be able to complete more tasks than less able persons. Thus, chi-square fit statistics examine the response (able or unable) and how expected (or unexpected) that response was. Misfit (highly unexpected "passes" or "failures") is an indication that the task may be measuring a construct other than the one being measured by rest of the tasks since the pattern of responses does not follow what would be expected (Wright & Stone, 1979). RA is unique in that it enables the creation of a scale on which items and people are calibrated in the same metric. In the same way, tasks, raters, judges, and environmental settings can be calibrated simultaneously on the same metric (Lunz & Stahl, 1993; Wright & Masters, 1982). The advantages are enormous since a worker's ability measure on job demands can be simultaneously adjusted for the difficulty of the job they are performing, the environment in which the perform it, and for the leniency/severity of the person observing them.

Bond, T. G. & Fox, C. M. (2001). *Applying the Rasch model: Fundamental measurement in the human sciences*. **Mahwah NJ: Erlbaum.**

This book is specifically designed for use by researchers and practitioners and presents an overview of the basic properties and principles of Rasch analysis. It begins with an introduction to the basic principles of measurement and how these rules are realized through Rasch analysis. The text then moves on to designing and analyzing surveys that include rating scales. The authors then show how the principles of measurement can be applied to quite sophisticated problems such as empirical examination of psychological theories, the impact of rater severity on measurement, and construct validation studies. As a practical feature, the data sets described in the text can be downloaded so that the reader can begin performing their own Rasch analyses and interpretation of results.

Embretson, S. E., & Hershberger, S. L. (1999). *The new rules of measurement: What every psychologist and educator should know*. **Mahway, NJ: Erlbaum.**

This book discusses well-known, long-standing problems with raw scores and presents these as the "old" rules, countering them with "new" rules. Some examples include standard errors that do not reflect differences in precision across the distribution of items, reliability of tests that traditionally is considered as related to test length but is more appropriately a function of test targeting, and the need for

sample-free estimates, i.e., that items are evaluated on their own merits and not depending on the sample on which they were measured. One feature of this book that may be confusing for readers who are new to the topic is the authors' use of the term IRT (item response theory). The authors do not distinguish between more general forms of IRT and the Rasch model, even when referring to principles that apply only to the Rasch model. For example, "IRT item parameters are not biased by the population ability distribution" (p. 2). As has been demonstrated repeatedly, this is a characteristic of only the Rasch model and not at all a general characteristic of IRT models. However, this is an important book for those who are interested in moving beyond the use of raw scores in the analysis of survey data.

Merbitz, C., Morris, J., & Grip, J. C., (1989). Ordinal scales and foundations of misinference. *Archives of Physical Medicine & Rehabilitation***, 70, 308-12.**

The authors examine how problems inherent in ordinal raw scores, such as those obtained from a rating scale, limit the logical inferences that can be drawn. They note that because differences in raw scores do not represent equal "amounts" of difference in the underlying functional status, inferences about progress in treatment are vulnerable to misinterpretation. They comment that the reliance on raw scores may have serious consequences when attempting to measure the impact of treatment on patient progress. This is a readable article that points out the dilemmas of misestimation that occur if one assumes that raw scores operate the same way as equal interval measures.

van der Linden, W. J. & Hambleton, R. K. (Eds.). (1997). *Handbook of modern item response theory***. New York: Springer.**

This book is a thorough discussion of modern item response theory (IRT). The authors include Rasch analysis as one of the many possible approaches to IRT. The authors note that "the central feature of item response theory (IRT) is the specification of a mathematical function relating the probability of an examinee's response to a test item to an underlying ability." The main difference between IRT and Rasch analysis is that whereas IRT models in general see properties of test items such as their difficulty, discriminating power, as "nuisance" factors that must be controlled, Rasch analysis suggest that for true measurement to occur, it is the differences in item difficulty (or their extension into rating scale categories) which define what is being measured. Rasch specifies the requirements of measurement, including linearity, additivity, objectivity, separability, sufficiency, and their "sample-free" and "test-free" properties. IRT by contrast is more concerned with modeling obtained data.

