CTBSSP
SYNTHESIS 21

COMMERCIAL TRUCK AND BUS SAFETY

Driver Selection Tests and Measurement

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A Synthesis of Safety Practice

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COMMERCIAL TRUCK AND BUS SAFETY SYNTHESIS PROGRAM

CTBSSP **SYNTHESIS 21**

Driver Selection Tests and Measurement

A Synthesis of Safety Practice

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COMMERCIAL TRUCK AND BUS SAFETY SYNTHESIS PROGRAM

Safety is a principal focus of government agencies and private-sector organizations concerned with transportation. The Federal Motor Carrier Safety Administration (FMCSA) was established within the Department of Transportation on January 1, 2000, pursuant to the Motor Carrier Safety Improvement Act of 1999. Formerly a part of the Federal Highway Administration, the FMCSA's primary mission is to prevent commercial motor vehicle-related fatalities and injuries. Administration activities contribute to ensuring safety in motor carrier operations through strong enforcement of safety regulations, targeting high-risk carriers and commercial motor vehicle drivers; improving safety information systems and commercial motor vehicle technologies; strengthening commercial motor vehicle equipment and operating standards; and increasing safety awareness. To accomplish these activities, the Administration works with federal, state, and local enforcement agencies, the motor carrier industry, labor, safety interest groups, and others. In addition to safety, security-related issues are also receiving significant attention in light of the terrorist events of September 11, 2001.

Administrators, commercial truck and bus carriers, government regulators, and researchers often face problems for which information already exists, either in documented form or as undocumented experience and practice. This information may be fragmented, scattered, and underevaluated. As a consequence, full knowledge of what has been learned about a problem may not be brought to bear on its solution. Costly research findings may go unused, valuable experience may be overlooked, and due consideration may not be given to recommended practices for solving or alleviating the problem.

There is information available on nearly every subject of concern to commercial truck and bus safety. Much of it derives from research or from the work of practitioners faced with problems in their day-to-day work. To provide a systematic means for assembling and evaluating such useful information and to make it available to the commercial truck and bus industry, the Commercial Truck and Bus Safety Synthesis Program (CTBSSP) was established by the FMCSA to undertake a series of studies to search out and synthesize useful knowledge from all available sources and to prepare documented reports on current practices in the subject areas of concern. Reports from this endeavor constitute the CTBSSP Synthesis series, which collects and assembles the various forms of information into single concise documents pertaining to specific commercial truck and bus safety problems or sets of closely related problems

The CTBSSP, administered by the Transportation Research Board, began in early 2002 in support of the FMCSA's safety research programs. The program initiates three to four synthesis studies annually that address concerns in the area of commercial truck and bus safety. A synthesis report is a document that summarizes existing practice in a specific technical area based typically on a literature search and a survey of relevant organizations (e.g., state DOTs, enforcement agencies, commercial truck and bus companies, or other organizations appropriate for the specific topic). The primary users of the syntheses are practitioners who work on issues or problems using diverse approaches in their individual settings. The program is modeled after the successful synthesis programs currently operated as part of the National Cooperative Highway Research Program (NCHRP) and the Transit Cooperative Research Program (TCRP).

This synthesis series reports on various practices, making recommendations where appropriate. Each document is a compendium of the best knowledge available on measures found to be successful in resolving specific problems. To develop these syntheses in a comprehensive manner and to ensure inclusion of significant knowledge, available information assembled from numerous sources, including a large number of relevant organizations, is analyzed.

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The CTBSSP is governed by a Program Oversight Panel consisting of individuals knowledgeable in the area of commercial truck and bus safety from a number of perspectives—commercial truck and bus carriers, key industry trade associations, state regulatory agencies, safety organizations, academia, and related federal agencies. Major responsibilities of the panel are to (1) provide general oversight of the CTBSSP and its procedures, (2) annually select synthesis topics, (3) refine synthesis scopes, (4) select researchers to prepare each synthesis, (5) review products, and (6) make publication recommendations.

Each year, potential synthesis topics are solicited through a broad industry-wide process. Based on the topics received, the Program Oversight Panel selects new synthesis topics based on the level of funding provided by the FMCSA. In late 2002, the Program Oversight Panel selected two task-order contractor teams through a competitive process to conduct syntheses for Fiscal Years 2003 through 2005.

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FOREWORD

Administrators, commercial truck and bus carriers, government regulators, and researchers often face problems for which information already exists, either in documented form or as undocumented experience and practice. This information may be fragmented, scattered, and underevaluated. As a consequence, full knowledge of what has been learned about a problem may not be brought to bear on its solution. Costly research findings may go unused, valuable experience may be overlooked, and due consideration may not be given to recommended practices for solving or alleviating the problem.

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For each topic, the project objectives are (1) to locate and assemble documented information; (2) to learn what practices have been used for solving or alleviating problems; (3) to identify relevant, ongoing research; (4) to learn what problems remain largely unsolved; and (5) to organize, evaluate, and document the useful information that is acquired. Each synthesis is an immediately useful document that records practices that were acceptable within the limitations of the knowledge available at the time of its preparation.

PREFACE

By Donna L. Vlasak
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This report synthesizes current information on driver selection methods of commercial truck and bus companies, based primarily on the use of tests, measurements, and other assessments of applicants. It identifies and describes driver selection methods and instruments and their usefulness in predicting driver safety. The audience for this study includes motor carrier safety managers, other carrier executives and managers, and government and industry officials.

