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Selection of Railroad Dispatcher Candidates

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16. Abstract

This report presents the results of a study to explore approaches to railroad dispatcher trainee selection. The work was conducted in response to an indication from railroad industry representatives that there is a need for guidance in developing a dispatcher selection program, particularly with respect to assessing candidates with no prior railroad experience. The development of a selection program involves the following steps: job analysis, employee specification, assessment instrument development/identification and validation. A job analysis, using the Position Analysis Questionnaire (PAQ) and based on interviews with dispatchers from four different dispatching centers, identified the skills, abilities and other characteristics against which dispatcher candidates can be evaluated. Cognitive abilities comprised the largest number of characteristics. A variety of tools for assessing these characteristics were identified. These include structured interviews and test instruments. Specific tests for intelligence and numerical aptitude were identified by the PAQ methodology. In addition, the Myers-Briggs Type Indicator (MBTI), a self-report personality inventory, may provide useful information with regard to personal characteristics. The overall dispatcher selection program should be some combination of the "total assessment" and "multiple hurdles" approaches. Site visits to seven dispatching centers provided information about each railroad's current dispatcher candidate recruitment and selection process. The experiences of these seven railroads illustrate the utility of the various selection methods and offer some additional recruitment and selection strategies. Occupations that are potential sources of dispatcher candidates were identified using both the PAQ methodology and a U.S. Department of Labor occupational database (O*NET). These occupations are in the protective services, transportation, mining and utilities industries. Recommendations with regard to the development and implementation of a selection program for railroad dispatcher candidates are based on accepted practice in the human resource literature, the dispatcher job analysis conducted as part of this research and railroad industry experiences.

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PREFACE

This report presents the findings and results of a study designed to examine methods for evaluation and selection of railroad dispatcher candidates. The work was performed under Contract DTFR53-95-C-00049 with guidance from Dr. Thomas Raslear of the Office of Research and Development, Federal Railroad Administration.

Thanks are also due to the management of the seven railroads that arranged for the author to visit their facilities and meet with individuals involved in the evaluation of dispatcher candidates. The dispatcher job analysis would not have been possible without the cooperation of the railroads, the American Train Dispatchers Department of the Brotherhood of Locomotive Engineers, and the dispatchers who participated in the job analysis interviews. In addition, appreciation is also extended to the Boston Police and Fire Departments for allowing project staff to visit their dispatching operations and meet with officers involved in the recruitment and training of dispatchers.

The author also wishes to thank several individuals from Foster-Miller for their support during this project. Dr. Stephen Popkin contributed to the study design and participated in several site visits. Ms. Sally Pham participated in the interviews at the Boston Police and Fire Departments and assembled information on the FAA's selection methods for air traffic controllers. Ms. Sarah Acton assisted in analyzing the data from the PAQ job analysis and in identifying related occupations in other industries. Dr. William Stankard, a consultant to Foster-Miller, conducted the PAQ job analysis interviews.

SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
LENGTH				
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
AREA				
in^2	square inches	645.2	millimeters squared	mm^2
ft^2	square feet	0.093	meters squared	m^2
yd^2	square yards	0.836	meters squared	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	kilometers squared	km^2
VOLUME				
fl oz	fluid ounces	29.57	milliliters	ml
gal	gallons	3.785	liters	l
ft^3	cubic feet	0.028	meters cubed	m^3
yd^3	cubic yards	0.765	meters cubed	m^3
NOTE: Volumes greater than 1000 l shall be shown in m^3.				
MASS				
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams	Mg
TEMPERATURE (exact)				
°F	Fahrenheit temperature	5(F-32)/9 or (F-32)/1.8	Celcius temperature	°C
ILLUMINATION				
fc	foot-candles	10.76	lux	l
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
FORCE and PRESSURE or STRESS				
lbf	poundforce	4.45	newtons	N
psi	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
LENGTH				
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
AREA				
mm^2	millimeters squared	0.0016	square inches	in^2
m^2	meters squared	10.764	square feet	ft^2
m^2	meters squared	1.195	square yards	ac
ha	hectares	2.47	acres	mi^2
km^2	kilometers squared	0.386	square miles	
VOLUME				
ml	milliliters	0.034	fluid ounces	fl oz
l	liters	0.264	gallons	gal
m^3	meters cubed	35.71	cubic feet	ft^3
m^3	meters cubed	1.307	cubic yards	yd^3
MASS				
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg	megagrams	1.103	short tons (2000 lb)	T
TEMPERATURE (exact)				
°C	Celcius temperature	1.8C + 32	Fahrenheit temperature	°F
ILLUMINATION				
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
FORCE and PRESSURE or STRESS				
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	psi

* SI is the symbol for the International System of Units

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EXECUTIVE SUMMARY

Two Federal Railroad Administration (FRA) assessments of railroad dispatcher operations in the United States found a number of deficiencies with regard to training. An FRA Report to Congress in 1995 expressed the concern that, given the rapidly evolving changes in railroad dispatching technology and the lack of new dispatcher candidates with relevant railroad experience, a continuing lack of adequate training for dispatchers could lead to safety risks. Following the 1995 Report to Congress, the FRA initiated work to support the development of minimum training standards for railroad dispatchers. A subsequent comprehensive study led to the development of dispatcher training objectives, model syllabi and test designs for initial training, initial territory training and refresher training. At an FRA-sponsored workshop where dispatcher training issues were discussed, industry representatives expressed concern that with the closing of control towers, the industry's in-house source of dispatcher candidates is all but gone resulting in a situation in which railroads must recruit individuals with no prior railroad experience. There was unanimous agreement among workshop participants that guidance and information on dispatcher selection criteria and methods are needed.

The FRA initiated this research to understand current railroad industry approaches to dispatcher trainee selection and to offer alternative tools and techniques especially for selecting and evaluating dispatcher candidates with no prior railroad experience. The specific goals of the project were to:

- Document current approaches to dispatcher selection.
- Formulate an objective procedure for development of a dispatcher selection program.
- Provide guidance on developing and implementing a dispatcher selection program.

The overall approach involved combining accepted personnel selection approaches from the human resources community with the experiences of the railroad industry as well as industries that have jobs similar to that of a railroad dispatcher. Accepted human resources approaches to employee assessment and selection, including a job analysis of railroad dispatchers, provided the basis for identifying the prerequisite knowledge, skills, abilities and other characteristics (KSAOs) that a dispatcher must have. Site visits to seven railroad dispatching centers and structured interviews with dispatching center management provided insights on current industry practices. Based on the job analysis, other occupations with similar KSAOs were identified as potential sources of dispatcher candidates.

Development of a selection program requires a concerted and focused effort to insure that information that is collected from applicants is closely related to job performance and that the

information is effectively used to identify the best applicants for the position. The process for developing a selection program has the following elements:

- Job analysis.
- Employee specification.
- Assessment instrument development/identification.
- Validation.

Job analysis is a systematic process used to identify the tasks, duties, responsibilities and working conditions associated with a job. The job analysis is the basis for determining the characteristics against which all applicants will be evaluated. The results of the job analysis provide information that is used to determine and specify the characteristics or KSAOs that an employee must possess to perform the job. Once KSAOs are identified, appropriate selection instruments must be identified and validated for the position.

A wide variety of selection instruments is available. These range from ability and achievement tests to biodata inventories, interviews and assessment centers. Each is appropriate for identifying different types of KSAOs. In developing a selection system, care must be exercised to assure that the appropriate instruments are selected and that there is no adverse impact on protected classes of individuals.

Since the focus of this research is on developing dispatcher selection guidance that is applicable to a variety of railroad operating environments, a job analysis was designed to provide a generic description of railroad dispatching and not to reflect a specific environment. The Position Analysis Questionnaire (PAQ®), a widely used and accepted methodology, was selected for this purpose. A total of 36 dispatchers from four different dispatching centers participated in group job analysis interviews. Results of this job analysis determined the skills, abilities and other characteristics required by the job of railroad dispatcher. Knowledge requirements, other than a high school degree, are achieved for novice dispatchers through initial training.

The PAQ job analysis indicated that simple reaction time was the only significant psychomotor skill required of a dispatcher. There were no significant physical skill requirements. In terms of abilities, the PAQ identifies three categories of abilities: sensory, perceptual and cognitive. Auditory acuity was the most important sensory ability. The dispatcher's need to deal with peaks in workload, characterized by multiple sources of information, rapidly changing conditions and the need for decisiveness, was reflected in the PAQ identified perceptual abilities of closure, perceptual speed, selective attention and time sharing. Seven cognitive abilities, including short-term memory, long-term memory, intelligence and convergent thinking, were among the significant abilities required by the job of railroad dispatcher. The relatively large number of cognitive abilities is proof of the cognitive nature of this job.

In terms of other characteristics, the PAQ job analysis identified two significant interest characteristics and a total of seven temperament characteristics. A dispatcher should have interest in directing/controlling/planning and a variety of duties. With respect to temperament,

the two most important characteristics are working under pressure of time and attainment of set standards.

A number of methods are suitable for assessing applicants' KSAOs with respect to the job of railroad dispatcher. The PAQ methodology identified specific tests that may be used to assess intelligence and numerical aptitude. Other tests can be identified for psychomotor and sensory skills as well as interest and temperament characteristics. The Myers-Briggs Type Indicator (MBTI), a self-report personality inventory that measures basic preferences regarding perception and judgment, is one test that may provide useful information with regard to personal characteristics, which are not captured by aptitude and ability tests and tend to be difficult to assess. Structured interviews conducted by skilled interviewers can be used to assess knowledge of railroad operations and dispatching as well as to judge selected abilities and personality characteristics. Recommendations and reference checks, because they have not proven to be effective predictors of future job performance, should be used only to verify biographical data provided by the dispatcher candidate. The biodata inventory has promise as a candidate assessment tool, but the expense of developing this type of tool may preclude its use in all but the larger Class 1 railroads.

The nature of the job of railroad dispatcher requires a selection program that utilizes a variety of methods for assessing candidates. The selection program can be a "total assessment approach" where all candidates are evaluated with each tool, a "multiple hurdles" approach where candidates must pass each step to proceed on in the selection process, or, preferably, a combination of the two methods.

Site visits to seven dispatching centers, representing Class 1, commuter and shortline/ regional railroads, provided information about each railroad's current candidate recruitment and selection process. The size of these dispatcher centers ranged from three to 95 desks. All seven railroads use interviews; five use structured interviews. Five of the railroads use some type of test instrument. Each of the Class 1 railroads uses a dispatcher aptitude test instrument that was developed specifically for their organization. The selection procedure at all of the railroads involves some combination of the "multiple hurdles" and "total assessment" approaches.

Prior to evaluation and selection of dispatcher candidates, each railroad must recruit potential candidates. Two methods were used to identify occupations that may be potential sources of dispatcher candidates. The PAQ methodology provided one set of occupations and a U.S. Department of Labor occupational database allowed for the identification of additional similar occupations. The occupations identified through the PAQ job analysis that appear most similar to railroad dispatcher are gas dispatcher, radioactive waste disposal dispatcher, and service dispatcher. Through examination of data in the Occupational Information Network (O*NET), 13 additional occupations in the protective services, transportation, mining and utilities industries were identified. These include fire alarm operator, radio dispatcher, protective-signal operator, interstate bus dispatcher, traffic or system dispatcher, dispatcher (mine and quarry) and oil dispatcher.

Conclusions and recommendations were identified with regard to the development and implementation of a selection program for railroad dispatcher candidates. They include the following:

- A thorough job analysis should be the foundation for any railroad dispatcher selection program. The results of the composite job analysis conducted as part of this research can be a starting point for organizations lacking resources to conduct a job analysis.

- Structured interviews are preferable over unstructured interviews because they have been shown to have higher predictive validity.

- Only reliable test instruments and procedures should be included in a dispatcher selection program.

- Assessing a candidate's "will do" or motivational characteristics is difficult. An intensive "job preview" of the dispatcher's job and work environment may help to identify those candidates not suited to the requirements of the job.

- Job postings on the internet will generate interest in the opportunity to become a dispatcher, but the response can be overwhelming if the posting appears for too long.

- There are a number of occupations in the protective services, transportation, utilities and mining industries that have job requirements similar to those of a railroad dispatcher. Individuals in these occupations should be explored as a potential source of dispatcher candidates.

- A comprehensive computer-based dispatcher screening tool, such as the one developed by the FAA for air traffic controllers, is possible, however, the expense is likely to be more than any one railroad can justify.

1. INTRODUCTION

1.1 Background

Two Federal Railroad Administration (FRA) assessments of railroad dispatcher operations in the United States found a number of deficiencies with regard to training. An FRA Report to Congress in 1995 expressed the concern that, given the rapidly evolving changes in railroad dispatching technology and the lack of new dispatcher candidates with relevant railroad experience, a continuing lack of adequate training for dispatchers could lead to safety risks. Following the 1995 Report to Congress, the FRA initiated work to support the development of minimum training standards for railroad dispatchers. Specifically, FRA sought recommendations with respect to training objectives and methods, and duration and frequency of training for railroad dispatchers (FRA, 1995).

A subsequent comprehensive study led to the development of dispatcher training objectives, model syllabi and test designs for initial training, initial territory training and refresher training. Information about current railroad dispatching methods and training programs, assembled through site visits and interviews with railroad training officials, provided the basis for developing the training objectives, syllabi and test designs (Reinach, Gertler, and Kuehn, 1998). A one-day FRA-sponsored workshop, "Train Dispatcher Training: Preparing for the 21st Century," held in October 1998 included a presentation on the study results as well as presentations from railroad officials and panel discussions on dispatcher training challenges facing Class 1 and short line and regional railroads operating both passenger and freight services.

Workshop participants voiced a number of concerns regarding dispatching operations. Changes in communications technology have made control towers obsolete and most railroads have closed or are in the process of closing their remaining towers. Historically, tower or block operators have been ideal candidates to become dispatchers. With the closing of towers, this source of dispatcher candidates has all but disappeared and many railroads are forced to look elsewhere, both within and outside the railroad industry, when hiring dispatchers. One participant stated that he is faced with "…the challenge of selecting and training new dispatchers who have little or no experience as a block operator." Another individual added that, "I see one of my greatest challenges is going to be the selection [of new dispatchers]." Since the cost to a railroad of training a new dispatcher can exceed $50,000, selection of the most promising candidates can have economic as well as safety consequences. While some railroads have successfully recruited and trained new dispatchers, there was unanimous agreement among workshop participants that guidance and information on selection criteria and methods are needed.

1.2 Purpose

The purpose of the research described in this report was to understand current railroad industry approaches to dispatcher trainee selection and to offer alternative tools and techniques especially for evaluating individuals with no prior railroad experience. The project had the following goals:

- Document current approaches to dispatcher selection.
- Formulate an objective procedure for development of a dispatcher selection program.
- Provide guidance on developing and implementing a dispatcher selection program.

In addition to providing information to the FRA, this report is designed to serve as a resource for railroad officials at both passenger and freight railroads who are responsible for evaluation and selection of dispatcher trainee candidates.

1.3 Scope

The focus of this study was on methods for initial evaluation of railroad dispatcher candidates with the goal of identifying selection methods that help railroad management to select dispatcher trainees in a way that minimizes the failure rate during training and maximizes the retention rate beyond the training period. Since future candidates for dispatcher positions will likely have no prior exposure to or knowledge of railroad or dispatching operations, this study focused on selection methods for this type of candidate.

1.4 Overall Approach

The overall approach to this project (see Figure 1) involved combining accepted personnel selection approaches from the human resources community with the experiences of the railroad industry as well as industries that have jobs similar to that of a railroad dispatcher. Accepted human resource practices for employee assessment and selection provided the basis for the development of a dispatcher selection process. A job analysis of the job of a dispatcher in four different dispatching centers identified the prerequisite knowledge, skills, abilities and other characteristics (KSAOs) that a dispatcher must have. Site visits to seven railroad dispatching centers and structured interviews with dispatching center management provided insights on current industry practice and experiences. Similarly, visits to a police dispatching center and a fire alarm dispatching center provided information about two similar occupations. Methods for evaluating dispatcher candidates with respect to the KSAOs were identified based on information from the job analysis and current industry practices. Suggestions regarding the development and implementation of a dispatcher selection system were formulated based on both railroad industry experience and the human resources literature on employee selection.

1.5 Organization of the Report

Section 2 provides background information on the overall process for development of a selection program and the various methods for candidate assessment. Sections 3 and 4 describe,

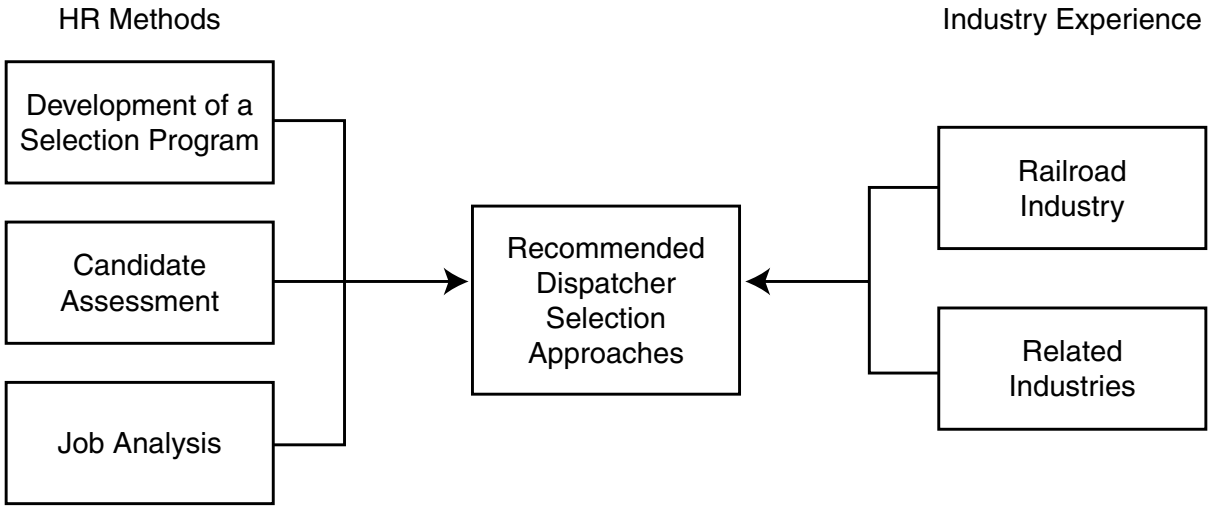

Figure 1. Overall technical approach

respectively, the dispatcher job analysis undertaken for this research and the resulting employee specification. Suitable methods for assessment of dispatcher candidates are discussed in Section 5. Current procedures for selection of dispatchers at seven railroads are described in Section 6 and similar information for related non-railroad occupations is presented in Section 7. Based on the results of the job analysis, Section 8 identifies jobs in other industries that may be sources of dispatcher candidates. Finally, Section 9 presents conclusions and recommendations with regard to the development of a selection program and recruitment of candidates. Three appendices contain a glossary of selection terminology, detailed job analysis results and contact information for the publishers of tests that are discussed in the report.

2. PERSONNEL ASSESSMENT AND SELECTION PROGRAMS

Selection is the process of collecting and evaluating information about an individual for the purpose of evaluating the individual's suitability for a specific position in the organization. A basic objective of this process is to identify, from a pool of applicants, those that have the appropriate knowledge, skills, abilities and other characteristics (KSAOs) to perform well in the position. With respect to railroad dispatchers, a properly developed selection program will provide a means to select individuals who will likely become effective dispatchers. Since one cannot assume that every applicant is qualified to perform the job, a systematic approach to collecting information from the applicants must be used. This section begins with a description of the steps for developing a selection system. Subsequent subsections elaborate on the individual steps. The final section summarizes employment laws that must be considered in developing and implementing an employee selection process.

2.1 Development of a Selection Program

Development of a selection program requires a concerted and focused effort. A selection program could be implemented readily by purchasing an application form, selecting some commonly used employment tests and selecting individuals to perform interviews. The important factor in an effective selection program is not whether or not information can be collected from job applicants. Rather, it is insuring that information that is collected from applicants is closely related to job performance and that the information is effectively used to identify the best applicant(s) for the position. The process for developing a selection program has the following elements:

- Job analysis.
- Employee specification.
- Assessment instrument development/identification.
- Validation.

Figure 2 presents the process for developing a selection program. The following sections briefly describe each of the four elements. Gatewood and Field (1994) contains a more detailed discussion of the elements of a selection program.

2.1.1 Job Analysis

Job analysis is a systematic process used to identify the tasks, duties, responsibilities, and working conditions associated with a job. Since information about the job is the basis for any

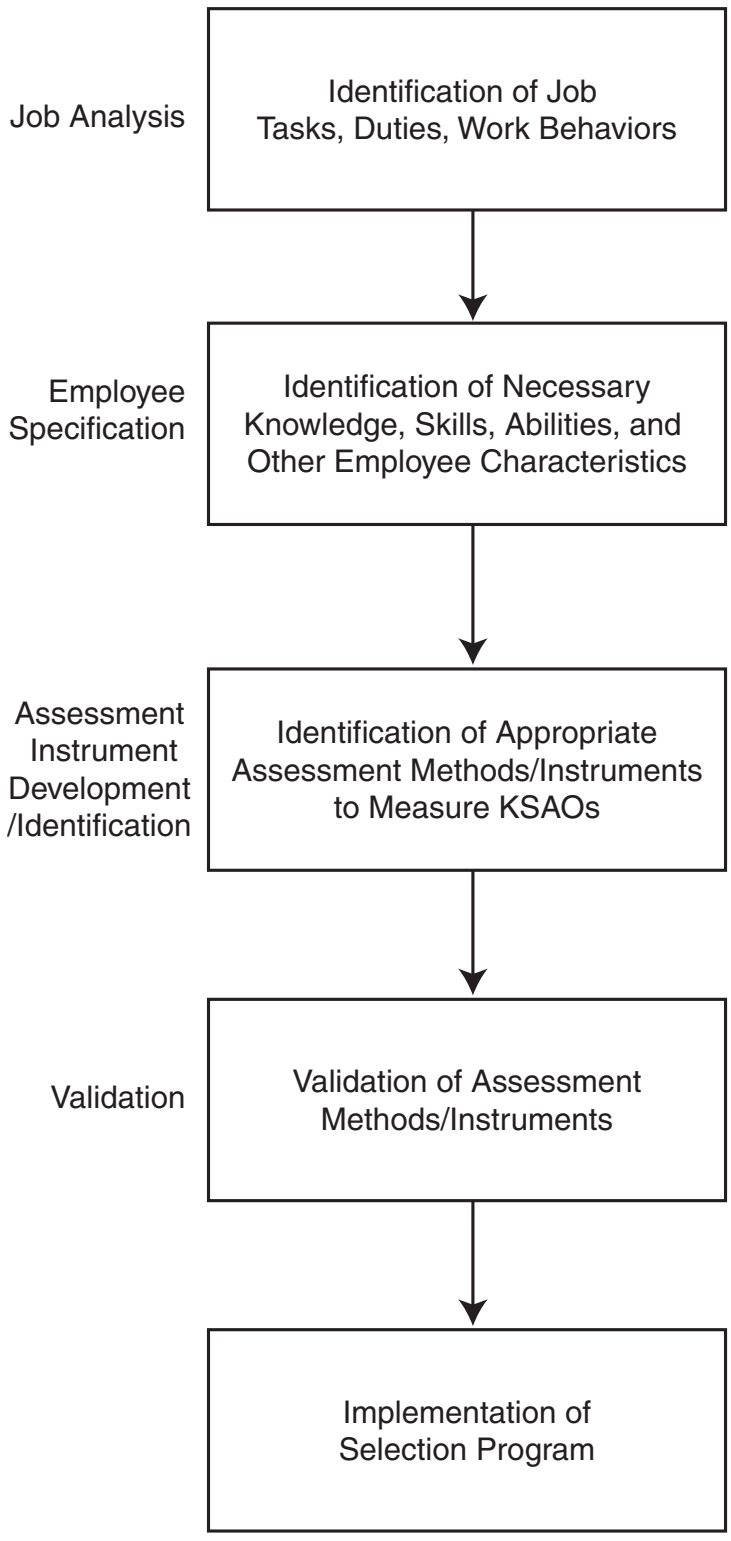

Figure 2. Process for development of a selection program

selection system, the job analysis is a key component and the logical starting point for the development of this system. The information gathered in the job analysis process should be descriptive of the tasks or activities, the equipment, material, individuals and working environment that characterize the job. While this information is essential to all human resource management activities, it serves two primary purposes with respect to selection. First, the information from the job analysis forms the basis for a description of the nature and demands of the job. This description is conveyed to potential applicants. Second, and probably more critical in terms of development of a selection program, the job analysis information serves as a database for the other steps in the development process. Job analysis information is central in deciding what characteristics to screen for.