CURRENT APPLICATIONS

Impact of the Social/Political Context on the Assessment of Disability

The works in this section come predominantly from the area of work rehabilitation but they address issues related to the dynamics of disability as a relationship between the person and the environment. These works also address some of the socio-political context in which work assessment occurs.

Blackwell, T. L. (1992). *The vocational expert under Social Security***. Athens, GA: Elliot & Fitzpatrick.**

The book is a supplement to SSA's Vocational Expert Handbook (1990). It is designed for vocational experts (VE) as a reference to the terminology and underpinnings of the field of vocational analysis, particularly with respect to the VE's role in the disability decision-making process. The glossary

is extensive and the definitions are explicit, including the definitions for the acronyms used by SSA. It walks the reader through the disability process step by step. This document is an invaluable resource for the VE even though it is now ten years old.

Eby, L. T., Johnson, C. D., & Russell, J. E. A. (1998). A psychometric review of career assessment tools for use with diverse individuals. *Journal of Career Assessment, 6*(3), 269-310.

Organizations are faced with difficult challenges as the number of individuals with disabilities in the workforce will increase as a result of passage of the Americans with Disabilities Act. Additional challenges include downsizing, part-time work, and outsourced work that have changed what is viewed as the "typical" work. These challenges have led the authors to realize that research is required to identify career assessment tools to meet these specialized needs. This paper reviews the psychometric properties of 44 career assessment tools.

Field, T. F. (1999). *Strategies for the rehabilitation consultant: Transferability, loss of employment, lost earning capacity, and damages***. Athens, GA: Elliot & Fitzpatrick.**

This book provides information to rehabilitation consultations on skill transferability, loss of employment, lost earning capacity, and damages.

Chapter 1, Transferability: An analysis of clients' previous work skills, work history, and current level of functioning at particular jobs are discussed. Also discussed is how injury or illness can affect the ability to work and adjustments that need to be made.

Chapter 2, Estimating Disability and Lost Employment: Residual functional capacity (RFC) is a process that is used to determine the access of employment. Both of these approached are used in the determination of percent of lost wages.

Chapter 3, Loss of Earning Capacity: This chapter outlines the methodology, termed LPE (the probability of Life, the probability of labor force Participation, and the probability of Employment) for estimating lost earning capacity.

Chapter 4, Damages: Special damages are discussed in this chapter, including how they apply to the affected individuals involved such as housewives and housekeepers, and children. The application of different measures is discussed to put a cost to activities of daily living surrounding those affected.

Appendixes: A) References, B) Case Illustration – Transferable Work Skills, C) Case Illustration – Labor Market Access, D) Case Illustration – Lost Earning Capacity, E) Case Illustration – Special Damages, F) Labor Market Survey – USA, G) Definitions of the Worker Traits, H) Economic Tables, I) Selected Glossary.

Ludlow, J. (1990). A practical guide for assessing physical demands requirements and environmental conditions. *Vocational Evaluation and Work Adjustment Bulletin, 23*, 64.

The Carl Perkins Vocational Education Act and the Job Training Act prompted more vocational assessments to be conducted in the school setting by educational professionals who are not customarily trained in vocational assessment. This article provides definitions for twenty physical demand factors along with assessment methods for each factor. The focus of this work is to provide this information to individuals who have not had the benefit of formal training.

Lusting, D. C., & Saura, K. M. (1996). Use of criterion-based comparisons in determining in the appropriateness of vocational evaluation test modifications for criterion referenced tests. *Vocational Evaluation and Work Adjustment Bulletin, 29*, 15-18.

These authors discuss the problems that vocational counselors encounter when they discover that test modifications are needed by persons with disabilities to complete a test, but the process of

accommodation results in scores with unknown validity. The authors present a systematic approach to testing accommodation for criterion-referenced tests.

Malzahn, D. E., Fernandez, J. E., & Kattel, B. P. (1996). Design-oriented functional capacity evaluation: The available motions inventory. [Review]. Disability and Rehabilitation, 18(8), 382-95.