The report reviewed the academic, commercial, and industrial literature on tests, measurements, and other procedures used by motor carriers to select safe commercial drivers. The study revealed large and enduring individual differences in crash risk among commercial drivers and highlighted the need for valid and usable driver selection procedures for carriers. Sources of this information were naturalistic driving studies, behavioral histories

("biodata"), driving behavioral histories, and other human performance studies, as well as federal regulations.

Surveys and interviews were used to obtain information from motor carrier safety managers and other experts on selection procedures and tests and on underlying driver characteristics relevant to risk. The project surveys of motor carrier safety managers and other experts on truck and bus safety were convenience samples of individuals active in national industry and research organizations. These individuals included professionals in government, industry trade associations, other industry roles (e.g., safety consulting), and research. These survey respondent groups of interested, knowledgeable individuals provided indications of industry thinking on safety management questions from two different perspectives.

A select group of ten motor carrier safety managers—those whose questionnaire responses indicated an active focus on driver assessment—were interviewed for case studies on driver selection practices. Each case study describes the company's driver selection methods and features innovative hiring and related human resources management practices.

Ron Knipling, Safety for the Long Haul, Arlington, Virginia, Stephen V. Burks, Kristen M. Starner, Christopher P. Thorne, and Michael R. Barnes, University of Minnesota, Morris, and Gene Bergoffen, MaineWay Services, Fryeburg, Maine, collected and synthesized the information and wrote the report. The Commercial Truck and Bus Safety Synthesis Program Oversight Committee members are acknowledged on the preceding page. This synthesis is an immediately useful document that records the practices that were acceptable within the limitations of the knowledge available at the time of its preparation.

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DRIVER SELECTION TESTS AND MEASUREMENT

SUMMARY

This report synthesizes current information on the driver selection methods of commercial truck and bus companies. Drivers are selected primarily through the use of tests, measurements, and other assessments of applicants. This report reviews the academic, commercial, and industry literature on these assessments, and how they are used within carriers' driver selection processes. It also includes a background discussion of driver hiring and the selection process, explanations of major types of selection instruments, and an explanation of test validity in the context of commercial driving. It presents a survey of carrier safety managers and other experts; case studies of carrier selection schemes; a summary of reported effective practices; and research, development, and analysis needs relating to improved commercial driver hiring and selection. The audience for the study includes motor carrier safety managers, other carrier executives and managers, and government and industry officials.

Driver assessments are intended to capture and quantify underlying, enduring, and safety-relevant individual differences. Past research has indicated that individual differences in both commercial and noncommercial driver crash risk are significant, with a relatively small percentage of drivers disproportionately involved in crashes and incidents. Differences in driver crash risk arise in part from enduring individual differences, some of which are discernible during driver selection. Because safety and driver retention are associated, driver factors relating to retention are also considered. The following areas of driver individual differences are examined: personality, attitudes, psychomotor performance, medical status and conditions, behavioral history, and mental abilities. Specific selection procedures and tests described are generally designed to target one of these areas, or a more specific dimension within one of these areas. Individual differences and assessments relevant to predicting job retention are also addressed, because driver safety and retention are interrelated.

In addition to exploring individual dimensions relevant to safe driving, the report reviews fundamental characteristics of valid and fair selection procedures, as well as key legal requirements. It identifies and describes driver selection methods and instruments in relation to their psychological or medical basis and their usefulness in predicting driver safety. The report reviews general driver selection and hiring procedures used by motor carriers, as well as specific procedures addressing personal dimensions underlying differential driver risk. It also articulates potential research and development needs relating to commercial driver selection.

Based on literature and product reviews, the report presents information on a representative group of assessment instruments and other products supporting the selection of safe and successful commercial drivers. The product review is intended to be illustrative; it is not exhaustive, nor is it evaluative in the sense of identifying "best" products. Rather, the information obtained from product vendors and other sources has been used to classify products, explain their scientific or theoretical basis in relation to safety, describe how they are constructed and administered, and report available findings on their relevance to safety. Products are not compared in a qualitative manner, and neither TRB nor the report authors endorse any product described in this report.

The project surveys of motor carrier safety managers and other experts on truck and bus safety were convenience samples of individuals active in national industry and research organizations. The primary project survey, a written questionnaire, was of motor carrier safety managers. The survey was designed to determine the individual driver dimensions and characteristics that respondents consider most important for safety. It also asked what specific selection practices and assessment tools they used, and their assessments of the success of their current procedures. Another perspective was provided by a similar survey polling other experts in motor carrier safety. These individuals included professionals in government, industry trade associations, other industry roles (e.g., safety consulting), and research. They are highly knowledgeable and experienced, but are not current practitioners in making driver assessments at the carrier level. Thus, their survey was limited to questions on views and opinions, as opposed to practices.

Most survey findings relate to the association of specific driver characteristics with risk, and to specific types of selection instruments and practices. Perhaps the most fundamental survey finding was that respondents believed driver *assessment* activities, including driver selection and postselection evaluation, to have greater effects on safety outcomes than other, nonassessment management activities. The latter included driver preparation (pre-job training), company communications (e.g., safety meetings), and company rewards and discipline. This survey finding reinforces observational and experimental evidence of enduring and safety-significant driver individual differences.

A select group of 10 motor carrier safety managers—those whose questionnaire responses indicated an active focus on driver assessment—were recruited to be interviewed for case studies on carrier driver selection practices. Each case study describes that company's driver selection methods and features five innovative hiring and related human resource management practices.