Job analysis information may be gathered by direct observation of people on the job, interviews with experienced supervisors and job incumbents, questionnaires, personnel and equipment records, and work manuals. Standardized methodologies, such as the Position Analysis Questionnaire (Copyright 1969, 1989, Purdue Research Foundation) and the Common-Metric Questionnaire® (CMQ®, Copyright 1993, Personnel Systems & Technologies Corporation) are available for conducting a job analysis. In order to meet the requirements of the *Uniform Guidelines* (Equal Employment Opportunity Commission (EEOC), 1978), it is advisable that the job analysis be conducted by a qualified professional, for example, an industrial and organizational psychologist or other professional well trained in job analysis techniques. (See subsection 2.4 for a description of the *Uniform Guidelines*.)

2.1.2 Employee Specification

The results of the job analysis will provide information about job tasks, duties and work behaviors as well as the work environment. From this information, the job analyst or HR specialist must determine the characteristics or KSAOs that a worker must possess to perform satisfactorily in the position. Some job analysis methodologies, such as the PAQ, provide information that directly identifies KSAOs. These KSAOs form the basic set of characteristics against which all applicants will be evaluated.

2.1.3 Assessment Method Development/Identification

After the KSAOs have been identified, the next step in the process is to either find or develop appropriate assessment methods for collecting information from job candidates. A variety of assessment methods are available (see subsection 2.2). Regardless of the method, there are two key principles for choosing the assessment method. First, the method must be appropriate for measuring the KSAOs that characterize the job. The primary consideration is the similarity between the KSAOs measured by the instrument or method and those necessary for the job, as specified through the job analysis. The second principle is that the assessment method should be able to differentiate among applicants. Lack of differentiation may result from interviews that emphasize general questions about career goals and self-assessment of strengths and weaknesses, personality inventories that are transparent in purpose, or simple math and clerical tests that do not tap higher level skills required by the job (Gatewood and Field, 1994).

2.1.4 Validation

The last step in the development of a selection program is referred to as *validation*. The purpose of this step is to insure that the worker characteristics determined to be important to the job are in fact related to successful job performance. A validation study typically involves selecting a representative sample of current job incumbents. Each individual is evaluated using the candidate selection methods. Then measures of each individual's performance on important elements of the job are obtained. Statistical data analysis is then used to provide evidence that data from the selection methods is related to job performance.

Validation is an important step in the development of a selection program. If selection methods are not properly validated, there is a risk that the group of workers selected is not necessarily the most qualified. This can have both economic and safety consequences. Subsection 2.3 provides more detailed information on the validation process.

2.2 Assessment Methods

Organizations often use several different types of assessment tools and procedures to conduct personnel assessment. These techniques may range from employment interviews and reference checks to various types of professionally developed assessment instruments. Many assessment tools and procedures require specialized training, education, or experience to administer and interpret correctly. This section briefly describes the most commonly used assessment tools and procedures. (Table 1 contains a summary of the assessment methods presented in this section.) This material is included to provide background information on the range of methods available. Not all of these methods will be suitable for screening dispatcher candidates. Much of the material in this and the following section is drawn from *Testing and Assessment: An Employer's Guide to Good Practices* (1999), which provides more detail than contained here.

Adverse impact refers to a situation in which members of a particular class (e.g., race, sex or ethnic group) have a substantially lower rate of selection. This is an important consideration when selecting assessment tools and it is addressed in subsection 2.5. In the descriptions that follow, methods that can be especially problematic with respect to adverse impact are identified.

Ability tests, often referred to as aptitude tests, are among the most useful and valid tools available for predicting success in jobs and training across a wide variety of occupations. These tests are most commonly used for entry-level jobs and for applicants without professional training or advanced degrees. Mental ability tests are designed to measure a candidate's *ability* to learn and perform particular job responsibilities. There are two categories of ability tests:

1. *General ability tests* typically measure one or more broad mental abilities such as verbal, mathematical, and reasoning skills. These skills are fundamental to success in the job of a railroad dispatcher as well as many different kinds of jobs, especially where cognitive activities such as reading, computing, analyzing, or communicating are required.

Table 1. Advantages and disadvantages of different assessment methods

Type of assessment instrument	Advantages	Disadvantages
Ability tests	Mental ability tests • Are among the most useful predictors of performance across a wide variety of jobs • Are usually easy and inexpensive to administer	• Use of ability tests can result in high levels of adverse impact • Physical ability tests can be costly to develop and administer
Achievement/ proficiency tests	• In general, job knowledge and work-sample tests have relatively high validity • Job knowledge tests are generally easy and inexpensive to administer • Work-sample tests usually result in less adverse impact than ability tests and written knowledge tests	• Written job knowledge tests can result in adverse impact • Work-sample tests can be expensive to develop and administer
Biodata inventories	• Easy and inexpensive to administer • Some validity evidence exists • May help to reduce adverse impact when used in conjunction with other tests and procedures	• Privacy concerns may be an issue with some questions • Faking is a concern (information should be verified when possible)
Employment interviews	• Structured interviews, based on job analyses, tend to be valid • May reduce adverse impact if used in conjunction with other tests	• Unstructured interviews typically have poor validity • Skill of the interviewer is critical to the quality of interview (interviewer training can help)
Personality inventories	• Usually do not result in adverse impact • Predictive validity evidence exists for some personality inventories in specific situations • May help to reduce adverse impact when used in conjunction with other tests and procedures • Easy and inexpensive to administer	• Need to distinguish between clinical and employment-oriented personality inventories in terms of their purpose and use • Possibility of faking or providing socially desirable answers • Concern about invasion of privacy (use only as part of a broader assessment battery)
Honesty/integrity measures	• Usually do not result in adverse impact • Have been shown to be valid in some cases • Easy and inexpensive to administer	• Strong concerns about invasion of privacy (use only as part of a broader assessment battery) • Possibility of faking or providing socially desirable answers • Test users may require special qualifications for administration and interpretation of test scores • Should not be used with current employees • Some states restrict use of honesty and integrity tests

Table 1. Advantages and disadvantages of different assessment methods (continued)

Type of assessment instrument	Advantages	Disadvantages
Education and experience requirements	• Can be useful for certain technical, professional, and higher level jobs to guard against gross mismatch or incompetence	• In some cases, it is difficult to demonstrate job relatedness and business necessity of education and experience requirements
Recommendations and reference checks	• Can be used to verify information previously provided by applicants • Can serve as protection against potential negligent hiring lawsuits • May encourage applicants to provide more accurate information	• Reports are almost always positive; they do not typically help differentiate between good workers and poor workers
Assessment centers	• Good predictors of job and training performance, managerial potential, and leadership ability • Apply the *whole-person approach* to personnel assessment	• Can be expensive to develop and administer • Specialized training required for assessors; their skill is essential to the quality of assessment centers
Medical examinations	• Can help ensure a safe work environment when use is consistent with relevant federal, state, and local laws	• Cannot be administered prior to making a job offer. Restrictions apply to administering to applicants postoffer or to current employees. • There is a risk of violating applicable regulations (a *written policy*, consistent with all relevant laws, should be established to govern the entire medical testing program)
Drug and alcohol tests	• Can help ensure a safe and favorable work environment when program is consistent with relevant federal, state, and local laws	• An alcohol test is considered a medical exam and applicable law restricting medical examination in employment must be followed. • There is a risk of violating applicable regulations (a written policy, consistent with all relevant laws, should be established to govern the entire drug or alcohol testing program)

Source: U.S. Department of Labor, *Testing and Assessment: An Employer's Guide to Good Practices, p. 4-10, 4-11*

2. *Specific ability tests* include measures of distinct physical and mental abilities, such as reaction time, written comprehension, mathematical reasoning, and mechanical ability, that are important for many jobs and occupations. For example, good abstract thinking may be important for success in dispatching while mechanical ability may be critical for carmen.

Achievement tests, often referred to as proficiency tests, are used to measure an individual's current knowledge or skills that are important to a particular job. Achievement tests fall into two categories:

1. *Knowledge tests* typically involve specific questions to determine how much the candidate knows about particular job tasks and responsibilities. These tests tend to have relatively high validity. A rules examination is an example of a knowledge test.

2. *Work-sample or performance tests* require the candidate to actually demonstrate or perform one or more job tasks. These tests generally show a high degree of job-relatedness. For example, an applicant for a signal maintainer position may be asked to diagnose the problem with a malfunctioning grade crossing signal. Test takers tend to view these tests as fairer than other types of tests. Though there is usually less adverse impact associated with the use of these tests than mental ability tests and job knowledge tests, they can be expensive to develop and administer.

Achievement tests would not be appropriate for screening novice dispatchers with no prior exposure to railroad dispatching.

Biodata inventories are standardized forms that gather job-relevant biographical information, such as amount and type of schooling, job experience, and hobbies. These instruments are used to predict job and training performance, tenure, and turnover. Some individuals might provide inaccurate information on biodata inventories to portray themselves as being more qualified than they really are. Internal consistency checks can be used to detect whether there are discrepancies in the information reported. Reference checks can also be used to verify information.

Some studies have reported reasonable predictive validities for biodata inventories, but their validity depends upon the nature of the information collected, what job attributes it is used to predict and other considerations (Mumford and Owens, 1987). Construct validation can potentially overcome these problems. (See subsection 2.3.1 for a discussion of validation methods.)

The **employment interview** is probably the most commonly used assessment tool. The interview can range from being totally unplanned (unstructured) to being carefully designed beforehand (structured). The most structured interviews have characteristics such as standardized questions, trained interviewers, specific question order, controlled length of time, and a standardized response evaluation format. A completely unstructured interview would probably be done with untrained interviewers, random questions, and with no consideration of

time. A structured interview that is based on an analysis of the job in question is more likely to be a valid predictor of job performance than an unstructured interview. Interviews may contain both structured and unstructured components, however, research has shown that structured interviews are more effective than unstructured interviews (Gatewood and Field, 1994). This type of interview tends to have higher inter-rater reliability (Conway et al., 1995). In addition, a standardized interview places more burden on the instrument than the interviewing and assessment skills of any particular interviewer (Kataoka et al., 1997). This characteristic probably accounts for the high inter-rater reliability of structured interviews in comparison with other methods.

Education and experience requirements are characteristic of most jobs. For example, employers may specify that only applicants with college degrees or equivalent training or experience will be considered. Such requirements are common in many technical and professional jobs. Certain licensing, certification, and education requirements are also mandated by law, as in the case of locomotive engineers, bus drivers and psychologists. This is done to verify minimum competence and to protect public safety.

Requirements for education and experience should be job-related. If such requirements result in adverse impact, it must be demonstrated that they are job-related and justified by business necessity. However, in some cases, job-relatedness might be difficult to demonstrate. For example, it is difficult to show that exactly three years of experience is necessary or that a high school degree is required for a particular job.

Personality inventories designed for use in employment contexts evaluate such characteristics as motivation, conscientiousness, self-confidence, or how well an employee might get along with other workers. Research has shown that, in certain situations, use of personality tests with other assessment instruments can yield helpful predictions of job performance (Hough and Oswald, 2000; Dipboye, Smith and Howell, 1994).

Honesty and integrity measures may be broadly categorized into two types:

1. *Overt integrity tests* gauge involvement in and attitudes toward theft and employee delinquency. Test items typically ask for opinions about frequency and extent of employee theft, leniency or severity of attitudes toward theft, and rationalizations of theft. They also include direct questions about admission of, or dismissal for, theft or other unlawful activities.

2. *Personality-based measures* typically contain disguised-purpose questions to gauge a number of personality traits. These traits are usually associated with a broad range of counterproductive employee behaviors such as insubordination, excessive absenteeism, disciplinary problems, and substance abuse.

Test takers may raise privacy concerns or question the relevance of these measures to job performance. If an honesty test is used to select candidates for a particular job, the business

necessity of such a test must be demonstrated. This would require a detailed job analysis, including an assessment of the consequences of hiring a dishonest individual.

Recommendations and reference checks are often used to verify education, employment, and achievement records already provided by the candidate in some other form, such as during an interview or on a resume or application form. This is primarily done for professional and high-level jobs. These verification reports generally do not help to distinguish between potentially good workers and poor workers because they almost always result in positive reports. However, use of these measures may serve two important purposes:

- They provide an incentive to candidates to be more honest with the information they provide.

- They safeguard against potential negligent hiring lawsuits.

Assessment centers use a wide variety of instruments and procedures to evaluate prospective candidates. These could include interviews, ability and personality measures, and a range of standardized management activities and problem-solving exercises. Assessment centers are most widely used for managerial and high-level positions to assess managerial potential, promotability, problem-solving skills, and decision-making skills.

Assessors must be appropriately trained. Their skills and experience are essential to the quality of the evaluations they provide. They can be very good predictors of job performance and behavior when the tests and procedures are constructed and used appropriately (Gaugler, Rosenthal, Thronton, and Bentson, 1987). However, recently criticisms of assessment centers have appeared in the personnel selection literature (Hough and Oswald, 2000).

Setting up an assessment center can be very costly. Large companies may have their own assessment centers. Small and mid-size companies sometimes send candidates to private consulting firms for evaluation.

Medical examinations are used to determine if a person can safely and adequately perform a specific job. For example, color blindness may disqualify an individual from becoming a dispatcher. Medical exams may also be part of a procedure for maintaining comprehensive employee health and safety plans. In some limited circumstances, medical exams may be used for evaluating employee requests for reasonable accommodation for disabilities.

Administering medical exams to job applicants or asking questions related to disability prior to making a job offer is prohibited. Once an organization makes a job offer to an applicant, a medical exam can be required as long as it is required of *all* persons entering the same job category. A medical exam can be required even if it bears no relevance to job performance. However, refusal to hire based upon the results of a medical exam must be justified by issues of job-relevance and business necessity.

Drug and alcohol tests are often administered by employers when federal law prohibits the use of alcohol and illegal drugs at the workplace or when company policy requires that employees not be under the influence of either while on the job. Some commonly reported work behaviors and outcomes associated with alcohol and drug abuse are industrial accidents, work-related injuries, excessive absenteeism or tardiness, and workplace violence.

2.3 Validation of Assessment Methods

The validity of any of the selection methods described above in subsection 2.2 must be determined to assure that it will in fact measure the worker characteristics important to the job. The process of validation is discussed below in terms of assessment tests. Before a test is selected to screen for a particular position, the quality and usefulness of the test must be established.

2.3.1 Measures of Quality and Usefulness

Test reliability and validity are two technical properties of a test that indicate the quality and usefulness of the test. These metrics can apply to any assessment method but are most frequently discussed in terms of test instruments. They are the two most important features of a test. *Reliability* refers to how dependably or consistently a test measures a characteristic. A test that yields similar scores for a person who repeats the test is said to measure a characteristic reliably. Reliable assessment tests produce dependable, repeatable, and consistent information about people that can contribute to making beneficial employment decisions.

Test manuals and independent reviews of tests provide information about test reliability. The reliability of a test is indicated by the *reliability coefficient*. It is denoted by the letter "r" and is expressed as a number ranging between 0 and 1.00, with r = 0 indicating no reliability, and r = 1.00 indicating perfect reliability. Test administrators should not expect to find a test with perfect reliability. Generally, the reliability of a test is reported as a decimal, for example, r = 0.80. The larger the reliability coefficient, the more repeatable or reliable the test scores. Table 2 provides general guidelines for interpreting test reliability. However, the selection or rejection of a test should not be based solely on the size of its reliability coefficient. To fully evaluate a test's reliability, the type of test, the type of reliability estimate reported, and the context in which the test will be used must be considered.

There are several types of reliability estimates, each influenced by different sources of measurement error. Test developers have the responsibility of reporting the reliability estimates that are relevant for a particular test. The acceptable level of reliability will differ depending on the type of test and the reliability estimate used. The following types of estimates of reliability are frequently reported:

- *Test-retest reliability* indicates the repeatability of test scores with the passage of time. This estimate also reflects the stability of the characteristic being measured by the test. Because some characteristics, such as reading ability, are more stable than others over time, their reliability coefficients are likely to be higher.

Table 2. Interpretation of test reliability coefficient

Reliability Coefficient	Interpretation
0.90 and above	Excellent
0.80 - 0.89	Good
0.70 - 0.79	Adequate
Below 0.70	May have limited applicability

- *Alternate* or *parallel form reliability* indicates how consistent test scores are likely to be if a person takes two or more forms of the test.

- *Inter-rater reliability* indicates how consistent test scores are likely to be if two or more raters score the test. This applies to tests where raters evaluate responses to questions and score them. Inter-rater reliability coefficients are typically lower than for other types of reliability, but higher levels can be achieved if raters are appropriately trained.

- *Internal consistency reliability* indicates the extent to which items on a test measure the same characteristic. High values for this type of reliability estimate indicate that the items on the test are very similar to each other in content.

Test developers also report a statistic called the *standard error of measurement (SEM)*. It gives the margin of error that can be expected in an individual test score because of imperfect reliability of the test. The SEM represents the degree of confidence that a test taker's "true" score lies within a particular range of scores. For example, a score of 90 and a SEM of 2 suggests the test taker's "true" score lies between 89 and 91. The smaller the SEM, the more accurate the measurements.

The process of establishing the job-relatedness of a test or other assessment method is referred to as *validation*. *Validity* refers to what characteristic the test measures and how well the test measures that characteristic. Validity is the most important issue in selecting a test. Validity indicates that the characteristic being measured by a test is related to job qualifications and requirements. Validity gives meaning to test scores. Validity evidence indicates that there is a linkage between test performance and job performance. If a test has been demonstrated to be a valid predictor of performance on a specific job, persons scoring high on this test are more likely to perform well on the job than persons who score low on the test, all else being equal.

A test's validity is established in reference to a specific purpose. The test may not be valid for different purposes. For example, a test that validly predicts mechanical proficiency may not be a valid predictor of problem-solving ability. Similarly, a test's validity is established in reference to specific groups of job candidates. The test may not be valid for different groups. For example, a test designed to predict managers' leadership performance might not be useful for predicting the leadership performance of clerical workers.

The *Uniform Guidelines* discuss three methods of conducting validation studies and describe conditions under which each type of validation strategy is appropriate. These methods are:

1. *Criterion-related validity* applies to tests that are used to predict employee and applicant job performance. In testing terms, whatever a test is designed to predict is called the criterion. A criterion can be any measure of work behavior or any outcome that can be used as the standard for successful job performance. Criterion-related validity requires demonstration of a correlation or other statistical relationship between test performance and job performance. In other words, individuals who score high on the test tend to perform better on the job than those who score low on the test. For example, for the position of millwright, employee's scores (predictors) on a test designed to measure mechanical skill could be correlated with their performance in servicing machines (criterion) in the mill. If the correlation is sufficiently high, it can be said that the test has a high degree of validation support, and its use as a selection tool would be appropriate. If the criterion is obtained at the same time the test is given, it is called concurrent validity; if the criterion is obtained at a later time, it is called predictive validity.

2. *Content validity* requires a demonstration that the content of a test represents important job-related behaviors. In other words, test items should be relevant to and measure directly important requirements and qualifications for the job. For example, a keyboard skills test would yield high validation support for a dispatcher position, assuming the dispatching center uses computer-aided dispatching (CAD) and all directives and records are computer-based. If, however, the job required only minimal typing, then the same test would have little content validity.

3. *Construct validity* requires a demonstration that a test measures the construct or characteristic it claims to measure, and that this characteristic is important to successful performance on the job. People differ on many psychological characteristics such as intelligence. Intelligence is referred to as a hypothetical construct because it cannot be observed directly, but its effects on other variables, such as certain job-related behaviors, can be observed. For example, if a publishing company wanted to test the verbal aptitude of applicants for a proofreading position, the company would have to demonstrate that the test actually measured verbal aptitude and that a certain level of verbal aptitude is necessary for success on the job.

Professionally developed tests should include reports on validity evidence, including detailed explanations of how validation studies were conducted. Employers have the ultimate responsibility for making sure that validity evidence exists for the employment decisions made as a result of using assessment tests. This applies to all assessment tests, whether they have been purchased off-the-shelf, developed externally, or developed in-house. Companies or consultants specializing in employment testing can provide assistance in interpreting test validity and reliability information.

2.3.2 Interpreting Validity Information

In evaluating validity information, it is important for an employer to determine if the test in question can be used in the specific way the employer intends, and whether the employer's target group is similar to the test reference group. Test manuals and reviews should provide:

- Validation evidence supporting use of the test for specific purposes. The manual should include a thorough description of the procedures used in the validation studies and the results of those studies.

- The possible valid uses of the test. The purposes for which the test can be legitimately used should be described, as well as the performance criteria that can be validly predicted.

- The sample group(s) on which the test was developed. For example, was the test developed on a sample of high school graduates, managers, or clerical workers? What was the racial, ethnic, age, and gender mix of the sample?

- The group(s) for which the test may be used.

The *validity coefficient* measures the criterion-related validity of a test. It is reported as a number between 0 and 1.00 that indicates the magnitude of the relationship, "r," between the test (predictor) and a measure of job performance (criterion). The larger the validity coefficient, the greater the likelihood that predictions based upon test scores will be accurate. However, a single test can never fully predict job performance because success on the job depends on so many varied factors. Therefore, validity coefficients, unlike reliability coefficients, seldom exceed $r = 0.40$.

As a general rule, the higher the validity coefficient, the more beneficial it is to use the test. Validity coefficients of $r = 0.21$ to $r = 0.35$ are typical for a single test. Validities for selection systems that use multiple tests will probably be higher because they measure/predict several different aspects of job performance, whereas a single test is not likely to measure/predict as many aspects of total job performance. Table 3 serves as a general guideline for interpreting the validity for a single test.

Table 3. Interpretation of test validity coefficient

Validity Coefficient	Interpretation
Above 0.35	Very beneficial
0.21 to 0.35	Likely to be beneficial
0.11 to 0.20	Depends on circumstances
Below 0.11	Unlikely to be useful

Evaluating test validity is a sophisticated task and may require the services of a testing expert. In addition to the magnitude of the validity coefficient, the following factors, at a minimum, should be considered:

- Level of adverse impact associated with the assessment test.
- Selection ratio (number of applicants to the number of openings).
- Cost of a hiring error (i.e., hiring someone who leaves the position or becomes a poor performer).
- Cost of the selection tool.
- Probability of hiring a qualified applicant based on chance alone.

Validity evidence is especially critical for tests that may have adverse impact. Adverse impact refers to a situation in which members of a particular race, sex, ethnic or other protected group have a substantially lower rate of selection in hiring, promotion or other employment decisions. (Subsection 2.5 contains a discussion of adverse impact.) When a test has adverse impact, the *Uniform Guidelines* require that validity evidence for that specific employment decision be provided.

2.3.3 Using Validity Evidence from Outside Studies

Many employers find it advantageous to use professionally developed assessment tests and procedures for which documentation on validity already exists. However, care must be taken to make sure that validity evidence obtained for an "outside" test study can be suitably "transported" to the employer's particular situation. The *Uniform Guidelines* and the *Standards* state that evidence of transportability is required. Therefore, test administrators should consider the following when using an outside test:

- *Validity evidence.* The validation procedures used in the studies must be consistent with accepted standards.
- *Job similarity.* A job analysis should be performed to verify that the job for which there is a vacancy and the original job for which the validity evidence was collected are substantially similar in terms of ability requirements and work behaviors.
- *Fairness evidence.* Reports of test fairness from outside studies must be considered for each protected group that is part of the employer's labor market. Where this information is not available for an otherwise qualified test, an in-house study of test fairness should be conducted, if feasible.
- *Other significant variables.* These include the type of performance measures and standards used, the essential work activities performed, the similarity of the employer's

target group to the reference samples, as well as other situational factors that might affect the applicability of the outside test to the employer's particular situation.

Identifying appropriate tests to include in a selection program requires careful consideration of many factors. Consultation with testing professionals will ensure that an outside test meets professional and legal standards.