The accommodation of a task to the unique abilities of an individual with a disability is becoming increasingly the responsibility of the employer. Functional capacity evaluation (FCE) provides the information necessary for rational design decisions when modifying work stations. The currently used FCE systems have been designed to assess an individual's performance for a range of reasons other than industrial task accommodation. The Available Motions Inventory (AMI) is a system that has been developed specifically to address the design issues raised when accommodating an industrial task to a person with a neuromuscular impairment. This system has a unique scoring system that allows intra-individual ability comparisons that support task allocation decisions. Some general principles of task design are developed for persons with cerebral palsy, but the strength of assessment lies in its application to a specific individual performing a specific task.

Rutman, I. D. (1994). How psychiatric disability expresses itself as a barrier to employment. *Psychosocial Rehabilitation Journal, 17*(3), 15-36.

This article discusses the barriers that people with psychiatric disabilities experience when trying to achieve employment. It provides a review of current opportunities to address the identified issues. The barriers identified include: (1) the manifestations of the disability in terms of cognitive, perception, affective and interpersonal impairments; (2) the episodic and unpredictability of the disability; (3) treatment interventions may have side effects that may affect the individual's appearance, mannerisms, or speech production; (4) values held by the individual with the disability may not be supportive of attitudes and work-related goals; (5) lack of agreement in the field on definitions and classifications of psychiatric rehabilitation; (6) fragmentation and communication gaps in the service systems who provide programming for persons with psychiatric disabilities; (7) work disincentives from the SSA programs that jeopardize benefits for those who work; (8) challenges presented by current assessment systems in general for predicting work readiness and vocational outcomes; and (9) the biases toward people with psychiatric disabilities. The author acknowledges the complexity and persistence of these barriers; he reviews developments that help support the return to work for people with psychiatric disabilities. Such developments include new technologies, medications, new training methodologies (e.g., supported employment, job coaching), revision of diagnostic and classification procedures, and legislative reforms including the Americans with Disabilities Act.

Sherman, S. W., & Robinson, N. M. (1982). *Ability testing of handicapped people: Dilemma for government science, and the public*. **Washington DC: National Academy Press.**

This publication focuses on the issues related to ability testing of people with disabilities (note: handicapped is the terminology used by the authors, the updated disability language will be used for this annotation.) Full participation in society is the goal of American society for people with disabilities. This publication is a result of the Panel on Testing of Handicapped People, Committee on Ability Testing, Assembly of Behavioral and Social Sciences, National Research Council. The panel identified ability testing, admissions testing, testing for job selection, the legal context of Section 504, the psychometric requirements of the legal regulations, the recommended policies and procedures to move forward, and the recommended research to be conducted. A chapter is devoted to each of these topics. This publication provides a solid foundation to explore the issues related to testing people with disabilities. It clearly sets out the history, the current context (as of 1982), and recommendations to modify the testing procedures used. The recommendations include suggestions of how various government agencies can work collaboratively to implement the recommendations.

Smart, J. F., & Smart, D. W. (1993). The rehabilitation of Hispanics with disabilities: Sociocultural constraints. *Rehabilitation Education, 7,* **167-184.**

This work is based on a review of over 120 references. An important issue that the authors identified was the use of standardized tests with individuals on whom the test was not standardized. The authors conclude with a call for the establishment of inclusive and clearly defined theories of career development for Hispanics. Additionally, they recommend that research move into the environment, the ecology of the work place, to provide researchers more meaningful psychosocial contextual information.

Szymanski, E. M., & Parker, R. M. (Eds.). (1996). *Work and disability: Issues and strategies in career development and job placement.* **Austin, TX: Pro-Ed.**

Szymanski, E. M., & Ryan, C., Merz, M. A., Beatriz, T., & Johnston-Rodriguez, S. *Psychosocial and economic aspects of work: Implications for people with disabilities.*

Chapter Two: The authors provide a brief overview of a variety of psychosocial and economic factors relating to employment of people with disabilities. They address issues such as personality and individual work motivation, and how such characteristics interact in a diverse environment considering race, gender, and cultural differences. The chapter provides a useful introduction to the psychosocial issues that people with disabilities face with employment and community participation, and the mediating factor of culture.