Based on the literature review, surveys, and case studies, the report summarizes effective practices for carriers to improve driver selection from the safety perspective. They include 15 specific practices consistently reported as effective as well as 9 other practices suggested for consideration by carriers. Perhaps the most basic advice to carriers is to create a positive, professional, and rewarding work environment where driver jobs with the company are valued. This produces the situation where driver recruitment efforts attract a large number of highly qualified applicants, which in turn allows a carrier to be highly selective in its hiring. Selectivity and the use of valid, predictive instruments are two necessary ingredients of a strong selection program.

Both research to find new knowledge and development efforts for new tools could contribute to better commercial driver selection and higher quality drivers on the road. Research could seek to define driver traits with relationships to safety more sharply. Development efforts could focus on tests and other assessments usable by carriers to screen drivers for hire. Much of the work would analyze test validity, or the ability of the test to predict on-the-job driving safety fairly and accurately.

CHAPTER ONE

INTRODUCTION

BACKGROUND

Research reveals large and enduring individual differences in crash risk among commercial drivers. These differences pervade the general population of drivers as well. Most commercial drivers are reliable and safe, but a relatively small percentage (perhaps 10%–15%) is heavily overinvolved in crashes and incidents. This phenomenon has been termed *differential driver risk*. *CTBSSP Synthesis 4* (Knipling et al. 2004) explored differential driver risk and high-risk drivers in particular. Evidence comes from various sources. Most compelling are naturalistic driving studies, which use instrumented vehicles to reliably count driver involvements in at-fault driving events, including crashes, near-crashes, and other incidents. Event counts can be compared with driver exposure (e.g., driving hours) to generate rates of driver involvements in at-fault events. The observed individual differences in driver risk are far greater than could possibly occur by chance variation alone. For example, in one major large truck naturalistic driving study (Hickman et al. 2005), a subset of drivers with just 19% of driving exposure was involved in 53% of all observed at-fault driving events. The remaining drivers, with 81% of exposure, had just 47% of at-fault events.

Although some drivers may change their driving styles for better or worse over time, most individual differences in driver risk are persistent (Miller and Schuster 1983; Lancaster and Ward 2002). Indeed, many individual differences in human performance and behavior are influenced by heredity (Larson and Buss 2005; Thiffault 2007). Principal correlates of differential driver risk include personality dimensions such as sensation-seeking, anger/hostility, impulsivity, intensity (i.e., "Type A"), agreeableness, and conscientiousness. Individual perceptions and attitudes about risk are reflective of personality and of course affect safety-related behaviors and outcomes. Mental abilities (e.g., spatial, mathematical) are also related to commercial driving safety and other measures of employee success (Burks et al. 2009). Driver risk can also be related to driver physical and sensorimotor abilities, such as dynamic vision, information processing proficiency, and reaction time. Various medical conditions are also associated with driver risk, including cardiovascular illness, sleep apnea, other sleep disorders, diabetes, and obesity. Behavioral history ("biodata") is also predictive of commercial driver risk (Murray et al. 2005). Driving behavioral history (i.e., crashes and moving violations) is most indicative, although nondriving behavioral history (e.g., criminal record) is predictive of risk as well (Knipling et al. 2004).

Past research highlights the need for valid and usable driver selection procedures for carriers. These selection procedures seek to measure enduring individual differences relevant to driving safety. Ideally, companies could employ a battery of tests, measurements, and questionnaires designed to fairly measure these driver traits and thereby identify likely high- and low-risk drivers. Research indicates that no one test is likely to be definitive. Tests must be validated against job performance criteria such as crash, violation, and incident rates. The opportunity for improving the quality of fleet drivers is strongest when, owing to economic or other conditions, there are larger numbers of commercial driver applicants and carriers can afford to be more selective in hiring. A caveat, however, is that greater selectivity increases fleet driver quality only if a fleet employs valid selection procedures and devices. Multiple devices have the greatest combined benefit when they tap into different driver traits and dimensions relating to risk.

One constraint on the use of selection tests in hiring commercial drivers is that all employee selection tests must meet Equal Employment Opportunity Commission (EEOC) standards for test validity. These standards help to ensure that tests fairly capture job performance-related personal dimensions and do not arbitrarily discriminate based on non-performance-related applicant characteristics. There are several ways of demonstrating job test validity. This report will review these requirements as they relate to carrier practices to help ensure fair, legal, and safety-effective driver selection. This information, together with information on the tests themselves and their use within commercial transport, can be a useful foundation for carriers to make greater use of selection devices as well as better choices among available instruments. Selection tests and measurements for use by carriers will be described within the overall framework of commercial driver qualifications, licensing, and federal requirements for the fair use of employee selection instruments.

The safe selection of commercial drivers may be seen within at least two larger contexts. The first of these is crash risk factors in general. Much of road safety research seeks to

identify crash risk factors and reduce risk. For example, the U.S.DOT Large Truck Crash Causation Study (LTCCS) was performed to "identify associations between various factors and an increased risk of crash involvement in either relative or absolute terms" (Blower and Campbell 2005). The following box presents a taxonomy of potential crash risk factors based on multiple sources (Evans 2004; Starnes 2006; Shinar 2007; Thiffault 2007; Knipling 2009a; Murray et al. 2009). The principal focus of this project is on the category of persistent driver characteristics, though other categories were also addressed in the project survey and in interviews. Enduring human characteristics are also known as *traits*, in contrast to temporary characteristics, also known as *states*.