2.4 Employment Laws Governing Personnel Assessment

All assessment methods used to make employment decisions are subject to professional and legal standards. The general purpose of employment laws is to prohibit unfair discrimination in employment and to provide equal employment opportunity for all. Unfair discrimination occurs when employment decisions are based on race, sex, religion, ethnicity, age, or disability rather than on job-relevant knowledge, skills, abilities and other characteristics. Employment practices that unfairly discriminate against people are unlawful and are called discriminatory employment practices.

The following summaries of relevant laws and guidelines focus on selection methods, but are not meant as a substitute for careful reading of specific laws regarding these topics or consultation with legal counsel regarding the implications for proposed assessment programs (U.S. Department of Labor, 1999).

Title VII of the Civil Rights Act (CRA) of 1964 (as amended in 1972) (Public L. 88-352) – Title VII is landmark legislation that prohibits unfair discrimination in all terms and conditions of employment based on race, color, religion, sex or national origin. Subsequent legislation added age and disability to this list.

Tower Amendment to Title VII – The Tower Amendment stipulates that professionally developed workplace tests can be used to make employment decisions. However, only instruments that do not discriminate against any group protected under Title VII can be used.

Age Discrimination in Employment Act (ADEA) of 1967 (Pub. L. 90-202) – This Act prohibits discrimination against employees or applicants aged 40 or older in all aspects of the employment process. If an older worker alleges discrimination under the ADEA, the employer may defend the practice if it can be shown that the job requirements are a matter of business necessity. Certain groups of employees are exempt from ADEA coverage, such as police officers, firefighters, and uniformed military personnel.

Title I of the Civil Rights Act of 1991 (Pub. L. 102-166) – Title I reaffirms the principles established in Title VII of the CRA of 1964, but includes significant changes. The Act prohibits score adjustments, the use of different cutoff scores for different groups of test takers, or alteration of employment-related test results based on the demographics of the test takers. These practices, referred to as race norming, were used by some employers and government agencies to avoid adverse impact. The Act also makes compensatory and punitive damages available as a remedy for claims of intentional discrimination under Title VII and the ADA.

Americans with Disabilities Act (ADA) of 1990 (Pub. L. 101-336) – Under the ADA, qualified individuals with disabilities must be given equal opportunity in all aspects of employment. Prohibited discrimination includes failure to provide reasonable accommodation to persons with disabilities when doing so would not pose undue hardship.

Uniform Guidelines on Employee Selection Procedures (1978) – Jointly developed by the Equal Employment Opportunity Commission, the Civil Service Commission (predecessor of the Office of Personnel Management), the Labor Department, and the Justice Department, the *Uniform Guidelines* incorporate a set of principles governing the use of employee selection procedures according to applicable laws. They apply to all tests, inventories, and procedures used to make employment decisions. They provide a framework for employers and other organizations for determining the proper use of tests and other selection procedures. The *Uniform Guidelines* are legally binding under a number of civil rights laws. The courts generally give great importance to the *Uniform Guidelines'* technical standards for establishing the job-relatedness of tests. The *Uniform Guidelines* were intended to be consistent with generally accepted standards for validating and evaluating standardized tests and other selection procedures. In this respect, the *Uniform Guidelines* refer specifically to the *Standards for Educational and Psychological Testing* (EEOC, Office of Personnel Management, U.S. Department of Justice, and U.S. Department of Labor, 1978).

Standards for Educational and Psychological Testing (1999) – Developed jointly by the American Psychological Association, the National Council on Measurement in Education, and the American Educational Research Association, the *Standards* are an authoritative and comprehensive source of information on how to develop, evaluate and use tests and other assessment procedures in educational, employment, counseling and clinical settings. Although developed as professional guidelines, they are consistent with applicable regulations and are frequently cited in litigation involving testing practices (American Psychological Association, National Council on Measurement in Education, and American Educational Research Association, 1999).

2.5 Adverse Impact

One of the basic principles of the *Uniform Guidelines* is that it is unlawful to use a test or selection procedure that creates adverse impact, unless justified. Adverse impact occurs when there is a substantially different rate of selection in hiring, promotion, or other employment decisions that work to the disadvantage of members of one race, sex, or ethnic group. Adverse impact is normally indicated when the selection rate for one group is less than 80 percent (4/5) that of another group. This measure is commonly referred to as the 80 percent or four-fifths rule. However, the four-fifths rule may not be accurate in detecting substantially different rates of selection in very large or small samples. In these cases, more sensitive tests of statistical significance must be employed.

When there is no charge of adverse impact, the *Uniform Guidelines* do not require that the job-relatedness of the assessment procedures be demonstrated. If an assessment process results in adverse impact, it must be eliminated, or its continued use must be justified. For the continued

use of assessment tests or procedures that cause adverse impact, courts have required justification by business necessity as well as evidence that the procedures validly measure job-related characteristics.

Demonstrating the business necessity of using a particular assessment instrument involves showing that its use is essential to the safe and efficient operation of the business and there are no alternative procedures that are substantially equally valid to achieve the business objectives with a lesser degree of adverse impact. Demonstrating the job-relatedness of a test is the same as establishing that the test may be validly used as desired (see subsection 2.3.2).

Another issue of importance discussed in the *Uniform Guidelines* relates to *test fairness*. The *Guidelines* define biased or unfair assessment procedures as those assessment procedures on which one race, sex, or ethnic group characteristically obtains lower scores than members of another group and the differences in the scores are not reflected in differences in the job performance of members of the groups.

3. JOB ANALYSIS

As described in subsection 2.1, a job analysis forms the basis for any selection program. Understanding the job is key to identifying appropriate selection methods. Since the focus of this research is on developing dispatcher selection guidance that is applicable to a variety of railroad operating environments, the job analysis was designed to provide a generic description of railroad dispatching and not to reflect the unique requirements of a specific railroad. This section describes the job analysis procedure that was used and the dispatcher job tasks, duties and work behaviors that were identified by the job analysis process. The elements of the job analysis process and their relationship to the resulting dispatcher KSAOs are shown in Figure 3.

3.1 Procedure

There are a variety of methods for performing a job analysis. A widely used method is the Position Analysis Questionnaire (PAQ®). The PAQ methodology is a systematic investigation into work behaviors that relates job characteristics to human characteristics. The PAQ instrument consists of 187 job elements or items of a generic nature that provide for analyzing jobs in terms of work activities and work-situation variables. These 187 job elements are divided into the following six categories:

1. Information Input.
2. Mental Processes.
3. Work Output.
4. Relationships with Other Persons.
5. Job Context.
6. Other Job Characteristics.

The PAQ job elements are "worker-oriented" in that they characterize, or strongly imply, the generic human behaviors that are involved in jobs. In contrast, a "job-oriented" or "task-oriented" approach deals more with the technological processes of jobs or with the specific objective or results of work. The nature of the job elements of the PAQ makes it appropriate for analyzing virtually any type of position or job. For the past 30 years a wide variety of organizations has successfully used the PAQ methodology for conducting job analyses. The PAQ provides reliable and valid job data and its methods are supported by extensive research. Because of the widespread use and acceptance of the PAQ, it was selected as the methodology for the job analysis of railroad dispatchers.

The purpose of the job analysis for this research was to develop a general profile of the job of railroad dispatcher. The intent was not to analyze dispatchers at a specific railroad. For this

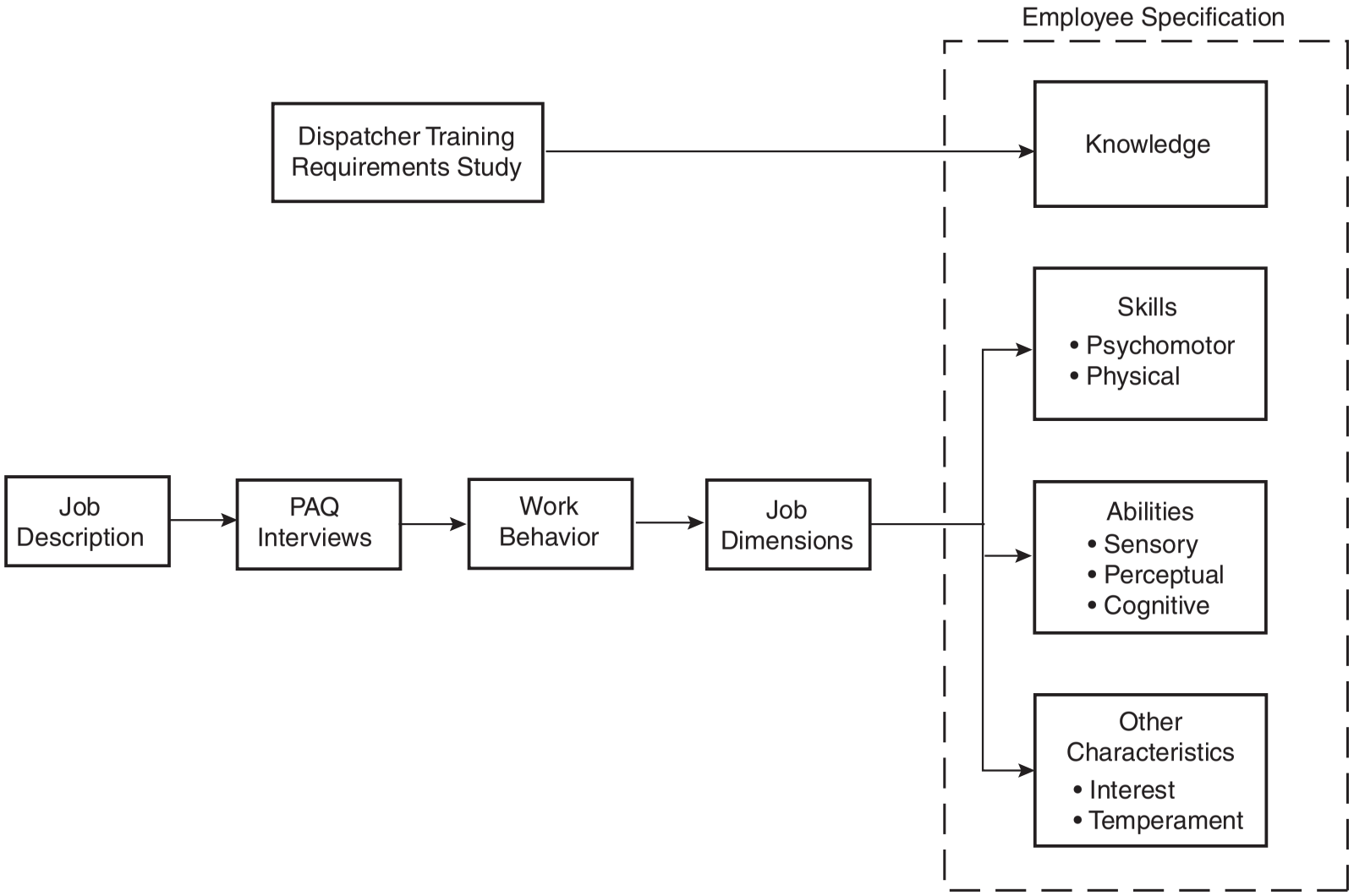

Figure 3. Elements of the PAQ job analysis

reason, input from dispatchers at four different dispatching centers formed the basis for the analysis. The four dispatching centers represented Class 1, commuter and short line operations. The PAQ methodology requires that job analysis interviews be conducted with job incumbents either individually or in small groups. These interviews consist of a structured discussion of the job that allows the job analyst to evaluate the job, based on the information obtained from the interviewees, in terms of each of the 187 PAQ job elements (McPhail, Jeanneret, McCormick, and Mecham, 1998).

A job analyst interviewed dispatchers from four dispatching operations in groups of up to four individuals. The number of dispatchers at each center determined the number of interviewees. In general, the PAQ methodology recommends that 10 percent of the incumbents in the job be interviewed. However, if there are over 200 incumbents, then as few as 5 percent is adequate. Table 4 presents the distribution of the interviewees for this study. Dispatchers participated in the PAQ interviews on their own time and were compensated for their participation.

Table 4. Distribution of interviewees

Dispatching Operation	Number of Interviewees	Number of Interview Groups
MetroNorth Railroad	6	2
Metra Railroad	3	1
Conrail Shared Assets	3	1
BNSF	24	8
Total	36	12

The job analyst coded the responses from each set of interviews. PAQ Services, Inc., North Logan, Utah, analyzed the coded responses and provided the results that are presented in this section and Section 4.

The PAQ results from the individual sites were so similar that they are reported here as a composite based on the input from the interview participants at all four sites.

3.2 Job Tasks and Duties

The job analysis procedure typically begins with a description of the job. The U.S. *Department of Labor's Dictionary of Occupational Titles* (1991) contains a description for "train dispatcher."[1] This definition has not been revised since 1977 and does not reflect the changes in technology and operating procedures that have occurred over the past 20 years. A more up-to-date description of the duties and responsibilities of a railroad dispatcher, without reference to the specific technology employed, is the following:

[1]This study uses the term "railroad dispatcher" rather than "train dispatcher" to reflect the fact that a dispatcher is responsible for all track users, not just trains, and is responsible for managing unplanned events that may not involve a train.

- Dispatch trains and other vehicles/equipment that travel on or along the rail safely and efficiently, and protect those individuals who work on or around the track. Principle duties include:

- Monitor radio and telephone and communicate with other railroad personnel regarding train and track information.

- Schedule the routing and movement of trains to provide for safe meets and passes.

- Arrange for track use by engineering forces for maintenance activities.

- Manage unplanned events to protect the safety of the public, railroad employees and railroad property.

- Maintain records of train movements, track assignments, maintenance activities and other events.

Duties may be carried out with manual processes and/or computer-aided dispatching systems.

3.3 Work Behaviors

Each of the 187 PAQ items is evaluated using one of four scales. These scales are the following:

- Extent of use – specifies to what extent the source of information described in an item is used in performing the job.

- Importance to this job – specifies how important the activity described in an item is to the performance of the job.

- Amount of time – reflects the proportion of time that the dispatcher is exposed to each condition or engaged in a particular activity.

- Possibility of occurrence – indicates the likelihood that the worker will be exposed to job-related hazards.

The ratings for each of the scales are presented in Table 5. Three PAQ items having to do with responsibility use a separate scale, which is also included in Table 5.

Table 6 describes the work behaviors characteristic of the railroad dispatcher position. Each work behavior has several associated items. Only those items with ratings of 3 or more are shown. Given the nature of railroad dispatching, it is not surprising that the "Sensory," "Cognitive" and "Job Demands" categories have the largest numbers of highly-ranked items.

Table 5. PAQ rating scales

Rating	Extent of Use	Scale			
		Importance to Job	Amount of Time	Possibility of Occurrence	Level of Responsibility
0	Does not apply	Does not apply	Does not apply	Almost no possibility	Does not apply
1	Nominal/Very Infrequent	Very Minor	Under 1/10 of time	Very limited	Very limited
2	Occasional	Low	Between 1/10 and 1/3 of time	Limited	Limited
3	Moderate	Intermediate	Between 1/3 and 2/3 of time	Moderate	Intermediate
4	Considerable	High	Over 2/3 of time	Fairly high	Substantial
5	Very Substantial	Extreme	Almost continually	High	Very substantial

Table 7 lists the PAQ-identified work behavior items from Table 6 that have the highest percentile scores. This percentile indicates the number of jobs in a representative sample of 2200 jobs in the U.S. economy that had scores equal to or lower than the job/position analyzed. The percentile scores indicate the items, dimensions, or attributes that have particular significance for a job. Items with a percentile score of 70 or over are considered to be important aspects of the job and are reported here. A percentile score of over 90 indicates an item that is extremely important.[2]

The organization of the PAQ reflects a worker-job frame of reference, with items being separated into divisions representing various types of such interactions. The divisions provide a logical structure to use in approaching the analysis of any job and in organizing the data obtained from the job analysis (McPhail, et al., 1998). There are six divisions that address the various types of activities a person may encounter in a job:

1. *Information Input* is concerned with where and how workers obtain the information to perform their jobs. Information may be acquired from written sources, oral instructions, observations of visual displays or materials being processed, or other sources.

2. *Mental Processes* delineates the mental activities required to perform jobs, including the combination of information input with knowledge obtained from previous education, training, and experience.

[2]Personal communication with P. R. Jeanneret, Ph.D., one of the developers of the PAQ.

Table 6. Highly-ranked items associated with dispatcher work behaviors

Work Behavior	Item Name	Scale	Rating
Sensory	Verbal sources	Extent of Use	Very Substantial
	Visual displays	Extent of Use	Very Substantial
	Events or circumstances	Extent of Use	Very Substantial
	Pictorial materials	Extent of Use	Considerable-Substantial
	Mechanical devices	Extent of Use	Considerable-Substantial
	Written materials	Extent of Use	Considerable
	Near-visual acuity	Extent of Use	Considerable detail
	Quantitative materials	Extent of Use	Moderate
Perceptual	Far-visual acuity	Importance	Average-High
Cognitive	Short-term memory	Importance	Extreme
	Estimating time	Importance	High-Extreme
	Decision making	Extent of Use	Substantial-Very Substantial
	Reasoning in problem-solving	Extent of Use	Substantial-Very Substantial
	Amount of Planning/Scheduling	Extent of Use	Very Substantial
	Combining information	Importance	High
	Analyzing information	Importance	High
Psychomotor	Machines/equipment	Importance	Extreme
	Keyboard devices	Importance	High-Extreme
	Remote-controlled equipment[3]	Importance	High-Extreme
	Finger manipulation	Importance	High
Physical	Sitting	Amount/Time	Almost All
Social/Communications	Routine information exchange	Importance	Extreme
	Non-routine information exchange	Importance	Extreme
	Job-required personal contact	Importance	Extreme
	Supervisors	Importance	High
	Manual and service workers	Importance	High
Work Conditions/Hazards	Noise intensity	Occurrence	Moderate
Job Demands	Specified work pace	Importance	Extreme
	Following set procedures	Importance	Extreme
	Time pressure of situation	Importance	Extreme
	Precision	Importance	Extreme
	Attention to detail	Importance	Extreme
	Vigilance: infrequent events	Importance	Extreme
	Vigilance: frequent events	Importance	Extreme
	Working under distractions	Importance	High-Extreme
	Updating job knowledge	Importance	High
	Repetitive activities	Importance	High
	Cycled work activities	Importance	High
Responsibilities	Coordination of activities	Importance	High
	Responsibility for safety of others	Responsibility	Substantial-Very Substantial
	Responsibility for material assets	Responsibility	Substantial-Very Substantial
	General responsibility	Responsibility	Substantial-Very Substantial

[3]"Remote-controlled equipment" refers to equipment that causes a change in something that is remote from the operator.

Table 7. PAQ work behaviors with highest percentile scores

Item Name	Percentile
Use of Remote-Controlled Equipment	99
Specified work pace	99
Supervision of Track Occupants	99
Use of machines/equipment	99
Color Perception	98
Vigilance for Infrequent Events	98
Coordination of Activities	98
Nonroutine Information Exchange	98
Machines/equipment	98
Use of Visual Displays	97
Responsibility for the Safety of Others	97
Vigilance for Continually Changing Events	97
Awareness of Events or Circumstances	97
Sitting	96
Amount of Planning and Scheduling	96
Time Pressure of Situation	96
Routine Information Exchange	95
Use of mechanical devices	94
Use of Keyboard Devices	94
Use of Pictorial Materials, Including Maps and Diagrams	94
Reasoning in Problem Solving	94
Decision Making	94
Short-Term Memory	93
Recognition	93
Following Set Procedures	93
Estimating time	92

3. *Work Output* describes physical activity, including the use of the body (i.e., hands, arms, legs, etc.), as well as the use of tools, control mechanisms, or other devices to either directly or indirectly accomplish a desired objective.

4. *Relationships with Other Persons* deals with relationships with other persons. Interpersonal aspects of jobs include both the nature of communications, as well as the roles of the people with whom the individual communicates. Some jobs require only nominal relationships with other people, whereas other jobs demand a greater participation.

5. *Job Context* relates to the physical and social contexts in which the work is performed, or the individual's work environment.

6. *Other Job Characteristics* such as work schedule, job demands, responsibilities, job structure, and criticality of position, are intended to help distinguish between jobs that might otherwise be quite similar.

The six divisions are sub-divided into job dimensions. Table 8 presents the evaluation of the railroad dispatcher job in terms of the various PAQ job dimensions. Percentile ratings for all of the PAQ job dimensions are presented in Table B-1 in Appendix B. Table 8 contains only the most significant job dimensions for a dispatching job. Job dimensions with a percentile score of 70 or more are considered "most significant." These may be considered the most important dimensions of the job in terms of defining desirable employee characteristics. The PAQ methodology uses these job dimensions to define the employee characteristics of candidates most likely to perform successfully in the job of railroad dispatcher.

Table 8. Percentile ratings of most significant job dimensions associated with PAQ job divisions

Division	Dimension Name	Percentile
Information Input	Using Various Sources of Information	93
	Interpreting What is Sensed	75
Mental Processes	Processing Information	77
	Making Decisions	74
Work Output	Using Machines and/or Equipment	97
	Using Miscellaneous Equipment (Remote-Controlled)	93
Relationships with Other Persons	Exchanging Job-Related Information	75
Job Context	None	
Other Job	Performing Unstructured versus Structured Work	98
Characteristics	Being Alert to Changing Conditions	96
	Wearing Specified versus Optional Apparel	79
	Working Under Job-Demanding Circumstances	78
	Working on an Irregular versus Regular Schedule	74
	Working Non-Typical versus Day Schedule	71

4. EMPLOYEE SPECIFICATION

After the tasks, duties, and responsibilities associated with a job have been determined, they can be used to extrapolate the personal characteristics necessary to perform a job. This section presents the knowledge, skills, abilities and other characteristics identified for the job of railroad dispatcher. The knowledge requirements are based on an earlier study of railroad dispatchers. The PAQ methodology identified the relevant skills, abilities and other characteristics.

4.1 Knowledge

The specialized knowledge characteristic of most train dispatcher positions is typically learned on the job (Reinach, Gertler, and Kuehn, 1998) and includes:

- Knowledge of the basic operational and administrative structure of the railroad.
- Knowledge of the railroad's operating and safety rules, including applicable federal regulations.
- Knowledge of movement authority and protective authority, including procedures for controlling signals, switches, and blocking devices.
- Knowledge of track bulletins, train dispatcher bulletins, special instructions, and other forms of operational updates.
- Knowledge of procedures for an unplanned event or emergency.
- Knowledge of the general principles of railway signaling.
- Knowledge of the terminology, jargon, and shorthand used by dispatchers.
- Knowledge of the characteristics of rolling stock such as power ratings and types of locomotives as well as types, capacities, usage, and tonnage of railroad cars.
- Knowledge of the physical and operating characteristics of different types of equipment used on the railroad.
- Knowledge of the physical characteristics of the dispatcher's assigned territory.

- Knowledge of procedures for the transport of hazardous materials, including precautions, emergency procedures, and placement within a train.

- Knowledge of the electric power traction systems (i.e., third rail or catenary) used by the railroad, if applicable.

- Knowledge of appropriate radio and telephone communications protocols.

- Knowledge of record keeping and reporting requirements.

Most railroads hire dispatchers with a minimum of a high school diploma but many have begun to recruit college graduates. Information from the PAQ group interviews confirmed this education requirement.

4.2 Skills

Skill is often defined as a proficiency or expertness (mental or physical) that results from a combination of experience, training, practice and innate capacity. In terms of the job analysis, job-related skill requirements refer to only proficiency in specific psychomotor and physical activities. The PAQ identifies psychomotor and physical skills required by the position of railroad dispatcher. Only one psychomotor skill, "simple reaction time" was in the 70th percentile or higher. There were no physical skills that exceeded this threshold, and the highest ranked physical skill, "explosive strength," was at the 31st percentile. Complete results from the PAQ analysis are in Table B-2 in Appendix B. As these results indicate, the job of a dispatcher has low physical skill requirements and "simple reaction time" is the primary psychomotor skill.

4.3 Abilities

Ability is a term that is often used synonymously with skill. In terms of the job analysis, it is intended to refer only to proficiency in the mental activities specified in Table 9.