Szymanski, E. M., Hershenson, D. B., Enright, M. S., & Ettinger, J. M. *Career development theories, constructs, and research: Implications for people with disabilities.*

Chapter Four: The authors discuss career development theories, constructs, and research. Within that context, the authors review the history of career development theories and their applications to people with disabilities. The chapter provides a review of the implication for research within the field of career development and job placement for people with disabilities. The authors conclude with recommendations for future research and several caveats for conducting research in this area.

Parker, R. M, & Schaller, J. L. Issues in vocational assessment and disability.

Chapter Five. This chapter reviews traditional assessment methods and the theoretical underpinnings of those methods. It reviews the methods and tools in light of their technical limitations and optimal use. Such limitations concern the nature of the administration of the test (e.g., group vs. individual) and in some of the adaptations required for individuals with disabilities. The chapter is well written and provides a broad overview with enough detail to support the work of the vocational evaluator.

Brodwin, M., Parker, R. M., & DelaGarza, D. Disability and accommodation.

Chapter Six. This is the central chapter in this book. It covers definitions of disability, functional aspects of disability, prevalence of major categories of medical disabilities, categories of functional limitations associated with major medical disabilities, legal, economic, and practical aspects of accommodations in the workplace, and accommodating individuals with specific functional limitations in the workplace. These are important for consideration in both career development and job placement. This chapter provides a good overview of this topic area.

Boland Patterson, J. Occupational and labor market information and analysis.

Chapter Seven. This chapter addresses the work environment factors of occupational information and job analysis. The chapter broadens the focus for this book by including the labor market. It examines the relationship between job analysis and the ADA, and the ethical ramifications of the use of occupational information and job analysis. It provides an interesting perspective for the vocational expert.

Wong, D. W., Chan, F., Gay, D. A., Ho, C., & Hattori, K. (1992). Toward the development of a second generation computerized job-matching system for persons with disabilities: A conceptual framework. *Journal of Rehabilitation, 58*(1), 70-77.

This article seeks to address the known problems with the current DOT-based, computerized job-matching systems - they discriminate against people with disabilities. The DOT uses strict cut off scores in the job matching process for persons with disabilities, ignoring the adaptability of the clients and early planning for job modifications and accommodations. A major critique is that current systems look at the fit between person and job requirements rather than person-work environment fit. This article encourages the development of a computer-based, "expert" matching system. The system reflects the expertise of a panel of experts who have been successful in helping people with disabilities find employment. The system, ideally, should have reasoning capabilities to deal with real life job placement and the ambiguities that come with that in decision-making.

Appendix D:

CONTENT REVIEW OF JOB DEMANDS CONTAINED WITHIN CURRENT JOB ANALYSIS SYSTEMS

Table1. Functional Job Analysis

Content Domain	Job Demand Constructs	Job Demand Constructs
DATA	Information, knowledge, and conceptions, related to data, people, or things, obtained by observation, investigation, interpretation, visualization, and mental creation. Data are intangible and include numbers, words, symbols, ideas, concepts, and oral verbalization	
	Synthesizing Coordinating Analyzing Compiling	Computing Copying Comparing
PEOPLE	Human beings; also animals dealt with on an individual basis as if they were human.	
	Mentoring Negotiating Instructing Supervising Serving	Diverting Persuading Speaking/Signaling Taking Instructions/Helping
THINGS	Inanimate objects as distinguished from human beings, substances or materials; and machines, tools, equipment, work aids, and products. A thing is tangible and has shape, form, and other physical characteristics.	
	Setting-Up Precision-Working Operating/Controlling Driving/Controlling	Manipulating Tending Feeding-Off Bearing Handling

Table 2. Common Metric Questionnaire (CMQ)