The second broader context for commercial driver selection is that of employee selection in general. Employee performance differences permeate the workplace and create the need for valid employee assessments and, in particular, selection procedures. The U.S. Department of Labor (DOL 2000) points out various work situations where employee selection is particularly important for organizational success. Among these situations are (1) when employee errors can have catastrophic consequences and (2) when there is high employee turnover. Both of these conditions characterize commercial motor vehicle (CMV) transport. Carriers must therefore emphasize driver selection and hiring if they are to achieve high safety performance and stable workforces. Selection methods must assess the various enduring driver characteristics known to be related to risk, which include driver demographics, driving knowledge and skills, personality, risk perception and attitudes, psychomotor skills, medical status and conditions, behavioral history, and mental abilities. The text box, adapted from a DOL report (DOL 2000) lists assessment procedures that may be considered under the rubric "tests and measurements" for purpose of improved employee hiring.

The best carrier driver recruitment and selection systems are those that attract a large number of highly qualified applicants and have the highest and most accurate standards for selection. High selection "accuracy" requires the use of valid selection tests and other procedures to assess enduring driver characteristics relevant to safety (Cascio 2004). This study reviews motor carrier driver selection methods in general, with a focus on the scientific basis and validity of various driver selection tools.

PROJECT OBJECTIVES, METHODS, AND SCOPE

This report reviews the academic, commercial, and industry literature on tests, measurements, and other procedures used

Potential Crash Risk Factors

Enduring Driver Factors
- Demographics (e.g., age, gender)
- Driving knowledge and skills
- Personality (e.g., aggressiveness, sensation-seeking, stress level)
- Risk perception and attitudes
- Psychomotor skills (e.g., reaction time)
- Medical status and conditions, including fatigue susceptibility
- Behavioral history
- Mental abilities

Temporary Driver Factors
- Recent sleep
- Time-of-day and circadian rhythms
- Time awake (e.g., > 16 hours)
- Time-on-task (hours working and driving)
- Short-term illnesses
- Moods and recent stress
- Recent food and fluids
- Drugs, medications, and alcohol
- Familiarity with road

Vehicle Factors
- Vehicle design and configuration
- Mechanical condition
- Safety features and technologies

Roadway and Environmental Factors
- Mileage exposure in general
- Divided vs. undivided roads
- Level of access/types of intersections
- Traffic density
- Curves and ramps
- Intersections
- Lane restrictions
- Construction zones
- Weather and road surface condition

Carrier Operations and Management Factors
- Organization and operation type
- Driver selection
- Fleet-based driver training
- Communications and dispatching
- Driver performance monitoring and evaluation
- Rewards and discipline
- Pay and benefits

Government Policies and Practices
- Driver qualifications and licensing
- Hours of service (HOS)
- Enforcement practices
- Information and education programs.

Candidate Assessment Procedures

- Observations
- Resume evaluations
- Application forms
- Questionnaires
- Observations
- Resume evaluations
- Application forms
- Questionnaires
- Public records review
- Biodata
- Interviews
- Work samples
- Performance tests
- Mental ability tests
- Physical ability tests
- Personality inventories
- Honesty/integrity inventories
- Work interest inventories
- Medical histories
- Medical examinations
- Drug/alcohol tests
- Probationary periods

Source: Adapted from DOL (2000).

by motor carriers to select safe commercial drivers. It presents evidence relating to individual driver trait differences relevant to safety, and describes ways that those differences can be assessed as part of hiring decision making. Surveys and interviews were used to obtain information from motor carrier safety managers and other experts on selection procedures and tests and on underlying driver characteristics relevant to risk. The report also describes important and prevalent carrier selection practices, discusses barriers to more widespread use of various selection tools, and identifies research and development needs relating to driver selection by carriers.

This *Driver Selection Tests and Measurements* synthesis project has been based on the following information-gathering activities:

- Research literature review
  - Safety-relevant individual differences
  - Retention- and performance-quality-relevant individual differences
  - Tests and measurements
- Vendor product review
- Surveys
  - Carrier safety manager questionnaire
  - Other expert (e.g., research, government, trade association) questionnaire
- Carrier safety manager interviews (for case studies)
- Review of federal regulations
  - FMCSA
  - EEOC hiring guidelines (EEOC 2003).

The survey and interview methodologies are each described in chapters focusing on those efforts. The research literature and vendor product review methodology is described here. Searches were performed using websites, academic databases, books, trade press publications, and articles. The following databases were used to conduct the reviews:

- Transportation Research Information Services: The largest online bibliographic database of transportation research, containing more than 650,000 records of published research.
- Business Source Premier: Features the full text for more than 2,200 journals. Full text is provided back to 1965, and searchable cited references back to 1998.
- PsycINFO: From the American Psychological Association, contains nearly 2.3 million citations and summaries of scholarly journal articles, book chapters, books, and dissertations, all in psychology and related disciplines
- PsycARTICLES: From the American Psychological Association, contains more than 45,000 articles from 57 journals, 46 published by the association and 11 by allied organizations.
- EconLit: From the American Economic Association's electronic database, covers economic literature, with more than 735,000 records.

These databases were searched using a variety of topic-related key words and phrases, often in combinations to improve focus. Key words included trucking, safety, screening, driver, commercial trucking, driving measurements, driving behaviors, personality factors, retention, driver characteristics, hiring, traits, job performance, and tests.

The material in this report requires three disclaimers:

- Although there may be regulatory issues and activities relating to some study topics, the study did not address them in that context and does not make recommendations relating to government regulations.
- No product or service was formally evaluated for this report. Company and brand names are provided to illustrate available products and services. Neither TRB nor this report endorses any company, product, or service.
- The project survey data presented in chapter four and cited elsewhere are based on convenience samples of responding safety managers and other experts. Survey data represent the opinions and practices of the respondents, not larger populations such as "all carrier safety managers." Safety manager respondents were generally from larger fleets with sufficient resources and safety interest to participate in national industry organizations and meetings, through which they were contacted.