Table 9 lists and describes the sensory, perceptual, and cognitive ability requirements associated with the railroad dispatcher position. Complete PAQ results are in Table B-3 in Appendix B. According to the PAQ results, "auditory acuity" is the most important sensory ability. This reflects the fact that dispatchers spend a good deal of time communicating with train crews and other track users over the radio. The dispatcher's need to deal with peaks in workload, characterized by multiple sources of information, rapidly changing conditions and the need for decisiveness is reflected in the perceptual abilities listed in Table 9. The relatively large number of cognitive abilities shown in Table 9 is proof of the cognitive nature of this job.

4.4 Other Characteristics

Other characteristics refer to personal characteristics such as preferences, values, and predispositions. Table 10 lists and describes the significant interest and temperament requirements associated with the railroad dispatcher position. Complete PAQ results are in Table B-4 in Appendix B.

Table 9. Significant sensory, perceptual, and cognitive abilities

Ability	Attribute Name and Description	Percentile
Sensory	*Auditory Acuity* - ability to perceive relevant cues by sound.	69
Perceptual	*Closure* - ability to perceptually organize a chaotic or disorganized field into a single perception	91
	Perceptual Speed - ability to make rapid discriminations of visual detail.	89
	Selective Attention - the ability to perform a task in the presence of distracting stimulation or under monotonous conditions without significant loss in efficiency.	85
	Time Sharing - the ability to utilize information obtained by shifting between two or more channels of information. The information obtained from these sources is either integrated and used as a whole or retained and used separately.	79
Cognitive	*Short-Term Memory* - ability to learn and store pertinent information and selectively retrieve or recall, within a brief period of time, that which is relevant to a specific context.	85
	Long-Term Memory - ability to learn and store pertinent information and selectively retrieve or recall, much later in time, that which is relevant to a specific context.	82
	Intelligence - the level of abstraction or symbolic complexity with which one can ultimately deal.	80
	Convergent Thinking - ability to select from possible alternative methods, the method of processing information that leads to the potentially best answer or solution to a problem.	80
	Divergent Thinking - ability to generate or conceive new or innovative ideas or solutions to a problem.	77
	Problem Sensitivity - the ability to recognize or identify the existence of problems. This attribute does not include any of the reasoning necessary for the solution of a problem.	72
	Verbal Comprehension - ability to understand the meaning of words and the ideas associated with them.	70

Table 10. Significant interest and temperament charracteristics

Characteristic	Attribute Name and Description	Percentile
Interest	*Directing/Controlling/Planning* - operations involving the activities of others, or processes with which others are involved.	80
	Variety of Duties - duties often characterized by frequent change.	71
Temperament	*Pressure of Time* - working in situations where time is a critical factor for successful job performance.	96
	Attainment of Set Standards - attainment of set limits, tolerances, or standards.	96
	Measurable/Verifiable Criteria - arriving at generalizations, judgements, or decisions based on known or obtainable standards, or characteristics, or dimensions.	89
	Sensory Alertness - alertness over extended periods of time.	88
	Conflicting/Ambiguous Information - ability to tolerate and critically evaluate information of an uncertain or opposing nature.	84
	Working Under Specific Instructions - i.e., those that allow for little or no room for independent action or judgement in working out job problems.	83
	Social Welfare - working with people for their presumed good.	74

4.5 Overall Job Requirements

Table 11 provides a summary of the job attributes with the percentile scores of 70 or more. (The items in Table 11 are a combined list of the skills, abilities and other characteristics that appear in Tables 9 and 10.) Job attributes in this percentile range are considered most significant in terms of uniquely defining a job. Three attributes – pressure of time, attainment of set standards and closure – have percentile ratings over 90. This suggests that these attributes are extremely important to the job of railroad dispatcher. Based on the PAQ analysis, individuals who have these skills, abilities and other characteristics will likely perform satisfactorily in railroad dispatching. Therefore, selection methods should focus on assessing these attributes. In terms of knowledge, dispatchers must at a minimum have a high school degree. Job specific knowledge, as described in subsection 4.1, is acquired through the railroad's dispatcher training program unless the candidate has prior dispatching experience.

Table 11. Highest ranked skills, abilities and other characteristics

Attribute Name and Description	Percentile
Pressure of Time - working in situations where time is a critical factor for successful job performance.	96
Attainment of Set Standards - attainment of set limits, tolerances, or standards.	96
Closure - ability to perceptually organize a chaotic or disorganized field into a single perception.	91
Measurable/Verifiable Criteria - arriving at generalizations, judgements, or decisions based on known or obtainable standards, characteristics, or dimensions.	89
Perceptual Speed - ability to make rapid discriminations of visual detail.	89
Sensory Alertness - alertness over extended periods of time.	88
Selective Attention - the ability to perform a task in the presence of distracting stimulation or under monotonous conditions without significant loss in efficiency.	85
Short-Term Memory - ability to learn and store pertinent information and selectively retrieve or recall, within a brief period of time, that which is relevant to a specific context.	85
Conflicting/Ambiguous Information - ability to tolerate and critically evaluate information of an uncertain or opposing nature.	84
Working Under Specific Instructions - i.e., those that allow little or no room for independent action or judgement in working out job problems (rules and regulations).	83
Long-Term Memory - ability to learn and store pertinent information and selectively retrieve or recall, much later in time, that which is relevant to a specific context.	82
Directing/Controlling/Planning - operations involving the activities of others, or processes with which others are involved.	80
Intelligence - the level of abstraction or symbolic complexity with which one can ultimately deal.	80
Convergent Thinking - ability to select from possible alternative methods, the method of processing information that leads to the potentially best answer or solution to a problem.	80
Time Sharing - the ability to utilize information obtained by shifting between two or more channels of information. The information obtained from these sources is either integrated and used as a whole or retained and used separately.	79
Simple Reaction Time - the period of time elapsing between the appearance of any stimulus and the initiation of an appropriate response.	78
Divergent Thinking - ability to generate or conceive new or innovative ideas or solutions to a problem.	77
Social Welfare - working with people for their presumed good.	74
Problem Sensitivity - the ability to recognize or identify the existence of problems. This attribute does not include any of the reasoning necessary for the solution of a problem.	72
Variety of Duties - duties often characterized by frequent change.	71
Verbal Comprehension – ability to understand the meaning of words and the ideas associated with them.	70

5. METHODS FOR ASSESSMENT OF DISPATCHER CANDIDATES

A number of methods are suitable for assessing applicants' KSAOs with respect to the job of railroad dispatcher. This section discusses each method in terms of the specific dispatcher KSAO that it can assess and offers some suggestions regarding the application of each method to the assessment of dispatcher candidates. Table 12 summarizes the suitable methods for each KSAO. Regardless of the method, each railroad must establish validity of the method for screening dispatchers in its environment. For available tests, this can be done from published validity and reliability statistics. Face validity may be acceptable for the other methods. Since validation must be done relative to each railroad's environment it was not a part of the present study.

5.1 Test Instruments

The PAQ methodology identifies test instruments that have been proven to be valid in screening for the knowledge, skills, abilities and other characteristics identified through the PAQ job analysis. Based on the unique set of skills needed for the job, the PAQ methodology and analysis identifies specific tests that will detect these skills in the applicants.

When the PAQ methodology was developed, the General Aptitude Test Battery (GATB) of the United States Employment Service was an accepted and commonly used test for candidate assessment. This instrument was designed to test nine abilities for a broad range of jobs. The

Table 12. Assessment methods for dispatcher candidates

Characteristic	Item	Method(s)
Knowledge	Railroading and Dispatching	Interview Biodata questionnaire References
Skills	Psychomotor	Test
Abilities	Sensory – auditory	Test
	Perceptual	Interview References
	Cognitive	Test
Other Characteristics	Interest	Interview Test
	Temperament	Interview Test

PAQ developers chose to validate the PAQ methodology against this widely used aptitude test. Since the development of the PAQ, potential adverse impact consequences of the GATB have been identified. For this reason, the PAQ methodology also suggests some other available tests that will assess the same skills and abilities as the GATB. Table 13 presents the target GATB scores that are indicative of skill levels required for the job of railroad dispatcher. The table also provides information on the extent to which these tests will be helpful in assessing candidates as potential railroad dispatchers.

The predicted score range in Table 13 consists of low, average and high scores. The average value is an average for satisfactorily performing railroad dispatchers. The low and high values indicate scores within one standard deviation of the average. Only 16 percent of individuals satisfactorily performing the job would have scores below the low score. Similarly, only 16 percent will have scores above the high score.

The information in the right-hand column of Table 13 helps to determine whether or not the test is useful as part of a selection program for identifying candidates who are likely to adequately perform the job of railroad dispatcher. The "predicted validity coefficient" is an estimate of the correlation between test score and successful job performance. (See subsection 2.3.2 for a discussion of validity.) The higher the validity coefficient, the more likely that the test will be useful as a predictor of job performance. A validity coefficient of over 0.20 indicates that the test is likely to be beneficial to the selection process. In Table 13, the GATB components that are above this threshold value are marked with an asterisk (*).

Based on the predicted validity coefficients, the PAQ analysis identified three skills and abilities that can be effectively assessed through testing. These are: intelligence, numerical

Table 13. Predicted GATB results for railroad dispatchers

	Predicted Score Range			
GATB Component	Low	Average	High	Predicted Validity Coefficent
Intelligence*	103	116	129	0.262
Verbal Aptitude	98	112	126	0.175
Numerical Aptitude*	100	115	129	0.276
Spatial Aptitude	88	106	123	0.119
Form Perception	93	109	126	0.144
Clerical Perception	101	116	131	0.156
Motor Coordination*	93	109	126	0.229
Finger Dexterity	82	101	120	0.069
Manual Dexterity	82	102	122	0.112

*Validity coefficient exceeds 0.2.

aptitude, and motor coordination. Since the GATB is rarely used in the United States due to potential adverse impact, PAQ Services identified alternate tests that are equally valid test instruments for assessing these skills and abilities. Table 14 lists each of the three GATB components with the alternate test instruments.

The PAQ methodology suggests tests that will identify candidates with skills required by the job of a railroad dispatcher. Three alternatives to the GATB Intelligence Test and six for the Numerical Aptitude Test were identified by the PAQ analysis. (Appendix C provides information on the test publishers for these tests.) Table 14 presents these alternative tests along with predicted score ranges for candidates likely to perform satisfactorily as a dispatcher. Although measuring motor coordination is important, the PAQ does not offer an alternative to the GATB. Organizations interested in identifying a suitable test for motor coordination can consult the Buros *Mental Measurements Yearbook* (1998). This reference book is also a source for reliability and validity information on the tests listed in Table 14. Another resource for identifying tests is the Test Collection Database from the Educational Testing Service (ETS). The database includes over 10,000 test and research instruments and is accessible through *http://ericae.net.* This web site also provides references to reviews of the instruments in the Test Collection Database.

If a test instrument is part of a dispatcher selection program, the railroad must establish a cut-off or minimum score that a candidate must have to qualify for the position. This is usually established to reflect a level that the railroad has determined is directly related to job success. Candidates who score below the cut-off score are not considered for selection. Test publishers generally recommend that employers base their selection of a cut-off score on the norms for the

Table 14. Alternate test instruments for selected railroad dispatcher skills and abilities

GATB Component and Alternate Tests	Predicted Score Range			Predicted Validity Coefficent
	Low	Average	High	
Intelligence	103	116	129	0.262
Adaptability	17	20	26	
Learning Ability Test	38	44	49	
Wonderlic Personnel Tests	16.5	23.7	31.0	
Numerical Aptitude	100	115	129	0.276
Arithmetic Fundamentals	32	37	41	
Arithmetic Index	41	48	54	
Employee Aptitude Survey	25	35	44	
Flanagan Industrial Tests	28	35	40	
Personnel Tests for Industry	14	21	25	
Short Employment Tests	29	41	53	
Motor Coordination	93	109	126	0.229
None				

test. Literature provided by test publishers along with the PAQ projections for the predicted score ranges can be used to establish an appropriate cut-off score.

The PAQ analysis also provides predictions for the Myers-Briggs Type Indicator® (MBTI®)[4]. The MBTI is a self-report personality inventory that measures basic preferences regarding perception and judgment. It produces scores on four bipolar indices:

- EI – Extroversion versus Introversion.
- SI – Sensing versus Intuitive perception.
- TF – Thinking versus Feeling judgment.
- JP – Judgment versus Perception.

Scores on the MBTI tend to be associated with occupational choice and the percentage of persons within occupations who report a preference for each pole of the four indices. Based on test data for over 25,000 people in 95 occupations, the PAQ job dimensions were correlated with test data from the MBTI. The PAQ developers have shown that the PAQ job dimension scores have considerable potential for deriving estimates of "personality" requirements for jobs (McCormick, Mecham, and Jeanneret, 1998).

The MBTI classifies people by indicating the poles on each index for which they received the highest scores. Based on the PAQ job analysis of railroad dispatchers, the PAQ methodology provides an MBTI prediction. Table 15 contains the likely MBTI profile for a railroad dispatcher. The numbers in the table indicate the percent of satisfactorily performing dispatchers who are likely to have the given psychological type preference. For example, dispatchers are more likely to be sensing (72 percent) than intuitive (28 percent).

In general, railroad dispatchers can be either an extrovert or an introvert, but are sensing, thinking, and judging (STJ). (See Table 15.) These scores indicate a person who prefers dealing with facts and makes decisions using logic along with tried and trusted solutions to solve practical problems. According to the developers of the MBTI, the STJ personality uses logic and analysis as guiding principles in life. S/he has an orderly and logical way of evaluating

Table 15. MBTI predictions for railroad dispatchers (estimated percent with high score)

Psychological Type Preference			
Extroversion (E)	47.1	Introversion (I)	52.8
Sensing (S)	71.9	Intuitive (N)	28.0
Thinking (T)	65.7	Feeling (F)	34.2
Judgment (J)	67.8	Perception (P)	32.1

[4]Myers-Briggs Type Indicator and MBTI are trademarks of Consulting Psychologists Press, Inc.

situations and generally prefers a task-oriented and structured atmosphere. STJs are responsible and strive to complete tasks. They exhibit keen observation and develop good understanding of situations. They observe rules and procedures, are practical and realistic and strive for accuracy. This personality type is often attracted to a job that requires the careful administration of goods and services and may become a supervisor or manager (Myers and McCaulley, 1985).

This description of an STJ matches the job requirements for railroad dispatchers. Railroad dispatchers are called upon to use logical processes to determine safe positions for trains and other track users. They must follow rules and procedures precisely to avoid creating unsafe conditions. Facts and figures are part of the dispatcher's decision making process. The job requires careful observation and monitoring of track occupants and a logical, rule-based process for decision making.

No one test should be the sole determinant of employment potential for dispatchers, however, those applicants who show a personality type of ESTJ or ISTJ probably have the potential to be a railroad dispatcher. These results indicate that the MBTI might provide useful information as part of a dispatcher screening program, particularly with respect to personal characteristics, which are not captured by aptitude and ability tests and tend to be difficult to assess.

5.2 Interviews

While tests are most suitable for gauging an applicant's cognitive skills, interviews are most suitable for assessing personal relations, good citizenship and job knowledge. In the dispatching environment, "personal relations" refers to characteristics such as verbal communication and the ability to work cooperatively with train crews and other track users. "Good citizenship" includes factors such as dependability, working under specific instructions, and working under time pressure. Using the terminology of the PAQ, interviews can provide information on perceptual, interest and temperament characteristics of a candidate. Interviews can be used to assess the candidate's knowledge of railroading and/dispatching. Properly structured interview questions can also provide information on some perceptual skills such as the ability to assess a situation and come to closure on a decision, interest in becoming a dispatcher and temperament characteristics.

Theoretically, one advantage of the interview over other selection methods is that the data gatherer and interpreter is a human being who understands railroading and the job of the dispatcher. The interviewer can vary questions as the situation demands, thereby obtaining appropriate and necessary information from the candidate. Other methods are not adaptable in real time. However, this flexibility must be exercised with care. The key to an effective interview is an appropriate design or structure.

There are two primary characteristics of an effective interview in the selection of dispatchers: structure and skilled interviewers. A structured interview is based on a set of questions that are job-related. Careful consideration must go into identifying the dispatcher KSAOs that will be explored through the interview and then developing appropriate questions. Using these same questions with all applicants assures that information about the same topics is collected from all

applicants. Questions that might be used to explore the applicant's temperament and interest in becoming a dispatcher include:

- Describe a stressful situation and how you handled it.

- Why do you think you are well suited to become a dispatcher?

- Becoming a dispatcher will involve working irregular schedules, nights and weekends. Are you prepared to adjust your lifestyle to this type of work schedule?

As with test instruments, the validity and reliability of an interview procedure should be established.

The interview process is an interaction between two individuals. Railroads involve HR professionals, operations supervisors and experienced dispatchers in this process. An effective interview depends upon the skills of the interviewer. An effective interviewer will:

- Create an open-communication atmosphere.
- Deliver questions consistently.
- Maintain control of the interview.
- Display effective speech and listening skills.
- Take appropriate notes.
- Keep the conversation moving and avoid leading the interviewee.

Interview training programs that include role-playing exercises can help to develop these skills in individuals who interview dispatcher candidates.

5.3 Biodata Inventory

A biodata instrument is an application blank containing questions that research has shown to measure the difference between successful and unsuccessful performers on a job. A biodata inventory might be used to predict dispatcher job tenure based on characteristics such as number of jobs in the past five years, education and prior railroad experience. Each question receives a weight that indicates how well it differentiates poor from good performers. The higher the weight the better the differentiation. Biodata instruments are easy to use, quickly administered, inexpensive to administer and not as subject to individual bias as interviews, references and resume evaluation. However, creating a reliable biodata instrument requires a sample size of several hundred dispatchers. Given this requirement, only the large Class 1 railroads have adequate numbers of dispatchers to develop a reliable biodata instrument. While the process for developing the biodata instrument is relatively straightforward, it is time consuming and requires the commitment of corporate HR resources.

In designing a biodata instrument and selecting items to include, the following guidelines apply (Aamodt, 1999):

- The item must be job-related. Specifically, avoid items that may not meet the legal requirements stated in the *Uniform Guidelines* (41 CFR, Part 60-3). (See subsection 2.4 for a discussion of the *Uniform Guidelines*.)

- The items must deal with events under the applicant's control. For example, the applicant has no control over his/her birthplace but would have control over job choices.

- The answer to the item must be verifiable. For example, level of education and prior employment can be verified.

- The item must not invade an applicant's privacy.

If a formal biodata inventory process is not feasible or available, an application blank can gather biographical information, such as education and job history, that the railroad has found helpful in identifying applicants who are likely to become proficient dispatchers.

5.4 Recommendations and Reference Checks

Because recommendations and reference checks have not proven to be effective predictors of future job performance, their use should be limited to verifying biodata provided by the applicant. Because of the safety sensitive nature of the dispatcher's job, if the candidate has prior railroad experience, it is important to know if the candidate has any history of disciplinary action or rules violations. This information can be verified through a reference check.

5.5 Overall Selection Procedure

The most effective selection programs utilize a variety of methods for assessing candidates. Since different assessment tools provide different types of information this approach will provide a comprehensive picture of the candidates' knowledge, skills, abilities and other characteristics that relate to the job. The choice of the ways to assess relevant dispatcher KSAOs requires consideration of a number of factors as described above.

There are two common strategies for combining the various assessment tools into an overall dispatcher selection program. They are the "multiple hurdles approach" and the "total assessment approach." With the multiple hurdles approach there are a series of prescribed steps and a candidate must pass each hurdle or step to proceed on in the selection process. For example, the first step in the evaluation process may involve the review of the candidate's education and experience. If a high school education is required to become a dispatcher, then only candidates with this level of education will continue in the selection process. Similarly, if the railroad prefers to hire experienced dispatchers, only veteran dispatchers will proceed to the next step in the process. The advantage of this procedure is that it reduces the time and cost of the process since only the most qualified individuals will be screened with the entire suite of the selection tools. For efficiency, the screening sequence could be arranged so that the more expensive and most time consuming screening tools are administered as the last steps in the process.

In contrast, the total assessment approach requires that every test and procedure in the selection process be administered to every candidate. Then, using a weighting procedure, the selection committee or selection official ranks the candidates based on their performance on the various assessments. The advantage of this approach is that it provides a balanced assessment of the candidates' knowledge, skills, abilities and other characteristics. However, a key decision in using this approach is how the weights are assigned to the results of each assessment tool.

In practice, most railroads use a combination of the two approaches. (The details of the selection programs for seven different railroads are described in Section 6.) The initial stages of the selection process typically use the multiple hurdles approach to identify the candidates who meet initial screening criteria such as education and experience requirements. Then these individuals may be invited to take an ability test. At this point the total assessment approach is used for the pool of candidates who pass the ability test. Candidates are invited to the railroad for an interview. The results of the interview process are considered along with information, such as prior work experience, education and references, that may have been gathered and used in the "hurdle" portion of the selection process. The combined approach has the advantages of both methods. It provides for a complete picture of the most promising candidates, but the relative weighting of each evaluation factor must be done to reflect the factors that are most predictive of future success as a dispatcher.

6. CURRENT DISPATCHER SELECTION PROCEDURES

While the job analysis described in Section 3 found no differences in the nature of the job at seven different dispatching centers, each operation has unique features. In addition, the resources and experiences of each operation differ. The job analysis provides valuable information about the nature of the job, but the experiences of individual railroads offer insights into the process of evaluating dispatcher candidates. To capture these individual experiences, site visits were conducted at seven railroads. These railroads represent Class 1, commuter and shortline/regional railroads. Table 16 presents the characteristics of the seven sites. The purpose of the site visits was to gather information about the railroad's current selection process and specific methods that proved effective. The following subsections describe each dispatching operation and provide information on each railroad's candidate recruitment and selection process.

6.1 Metra Railroad

6.1.1 Nature of the Job

Metra Railroad is a commuter railroad providing service in the greater Chicago area. The Metra Consolidated Control Facility (CCF) was established five years ago in an effort to reduce expenses and improve operations. The Consolidated Control Facility and nine towers control train movements on Metra's network. Currently there are four desks, with another to come on line shortly. This new desk resulted from the closing of an interlocking tower and the relocation of the control to CCF. Four desks and a chief work the first two shifts, and on the night shift and on weekends there are three active desks. As with the existing desks, the new desk will be consolidated with an existing desk on third shift and on weekends. During periods of construction activity, center management may add an additional desk at night. Typical of a commuter railroad, the morning rush hour runs from 6 to 10 a.m. and the afternoon rush is from 4 to 8 p.m.

The Metra system consists of both electrified and non-electrified territories. Nearly the entire system is signalized with either ABS or CTC. There is one five mile stretch of double track that is dark territory. Over 250 trains travel daily over territory controlled by the CCF. About 130 freight trains are interspersed with Metra's commuter trains in this territory throughout the day. The busiest desk in the center handles 130 trains a day, about half of them are freight trains.

There are 23 qualified dispatchers at the CCF. Twenty hold regular assignments, including four regular relief, one guaranteed extra board position and one Assistant Chief. The remaining three individuals hold positions in towers and are called to work as dispatchers when needed.

Table 16. Characteristics of case study sites

	Type	Number of Desks	Total Staff	Selection Methods	Location of Dispatching Center
Metra Railroad	Commuter	4	24	Structured interview; vision test	Midwest
Metro-North Railroad	Commuter	10	52	Tests for written comprehension, deductive reasoning, oral comprehension; structured interview; background check (outside candidates only)	Northeast
Long Island Railroad	Commuter	5	33	Job preview; interview	Northeast
Conrail Shared Assets	Shortline	3	24	Block counting test; structured interview	Mid-Atlantic
Burlington Northern	Class 1	92*	485*	Dispatcher Aptitude Test; structured interview	Midwest
Union Pacific	Class 1	N/A	375	Apprentice Train Dispatcher Screening Test; screening interview; structured interview	Midwest
Wisconsin Central	Shortline/ Regional	5	32	Occupational Personality Questionnaire; interview	Midwest

*Located in Ft. Worth, TX Network Operations Center.

Metra qualifies trainees on all four territories so that they can work any of the desks. However, once an individual begins working a regular position and does not work the other territories for a year, then s/he is no longer qualified on those other territories.

6.1.2 Candidate Recruitment and Selection Process

Because the Metra system still includes towers, dispatcher positions can be filled from the pool of clerks working in the towers. Part of Metra's current agreement with the TCIU (clerk's union) is that all dispatcher trainee positions will be posted and made available to clerks. This mechanism has proven successful in recruiting dispatcher trainees. The last time a notice was posted there were 20 applicants for four positions.