#	Content Domain	Job Demand Constructs	Job Demand Constructs
4	**Interpersonal:** The extent to which individuals have human contact within and outside the Organization.		
		Kinds of supervision received Kinds of employees supervised, closeness of supervision given	Internal contacts External contacts
5	**Decision Making/Information Processing Activities:** The extent to which individuals use and synthesize information and make decisions.		
		Required areas of job knowledge Using senses to assess the work environment Impact/scope of managerial decisions	Language usage Managerial decisions
9	**Physical, Mechanical, and Contextual Aspects of Work:** The extent to which individuals are required to complete physical activities and operate machinery. Also includes environmental aspects of the occupation.		
		Required physical activities Impact of tool/machine usage Consequences/hazards of working environment conditions Kinds/sources of performance feedback Kinds of reward systems, work scheduling	Machine/equipment usage Working environment conditions Demanding/stressful job situations Task/skill variety, autonomy, identity, dependence

Table 3. Fleishman – Job Analysis Survey

#	Content Domain		Job Demand Constructs	Job Demand Constructs
13	cognitive		*	
			oral comprehension number facility Written comprehension oral expression Written expression Fluency of ideas Originality	memorization problem sensitivity mathematical reasoning deductive reasoning inductive reasoning information ordering
11	physical		*	
			static strength (upper/lower body) dynamic strength (upper/lower body) explosive strength (upper/lower body) trunk strength flexibility (extent and dynamic) gross body equilibrium	category flexibility speed of closure flexibility of closure gross body coordination cardiovascular endurance - stamina
17	psychomotor		*	
			Control precision multi limb coordination reaction time response orientation Timing arm-hand steadiness finger/manual dexterity speed of limb movement wrist-finger speed	perceptual speed selective attention time sharing control precision rate control reaction time spatial orientation visualization
13	sensory-perceptual		*	
			depth perception near vision far vision speed recognition Hearing visual color discrimination night vision	peripheral vision glare sensitivity auditory attention sound localization speech recognition speech clarity
9	Social / Interactive		*	
	New – little information		Persuasion Persistence	

13	Job Skills / Knowledge		*	
	New – little information		mechanical knowledge Driving	

Table 4. Occupational Analysis Inventory

#	Content Domain	Job Demand Constructs	Job Demand Constructs
125	Information Received	These work elements categories represent demand constructs that relate to types of information an employee would receive and have to interpret.	
		Mechanical Information	Semantic/Symbolic Information
		Electrical and Electronic Information	Business/Sales Information
		Spatial/Structural Information	Information about People and
		Materials Information	Animals
		Environmental Information	Sensory Channel
		Art/Decorative Information	Biological/Health Information
41	Mental Activities	These work element categories represent systems of understanding information that is received.	
		Figural Information Processing	Semantic Information Processing
		Symbolic Information Processing	
262	Work Behavior	These work element categories represent physical, representational, and interpersonal work behaviors.	

		Tool, Machine and Equipment Usage
		   Nonpowered hand tools
		   Portable powered tools/equipment
		   Portable nonpowered hand tools
		   Stationary Machines and Equipment
		   Mechanized Equipment
		   Setting/Control Devices
		   Measurement, layout, and scientific
		   Devices
			General Physical Requirements and Work Activities
			   General Physical Requirements
			   Work Activities involving materials,
			   Objects, and machines
			   Work activities involving humans
			   and animals

		Representational Work Behavior
		   Representational devices
		   Written and spoken verbal Communication
		   Symbolic and numerical Communication
		   Miscellaneous aspects of Communication
		   Data processing activities
			Objects/Materials Acted Upon
			   Living objects
			   Crude materials
			   Processed materials
			   Finished parts and components
			   Finished products

		Interpersonal Work Behavior
		    Interpersonal activities
		    Person types	

112	Work Goals	These elements define various kinds of work objectives, that is, outcomes or conditions the worker is responsible for bringing about or maintaining.	
		Mechanical Objectives	Semantic/Symbolic Objectives
		Electrical Objectives	Biological/Health Objectives
		Objectives Accomplished through Material/Object Arrangement or Modification	Business/Organizational Objectives
		Environmental /Earth Objectives	Objectives Related to People and Animals
		Art/Decorative Objectives	
77	Work Context	These work element categories represent various domains of work context, including physical, job structure, social, and incentives.	
		Physical Context	Social Context
		Job Structure	Incentives
		Miscellaneous Conditions and Requirements	