The remaining chapters of this report review basic commercial driver qualifications, examine safety-relevant individ-

ual differences, summarize typical carrier hiring procedures, describe various tests and measurements to assess driver safety, present the project surveys and report their results, present several carrier case studies, and state conclusions and research needs. Report appendices provide the project survey forms and supplemental information on commercial driver hiring and selection.

CHAPTER TWO

OVERVIEW OF DRIVER INDIVIDUAL DIFFERENCES

In the book *Using Psychology: Principles of Behavior and Your Life*, Holland (1975) presents following two "metaprinciples" of human behavior:

1. *Individual Differences*: Each person is physically and psychologically unique.

2. *Behavioral Consistency*: Each person behaves relatively consistently over time and across different situations.

People have significant individual differences, and these individual differences persist over long periods because each individual behaves consistently in many ways over time. These consistent, enduring human individual differences have significant influences on the probability of crash involvement (Lancaster and Ward 2002; Knipling et al. 2004). They are a potentially fair basis for commercial driver selection because they are likely to persist on the job and affect job performance.

This chapter will first define the general characteristics and qualifications that all U.S. commercial drivers must have. It will then describe and define key driver characteristics and personal dimensions with known relationships to safety-related behavior and especially to driving safety. This will lay the groundwork for the following chapter, which will address procedures, tests, and measurements to assess safety-related driver individual differences in the hiring process.

GENERAL DRIVER QUALIFICATIONS

This report focuses on carrier assessment of driver applicants' crash risks during the hiring process. It does not focus on federal minimum qualifications for drivers, or required carrier tasks to verify that those qualifications are met. Rather, the emphasis is on driver risk assessments *beyond* verification that they meet minimum requirements. Nevertheless, it is worthwhile to briefly review those qualifications, as they are a baseline for any further consideration of driver applicants, and they also reflect risk factors officially considered safety-critical. This section briefly reviews those requirements.

General Federal Requirements for Drivers

Commercial driver general qualification standards are found in Federal Motor Carrier Safety Regulations (FMCSR) Part 391 at 49 CFR 391. These regulations also establish minimum duties of motor carriers in verifying driver qualifications. An owner-operator with DOT operating authority must meet both the driver and carrier requirements. An excellent summary of driver qualifications as well as other safety-related regulations and best practices is *A Motor Carrier's Guide to Improving Highway Safety* (FMCSA 2008), available from the agency.

Although there are several farming-related and other exemptions, the following are key commercial driver requirements and responsibilities:

- Be at least 21 years old
- Speak and read English
- Be able to drive the vehicle safely
- Possess a medical certificate
- Have a valid Commercial Drivers License (CDL)
- Provide motor carrier employer with a list of all violations during the past 12 months
- Pass a driver's road test or equivalent
- Know how to safety load and secure cargo.

Every motor carrier must have a qualification file for each regularly employed driver, including the following:

- Driver's application for employment
- 3-year driving record from state agency
- Driver's road test certificate
- Annual inquiries to state agencies for driving records
- Annual carrier review of the above
- Annual driver's certification of violations during previous 12 months
- Medical examiner's certificate
- Special certificates as applicable (e.g., drivers with lost limbs, longer combination vehicle drivers)
- Driver investigation history file
  - Inquiry to previous employer(s) over 3 years
  - Drug and alcohol testing release form
  - Notes of responses received from above.

Driver Physical Qualifications

Commercial driver physical qualification standards are found in 49 CFR 391.41. These regulations prevent persons with certain specified medical conditions from operating a

CMV in interstate commerce. FMCSA provides guidance to medical examiners (and motor carrier companies) in an online handbook (FMCSA n.d.), and the training specifications for medical examiners who conduct the examinations are available in the core curriculum.

FMCSA (2008) cites the following, from 49 CFR 391.41, as examples of its physical requirements for drivers:

- Has no loss of a foot, a leg, a hand, or an arm, or has been granted a skill performance evaluation certificate pursuant to 49 CFR 391.49.
- Has no impairment of a hand or finger which interferes with prehension or power grasping or has been granted a skill performance evaluation certificate pursuant to 49 CFR 391.49.
- Has no impairment of an arm, foot, or leg which interferes with the ability to perform normal tasks associated with operating a CMV or has been granted a skill performance evaluation certificate pursuant to 49 CFR 391.49.
- Has no established medical history or clinical diagnosis of diabetes mellitus currently requiring insulin for control or has been issued a diabetic or vision exemption.
- Has no current clinical diagnosis or any disqualifying heart disease.
- Has no established medical history or clinical diagnosis of a respiratory dysfunction.
- Has no current clinical diagnosis of high blood pressure.
- Has no established medical history or clinical diagnosis of arthritis.
- Has no clinical diagnosis or clinical history of epilepsy.
- Has no mental, nervous, organic, or functional disease or psychiatric disorder.
- Has 20/40 vision or better with or without corrective lenses.
- Has distant binocular acuity of at least 20/40 in both eyes with or without corrective lenses.
- Has the ability to recognize the colors (red, green, and amber) of traffic signals.
- Has hearing to perceive a forced whisper voiced equal to or greater than 5 feet with or without hearing aid, or average hearing loss in the better ear equal to or less than 40 dB.
- Has no history of drug use or any other substance identified in Schedule 1.
- Has no clinical diagnosis of alcoholism.

Many detailed medical definitions and fine distinctions are applied in determining disqualifications. FMCSA's website and the FMCSRs have specific interpretations of the qualifications and the latest changes. Changes and refinements to these requirements are continuously under consideration, and there are exemption programs for some conditions such as monocular vision.