After the job posting closes, HR screens the applications to make sure that each candidate meets the minimum qualifications for the position. These qualifications include a working knowledge of General Code of Operating Rules (GCOR), being a qualified Tower Clerk who has worked within the past six months and good color vision. All qualified candidates are referred to the Director, Consolidated Control Facility.

The Director, Consolidated Control Facility, interviews each candidate with a HR representative present. The interview consists of a set of structured questions. The Director usually knows the candidates since they are clerks who work with the Consolidated Control Facility staff. Based on each candidate's responses during the interview, the individual's discipline record and the Center's experience with the candidate, the Director and the Senior Manager Train Operations rank the candidates. The Director then reviews his selection with the Metra Selection Committee, which consists of HR and EEO representatives.

Metra has been using this recruitment and selection process successfully and does not plan any changes. Because there will continue to be towers on the Metra system, it is not likely that Metra will look outside the railroad in the near term for dispatcher candidates.

6.1.3 Retention

Since the opening of the center five years ago, retention of dispatchers has been high. A total of eight people have dropped out of the training program before completing it because they felt the job was not suitable for them. No one has been terminated from the training program for unsatisfactory performance. In addition, one dispatcher was promoted to trainmaster and two left to join a Class 1 railroad as dispatchers.

6.2 Metro-North Railroad

6.2.1 Nature of the Job

Metro-North Railroad is a commuter railroad providing service between New York's Grand Central Station and Southern Connecticut, Westchester and the Hudson River Valley. On weekdays Metro-North operates approximately 550 scheduled trains. Including deadhead runs and shuttle services on branch lines, there may be as many as 650 trains daily. Metro-North's territory is predominantly all electrified and controlled by CADS or CTC, however, there are three areas of dark territory and four areas on the Hudson River line that are non-electrified. The morning rush hour runs from 6 to 10 a.m., with 7 to 9 a.m. being the busiest period, and the afternoon rush hour is from 4 to 8 p.m. The morning rush hour is more difficult for the rail traffic controllers to manage because all of the trains must be carefully monitored entering Grand Central Terminal.

The dispatching operation is centralized in the Operations Control Center at Grand Central Terminal. The center has 10 rail traffic controller desks plus two assistant chief rail traffic controllers on duty during day and evening shifts. Four of these desks manage the Grand Central Terminal area. At night and on weekends the 10 desks are collapsed into 5 and there is one

assistant chief. A total of 52 rail traffic controllers staff the Operations Control Center. The only non-centralized part of Metro-North's operation is one tower and several bridge tenders in Connecticut. Once the Northeast Corridor Improvement Program is completed, Metro-North plans to phase out the remaining tower.

All routine track work is done during the day shift. In addition to the high volume of passenger trains, each day Metro-North's rail traffic controllers handle up to 20 freight trains and 50 Amtrak trains.

6.2.2 Candidate Recruitment and Selection Process

Anticipating that the pool of potential rail traffic controllers would diminish with the closing of towers, in May 1990 Metro-North's Personnel, Testing and Validation Department undertook a process to develop a basic aptitude battery for screening rail traffic controller candidates. First a list of 56 tasks and 21 abilities was defined as the basis for the job analysis. Then a job analysis survey was conducted to identify the most critical tasks and abilities. Based on the results of the job analysis, tests designed to measure the 11 most critical abilities were selected from readily available sources or were developed in-house. A concurrent validity study, conducted on current dispatchers, found that five tests correlated with job performance. Four of the five tests were included in future testing to refine the validities and passing scores. Subsequently three tests were validated for use in the rail traffic controller screening process. These tests measure written comprehension, deductive reasoning and oral comprehension.

Future rail traffic controllers will be evaluated through a multi-step process. The jobs will be posted internally and an advertisement will also be placed in the newspaper. All of the candidates will take the three screening tests, and those who pass the tests will be referred for further screening. A group of three people, two from employment and one chief dispatcher, will conduct a structured interview with each candidate. Then, for outside candidates, the employment department will conduct a background check and validate the candidate's employment history. The final selection will be made in a "consensus meeting" involving representatives from the hiring department, the employment department and possibly, the training department.

6.2.3 Retention

Turnover among rail traffic controllers is very low, two or less per year. Attrition results from promotions and retirements. Since 1992, only one new hire has left because he was not well suited for the job. Center management attributes this low attrition rate to the fact that all of their rail traffic controllers had railroad experience prior to taking the position.

6.3 Long Island Railroad

6.3.1 Nature of the Job

The LIRR is the largest commuter operation in the country. On an average weekday the railroad runs 740 trains in a commuter rail operation that serves 265,000 passengers. The western terminus points of the railroad are at Penn Station, Flatbush (Brooklyn) and Hunterspoint Avenue. During rush hours, from 6 to 10 a.m., and from 4 to 8 p.m., as many as 100 trains an hour move through the system. Jamaica Station is a major interchange point with many passengers changing trains to reach their destinations. On time performance of the trains is critical to achieving smooth operation at this key location.

The LIRR has a non-centralized dispatching operation consisting of 13 towers, each staffed by some combination of train movement directors and block/tower operators, and five train dispatchers located at the LIRR Operations Center in Jamaica Station. (The LIRR plans to phase out all 13 towers by 2006, but the project is still in the preliminary planning stage.) The LIRR's network contains ABS, CTC and dark territory operations.

A total of 33 dispatchers staff the Operations Center. On the day and evening shifts there are five dispatchers but at night and on weekends the five desks are collapsed into two. There is also a chief assigned to all shifts, seven days a week.

Track work is done during daylight hours on the LIRR. Larger projects are done overnight and on weekends. In addition to handling the high volume of passenger trains and daytime work crews, LIRR dispatchers handle a few daily freight trains during off peak hours, usually at night.

6.3.2 Candidate Recruitment and Selection Process

Recruitment of dispatchers is done from in-house tower operators. However, over time towers will be closed and eventually the LIRR will be hiring dispatchers with no prior railroad experience. When there is an opening for a dispatcher, a notice is posted at the towers asking individuals who are interested in becoming a dispatcher to notify the Superintendent, Train Movement. All who express interest are invited to visit the Operations Center in Jamaica for a job preview. At this time the nature of the job is explained to the candidates. In particular, it is emphasized that the job requires the individual to do trouble shooting, deal with other departments and in general perform a kind of "command and control" function. Historically, about a quarter of the candidates drop out at this point. The Superintendent, Train Movement and the Supervisor, Train Movement interview the remainder. The purpose of the interviews is to assess the candidate's suitability for the position. The interviewers look for qualities such as willingness to accept responsibility for decisions, effective communication skills and an understanding of the various functions of the railroad. The LIRR is making an effort to formalize this interview process. The Superintendent, Train Movement and the Supervisor, Train Movement make the final selection decision.

Since the tower operators become candidates for the dispatching position, it is worthwhile to consider how they are hired. First, the Human Resources Department gives tests to candidates. For candidates not familiar with railroad operations, the LIRR has them come in on a Saturday and the HR department in conjunction with the Transportation Department gives the candidates definitions of selected railroad terminology and signals. The candidates are asked to study this information and return in three weeks for an examination. Those who pass the test proceed through the selection process for tower operators.

6.3.3 Retention

Because the individuals who become dispatchers on the LIRR have previously worked as tower operators, the retention rate is high. Rarely does a candidate complete the dispatcher training program and fail to become a qualified dispatcher. On average, two positions become vacant each year due to promotions or retirements.

6.4 Conrail Shared Assets

6.4.1 Nature of the Job

Conrail's shared assets dispatching operation in Mt. Laurel, NJ, owned by CSX and NS, is effectively a short line railroad. The dispatching center has three desks plus an assistant chief. A total of less than 500 track miles is controlled by this center. Prior to the break-up of Conrail between CSX and NS this center had an additional 11 desks and a total of 66 dispatchers. The train volume and train mix varies by territory. One territory is a mix of commuter trains and freights, another handles 20 freights a day in an urban area and the third, primarily dark territory, services industrial sites. All desks are in operation for all shifts, seven days a week.

The territories controlled from this center contain a mix of CTC, track warrant control and dark territory. Two of the three territories still have a limited number of block operators.

Currently there are a total of 24 people that staff the center. Seven of the current dispatchers were hired in March 1999 and an additional three were hired in January 2000.

6.4.2 Candidate Recruitment and Selection Process

In the early 1980s, Conrail performed a job analysis of nearly all jobs, including dispatcher. The job analysis led to the development of a battery of tests for screening candidates. Following a complaint of discrimination by a job candidate, the EEOC found the tests for all crafts to be racially biased. As a result, Conrail discontinued all testing and relied solely on interviews. Relying solely on interviews to identify the best candidates proved unsatisfactory and Conrail sought the services of an outside consulting firm to improve the process. For the past two to three years, Conrail has successfully used the professional services of a consulting firm to handle advertising and recruitment for all craft jobs, including dispatchers.

Conrail advertises openings on a company electronic bulletin board as well as in the local newspaper. Once dispatcher candidates are identified, the consulting firm administers the Block Counting Test. This test involves visualizing missing information in graphic displays in working memory. All candidates who pass the test are referred to Conrail for further screening. The screening process involves interviews with a professional interviewer from the outside firm, a Conrail recruiter and the Director, Train Operations or another management representative from this department. The consulting firm provides structure and guidance for the interview and each interviewer receives training on how to conduct an effective interview. Each interviewer independently gives the candidate a rating from 1 to 5. The outside firm computes an average rating for each candidate and all dispatcher candidates with a rank of 3.5 or greater are given a drug screen and physical. The hiring decision is based solely on the composite ranking of those candidates who pass the physical and drug screen.

6.4.3 Retention

Since January 1999, the Mt. Laurel facility has recruited and hired 11 dispatchers. One of these individuals subsequently chose to return to the position of clerk but the remaining 10 individuals are currently working as dispatchers at Mt. Laurel. This unusually large number of new hires was due in part to the realignment of territories that resulted from the buyout of Conrail by CSX and NS. Territories were transferred to Albany and Harrisburg and some dispatchers chose to move to these locations. In addition to the vacancies created due to the transfer of territories, two dispatchers were promoted to trainmaster positions and one individual passed away.

Historically the Mt. Laurel facility has been able to recruit individuals with prior railroad experience to become dispatchers. Although there are block operators in the territories controlled by Mt. Laurel, this has not proven to be a source of dispatcher candidates. The reason is that because of the distance between the block towers and Mt. Laurel, any block operator who becomes a dispatcher must relocate to be closer to Mt. Laurel.

6.5 Union Pacific

6.5.1 Nature of the Job

The Union Pacific Railroad's (UP) dispatching operations dispatch approximately 2800 trains daily over 33,000 miles of track in the western two-thirds of the country. There are four major dispatching locations. The Harriman Dispatching Center located in Omaha, NE is the largest. In addition UP has dispatchers located at Spring, TX, Fort Worth, TX and San Bernardino, CA. Most of these desks operate 24x7. While most of the former Southern Pacific (SP) desks are still located in the Harriman Center, they continue to use their DigiCon Dispatching System that differs from that employed for the UP Harriman Center dispatching desks. Because of the differences in dispatching technology, the Union Pacific US&S CAD-II system and the former Southern Pacific DigiCon system, the two operations cannot share dispatchers and as a result, to some degree, they are unique and separate operations. UP is

working on the design of their next generation dispatching system CAD-III, which will result in the consolidation of the two operations.

The Harriman Center currently has 375 active dispatchers on its staff. There are an additional 36 apprentice dispatchers in training. Due to the merger with SP and the resulting transfer of the SP personnel to Omaha, UP did significant hiring and training of dispatchers over the last three years, averaging over 60 new hires per year. Once the current class is fully qualified, UP feels the Harriman Center will be able to maintain current manpower needs and annual hiring will accommodate normal attrition.

6.5.2 Recruitment and Selection

UP management establishes its dispatcher recruitment plans one year ahead. Based on the expected attrition rate, management plans an average of three to four dispatcher classes per year of 10 to 15 trainees. Approximately three months in advance of the planned start date of a class, HR begins identifying and evaluating dispatcher candidates. The UP uses a variety of methods to identify candidates. Internal UP job posting along with internet posting of the job and newspaper advertisements are the most commonly used methods. In addition, UP receives many unsolicited applications. UP prefers candidates with college degrees although they will consider candidates without degrees who have work experience that illustrates the potential to be a dispatcher. They have not had a problem identifying suitable candidates.

The UP uses a multi-phase screening process. The first step in the process of evaluating candidates is entry of data from the resumes into a database. This facilitates review for minimum job requirements. Next is a preliminary review of the resumes by the Director, HR Services. Based on the preliminary review as many as 120 candidates who, based on their resumes, have the potential to become dispatchers, are invited to Omaha to take the Apprentice Train Dispatcher Screening Test.

The current screening test, which was validated with UP dispatchers and managers, has been in use since December 1999. The test assesses business reasoning, verbal reasoning, professional profile and various behavioral traits. Based on test results, applicants are ranked as qualified or not qualified. Only qualified applicants are given further consideration in the selection process.

The next step in the screening process is a structured interview with the Director, HR Services or a manager from the hiring department. Based on the ratings from this first interview, the UP invites two to three candidates per vacancy to return for a second interview.

The second set of interviews consists of two structured group interviews with two interviewers in each group. The Managers of Train Dispatchers and Corridor Managers[5] from the Harriman Center participate in these interviews. The interview process has been refined over

[5]At the UP, Corridor Managers oversee the day-to-day work of the dispatchers.

the past two years and is based on a structured set of questions. New managers are trained on the interview process by observing others conducting an interview.

Each interviewer scores the candidates independently. Then the Director, HR Services facilitates a meeting to discuss and rate the candidates. The highest ranked candidates are offered positions in the upcoming class. If there are additional exceptionally qualified candidates, they may be offered positions in subsequent classes. All offers are contingent on medical screening, including color vision test, and a satisfactory background check.

Many UP dispatchers have railroad career aspirations when they join UP. UP dispatchers in recent years have been promoted to Corridor Managers within the Harriman Center, Managers of Yard Operations as well as positions in other non-operating departments. UP management encourages career development within the railroad, however, UP requires that dispatchers work for three years following their qualification date before they can be considered for another position on the railroad.

6.5.3 Attrition

Attrition among UP dispatchers is less than 10 percent annually due primarily to promotions and retirements. Few dispatchers leave to work at another railroad or another type of job.

UP usually experiences some attrition during the training process. Although UP has a thorough candidate screening process and candidates are given a job preview, including the prospect of working irregular hours initially, UP's experience has been that one or two trainees out of a class of 15 will quit before completing training due to a personal or lifestyle issue. Few leave because they are unable to demonstrate adequate competency during training.

6.6 Burlington Northern and Santa Fe Railway Company (BNSF)

6.6.1 Nature of the Job

BNSF's dispatching operations are centralized in the Network Operations Center (NOC) located in Ft. Worth, TX. The NOC opened in 1996 as a centralization of seven former BN offices. After the consolidation, the BN merged with the ATSF and the ATSF dispatching operations were incorporated into the NOC. The BNSF rail system has a total of 589 dispatchers to cover 111 dispatching desks. A total of 485 dispatchers are located in the Ft. Worth NOC, which has 92 desks. The remaining dispatchers are spread across San Bernardino CA, Spring, TX, Kansas City and New Westminster, BC. (See Table 17.) All remote offices, except New Westminster, are co-dispatching offices with the UP. The Kansas City office also includes Kansas City Terminal.

The BNSF rail network is divided into 17 zones and Ft. Worth dispatchers are responsible for 14 of them. All desks are staffed 24x7. On average one desk is responsible for 250 miles of track with a mix of dark territory, CTC and CADS. Occasionally during periods of extensive track construction work, management may temporarily reconfigure a territory and add an additional desk.

Table 17. Distribution of BNSF dispatching operations

Location	Number of Dispatchers	Number of Positions
Ft. Worth	485	92
San Bernardino	32	7
Spring, TX	22	4
Kansas City	42	7
New Westminster, BC	8	1
Total	589	111

Dispatchers at the NOC are grouped in pods by district. Each pod has specialists to handle non-train movement issues. For example, there are a signal control desk, service interruption desk, power controller and maintenance desk for each pod. In the Chicago area, where passenger train volume is high, a passenger train service operation specialist is also part of the pod. This arrangement allows the dispatcher to focus on train movements.

6.6.2 Recruitment and Selection

In the early 90s, the BN conducted the first of two job analyses of the job of railroad dispatcher and developed a set of screening tests. Following the merger with the ATSF and consolidation of dispatching operations in Ft. Worth, the BNSF found that its test battery was not tapping all dimensions of the dispatcher's job. In addition the new location led to some workforce diversity issues. In 1998, the BNSF undertook a second comprehensive job analysis. The job analysis, conducted over a period of nine months, identified the key business competencies in the following areas:

1. Foundation skills.
2. Basic communication skills.
3. Interacting with others.
4. Handling information.
5. Solving problems.
6. Industry/company knowledge.
7. Using computers and equipment.
8. Resilience and adaptability.
9. Work ethic.
10. Safety orientation.

Based on the job analysis, a series of four tests, referred to as the Dispatcher Aptitude Test, were developed as an aid in screening candidates. A criterion validation study, with BNSF employees, supported the validity of the test instruments.

Every six months the BNSF establishes a pool of job applicants. They recruit three types of individuals to become dispatchers: experienced dispatchers from other railroads, other crafts within BNSF, and off-the-street candidates with no prior railroad experience. This last group includes graduates of the dispatcher training program at Terrant County College in Ft. Worth. Candidates are selected to fill three to four dispatcher trainee classes per year.

The process for evaluating candidates is slightly different depending upon the type of candidate. Experienced dispatcher candidates may come to the railroad's attention as the result of a job advertisement or may contact the railroad unsolicited. For experienced dispatchers, the BNSF first reviews the candidate's resume and experience. Then the candidate is invited to Ft. Worth for an interview and Dispatcher Aptitude Testing.

Craft transfer candidates are recruited through an internal company job posting. All craft transfer candidates take the Dispatcher Aptitude Test. HR requests a recommendation from the supervisors of all candidates who pass the Dispatcher Aptitude Test. If the recommendation is satisfactory, then the individual is interviewed.

Several sources are responsible for the identification of off-the-street candidates. Newspaper advertisements, college recruitment and outside recruiters are all productive sources. The first step in the review process for off-the-street candidates is review of the individual's resume and cover letter. Based on this preliminary screen, the BNSF invites candidates to Ft. Worth for an interview, a visit to the NOC and testing.

The interview is a structured interview conducted by a panel consisting of one person from HR and two from the hiring department. The interviewers score the candidates based on the interview. Then the same panel ranks all of the candidates based on the interview score and prior work history. Candidates are rank ordered and offered positions based on this composite ranking.

The BNSF began its off-the-street hiring program in 1993 when phasing out of towers eliminated block operator and clerk positions. Since that time, new hires have been distributed as shown in Table 18.

By design, recruitment of individuals with these three different backgrounds has given the BNSF a dispatching staff with a diversity of experiences and career goals. Management views the off-the-street candidates who are college graduates as having the potential to move into other positions in the railroad and as such they can be viewed as management trainees. The railroad encourages its employees to advance their careers within the various operating departments but stipulates that individuals must work as dispatchers for at least two years before applying for another position within the railroad. Because some individuals want to be career dispatchers, there will always be experienced dispatchers to serve as mentors to trainees.

6.6.3 Attrition

Attrition among BNSF dispatchers is about 10 percent annually. Attrition results from promotions within the company and retirements. Relatively few dispatchers leave the company to work at another railroad or another type of job. Due primarily to attrition, the BNSF hires approximately 60 dispatchers annually.

Table 18. Distribution of BNSF new hires

Type of Candidate	Share of Total New Hires
Experienced Dispatchers	10%
Off-the-Street	50%
Craft Transfers	40%

Eighty percent of all dispatcher candidates who take the Dispatcher Aptitude Test receive a passing grade and are interviewed. Of those selected as trainees, 15 percent drop out at various points during the training period. Some drop out voluntarily and a few fail to meet the standards for acceptable performance during training.

6.7 Wisconsin Central

6.7.1 Nature of the Job

Wisconsin Central System (WCS) is comprised of relatively low-density shortline railroads operated as an integrated regional network in the upper Midwest of the United States and Canada: Wisconsin, Illinois, Minnesota, Michigan's Upper Peninsula and Northern Ontario. The major operating subsidiaries are: WisconsinCentral Ltd., Fox Valley & Western Ltd., Algoma Central Railway, Inc., and Sault St. Marie Bridge Company. Inclusive of the Canadian operation (ACRI), WCS owns 2,633 miles of track and operates over 2,855 miles.

Most of WCS's 2600 miles of track is single track with passing sidings. There are limited segments of double track. U.S. operations are dispatched from the operations center in Stevens Point, WI, and a small operations center in Sault Ste. Marie, Ontario dispatches WCS's Canadian trains.

The Stevens Point operation has a total of five desks. Four of the desks operate 24x7 and the fifth desk currently operates 16x5. One desk is nearly all CTC, one desk is all dark territory and the other three are a mix of CTC and dark territory. All dispatchers use the computer-aided dispatching system along with a paper train sheet.

The dispatching center in Stevens Point began operating in 1987 when the company was formed from a division of the Soo Railroad. At that time there were two desks staffed by 13 dispatchers plus a chief dispatcher and an assistant chief. Today a staff of 32 work at the Stevens Point center. This includes four assistant chiefs, one of whom works one shift as a dispatcher, and seven guaranteed extra board dispatchers. WCS tries to provide the opportunity for all extra board dispatchers to become qualified on all five desks.

6.7.2 Recruitment and Selection

When there is a vacancy for a dispatcher, both internal and external experienced candidates are considered. Because WCS lacks the training resources of a larger railroad, management prefers to hire experienced dispatchers. To date this has been a viable strategy. HR posts the job announcement on the company bulletin board to notify company employees of the vacancy. Identifying non-WCS candidates has not been difficult. The railroad has been fortunate to have a continuous flow of unsolicited job inquiries from experienced dispatchers at other railroads and as a result has never had to advertise for dispatchers. WCS attributes the continuing flow of inquiries to the desire of some dispatchers in large operations centers to live in the North Central region and to work in a smaller operation. Because many WCS managers came from Class 1 railroads, they receive unsolicited inquiries from prior affiliations.

About two years ago, WCS began administering evaluation tests to all potential new hires. WCS uses the "Occupational Personality Questionnaire" from Saville and Holdsworth, Ltd. for all management and professional positions on the railroad. This test or assessment, which takes 2 to 3 hr to administer, has been validated. There are three parts: 1) occupational personality, 2) verbal critical thinking and 3) numerical critical thinking. The occupational personality assessment is designed to assess the typical or preferred behavior of individuals in a way that is relevant to the world of work. Typical behaviors measured are concerned with relationships with people, thinking style and emotions.

Evaluation of dispatcher candidates, both external and internal, involves: 1) a pre-screen consisting of a telephone interview to assess the candidate's qualifications, 2) on-site interview and 3) evaluation testing using the Occupational Personality Questionnaire. Based on the candidate's experience and the results of the prescreen, the most promising candidates are invited to Stevens Point for an interview with the Director HR, the Director Operations and the Chief Dispatcher, and evaluation testing. Each interview is conducted one-on-one; there is no group interview.

Both the Director Operations and the Chief Dispatcher have significant experience in dispatching and have each developed interview questions to judge the candidate's communication style and professionalism. They judge the individual's cognitive skills based on their prior experience and use the interview to assess "will do" potential. They prefer individuals who are PC literate but this is not a requirement. Ultimately they are looking for a candidate who would be a "good chess player" and a "good video game player." The Chief Dispatcher makes selection decisions with the concurrence of the Director Operations. The final selection is made based on the results of the evaluation test, a background check (including motor vehicle and criminal) and the interviews.

In the past 2-1/2 years, five dispatchers have been hired. One was a former WCS trainmaster and four came from other railroads. WCS sent the trainmaster to Terrant County College in Ft. Worth for initial training. (This is the organization that the BN uses for dispatcher training.)

6.7.3 Attrition

Growth in WCS's rail network has created the need for additional dispatchers. In addition, there have been retirements that resulted in job vacancies. Only one dispatcher left WCS for another position.