TABLE 5. OCCUPATIONAL INFORMATION NETWORK (O*NET)

#	Content Domain	Job Demand Constructs	Job Demand Constructs
	Worker Characteristics: Basic skills, cross-functional skills, knowledge, education, general attributes that are developed through education and experience.		
7	Cognitive		
		Verbal Abilities Quantitative Perceptual abilities Attentiveness	Idea generation and reasoning Memory Spatial Abilities
3	Psychomotor		
		Fine manipulative abilities Reaction time and speed abilities	Control movement abilities
3	Physical		
		Strength Flexibility balance and coordination	Endurance
2	Sensory		
		Visual	Auditory
	Occupation requirements: Generalized work activities, work context, organizational context.		
		Information input Work output	Mental processes Interacting with others

Table 6. Position Analysis Questionnaire

#	Content Domain	Job Dimensions	
6	Information Input	How do workers receive information needed to perform in their job? What do they see and what they hear? Senses of touch, taste, smell, or body position.	
		Perceptual interpretation Input from representational sources Visual input from devices / materials Evaluating / judging sensory input Environmental awareness Use of various senses	
11	Mental Processes	Processing of information gained on the job or from training. Various uses of learned information.	
		Decision making Information processing	
17	Work Output	Physical activities and tools used on the job.	
		Using machines / tools / equipment General body vs. sedentary Control and related physical coordination Skilled / technical activities Controlled manual / related activities Use of miscellaneous equipment Handling / manipulating / related activities Physical coordination	
13	Relationships with Others		
		Interchange of judgmental / related information General personal contact Supervisory / coordination / related activities Job-related communications Public / related personal contacts	
9	Job Context	Physical and social context of the work. Communication and personal contact. Supervision given or received.	
		Potentially stressful / unpleasant environment Personally demanding situations Potentially hazardous job situations	

13	Other Job Characteristics	Aspects of the work environment, physical work conditions, Hazards, personal and social aspects of the job.	
		Non-typical versus typical day work schedule Business situations Optional versus specific apparel Variable versus salary compensation Regular versus irregular work schedule Job demanding responsibilities Structured versus unstructured work activities Vigilant / discriminating work activities	
	Overall Dimensions		
		Decision / communication / general responsibilities Machine / equipment operations Clerical / related activities Technical / related activities Service / related activities Regular day schedule versus other work schedule Routine / repetitive work activity Environmental awareness General physical activities Supervising / coordination other personnel Public / customer / related contact activities Unpleasant / hazardous / demanding environment Non-typical schedule / optional apparel style	

Appendix E

Table 1. Examples of Common Job Demands Classified by Domain

Physical	Cognitive	Psychosocial
Lifting and/or carrying	Follow simple instructions.	Follow work rules
Walking, standing, or sitting	Follow complex instructions	Relate to co-workers
Pushing and Pulling	Measure	Deal with public
Repetitive use of upper extremities	Judge quality of work	Degree of job stress
Reaching and handling	Decisions based on job rules	Work without constant or close supervision
Stamina	and standards	Maintain attention and concentration.
Bending and kneeling		Consistently and reliably be at work on time.

Table 2. Example of Critical Physical Factors

Psychomotor Abilities	Positional Abilities
Hand dexterity	Sitting
Finger dexterity	Standing
Bilateral coordination	Reaching
Eye-hand-foot coordination	Overhead
Reaction time	Forward
Single stimulus – single response	Backward
Multiple stimulus – multiple response	Side to side
	Squatting
	Forward Bending
Dynamic Strength Abilities	From standing
	From sitting
Lifting	Kneeling
Bilateral/unilateral	
Floor waist	
Waist to eye level	Ambulatory Abilities
Carrying	
Bilateral	Walking
Unilateral	Climbing
Pushing	Stairs
Bilateral	Ladder
Unilateral	Crawling
Pulling	Running
Bilateral	
Unilateral	
Forceful gripping	Repetitive Movements
Forceful pinching	
	Trunk rotation
	Repetitive squatting
	Neck Rotation
	Forearm rotation
	Wrist flexion/extension

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