Driver physical qualifications focus primarily on major medical conditions such as cardiovascular conditions, or basic "static" psychomotor abilities such as visual acuity and color vision. Dynamic physical driving skills such as attentional focus and decision making are not assessed, nor are work-related functional requirements such as lifting and entering/exiting tractors and trailers. The nature of these skills and tests designed to assess them will be discussed later in this chapter and the next.

SAFETY-RELEVANT DRIVER TRAITS AND OTHER CHARACTERISTICS

A *trait* is a personal characteristic that *differs among people* and tends to be *persistent over time*. This report concerns personal traits and related characteristics that are (1) relevant to driving safety, and (2) potentially discernible through some kind of test, measurement, or other evaluation. Psychologists distinguish *traits* from *states*. Traits are enduring, often lifetime, characteristics, whereas states are temporary conditions (Pervin 2003). A consistent and persistent disposition toward anger, aggression, and/or hostility would be a trait. Temporary anger after an argument would be a state.

People differ from each other in many fundamental ways. These differences may be related to heredity, developmental environments, chronic life conditions, or a combination of these. Evidence points to the following types of human traits and other characteristics as being most relevant to driving safety (Lancaster and Ward 2002; Murray et al. 2003, Thiffault 2011), and thus of greatest potential interest for commercial driver assessments:

- Personality
- Attitudes
- Psychomotor skills and cognitive functions
- Medical status and conditions
- Behavioral history (not a trait per se but a similar indicator)
- Mental ability.

These six categories are not entirely mutually exclusive. Most notably, personality is a source of attitudes, and then both are sources of behavioral history differences. Psychomotor and cognitive skills are conceptually separable from medical conditions, but in practice the two may be conflated. In both research and practice, however, the six areas are generally addressed separately.

Each of these kinds of driver differences are defined and discussed here. Most can be further classified into more specific categories, like different personality types and different medical conditions. Evidence for the safety-relevance of each is presented.

Personality

This report employs a broad and simple definition of human personality: *any enduring tendency or consistency in a person's behavior or psychological makeup.* Personality traits are consistent tendencies in emotional adjustment, interpersonal relations, motivation, attitudes, and behavioral "style." "Personality traits are deep individual characteristics, most often biologically rooted, that determine the broad emotional and behavioral orientations of the person" (Thiffault 2007). Psychological consistencies extend in two dimensions: *consistency over time* and *consistency across diverse situations*. Of course, such consistencies are not absolute. People change in both predictable and unpredictable ways through life, and sometimes people behave markedly different in different situations. But there is enough individual behavioral consistency across time and across situations that it is considered a pervasive principle of psychology and a major determinate of behavior (Holland 1975; Pervin 2003). This includes commercial driver safety behavior.

CTBSSP Synthesis 4 on individual differences (Knipling et al. 2004) found that both carrier safety managers and other experts considered personality dimensions like aggressiveness and impulsivity/risk-taking to be among the top predictors of driver risk. Other research has also shown that these traits are associated with driver crash risk or safety-related behaviors. Other safety-relevant personality traits include sensation-seeking, "Type A" personalities, lack of conscientiousness, and high stress level.

Personality dimensions are not unitary physical dimensions like height or weight. Rather, they are *constructs* or explanatory labels for something that is not directly observable or cannot be captured by a single observation or measure (DOL 2000; Pervin 2003). Personality constructs are theoretical concepts that attempt to capture a cluster of closely related personal behaviors, attitudes, or emotions. "Conscientiousness," for example, cannot be directly seen or measured, but it exists as a human trait because its multiple manifestations are visible in behavior that is considered to be morally correct. This report will also discuss *construct validity*, the degree to which research confirms predictions based on the construct. In other words, construct validity is the degree to which a personality label is robust and useful as an explanation of behavior.

The research literature on personality includes numerous constructs representing personal traits and dimensions. For example, one major personality questionnaire uses multiple-choice answers to classify people on five dimensions or scales: neuroticism (anxiety), extraversion, openness to experience, agreeableness, and conscientiousness (Larson and Buss 2005). These have been called the "Big Five" personality dimensions, although not all are strongly related to driving safety.

The major personality dimensions relevant to safety include impulsivity/risk-taking, sensation-seeking, aggressiveness/anger/hostility, "Type A" personality, conscientiousness, and stress level. In some cases, similar or overlapping personality dimensions are also discussed. The focus here is on the personality dimensions themselves rather than on occupational tests of them. Chapter three presents specific tests known to predict driving safety.

Impulsivity/Risk-Taking

An impulsive person is one who makes hasty actions and therefore is prone to error. Often, the hard-to-control impulses are related to risky behaviors or even violence. Whenever a person reacts quickly and without forethought, he or she will be at higher risk for errors. Impulsivity and risk-taking are largely inseparable as personality traits because the perception of risk is what constrains most people from hasty actions (Shinar 2007). Many motor vehicle crashes are the result of voluntary at-risk behaviors, such as excessive speed, improper following distance, and illegal maneuvers.

Drivers' perception of the risk of their actions underlies, to a great extent, the extent to which they engage in at-risk behaviors. *Risk perception* is a cognitive process underlying an individual's perceived level of risk and that determines, or strongly influences, risk-taking behaviors (Thiffault 2007). Safety belt use provides a good example. Eby (2010) reviewed the reasons why some drivers do not wear safety belts. Reasons include forgetting, discomfort, inconvenience, social motivations, and complaints about how belts are installed in some vehicles. The biggest reason, however, was the perception that there was little risk in not wearing the belt. Here, "risk" included both injury risk and traffic violation risk. Laws and company policies mandating safety belt use are effective because they "up the ante" in regard to violation risk, even though, objectively, the legal consequences of not wearing a belt are small compared with the potential injury consequences. Young male drivers have the highest rates of not wearing a belt, consistent with their high rates of risky driving behaviors.