7. SELECTION PRACTICES IN RELATED INDUSTRIES

Occupations in other industries and public service agencies have duties and responsibilities similar to those of a railroad dispatcher. Positions in three different environments were explored as case studies with the goal of understanding the position and work environment and gathering information about the methods used to select individuals to fill the position. The three occupations that are discussed in this section are: 1) police dispatcher, 2) fire alarm operator/ dispatcher and 3) air traffic controller. With regard to air traffic controller, the emphasis is on selection methods. Because the Armed Services have done extensive research on selection methods, these were also investigated and are reported in this section.

7.1 Police Dispatching

7.1.1 Description of Position and Work Environment

Police dispatchers work around the clock monitoring activities needing police intervention in their district of control, and contacting the appropriate police units to respond to these events. They carry out their responsibilities through the use of Computer Aided Dispatcher (CAD) systems and radio consoles. 9-1-1 call-takers at the Boston Police dispatching center direct calls to the appropriate authorities, whether it be the fire department, ambulance, or Boston Police. If a call warrants police intervention, call-takers assign a category code for the call and enter it into the CAD system. The CAD system automatically prioritizes calls based on the category code and places each in the queue based on the degree of urgency. The dispatcher then receives this information and determines which police unit(s) to contact.

There are seven dispatchers working during each of three shifts at Boston Police Operations. One dispatcher handles any Big Dig concerns, and four dispatchers monitor each of the radio channels serving the police-designated districts in Boston[6]. Two relief dispatchers substitute during lunch and scheduled breaks. Boston Police dispatchers work in squads of two or three with one to two supervisors heading each squad. Each squad and supervisor(s) always work during the same shift.

All Boston Police Dispatcher squads work in a schedule of rotation, with four days on and two days off. This method guarantees that all dispatchers have one weekend off every six weeks.

Seniority is used when bidding for squads, and bidding occurs every year in July.

[6]The Big Dig is a major highway construction project in downtown Boston that has resulted in disruptions to traffic flow.

7.1.2 Becoming a Boston Police Dispatcher

At the Boston Police Department, only a police officer can become a dispatcher. The call-takers are the only non-uniformed personnel in the Operations Center. Anyone interested in becoming a police officer must take a statewide general knowledge exam administered annually by the state Civil Service Commission. Applicants who score 90 percent or better are usually drafted from the applicant pool. These candidates are then interviewed, and each given an extensive background check and psychiatric evaluation. Candidates who pass this selection cycle are then appointed to the police academy. Once in the academy, the trainees undergo intense training for a period of six to eight months in preparation for police officer duty. After this period, they have one probationary year of street duty before officially becoming a police officer.

At the Boston Police Department, dispatchers typically have had five years experience as a street-duty officer prior to dispatching. Boston Police Operations prefer volunteers to fill any vacant dispatcher positions, but because the job is so critical, police officers may be assigned to the job if there are no volunteers.

All training of new dispatchers is done through on-the-job training. Dispatcher trainees must first learn to use the CAD system and the radio channel console. Then they sit with a dispatcher and learn by observing an experienced dispatcher and by performing duties under supervision. Training takes two to four weeks, depending on the trainee's proficiency in performing the various duties.

Dispatcher turnover is low at the Boston Police Department. There are a number of dispatchers at the Boston Police Department who have been dispatching for over 10 years.

7.1.3 Characteristics of an Effective Police Dispatcher

There are a number of qualities that define an effective police dispatcher. First, a police dispatcher must have knowledge of the city, especially of the district the dispatcher is handling. This enables the dispatcher to create a mental picture of where police activities are taking place.

Knowing the individual police officers and units patrolling the dispatcher's assigned district is another important factor to successful dispatching. This knowledge enables the dispatcher to send the police unit that s/he believes is best suited to respond to the event. For example, when a dispatcher must send a police officer to handle a situation that involves potential domestic abuse, the dispatcher is likely to send someone s/he knows to be patient and understanding.

Having experience with computers is also a valuable skill in being a successful dispatcher. Much of the training and work involves the use of CAD, and being comfortable with computer technology facilitates the trainee's adjustment to the job.

Dispatchers must respond to a wide range of situations, anything from a traffic accident to a plane crash, so there is significant pressure and responsibility that comes with the job.

Dispatchers need to be able to assess an emergency situation quickly in order to contact the appropriate units. An even-temperament and the ability to foresee what resources may be needed at the scene are important abilities needed to carry out the demands of the job. Also, adaptability is needed so that job performance does not suffer when the dispatcher must respond to surges in workload, or deal with a situation that s/he has not previously experienced.

7.2 Fire Dispatching

7.2.1 Description of Position and Work Environment

The Boston Fire Dispatching Center is a 24 hr operation responsible for the communication of critical emergency fire information to fire companies and other fire intervention personnel. Each shift is staffed by a team made up of five to eight fire alarm operators, and headed by the captain who is responsible for final decisions and activities of the group. Second in command is the lieutenant, who has a supervisory role and heads the group when the captain is unavailable.

There are three jobs on the team: call-taker, dispatcher, and radio person. A fire alarm operator must be able to perform all three jobs. The call-taker receives both incoming 9-1-1 calls needing fire personnel intervention and regular business calls. As the call-taker answers the call, s/he enters the emergency information into the Computer Aided Dispatcher (CAD) system. The dispatcher contacts the appropriate fire company(ies) and relays information as indicated on the CAD. The dispatcher also ensures that the fire company(ies) have received the information and are en route to the scene. The radio person monitors the activities and progress of the fire companies and is responsible for overseeing the emergency situation from the time the fire company is en route to the scene until the situation has been taken care of.

The ability to perform duties across the three positions is critical when several calls come in simultaneously. Because the dispatcher can attend to only one emergency at a time, the call-taker and radio person are able to work on handling the other situations to pick up the slack. Workers rotate positions every two hours.

The dispatching team works with computer and radio consoles in the relaying of emergency events to fire companies. Once the call-taker has entered the emergency information into the CAD system, the system automatically identifies the fire company closest to the scene. Information on the status of all fire companies in Boston is shown on the computer screen, with status designated by color. The dispatcher uses his/her discretion in choosing another fire company to respond if s/he knows that the fire company listed on the screen is working on another event.

The number of fire companies to send out is pre-determined based on the location of the fire in relation to the section of the city and the severity of the fire, represented by the number of alarms. For example, a two-alarm fire warrants more fire intervention resources than a one-alarm fire. For one or two alarms, the CAD system will identify the resources to send. The number of alarms can go as high as nine. For situations rated over two alarms, the dispatcher must refer to paper records to determine the additional companies to assign to the incident.

The Boston Fire Department has four dispatching teams with eight members each. There are two shifts: a day shift and night shift. A day shift runs from 8 a.m. to 6 p.m., and a night shift from 6 p.m. to 8 a.m. Each team works one day and one night, and gets one day off, followed by another day, another night, and then three days off. In an eight-week cycle dispatchers work an average of 42 hr a week.

Not only do members of each team always work together on the same shift and rotation, but there is coordination with fire companies so that the same fire personnel at the various fire stations are also working the same shifts. This is helpful for all parties in building and maintaining rapport, and consistency in work styles and communication.

7.2.2 Selection of Fire Alarm Operators

State civil service procedures govern the hiring process for all positions in the Boston Fire Department. The Massachusetts Civil Service Commission administers a statewide examination for the position of fire alarm operator. The flier advertising the examination tells the applicant what materials to read in preparation for the exam. The exam consists of 100 questions, and tests the applicant's knowledge of the reading material. The Boston Fire Dispatching center receives a list of applicants and scores, and for every position open, they have the top-scoring applicant, plus two additional applicants, come in for a physical. Unless there is a job-related medical reason for not choosing the first applicant after the interview, the Boston Fire Department hires the top scorer on the exam.

The Boston Fire Dispatching Center has a six week classroom-training course for trainees. This includes learning all the rules and regulations of dispatching. The second stage is six weeks of hands-on training, where the new dispatcher is working the floor fielding real calls and working on the CADS console and radio. For those needing additional reinforcement after the full 12 weeks of classroom and hands-on training, there is an additional two weeks of remedial training available with the approval of the training officer.

Turnover among fire alarm operators in Boston is low. Average tenure for a fire alarm operator is 30 years.

7.2.3 Characteristics of an Effective Fire Alarm Operator

The wide range of responsibilities inherent in the job of fire dispatching requires that dispatchers are capable of multi-tasking, from taking calls and relaying information, to monitoring and keeping in contact with fire companies. Effective dispatchers are calm under pressure, and are able to obtain important information on the emergency event by asking the right questions in order to determine the appropriate resources needed. Also important is acting quickly in notifying fire companies of the situation, as well as providing any additional information so that they are as prepared as possible when they arrive at the scene. Attention to detail is crucial. An effective dispatcher also has the initiative to line up additional resources that s/he foresees will also be needed at the scene.

7.3 Air Traffic Control

The job of an air traffic controller (ATC) is similar in many respects to that of a railroad dispatcher. However, unlike dispatchers who work for individual railroads, all air traffic controllers are employed by the Federal Aviation Administration (FAA). The FAA has employed a standardized controller selection process for many years. A four-hour paper and pencil battery, assessing spatial and abstract reasoning, was the first step in the process as early as 1962. A later version of this selection instrument was authorized by the Office of Personnel Management and is referred to as the OPM test.

In response to a Congressional Committee recommendation to develop a standardized, centralized program to identify and remove from training those candidates who did not demonstrate sufficient aptitude to become ATCs, the FAA developed a multiple hurdle selection process. Beginning in 1976, candidates who passed the OPM test were enrolled in the ATC Academy Screen Program, which was both initial training and a screening tool. The nine-week Academy Screen Program was designed to assess the aptitude of individuals having no prior knowledge of air traffic control. First the candidates learned a set of nonradar-based air traffic control rules and principles. Then through a series of laboratory exercises the candidate demonstrated the application of those principles. The evaluation of each candidate was based 60 percent on five of six graded laboratory problems and 40 percent on paper-and-pencil tests, including a final exam that constituted 20 percent of the candidate's score. Candidates who were successful on the Academy Screen were assigned to an air traffic control facility for further on-the-job training (Manning, 1991).

This multiple hurdle selection process cost the FAA an estimated $20 to $25 million annually. Applicants selected to attend the ATC Screen Program also took a considerable personal risk by dedicating nine weeks of their time and having only a 55 to 60 percent chance of remaining in the occupation at the end of the program. In addition, the FAA was concerned about potential adverse impact on women and minorities. For these reasons, in 1990 the FAA initiated a program to replace the current screening process with a computer-administered test battery.

The initial phase of this effort to develop an improved selection process for ATCs led to the development of two computerized information processing tests: the Static Vector/Continuous Memory Test and the Time Wall/Pattern Recognition Test. A third test, the Air Traffic Scenario Test (ATST), which is a computer-administered work sample, was also developed. In 1992, the FAA substituted this group of tests, referred to as the ATCS Pre-Training Screen (ATCS/PTS), for the Academy Screen program. Implementation of this program reduced the FAA's per candidate selection cost from $10,000 to about $2,000. Candidates who pass the 4 hr written ATCS aptitude test battery take the ATCS/PTS. Those who successfully complete the ATCS/ PTS are eligible for enrollment in the FAA Academy ATCS training programs (Broach, 1997).

Recognizing that changes in the national airspace system architecture and evolution of air traffic operations would likely change both the nature of the air traffic controller's responsibilities and the desirable KSAOs for future controllers, the FAA undertook the Air

Traffic Selection and Training (AT-SAT) research program. The AT-SAT team set out to: 1) develop new predictor measures and criterion measures based on worker requirements generated from a job analysis of the ATC position, 2) perform a linkage study of the predictor measures to worker requirements, and 3) concurrently validate the predictor measures to the criterion measures. (See Figure 4.) The remainder of this subsection describes FAA's efforts under the AT-SAT program.

7.3.1 Job Analysis

An extensive job analysis was the first step in AT-SAT. Subject matter experts (SMEs) met in the different FAA regions to work through task lists describing the complex duties inherent to the ATC job. The SMEs worked together in consolidating tasks that were the same or virtually the same, and clarified and expanded upon tasks. The revised worker requirements, which include prioritization, tolerance for high intensity, composure, active listening, oral communication, situational awareness, and planning, were then sent in the form of a survey to air traffic controllers. The controllers rated each of the worker requirements based on criticality of the task and time performing the task in relation to overall time performing the ATC position. Based on the ATCs' input, worker requirements were weighted in terms of importance and criticality of task (Ramos, Heil, and Manning, 2000).

7.3.2 Predictor Measures

Based on worker requirements developed from the job analysis, predictor measures were developed to gauge the candidate's ability to perform various components of the ATC position.

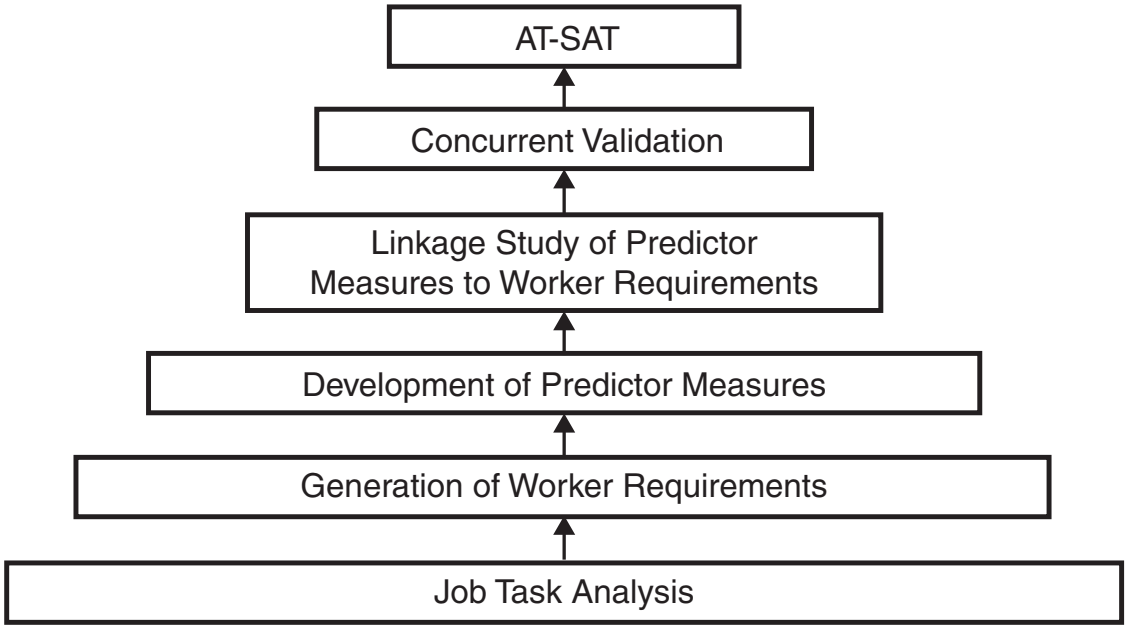

Figure 4. Development and validation of AT-SAT

The Math Test and Angles Test were developed to test applicants' knowledge-based, or crystallized, intelligence. The Scan Test, Dial Reading Test, and Analogies Test measured the ability to process information and make appropriate decisions, choose within the context of a set of information and rules to follow - fluid intelligence. The ATST work sample test was retained from the ATCS/PTS. This test consists of a medium-fidelity computer work sample made up of a simplified airspace with data blocks representing planes, and pilots talking through headphones. Based on the information from the computer and voice, the candidate must make decisions. The Letter Factory Test was developed to measure the ability to multi-task, plan ahead, and maintain situational awareness while executing decisions. The Experience Questionnaire was developed to measure the personality and interpersonal characteristics needed to perform the job, such as tolerance for high intensity, composure, taking charge, working cooperatively, and self-confidence.

7.3.3 Linkage Study of Predictor Measures and Worker Requirements

A separate study determined the degree of linkage between the predictor measures and the worker requirements. Twenty-five ATCs familiar with both the predictors and the worker requirements were asked to rate how well the predictor measures measured worker requirements. The raters used a five-point scale to rate each predictor/worker requirement pair and a mean rating was calculated for each worker requirement. The AT-SAT study team determined that a predictor with a mean rating of 3 or more for a worker requirement would effectively predict the requirement. The majority of the worker requirements were found to be linked to at least one predictor measure. Several predictor measures were linked to 3 or more worker requirements. Performance on the Letter Factory was linked to the most work requirements, a total of 14, examples being prioritization and planning (Morath, Bayless, and Archambault, 1999).

7.3.4 Criterion Measures

Criterion measures used to gauge ATC performance were also based on worker requirements. The Computer-Based Performance Measure (CBPM) was developed to measure the technical ability to effectively and efficiently separate air traffic through computer-administered simulations of air traffic scenarios with multiple choice questions. Peer and supervisory ratings of the ATC were made based on performance and behavioral dimensions which the applicant was rated on using a five-point scale. The ratings were independent of the CBPM, where the raters did not know what the ATC scored on the test.

7.3.5 Results

A total of 1083 Full Performance Level ATCs volunteered to participate in the concurrent validation which took place over a two-day period. The participants took the predictor measures on the first day, and the criterion measures on the second day.

Overall, the predictor measures had high validity with the composite criterion, as well as with the CBPM as an individual performance measure. There was moderate but significant validity between the predictor measures and the peer and supervisory ratings. The AT-SAT battery was

also found to have substantially higher validity than its predecessor, the ATCS/PTS. The predictor measures are now pending approval for applicant self-administration at Sylvan Learning Centers. The new selection process will replace both hurdles of the prior system with a single one-day, pre-hire computerized assessment.

The longitudinal validation will be conducted once test administration begins at the Sylvan Learning Centers. Applicants' item level data from the 6-1/2 hr test will be sent to the FAA Selection and Validation Group for analyses against future performance as Full-Performance-Level (FPL) ATCs. Since it takes an average of three years for a trainee to reach FPL status, it will be several years before the longitudinal validation is complete.

7.4 Armed Services

Like the FAA, the Armed Services have a long history of using assessment methods for screening and classifying recruits for the many military job classifications. While military jobs do not share common elements with the job of railroad dispatcher, the experiences from the military's extensive research, conducted by the Army Research Institute, on screening methods offers some lessons that do apply in the railroad environment.

In 1981, Congress directed the Armed Services to undertake an effort to assess the soldier selection and classification system. The program, referred to as Project A and subsequently Career Force, was initiated primarily to gauge how well the current enlistment standards predicted job performance. This research, which spanned a period of 12 years, was one of the largest studies of its kind, with impressive sample sizes, and a comprehensive list of predictive and performance measures. The study findings not only answered questions concerning the selection and classification practices of the Army, but also generated further developments and ideas in shaping and improving soldier selection and classification (Zook, 1996).

7.4.1 ASVAB and New Predictive Measures

All of the Services use the Armed Services Vocational Aptitude Battery (ASVAB) as the primary means to test applicants for selection and classification. The ASVAB was developed to measure four composite cognitive factors: verbal aptitude, quantitative (mathematical) aptitude, technical knowledge aptitude, and perceptual speed aptitude. Other important factors, such as discipline, dependability, and conscientiousness, needed to be considered as well. Tests developed to measure these were:

- Assessment of Background and Life Experiences (ABLE), to gather information on temperament and biodata.

- Job Orientation Blank (JOB), to measure preferences of job outcome such as autonomy or job security.

- AVOICE, to measure career interests.

All three were used as predictive measures for the motivational characteristics of individuals.

7.4.2 Jobs and Sample Sizes

Project A and Career Force examined data from 22 jobs. Due to constraints, such as soldiers not being available for testing and financial limitations in administration of measures, analyses were largely based on nine jobs: infantryman, cannon crewman, tank crewman, radio teletype operator, vehicle generator mechanic, administrative specialist, motor transport operator, medical care specialist, and military police. A total of 49,397 soldiers took the new predictor tests at entry. Performance measures were administered for: 34,305 soldiers after training, 11,266 soldiers after entry on first tour performance, and 1,595 soldiers followed in the second tour.

7.4.3 Project A: 1982 to 1989

Project A was primarily a concurrent design, with the exception of the ASVAB being administered and results used to predict performance over time. Soldiers who had been in the service for 12 to 24 months were given the new prediction measures and performance measures over the same two-day period. This was used in the validation analyses. Project A was designed not only to test the ASVAB's effectiveness in predicting performance, but also to test the new predictive measures (described above in subsection 7.4.1) designed to enhance the ASVAB. Project A's purpose also included using data obtained from the predictive measures and the performance measures to develop an initial model of performance. The model of performance consisted of five dimensions, the first two labeled as "can do": core technical proficiency and general soldiering proficiency. The last three are dimensions linked to soldier motivation and are labeled "will do" dimensions: discipline, effort and leadership, and physical fitness and military bearing (see Figure 5).

ASVAB was found to be a powerful predictor of "can do" performance, showing excellent validity for both core technical proficiency and general soldiering proficiency (Rumsey, Peterson, Oppler and Campbell, 1996). Although the ASVAB was only moderately effective in predicting "will do" performance, the ABLE was found to have substantial incremental validity over the ASVAB on the "will do" dimensions, especially in relation to military bearing and physical fitness. The validity of the spatial test was almost as high as that of the ASVAB in predicting "can do" performance. The computer exam testing perceptual and psychomotor skills also proved to be a very good predictor of "can do" performance.

7.4.4 Career Force: 1989 to 1995

Career Force was conducted to assess the predictive measures' power over time. Training performance measures, entry level performance measures, and supervisory level performance measures were administered for the longitudinal validation. These measures were in the form of job knowledge tests, hands-on tests, and administrative ratings. For supervisory level performance, there was an additional situational judgment test. In terms of the model of performance, dimensions were identical in models for training and first tour. The second tour had a model of performance quite similar to that of training and first tour, with the inclusion of

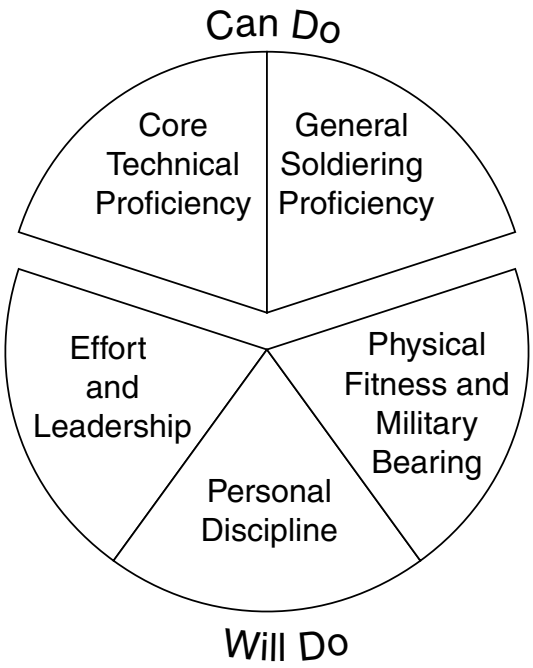

Figure 5. Job performance dimensions

an additional dimension of leadership, where many soldiers were in supervisory roles by the second tour of duty.

ASVAB emerged with strong predictive power in not only training performance, but also first and second tour of duty with respect to "can do" performance. Not only did it have high validity in predicting first tour duty, but it retained its predictive power over the course of three to six years in predicting job performance in the second tour of duty. The ASVAB power in predicting the leadership dimension increased over time, although the ABLE's incremental validity decreased with respect to "will do" over the first and second tour of duty, especially with respect to discipline.

For each dimension exclusively, when linking training performance to second tour performance, the correlational values were quite high, indicating that earlier performance predicts future performance.

7.4.5 The Leadership Dimension

The ASVAB was able to predict leadership in the second tour of duty better than in training. This may show that leadership is more related to cognitive factors than previously believed. Although the ABLE's effectiveness decreased over time, information on temperament and other non-cognitive data shows promise and the Army Research Institute recommended that further research be done.

8. IDENTIFICATION OF DISPATCHER CANDIDATES

Prior to evaluation and selection of dispatcher candidates, each railroad must recruit potential candidates. As described in Section 6, railroads employ a variety of recruitment strategies that include newspaper advertisements, internal job postings, internet job postings and personal referrals. This section provides information on occupations that have knowledge, skill, ability and other characteristic requirements that are similar to those of a railroad dispatcher. Two methods were used to identify these occupations. The PAQ methodology provided one set of occupations and a U.S. Department of Labor occupational database allowed for the identification of additional similar occupations. This information can potentially be of use to railroad recruiters in two ways. First, if candidates with job experience in any of these fields apply for a dispatching position, they should be given initial consideration. Second, railroads may want to investigate ways to circulate job announcements to individuals in these occupations.

8.1 Occupations Identified by PAQ Analysis

Although the PAQ methodology is designed for conducting a job analysis, PAQ Services is able to identify other occupations in its database of 2200 jobs that are most like the job of railroad dispatcher. PAQ Services identified 13 jobs that, based on a PAQ job analysis, are similar to the job of railroad dispatcher. Table 19 contains a list of these jobs along with a description of each job as provided in the *Dictionary of Occupational Titles*. Table 20 contains additional information that the *Dictionary of Occupational Titles* provides. This information is helpful in determining whether or not an individual with experience in this occupation will have skills, abilities and other characteristics similar to those required to be a dispatcher. The *Dictionary of Occupational Titles* provides information for the position of "train dispatcher." Table 20 includes information for "train dispatcher" along with the 13 occupations identified by the PAQ analysis.

The *Dictionary of Occupational Titles* was developed by the U.S. Department of Labor to classify jobs across the U.S. economy from a wide range of industries. The *Dictionary of Occupational Titles* assigns a nine-digit code to each job. These nine-digit occupational codes, such as the ones shown in Table 20, are divided into three groups of three digits. Each group of digits provides information about the job. The first three digits identify a particular occupational group. The first digit indicates the "primary occupational category." All of the jobs in Table 20, with the exception of "train dispatcher" fall into the "Miscellaneous Occupations" category. The position of "train dispatcher" is in "Professional, Technical, and Manager Occupations." The second and third digits indicate the industry that the job belongs to. Jobs with codes in the 50s are in the utilities industry and those in the 60s and 70s are in the "Amusement, Recreation, Motion Picture, Radio and Television" industries. All railroad jobs have 80s codes.

Table 19. Jobs with PAQ profiles similar to railroad dispatcher

Job Title (*Dictionary of Occupational Titles* Occupational Code)	Description
Dispatcher, Radioactive Waste Disposal (955.167-010)	Coordinates activities of workers engaged in mixing and controlling flow of chemicals and radioactive waste through pipelines, storage tanks, and sampling areas: Reviews processing schedule to determine receiving and transferring priorities, and notifies workers of type and quantities for processing, destinations, pumping schedule, and operating procedures. Monitors panelboard to ensure temperatures, pressures, pH readings, and contamination content of waste chemicals conform with schedule and processing specifications. Recommends change of pumping rates and pressures that will ensure rate of flow of chemicals or radioactive waste follows specifications. Reviews reports to verify accuracy of amounts received, processed, transferred, or stored.
Substation-Operator Helper (952.687-014)	Assists Substation Operator in controlling flow of electricity through transmission lines and in operation of equipment for converting direct current into alternating current. May record gauge and meter readings, may clean and lubricate auxiliary equipment.
Communications Technician (962.362-010)	Performs a variety of duties involved in production of educational information. Selects areas and locations for filming according to specification. Sets up equipment. Assists in design and construction. Requisitions materials. Edits materials. Operates equipment. Inspects and previews information.
Customer Service Representative (959.361-010)	Investigates complaints concerning gas leakage or low pressure and abnormal consumption of gas or electricity. Ascertains number and type of equipment used to determine rate of utility consumption. Examines meters and equipment for defects. May perform repairs or adjustments. May notify repair crews. May recommend and write specifications. May investigate use of gas or electricity.
Form Designer (970.361-010)	Develops forms to specifications. Uses equipment to design and produce. Makes changes according to client's specifications. Prepares final forms.

Table 19. Jobs with PAQ profiles similar to railroad dispatcher (continued)

Job Title (*Dictionary of Occupational Titles* Occupational Code)	Description
Dispatcher, Service (959.167-010)	Dispatches workers to install, service, and repair electric, gas, or steam powered systems or other equipment. Reviews work orders and determines and schedules work according to urgency. Contacts supply to verify availability of equipment and parts to ensure scheduled work performance. Receives check in calls by radio, telephone, or in person. Informs others of type and location of work to be performed and dispatches workers to job. Keeps records of repairs, installation, removal of equipment or appliance using computers.
Dispatcher, Chief Work (959.137-010)	Supervises and coordinates activities of service dispatchers and workers to increase efficiency of work crews and equipment. Assigns duties according to priority of trouble calls received. Relays information and technical instructions between line crews and appropriate department heads concerning troubles requiring action. Verifies that all switching operations are accurately recorded and reported to ensure safety.
Water-Treatment Plant Operator (954.382-014)	Controls treatment plant machines and equipment to purify and clarify water. Operates and controls electric motors, pumps, and valves to regulate flow of water into treatment plant. Dumps specified amounts of chemicals into tanks. Starts agitators to mix chemicals. Monitors panelboard and adjusts controls to regulate rates. Cleans and filters. Repairs and lubricates. Tests water samples. Records data.
Pump-Station Operator, Waterworks (954.382-010)	Operates pumping equipment to transfer water to treatment plant or to distribute processed water to residential, commercial and industrial establishments: Turns valves, pulls levers, and flips switches. Reads flowmeters and gauges to regulate equipment. Inspects, repairs, and lubricates. Records data, such as utilization of equipment, power consumption, and water output.
Gas-Pumping Station Operator (953.382-010)	Controls operation of steam, gas, or electric compressors to maintains specified pressures. Observes gauges to determine consumption rate variations and adjusts to regulate pressures. Reads meters and records amount of gas received and dispensed. May clean, lubricate and adjust. May regulated governors to maintain specified pressure.

Table 19. Jobs with PAQ profiles similar to railroad dispatcher (continued)

Job Title (*Dictionary of Occupational Titles* Occupational Code)	Description
Gas Dispatcher (953.167-010)	Coordinates flow of natural gas throughout distribution system of public utility or pipeline to ensure volume and pressure of gas required. Monitors telemetering panelboard to determine pressure and volume, and records readings in log. Reviews correlating data, such as gas quality, pressure and temperature with variables affecting consumer demand. Adjusts controls to regulate gas flow. Directs gas pumping station operator to pump gas from holding station into distribution system and return according to supply and demand. Informs station personnel to regulate flow of gas from wells into system to maintain specified pressure. Records data. Observes colorimeter. Notifies mixing station personnel when deviations occur.
Pressure Supervisor (953.137-014)	Supervises and coordinates activities of workers engaged in controlling gas pressure and moisture condensate in mains of city gas-distribution system to meet consumer demands and state regulations. Analyzes hourly estimates of pressure required to meet demands. Compares, estimates with pressure chart readings and reports of actual amount of gas consumed. Notifies pressure controller to adjust gas regulators. Directs drip pumper in keeping mains free from condensate.
Inspector (956.267-010)	Inspects steam heat systems in buildings to determine effect of system modifications reported by building inspector. Investigates changes made in layout and determines if changes affect metering equipment. Determines causes for abnormal meter readings by inspecting equipment. Submits reports on investigation.

The middle three digits are the Worker Functions ratings for the tasks performed in the occupation. They convey information about how the job incumbent must function in relation to data, people and things. A separate digit indicates the worker's relationship to each of the three categories. (See Table 21 for an explanation of the *Dictionary of Occupational Titles* Worker Function codes.) In general, worker functions involving more complex responsibility and judgment have lower numbers while those that are less complicated have higher numbers.

Examination of the Worker Function ratings for the 13 jobs in Table 20 provides some insight into how similar the job responsibilities are to those of a dispatcher. According to the *Dictionary of Occupational Titles*, the Worker Function code for "train dispatcher" is "167."

Table 20. Dictionary of Occupational Titles job information for PAQ identified jobs

Industry	Job Title	Job Code	General Educational Development**
Railroad	Train Dispatcher	184.167-262	R4 M3 L4
Utilities	Substation-Operator Helper	952.687-014	R2 M1 L1
	Pressure Supervisor	953.137-014	R4 M3 L3
	Gas Dispatcher	953.167.010	R4 M3 L3
	Gas-Pumping station Operator	953.382-010	R3 M2 L3
	Pump-Station Operator Waterworks	954.382-010	R3 M2 L3
	Water-Treatment Plant Operator	954.382-014	R3 M3 L3
	Dispatcher, Radioactive-Waste Disposal	955.167-010	R4 M4 L4
	Inspector	956.267.010	R4 M4 L3
	Dispatcher, Chief Work	959.137-010	R4 M3 L3
	Dispatcher, Service	959.167-010	R4 M3 L3
	Customer Service Representative	959.361-010	R4 M2 L3
Amusement, Recreation, Motion Picture, Radio and Television	Communications Technician	962.362-010	R4 M2 L3
	Form Designer	970.361-010	R3 M3 L3

**R = reasoning, M = mathematics, L = language

This means that the job of "train dispatcher" involves coordinating data, speaking with or signaling people and handling things. The following three jobs identified by the PAQ analysis have the same Worker Functions as "train dispatcher":

- Gas Dispatcher.
- Dispatcher, Radioactive Waste Disposal.
- Dispatcher, Service.

Two additional jobs, "Pressure Supervisor" and "Dispatcher, Chief Work," have Worker Function ratings that are at least as complex as those of a dispatcher.

The last three digits of the *Dictionary of Occupational Titles* job code serve to differentiate a particular occupation from all others. This part of the job code does not convey any information about the nature of the job. A number of occupations may have the first six digits, but no two can have the same nine digits.

Table 21. Definition of Dictionary of Occupational Titles worker function codes

Rating	Data (4th Digit)	People (5th Digit)	Things (6th Digit)
0	Synthesizing	Mentoring	Setting Up
1	Coordinating	Negotiating	Precision Working
2	Analyzing	Instructing	Operating/Controlling
3	Compiling	Supervising	Driving/Operating
4	Computing	Diverting	Manipulating
5	Copying	Persuading	Tending
6	Comparing	Speaking/Signaling	Feeding/offbearing
7	N/A	Serving	Handling
8	N/A	Taking Instructions/Helping	N/A

The *Dictionary of Occupational Titles* also provides an evaluation of each job with respect to the General Educational Development (GED) Scale. The GED scale is composed of three divisions: Reasoning Development, Mathematical Development and Language Development. Each division is rated on a scale of one to six. Levels 5 and 6 correspond to college level skills. Table 20 contains the GED ratings for "train dispatcher" and the 13 occupations identified through the PAQ analysis. Only one job in this list has a GED rating equal to or greater than those for "train dispatcher." It is "Dispatcher, Radioactive Waste Disposal." Five additional jobs have the same reasoning rating and the same or higher mathematics rating of a dispatcher but the language rating is one level lower. These jobs are the following:

- Pressure Supervisor.
- Gas Dispatcher.
- Inspector.
- Dispatcher, Chief Work.
- Dispatcher, Service.

Based on information provided through the PAQ analysis, there are 13 occupations that have job behaviors or requirements that are similar to a railroad dispatcher. However, closer examination of information provided in the *Dictionary of Occupational Titles*, indicates that six of these are most closely related to railroad dispatching. Thus individuals who have held these types of jobs are likely to have the skills, abilities and other characteristics that would make them suitable for the job of dispatcher.

8.2 Other Related Occupations

While the PAQ analysis was useful for identifying occupations that may be sources of dispatcher candidates, it was limited in that the database for the comparative analysis consisted

of 2200 occupations. This database is representative of jobs in the United States but it is not inclusive of all occupations, particularly those in public sector jobs. For this reason, an attempt was made to systematically identify other occupations with skill, ability and characteristic requirements that are similar to those defined for railroad dispatchers.

The U.S. Department of Labor issued the last edition of the *Dictionary of Occupational Titles* in 1991. At that time, a decision was made to move to a new system of job classification whereby all occupations listed in the *Dictionary of Occupational Titles* would be combined into 950 occupational groups. The new classification system, referred to as the Occupational Information Network (O*NET), is based largely on data supplied by occupational analysts using the *Dictionary of Occupational Titles* and other sources. O*NET provides information on each of the 950 occupational groups in terms of knowledge, skills, abilities, interests and work values as well as job tasks and work activities.

Unfortunately, the "Train Dispatcher" position from the *Dictionary of Occupational Titles* was not included in O*NET. This made it difficult to take advantage of O*NET's facility for directly identifying similar jobs. However, O*NET includes the occupational groupings "Police, Fire and Ambulance Dispatchers" and "Dispatchers, Except Police, Fire and Ambulance." Using the O*NET online database it was possible to identify the *Dictionary of Occupational Titles* jobs that constitute each group and then to examine those jobs using the methods applied to the jobs identified by the PAQ analysis. (The O*NET database is available online at *http://online.onetcenter.org*.) Because the skill and ability categories that O*NET uses to describe each occupational group differ from those of the PAQ, it was not possible to objectively and systematically use the detailed O*NET information to identify occupational groups that are similar to railroad dispatching.

Table 22 provides descriptions for the jobs that comprise the O*NET job grouping "Police, Fire and Ambulance Dispatchers." The Alarm Operator job is the same as the Boston Fire Department's Fire Alarm Operator position described in subsection 7.2.1. Both the Radio Dispatcher and Telecommunicator jobs are similar to the Police Dispatcher position of the Boston Police Department, which is described in subsection 7.1.1. The Protective-Signal Operator responds to coded signals in the central station of an alarm or security service. Both the *Dictionary of Occupational Titles* Occupational Codes and the GED ratings for these four jobs are presented in Table 23. For comparison purposes, Table 23 includes similar information for Train Dispatcher.

The Job Code for all four of the jobs in this grouping begins with "379" indicating that they are in the Protective Service Occupations. Based on the Worker Function code (middle three digits of the Job Code) and the GED ratings, the Alarm Operator position is most similar to that of Train Dispatcher. The complexity of responsibility, based on the Worker Function code, of the Alarm Operator is equal to that of the Train Dispatcher with respect to dealing with data and people and exceeds the dispatcher in dealing with things. The GED skill ratings for both jobs are the same. The other three jobs in this occupational grouping have lower skill ratings on one or more factors. In addition, based on their worker function codes, their requirements for working with data are in terms of "compiling data" while that of the dispatcher involve "coordinating

Table 22. Jobs in the O*NET job grouping "police, fire and ambulance dispatchers"

Job Title (*Dictionary of Occupational Titles* Occupational Code)	Description
Alarm Operator (379.162-010)	Operates municipal fire alarm system, radio transmitter and receiver, and telephone switchboard: Receives incoming fire calls by telephone or through alarm system. Questions caller, observes alarm register that codes location of fire, and scans map of city to determine whether fire is located within area served by city fire department. Determines type and number of units to respond to emergency. Notifies fire station, using radio, and starts alarm system that automatically contacts all fire stations and indicates location of fire. Relays messages from scene of fire, such as requests for additional help and medical assistance. Records date, time, type of call and destination of messages received or transmitted. Maintains activity, code, and locator files. Tests various communications systems and reports malfunctions to maintenance units. May operate telegraph to relay code as back-up if transmitter fails.
Dispatcher, Radio (379.362-010)	Receives complaints from public concerning crimes and police emergencies, broadcasts orders to police radio patrol units in vicinity to investigate complaint, and relays instructions or questions from remote units. Records calls broadcast and complaints received. In some municipalities coordinates all police, fire, ambulance, and other emergency requests, relaying instructions to radio unit concerned. May make operating adjustments to transmitting equipment where station is not automatic and be required to hold federal license. May transmit and receive messages between divisions of own agency and other law enforcement agencies. May monitor silent alarm system to detect illegal entry into business establishments.
Protective-Signal Operator (379.362-014)	Reads and records coded signals received in central station of electrical protective signaling system: Interprets coded audible or visible signals received on alarm signal board by direct wire or register tape from subscribers' premises that indicate opening and closing of protected premises, progress of security guard, unlawful intrusions, or fire. Reports irregular signals for corrective action. Reports alarms to police or fire department. Posts changes of subscriber opening and closing schedules. Prepares daily alarm activity and subscriber service reports. May adjust central station equipment to ensure uninterrupted service. May dispatch security personnel to premises after receiving alarm.

Table 22. Jobs in the O*NET job grouping "police, fire and ambulance dispatchers" (continued)

Job Title (*Dictionary of Occupational Titles* Occupational Code)	Description
Telecommunicator (379.362-018)	Operates communication equipment to receive incoming calls for assistance and dispatches personnel and equipment to scene of emergency: Operates telephone console to receive incoming calls for assistance. Questions caller to determine nature of problem and type and number of personnel and equipment needed, following established guidelines. Scans status charts and computer screen to determine units available. Monitors alarm system signals that indicate location of fire or other emergency. Operates two-way radio to dispatch police, fire, medical, and other personnel and equipment and to relay instructions or information to remove units. Types commands on computer keyboard to update files and maintain logs. Tests communications and alarm equipment and backup systems to ensure serviceability. May provide pre-arrival instructions to caller, utilizing knowledge of emergency medical techniques. May activate alarm system to notify fire stations.

Table 23. Dictionary of Occupational Titles job information for O*NET job grouping "police, fire and ambulance dispatchers"

Job Title	Job Code	General Educational Development**
Train Dispatcher	184.167-262	R4 M3 L4
Alarm Operator	379.162-010	R4 M3 L4
Dispatcher, Radio	379.362-010	R3 M2 L3
Protective-Signal Operator	379.362-014	R3 M2 L3
Telecommunicator	379.362-018	R4 M2 L4

**R = reasoning, M = mathematics, L = language

data," a more complex activity. In spite of these slight differences, individuals with experience in these four jobs most likely have the potential to become railroad dispatchers.

The O*NET grouping "Dispatchers, Except Police, Fire and Ambulance" encompasses 26 jobs. Three of these – Dispatcher, Radioactive-Waste Disposal; Dispatcher, Service; and Gas Dispatcher – were also identified by the PAQ and are discussed above in subsection 8.1. A subset of 13 of the 26 jobs in this grouping was identified for consideration. Any job with a Worker Function Code reflecting complexity at least at the level of Train Dispatcher was examined. These jobs are listed and described in Table 24.

Table 24. Jobs in the O*NET job grouping "dispatchers, except police, fire and ambulance" with work functions similar to train dispatcher

Job Title (*Dictionary of Occupational Titles* Occupational Code)	Description
Car Clerk, Pullman (215.167-010)	Assigns and dispatches sleeping cars to railroad company requesting cars: Keeps record of car movement and where assigned, using train schedules and movement charts. Assigns conductors to trains for trips and notifies them of assignments.
Dispatcher, Oil (914.167-014)	Directs and coordinates field activities of workers who route and control flow of oil and petroleum products through pipelines from point of origin, such as wells and storage tanks to delivery points, such as terminals, carriers, refineries, and tank farms, according to delivery schedules: Reviews oil movement schedules and notifies field personnel by teletype, telephone, and field radio as to type and quantities of oil to be moved, facilities and storage stock to be used, destinations, operating procedures, and pumping and delivery schedules. Studies data on oil and oil movement, such as temperatures, pressures, specific gravities, sediment and contamination content, and pumping rates, and ensures compliance with schedules and contract specifications by dispatching instructions to field personnel to increase or decrease pumping rates and pressures, to switch and inject feeder streams of crude and blend oil, and to gauge and test oil. Compares pumping reports with delivery reports to ascertain quantity of oil delivered. Computes data for production reports and for instruction changes relative to pumping rates and pressures, using calculator and slide rule. When scheduling and directing movement of petroleum products through processing, storage, and shipping departments of refineries, may be designated Dispatcher, Refinery (pipe lines).
Dispatcher (tel. & tel.) Alternate Titles: Cable Dispatcher 239.167-014	Establishes and reroutes telegraph and submarine cable circuits to ensure flow of messages: Orders irregular routing of telegrams to prevent congestion or wire shortage. Receives reports of delays in transmission of messages, and issues orders to facilitate transmission. Directs flow of messages during emergencies, such as storms, floods, and fires.

Table 24. Jobs in the O*NET job grouping "dispatchers, except police, fire and ambulance" with work functions similar to train dispatcher (continued)

Job Title (*Dictionary of Occupational Titles* Occupational Code)	Description
Dispatcher, Motor Vehicle 249.167-014	Assigns motor vehicles and drivers for conveyance of freight or passengers: Compiles list of available vehicles. Assigns vehicles according to factors, such as length and purpose of trip, freight or passenger requirements, and preference of user. Issues keys, record sheets, and credentials to drivers. Records time of departure, destination, cargo, and expected time of return. Investigates overdue vehicles. Directs activities of drivers, using two-way radio. May confer with customers to expedite or locate missing, misrouted, delayed, or damaged merchandise. May maintain record of mileage, fuel used, repairs made, and other expenses. May establish service or delivery routes. May issue equipment to drivers, such as handtrucks, dollies, and blankets. May assign helpers to drivers.
Dispatcher, Tugboat 911.167-010	Dispatches tugboats to guide ships entering or leaving port and to tow barges and log rafts: Receives written or oral customer request for services. Determines equipment required, such as tugs, barges, or derricks according to size, location and work performed. Selects tugboat captain from roster and notifies captain of order requirements, using radiotelephone. Obtains ship berthing and bunkering permits from port authorities. Reviews weather data and navigation charts and estimates time required to perform requested services. Maintains records and prepares bills for services. May notify captain of tugboat by radiotelephone of order changes. May dispatch work crews to tugboats in response to emergency requests from captain.
Bus Dispatcher, Interstate 913.167-010	Dispatches interstate or long-distance buses according to schedule and oversees bus drivers and bus attendants while they are at terminal: Issues orders for station departure of buses at specified hours, according to schedule. Arranges for extra buses and drivers in case of accidents or heavy traffic. Announces incoming and outgoing buses over public address system in bus terminal. May supervise loading, unloading, and checking of baggage or express packages shipped by bus. May inspect drivers' appearance and physical condition prior to dispatch.

Table 24. Jobs in the O*NET job grouping "dispatchers, except police, fire and ambulance" with work functions similar to train dispatcher (continued)

Job Title (*Dictionary of Occupational Titles* Occupational Code)	Description
Dispatcher, Service or Work 952.167-010	Dispatches workers for normal maintenance or emergency repairs to electric-power transmission and distribution lines and related equipment: Receives trouble calls from police, fire departments, and company offices. Records time, location, and nature of trouble and relays information to workers assigned to area in which work occurs, using telephone or radio. Receives work reports and makes reassignments. Informs work crews of changes in weather conditions and system status affecting safety, and answers questions requiring knowledge of system layout and electric equipment operation and repair. Relays and records all messages between line crews and load dispatcher concerning switching operations. May requisition supplies. May dispatch workers to answer customer service calls.
Dispatcher, Bus and Trolley 913.167-014	Supervises and coordinates activities of operators of buses, transit coaches, and trolleys in city or urban transportation system to convey passengers according to schedule: Records movement and location of vehicles and road crews to inform other departments or public regarding current schedules and routes. Receives telephone or radio reports of accidents, delays, fires, equipment breakdowns, and other operating or maintenance difficulties. Reports difficulties and dispatches orders to other divisions to maintain or restore service and schedules. Dispatches extra vehicles and emergency crews to scene of accident or breakdown, advising them of location of trouble and proximity of feeder lines and power circuits. Maintains log of scheduled runs, numbers of vehicles, and names of drivers. Records calls and emergencies. Makes report of all accidents. May suspend or call in operators for infractions of operating regulations.
Dispatcher, Traffic or System 919.162-010	Dispatches workers and equipment to prevent or rectify service disruptions of local transit system, using radiophone equipment: Receives reports of actual or anticipated disruptions and determines action required to rectify condition. Issues instructions to workers for maintenance and repair of roadway and structures. Coordinates movement of workers and equipment throughout system, using telephone communications system. Listens to radio traffic reports to alert traffic inspector of conditions affecting schedules. Records service disruptions, time, and action taken. May supervise activities of maintenance crews.