Beck et al. (2006) queried 2,030 U.S. drivers (mainly noncommercial) about their driving beliefs, attitudes, and behaviors. Of the 2,030, 305 were designated "aggressive" based on a self-report that they had driven aggressively, traveled 20 mph or more above the speed limit, violated a traffic sign or signal, or driven while under the influence in the past month. About 12% of the aggressive drivers admitted that they did not "always/nearly always" wear their belts, compared with just 2% of the remaining drivers.

Not wearing a safety belt appears to be an indicator of commercial driver risk as well. In the LTCCS, truck crash involvements could be separated into three categories: single-vehicle, multivehicle where the truck/truck driver is assigned the Criti-

cal Reason (CR) (i.e., is "at-fault"), and multivehicle where the other vehicle/driver is assigned the CR (Knipling 2009b). Single-vehicle crashes suggest the greatest driver failure, as they generally occur as a result of a catastrophic loss of vehicle control. In truck-CR multivehicle involvements, the truck driver is at fault, but the error is usually a traffic interaction mistake such as "looked but did not see" or false assumption. Truck driver error is minimal or nonexistent in multivehicle crashes where the other driver is assigned the CR. Not wearing a safety belt is strongly associated with these three crash categories and levels of driver culpability, as shown in Figure 1. Thus, not wearing a safety belt is associated not only with the risk of injuries in crashes, but also with the risk of causing crashes.

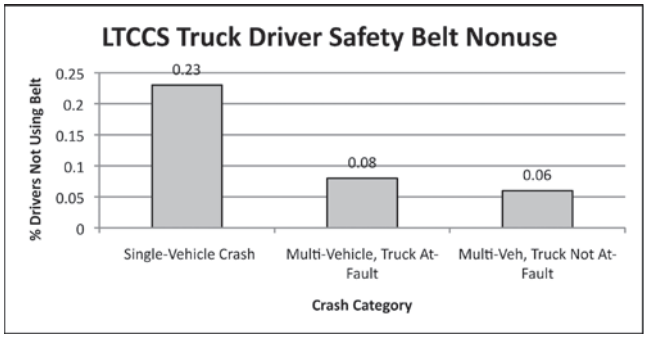

FIGURE 1 Association of truck driver safety belt nonuse and crash involvement category in the LTCCS. (*Source*: Knipling 2009b.)

Impulsivity overlaps strongly with sensation-seeking, aggressiveness/anger, "Type A" personalities, and (lack of) conscientiousness. Thus, the research findings relating to these traits generally apply qualitatively to impulsivity as well.

Sensation-Seeking

Sensation-seeking is the desire for varied, novel, and arousing experiences. It has well-established links to unsafe driving behaviors, traffic violations, and crash involvement (Schwebel et al. 2006). Sensation-seeking overlaps with other personality traits like impulsivity and aggressiveness. Sensation-seeking people tend also to be extraverts. Studies reviewed by Dewar and Olson (2002) and Knipling (2009a) link sensation-seeking with unsafe driving behaviors, traffic violations, and crash involvement. A meta-analysis by Jonah (1997) documented correlations between sensation-seeking and risky driving behaviors such as speeding, frequent lane changes, alcohol use, and failure to wear safety belts. Iverson and Rundmo (2002) also found a significant association between sensation seeking and risky driving. Rimmo (2002) found that sensation-seeking is strongly associated with violations of rules (e.g., speed limits and other traffic restrictions) but only weakly associated with driving mistakes not associated with rule violations, such as "looked but did not see." Dahlen and White (2006) found sensation-seeking to be related to unsafe driving behavior, although they noted that the exact path in which it affects driving is unknown. They speculated that the link was related to aggressive driving, lack of rule following (e.g., speed limits), and driver loss of concentration at critical times.

Drivers who seek sensation and/or experience negative emotions while driving are more likely to be in crashes and to commit violations. Matthews et al. (1996) developed a Driver Stress Inventory (DSI) to capture emotions during driving, including aggressive feelings toward other drivers, active dislike of driving, worry over hazards, thrill-seeking, and fatigue. Subjects taking the inventory answer 48 Likert scale items which together generate scores on these various aspects of stress. DSI scale scores for both U.S. and U.K. subject groups were compared with separate questionnaire responses relating to driving behaviors, crashes, and violations. Crash-involved drivers scored higher than non-crash-involved ones on feelings of thrill-seeking and aggression/hostility while driving. Thrill-seeking and aggressive emotions also correlated in the +0.4 to +0.6 range with traffic violations and with self-reported speeding.

Sensation-seekers appear to be generally more susceptible than other drivers to fatigue and drowsiness. Because

16 Driver Characteristics and Risk: Safety Manager Ratings
(Arranged Highest to Lowest)

1. Aggressive/angry
2. Impatient/impulsive
3. Inattentive
4. Inexperienced (new CMV driver)
5. Unhappy with job/company
6. Young driver (e.g., less than 25)
7. Sleep apnea/other sleep disorder
8. Unhappy marriage/family problems
9. Debt or other financial problems
10. Heart or other medical condition
11. Dishonest
12. Older driver (e.g., 60 or older)
13. New to company
14. Obese/overweight
15. Introverted/unsociable
16. Did not attend truck driving school

Source: Knipling et al. (2003).

they become bored with routine tasks more easily, sensation-seekers need and seek more stimulation to keep them awake; without it (as during long, boring drives), they become vulnerable to drowsiness. In contrast, non-sensation-seekers generate their own internal stimulation to sustain alertness. This finding is based on a driving simulator study by Thiffault and Bergeron (2003), as well as other studies and theories of individual differences in brain function.