Table 24. Jobs in the O*NET job grouping "dispatchers, except police, fire and ambulance" with work functions similar to train dispatcher (continued)

Job Title (*Dictionary of Occupational Titles* Occupational Code)	Description
Dispatcher, Service 959.167-010	Dispatches customer service workers to install, service, and repair electric, gas, or steam powered systems or appliances, or cable television systems: Reviews work orders from departments or complaints from customers and records type and scope of service to be performed. Determines and schedules orders according to urgency. Contacts supply storekeeper to verify availability of parts and equipment to ensure scheduled work performance. Receives check in calls from service workers by radio, telephone, or in person. Informs workers of type and location of work to be performed and dispatches workers to job. Keeps records of repairs, installation, removal of equipment or appliances, and hours required on each job. May maintain records, using computer terminal.
Dispatcher Mine and Quarry (932.167-010)	Coordinates movements of haulage trips (trains) in underground mine to or from working force or dump area: Schedules movements of trains hauling coal, ore, refuse, personnel, or supplies in accordance with capacity of system, interval between trains, and length and direction of trains. Directs movements of special vehicles, such as emergency and repair railcars, to minimize interference with scheduled operations, using telephone, radio, or track signals. Reroutes trains in event of emergency, such as power failure, explosion, fire, or accident. Investigates cause of train delays, using telephone, and reschedules subsequent operations. Transmits reports of accidents or system malfunctions to repair crew and safety engineer. Keeps records of train movements, or monitors movements on lighted panelboard showing location of each train in system. May move controls to throw track switches and regulate movement of trains.
Gas Dispatcher 953.167-010	Coordinates flow of natural gas throughout distribution system of public utility or pipeline to ensure volume and pressure of gas required for consumers demands: Monitors telemetering panelboard to determine gas pressure and volume, and records instrument readings in log. Reviews correlating data, such as gas quality, pressure and temperature with variables affecting consumer demand, such as weather conditions and time of day to forecast load adjustments. Adjusts controls to regulate gas flow and pressure through system or telephones gas-compressor operator to increase

Table 24. Jobs in the O*NET job grouping "dispatchers, except police, fire and ambulance" with work functions similar to train dispatcher (continued)

Job Title (*Dictionary of Occupational Titles* Occupational Code)	Description
Gas Dispatcher 953.167-010 (continued)	or decrease pressure in pipelines according to forecast. Directs gas-pumping-station operator to pump gas from holding station into distribution system and return according to supply and demand. Informs station personnel to regulate flow of gas from wells into system to maintain specified pressure and volume in pipelines. Records data, such as gas pressure and volume from outlying stations. Observes colorimeter to detect deviations in mixture of natural gas with manufactured gas according to specified Btu rating. Notifies mixing station personnel when deviations occur. May discontinue gas service to specified areas when emergencies or gas shortages exist.
Dispatcher, Radioactive Waste Disposal (955.167-010)	Coordinates activities of workers engaged in mixing and controlling flow of chemicals and radioactive waste through pipelines, storage tanks, and sampling areas: Reviews processing schedule to determine receiving and transferring priorities, and notifies workers of type and quantities for processing, destinations, pumping schedule, and operating procedures. Monitors panelboard to ensure temperatures, pressures, pH readings, and contamination content of waste chemicals conform with schedule and processing specifications. Recommends change of pumping rates and pressures that will ensure rate of flow of chemicals or radioactive waste follows specifications. Reviews reports to verify accuracy of amounts received, processed, transferred, or stored.

The jobs in this table are found in the transportation, mining and utilities industries. Both the *Dictionary of Occupational Titles* Occupational Codes and the GED ratings for these jobs and for train dispatcher are presented in Table 25. Five of the jobs have GED ratings equivalent to or greater than those for Train Dispatcher. Seven have reasoning and mathematics requirements equal to Train Dispatcher. It is likely that dispatcher candidates with experience in any of these jobs have the skills required for railroad dispatching. Only one job, Dispatcher, Motor Vehicle, appears to have lower skill requirements than Train Dispatcher.

Table 25. Dictionary of Occupational Titles job information for subset of O*NET job grouping "dispatchers, except police, fire and ambulance"

Job Title	Job Code	General Educational Development**
Train Dispatcher	184.167-262	R4 M3 L4
Car Clerk, Pullman	215.167-010	R4 M3 L3
Dispatcher, Oil	914.167-014	R4 M4 L4
Dispatcher, Cable	239.167-014	R4 M3 L4
Dispatcher, Motor Vehicle	249.167-014	R3 M2 L3
Dispatcher, Tugboat	911.167-010	R4 M3 L4
Bus Dispatcher, Interstate	913.167-010	R4 M3 L3
Dispatcher, Service or Work	952.167-010	R4 M3 L3
Dispatcher, Bus and Trolley	913.167-014	R4 M3 L4
Dispatcher, Traffic or System	919.162-010	R4 M3 L3
Dispatcher, Service	959.167-010	R4 M3 L3
Dispatcher (Mine and Quarry)	932.167-010	R4 M3 L3
Gas Dispatcher	953.167-010	R4 M3 L3
Dispatcher, Radioactive-Waste Disposal	955.167-010	R4 M4 L4

**R = reasoning, M = mathematics, L = language

9. CONCLUSIONS AND RECOMMENDATIONS

This section presents a number of conclusions and recommendations with regard to the development and implementation of a selection program for railroad dispatcher candidates. The intent of these recommendations is to suggest some alternative or additional ways to improve a railroad's dispatcher selection procedure. Conclusions and recommendations are offered with respect to the following four aspects of recruitment and selection:

1. Development of a selection program.
2. Recruitment and selection strategies.
3. Potential sources of dispatcher candidates.
4. New assessment tools.

Ultimately the size of a railroad, the resources available for recruitment and selection of dispatchers, and the unique characteristics of each environment will determine the approaches that are most suitable for a given organization.

As the technology of railroad dispatching continues to evolve, the KSAO requirements for dispatchers will undoubtedly change. In addition, the introduction of Positive Train Control has the potential to change the job from one of actively dispatching trains and other track users to one of passively monitoring or supervising a closed loop system. Regardless of the changes in the job of the railroad dispatcher, the process used in this study to develop job requirements and suitable candidate assessment methods can be applied again as the dispatcher's job changes.

9.1 Development of a Selection Program

A thorough job analysis is the foundation of any personnel selection program. Conducting a job analysis is a significant undertaking for any organization and one that requires commitment of corporate resources. Any organization undertaking a job analysis should be careful not to underestimate the logistics involved in such an effort. Even if the majority of the effort will be outsourced, there must be an individual within the railroad who has adequate knowledge to oversee the process. Small railroads with limited resources or other organizations that do limited hiring of dispatchers usually cannot justify the expense involved in conducting a job analysis. The job analysis conducted as part of this research can be a starting point for these organizations in identifying the knowledge, skills, abilities and other characteristics of individuals who will become effective dispatchers.

The job of a railroad dispatcher is a complex one requiring a variety of knowledge, skills, abilities and other characteristics. There is adequate research in the human resources literature to

support the need for various types of candidate assessment methods for the complex job of railroad dispatcher. As described in Section 5, structured interviews, tests and biodata appear to be the most appropriate assessment methods. With regard to interviews, the following suggestions are offered:

- Structured interviews are preferred because they have been shown to have higher predictive validity than unstructured interviews.

- Multiple interviewers can improve the reliability of the interview process.

- Train the interviewers with role playing exercises and/or observation of experienced interviewers.

- Use the interview to validate information obtained from other sources, such as application blanks, that provide biographical data.

Development of a dispatcher aptitude test is an expensive undertaking. For railroads that cannot justify the expense of developing a test, there are numerous ability and personality tests available from test publishers that can be used to assess the qualifications of dispatcher candidates. The following guidelines are offered to assure that only appropriate instruments are used in the selection process:

- Use only reliable test instruments and procedures. A reliable method will provide accurate and consistent results.

- Use only methods that have been demonstrated to be valid for the specific purpose for which they will be used.

- Carefully evaluate any test instrument. The checklist shown in Figure 6 includes the various considerations that are involved in evaluation of a test instrument. Test reviews and materials from the test publisher are the primary sources for information about a test.

Existing industry practices described in Section 6 illustrate the range of dispatcher selection programs. All use multiple predictors, which helps to assure that the most promising candidates are identified. Most use a combination of the multiple hurdle and total assessment approaches to the selection procedure. The relatively low attrition rate among these seven railroads is evidence of the success of these methods. According to the railroads contacted in conjunction with this project, most reported occasionally selecting candidates who completed the training period and within the first year of dispatching quit because they did not like working nights and weekends on an irregular schedule. This experience illustrates the difficulty in assessing "will do" characteristics of dispatcher candidates during the selection process. An intensive job preview to give the candidate an understanding of the environment of the dispatching center and a typical novice dispatcher schedule helps to convey job expectations to the dispatcher candidate. Unfortunately there does not appear to be a reliable way to predict which candidates will drop out.

CHECKLIST FOR EVALUATING A TEST

Characteristic to be measured by test (skill, ability, personality trait):	
Job/training characteristic to be assessed:	
Candidate population (education, or experience level, other background):	
TEST CHARACTERISTICS	
Test name: **Version:**	
Type: (paper-and-pencil, computer) **Alternate forms available:**	
Scoring method: (hand-scored, machine-scored)	
Technical considerations:	
Reliability: r= **Validity: r=** **Reference/norm group:**	
Test fairness evidence:	
Adverse impact evidence:	
Applicability (indicate any special group)	
Administration considerations:	**Administration time:**
Materials needed (include start-up costs, operational and scoring cost):	**Costs:**
Facilities needed:	
Staffing requirements:	
Training requirements:	
Other considerations (consider clarity, comprehensiveness, utility):	
Test manual:	
Supporting documents from the publisher:	
Publisher assistance:	
Independent reviews:	
Overall evaluation:	

Source: U.S. Department of Labor, Testing and Assessment: An Employer's Guide to Good Practices, p. 5-7.

Figure 6. Checklist for evaluation of a test instrument

9.2 Recruitment and Selection Strategies

The railroads whose programs are described in Section 6 employ some strategies that appear to contribute to their success in recruiting and selecting dispatchers. In terms of recruitment, the UP has found the internet to be a useful vehicle for job postings, although they caution that the number of responses can be overwhelming if the posting appears for too long a period of time. With regard to selection, the LIRR, because it still has tower operators, recruits dispatchers from this pool of employees. In some respects, selection of tower operators is the first step in screening potential dispatchers. As described in subsection 6.3.2, the LIRR pre-screens potential tower operators on their ability to learn railroad terminology. Another example of this type of screening occurs with candidates for Fire Alarm Operators in Boston. The Civil Service examination for Boston Fire Alarm Operators is a test of subject matter knowledge. Candidates are instructed to study specific materials prior to the examination. This pre-screen procedure might also be useful in screening dispatchers with no prior railroad experience.

9.3 Potential Sources of Dispatcher Candidates

Hiring individuals with non-railroad backgrounds to become dispatchers is a relatively recent occurrence. As a result, the railroad industry is still trying to determine if experience in any specific occupations pre-disposes an individual to be an effective dispatcher. The data provided through the PAQ analysis and examination of the O*NET job groupings identified some additional occupational groups that may in fact be potential sources of dispatcher candidates. A number of jobs in the utilities, protective services, transportation and mining industries appear to have KSAO requirements similar to those of a railroad dispatcher. Dispatcher candidates with experience in any of these fields should be given at least initial consideration in the candidate assessment and selection process. In addition, railroads may want to investigate ways to target individuals in these occupations when advertising for dispatchers.

The jobs of police and fire dispatchers and air traffic controllers are similar in many respects to those of a railroad dispatcher. Many railroads report hiring former air traffic controllers who became successful dispatchers. As research with the O*NET database indicated, police and fire dispatchers might also have the appropriate skill set to become railroad dispatchers. Based on the experiences of the Boston Police and Fire Departments, these two groups tend to have low attrition rates and eventually retire from their positions so it is unlikely that they represent a large pool of potential applicants. However, in cities where police dispatchers do not come from the uniformed ranks, this may not be the case.

9.4 New Assessment Tools

The FAA has demonstrated that it is possible to develop a computer-based screening tool for air traffic controllers. The availability of this tool will shorten the screening period for air traffic controllers and considerably reduce the cost. Based on the FAA's experience and the similarity between air traffic control and railroad dispatching, it is likely that a similar tool could be developed for screening railroad dispatcher candidates. However, the expense involved in this

type of endeavor is likely to be more than any one railroad can justify and for at least the near-term more conventional methods will have to continue to suffice.

The biodata inventory is a technique that could be employed by the larger railroads. This method uses a set of biographical characteristics that correlate with successful job performance. The characteristics are identified using statistical methods that require both performance measures and biographical data from a large sample of dispatchers. The Class 1 railroads with several hundred dispatchers might consider this technique.

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APPENDIX A

GLOSSARY OF ASSESSMENT AND SELECTION TERMS

Ability test. A test that measures the current performance or estimates future performance of a person in some defined area of cognitive, psychomotor or physiological function.

Achievement test. A test that measures acquired knowledge or skills.

Adverse impact. A situation in which members of a particular class (e.g., race, sex or ethnic group) have a substantially lower rate of selection in hiring or other employment decisions.

Assessment. Any test or procedure for evaluating an individual's qualifications or characteristics relative to employment in a specific job.

Construct. A theoretical characteristic or concept (e.g., numerical ability, conscientiousness) that has been formulated to explain observable patterns of behavior.

Construct validity. The extent to which an assessment method measures a specific theoretical construct, characteristic or trait. Mechanical ability and physical endurance are examples of constructs.

Content validity. The extent to which the content of a test samples or represents the subject area or behavior it is intended to measure.

Criterion-related validity. The degree to which an assessment method correlates with some external criterion such as job performance. When the assessment instrument and the criterion are measured at about the same time, it is called *concurrent validity*; when the criterion is measured at some future time, it is called *predictive validity*.

Job analysis. A systematic process for identifying the tasks, duties, responsibilities and working conditions associated with a job and the knowledge, skills, abilities and other characteristics required to perform that job.

Percentile. For a given population or group, the percentage of the group that ranked below the item of interest.

Reliability. The degree to which an assessment method is consistent, dependable or repeatable.

Reliability coefficient. A coefficient of correlation that indicates the degree to which an assessment method is consistent, dependable or repeatable.

Validity. The degree to which actions or inferences based on an assessment method are meaningful or supported by theory and statistical analysis.

Validity coefficient. A numerical index that indicates the strength of the relationship between the assessment method and a criterion such as job performance.

APPENDIX B

COMPLETE (PAQ) JOB ANALYSIS RESULTS

Table B-1. Percentile ratings of all PAQ job dimensions associated with divisions

Division	Dimension Name	Percentile
Information Input	Using Various Sources of Information	93
	Interpreting What is Sensed	75
	Being Aware of Environmental Conditions	40
	Watching Devices and/or Materials For Information	38
	Evaluating and/or Judging What is Sensed	27
	Using Various Senses	10
Mental Processes	Processing Information	77
	Making Decisions	74
Work Output	Using Machines and/or Equipment	97
	Using Miscellaneous Equipment (Remote-Controlled)	93
	General Physical Coordination	67
	Controlling Machines and/or Processes	28
	Performing Controlled Manual Activities	24
	Performing Handling and/or Related Manual Activities	21
	Performing Skilled and/or Technical Activities	9
	Performing Activities Requiring General Body Movements	4
Relationships With Other Persons	Exchanging Job-Related Information	75
	Communicating Judgements and/or Related Information	63
	Engaging in General Personal Contact	53
	Performing Supervisory/Coordination/Related Activities	35
	Public and/or Related Personal Contacts	8
Job Context	Engaging in Personally Demanding Situations	64
	Being in a Stressful and/or Unpleasant Environment	33
	Being in Hazardous Job Situations	21
Other Job Characteristics	Performing Unstructured versus Structured Work	98
	Being Alert to Changing Conditions	96
	Wearing Specified versus Optional Apparel	79
	Working Under Job-Demanding Circumstances	78
	Working on an Irregular versus Regular Schedule	74
	Working Non-Typical versus Day Schedule	71
	Being Paid on a Salary versus Variable Basis	57
	Working in a Businesslike Situation	34

Table B-2. Percentile ratings of psychomotor and physical skills

Type of Skill	Attribute Name and Description	Percentile
Psychomotor	*Simple Reaction Time* - the period of time elapsing between the appearance of any stimulus and the initiation of an appropriate response.	78
	Rate Control - ability to make continuous anticipatory motor adjustments, relative to change in speed and direction of continuously moving objects.	67
	Eye-Hand-Foot Coordination - ability to move the hand and foot coordinately with each other in accordance with visual stimuli.	41
	Eye-Hand Coordination - ability to coordinate hand movements with visual stimuli.	39
	Response Integration - ability to rapidly perform various appropriate psychomotor responses in proper sequence.	37
	Rate of Arm Movement - ability to make gross, rapid arm movements.	32
	Manual Dexterity - ability to manipulate things with the hands.	29
	Continuous Muscular Control - ability to exert continuous control over external devices through continual use of body limbs.	26
	Speed of Limb Movement - this ability involves the speed with which discreet movements of the arms and legs can be made. The ability deals with the speed with which the movement can be carried out after it has been initiated; it is not concerned with the speed of initiation of the movement.	26
	Finger Dexterity - ability to manipulate small objects (with the fingers) rapidly and accurately.	26
	Arm/Hand Positioning - ability to make precise, accurate movements of the hands and arms.	25
Physical	*Explosive Strength* -ability to expend a maximum amount of energy in one or a series of explosive or ballistic acts (as in throwing, pounding, etc.).	31
	Static Strength - ability to maintain a high level of muscular exertion for some minimum period of time.	26
	Dynamic Strength - ability to make repeated, rapid, flexing movements in which the rapid recovery from muscle strain is critical.	25

Table B-3. Percentile ratings of sensory, perceptual, and cognitive abilities

Ability	Attribute Name and Description	Percentile
Sensory	*Auditory Acuity* - ability to perceive relevant cues by sound.	69
	Near-Visual Acuity - ability to perceive detail at normal reading distance.	46
	Far-Visual Acuity - ability to perceive detail at distances beyond normal reading distance.	42
Perceptual	*Closure* - ability to perceptually organize a chaotic or disorganized field into a single perception	91
	Perceptual Speed - ability to make rapid discriminations of visual detail.	89
	Selective Attention - the ability to perform a task in the presence of distracting stimulation or under monotonous conditions without significant loss in efficiency.	85
	Time Sharing - the ability to utilize information obtained by shifting between two or more channels of information. The information obtained from these sources is either integrated and used as a whole or retained and used separately.	79
	Movement Detection - ability to detect physical movement of objects and to judge their direction.	61
	Color Discrimination - ability to perceive similarities of differences in colors or shades of colors of the same color, or the identification of certain colors.	53
	Spatial Visualization - ability to manipulate visual images in two or three dimensions mentally.	53
	Visual Form Perception - ability to perceive pertinent detail or configuration in a complex visual stimulus.	50
	Spatial Orientation - maintenance of one's orientation with respect to objects in space or the comprehension of the position of objects in space with respect to the observer's position.	38
	Depth Perception - ability to estimate depth of distance or objects (or to judge their physical relationships in space).	37
Cognitive	*Short-Term Memory* - ability to learn and store pertinent information and selectively retrieve or recall, within a brief period of time, that which is relevant to a specific context.	85

Table B-3. Percentile ratings of sensory, perceptual, and cognitive abilities (continued)

Ability	Attribute Name and Description	Percentile
Cognitive (continued)	*Long-Term Memory* - ability to learn and store pertinent information and selectively retrieve or recall, much later in time, that which is relevant to a specific context.	82
	Intelligence - the level of abstraction or symbolic complexity with which one can ultimately deal.	80
	Convergent Thinking - ability to select from possible alternative methods, the method of processing information that leads to the potentially best answer or solution to a problem.	80
	Divergent Thinking - ability to generate or conceive new or innovative ideas or solutions to a problem.	77
	Problem Sensitivity - the ability to recognize or identify the existence of problems. This attribute does not include any of the reasoning necessary for the solution of a problem.	72
	Verbal Comprehension - ability to understand the meaning of words and the ideas associated with them.	70
	Originality - the ability to produce unusual or clever responses related to a given topic or situation.	66
	Oral Communication - ability to communicate ideas with gestures or with spoken or written words.	65
	Ideational Fluency - the ability to produce a number of ideas concerning a given topic. This attribute is only concerned with the number of ideas produced and does not extend to the quality of those ideas.	64
	Arithmetic Reasoning - ability to reason abstractly using quantitative concepts and symbols.	63
	Word Fluency - ability to rapidly produce words associated with a given word.	62
	Mechanical Ability - ability to determine the functional interrelationships of parts within a mechanical system.	58
	Numerical Computation - ability to manipulate quantitative symbols rapidly and accurately, as in various arithmetic operations.	57

Table B-4. Percentile ratings of interest and temperament characteristics

Characteristic	Attribute Name and Description	Percentile
Interest	*Directing/Controlling/Planning* - operations involving the activities of others, or processes with which others are involved.	80
	Variety of Duties - duties often characterized by frequent change.	71
	Repetitive Short-Cycle Operations - operations carried out according to set procedures or sequences.	68
	Creative Activities - preferences for situations involving the finding of new solutions to a problem or new modes of artistic expression.	67
	Scientific/Technical Activities - using technical methods or investigating natural phenomena using scientific procedures.	65
	Dealing With Concepts/Information - preference for situations that involve conceptual or informative ideas and the possible communication of these ideas to others.	63
	Processes/Machines/Techniques - situations which are non-social in nature, being primarily concerned with methods and procedures often of a mechanical or chemical nature.	63
	Influencing People - influencing opinions, attitudes, or judgements about ideas or things.	54
	Dealing With Things/Objects - preference for situations involving activities which deal with things and objects rather than activities concerned with people or the communication of ideas.	39
Temperament	*Pressure of Time* - working in situations where time is a critical factor for successful job performance.	96
	Attainment of Set Standards - attainment of set limits, tolerances, or standards.	96
	Measurable/Verifiable Criteria - arriving at generalizations, judgements, or decisions based on known or obtainable standards, or characteristics, or dimensions.	89
	Sensory Alertness - alertness over extended periods of time.	88
	Conflicting/Ambiguous Information - ability to tolerate and critically evaluate information of an uncertain or opposing nature.	84

Table B-4. Percentile ratings of interest and temperament characteristics (continued)

Characteristic	Attribute Name and Description	Percentile
Temperament (continued)	*Working Under Specific Instructions* - i.e., those that allow for little or no room for independent action or judgement in working out job problems.	83
	Social Welfare - working with people for their presumed good.	74
	Sensory/Judgmental Criteria - arriving at generalizations, judgements, or decisions which require sensory discrimination or cognitive appraisal.	67
	Interpretation from Personal Viewpoint - interpretation of feelings, ideas, or facts in terms of personal viewpoint or values.	67
	Empathy - seeing things from another person's point of view.	65
	Dealing With People - i.e., personal contacts beyond giving and receiving instructions.	63
	Susceptibility to Fatigue - diminished ability to do work, either physical or mental, as a consequence of previous and recent work done.	62
	Prestige/Esteem From Others - working in situations resulting in high regard from others.	61
	Working Alone - working in physical isolation from others although the activity may be integrated with that of others.	58
	Stage Presence - speaking to or performing for an audience.	55
	Personal Risk - risk of physical or mental illness or injury.	39
	Tangible/Physical End-Products - working with material elements or parts which ultimately result in a physical product.	36

APPENDIX C

TEST PUBLISHERS

Test of Learning Ability
Arithmetic Fundamentals Test

Richardson, Bellow, Henry & Co.
2700 South Qunicy Street, Suite 310
Arlington, VA 22206
(703) 998-4800

Wonderlic Personnel Tests

Wonderlic Personnel Tests
1509 North Milwaukee Avenue
Libertyville, IL 60048-1387
(847) 680-4900

Employee Aptitude Survey (Numerical)

Psychological Services, Inc.
100 West Broadway, Suite 1100
Glendale, CA 91210
1-800-367-1565 or (818) 244-0033

Myers-Briggs Type Indicator (MBTI)

Consulting Psychologists Press
577 College Avenue
Palo Alto, CA 94306
1-800-624-1765

Adaptability Test
Arithmetic Index
Flanagan Industrial Tests (Arithmetic)

Sumas Testing Co.
603 Cherry Street
Sumas, WA 98295
1-888-818-8378

Personnel Tests for Industry (Numerical)
Short Employment Tests (Numerical)

The Psychological Corporation
555 Academic Court
San Antonio, TX 78204-2498
(210) 299-1061