Aggressiveness/Anger/Hostility

In the *CTBSSP Synthesis 1* Safety Manager survey (Knipling et al. 2003), respondents rated "aggressive/angry" as the driver characteristic most highly associated with driver risk. The textbox shows the rank-ordered list of characteristics presented in the questionnaire. Other research corroborates this strong association. Numerous studies show relationships between aggression/anger and crashes and violations (Knipling et al. 2004; Schwebel et al. 2006; Thiffault 2007). "Road rage" incidents are the most extreme and highly publicized manifestation of driver anger, but such incidents represent only the most visible part of a larger problem.

Dahlen and White (2006) compared the "Big Five" personality factors, sensation-seeking, and driving anger to driving behaviors and history. Subjects were 312 undergraduate students who drove more than 60 miles weekly. Driving anger was measured by a 14-item questionnaire, an abridged version of a 33-item Driving Anger Scale (DAS; Deffenbacher et al. 2001). Although other measured personality traits (including sensation-seeking) showed correlations with driving risk, the trait driving anger had the clearest associations. Scores on the 14-item DAS correlated positively with close calls (+0.18), risky driving (+0.31), and aggressive driving (+0.38). The authors considered individual differences in anger while driving to be important in assessing crash risk, and recommended driving anger as a principal factor to include in any personality inventory to screen for risky drivers.

Schwebel et al. (2006) compared personality traits with both driving behavioral history and performance on a simulated virtual environment task designed to assess risk-taking during driving. Traits examined included anger/hostility, sensation-seeking, and conscientiousness, all of which previous studies had linked to risky driving. Anger/hostility was measured using the DAS and behavioral history using a Driver Behavior Questionnaire (DBQ; Parker et al. 1995). Subjects high in anger/hostility took more chances in the simulated driving and also had stronger histories of speeding, violations, and crashes. Findings for sensation-seeking were similar, whereas those for conscientiousness were similar but inversed.

"Type A" Personality

"Hard charging" is a description that may have a positive connotation when applied to successful entrepreneurs or other high-achieving individuals, but has a negative connotation if it implies chronic anger, dissatisfaction, impatience, overcompetitiveness, and hostility. The "Type A" personality encompasses these characteristics. In a review of several studies, Dewar and Olson (2002) note that the Type A personality is reflected in people's choice of vehicles, driving style, violation rates, crash rates, and heart attack rates. They also report a surprising association with psychomotor skills: Relative to controls, Type A individuals have slower reaction times and generally perform worse. Type A individuals often exhibit life stress both at home and at work, are quickly irritated by other drivers, tend to dehumanize other drivers, and express anger outwardly rather than inwardly. For them, the shell of a car or truck cab can be an insulated and "safe" environment from which to project anger and hostility.

Nabi et al. (2005) compared questionnaire responses on the Bortner Rating Scale for Type A Behavior Patterns (TABP) to responses relating to risky driving behaviors and past crash involvements. The subject group for this comparison was 11,965 French national utility (electricity and gas) company employees. The researchers found a significant association between Type A behaviors and both crash rates and serious crash rates. The study controlled for annual mileage, gender, and age. Figure 2 shows driving "hazard ratios" for low, medium, and high scorers on the TABP scale. Explanations for the association include that Type A drivers engage in more risky driving behaviors (e.g., talking on cellular phones, eating), are less patient, and are more prone to anger in frustrating or stressful driving situations.

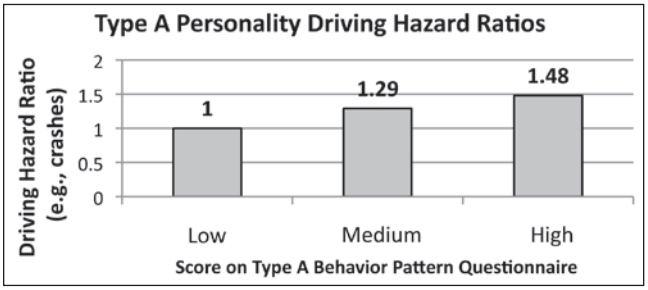

FIGURE 2 Driving "hazard ratios" for low, medium, and high Type A questionnaire scorers in French utility company study. (*Source*: Nabi et al. 2005.) *Note*: Normed relative to "Low" hazard (1.00).

Conscientiousness

Conscientious people have a strong sense of right and wrong and believe in an obligation to act accordingly. Thus, they tend to be careful, scrupulous, responsible, and reliable. Unconscientious people are at the opposite extreme. Level of conscientiousness in the population may follow a skewed distribution much like that of driver risk. That is, most people are in the "hump" at the good end of the spectrum, whereas a relatively small number are in the long "tail" at the bad end.

Arthur and Graziano (1996) administered questionnaires on conscientiousness and five other personality traits to nearly 500 subjects, including both college students and workers. Conscientious individuals were those who characterized themselves as self-disciplined, responsible, reliable, and dependable. Of the six traits measured, conscientiousness was found to have the strongest relation (in this case, an inverse relation) to crash involvement for both students and workers. The authors noted that "conscientious individuals may be especially sensitive to social responsibility norms," making them less likely to engage in dangerous activities. Controlling for other factors, the correlation between conscientiousness and number of at-fault crashes was −0.22, which may be considered a moderate correlation given the various measurement difficulties and confounding factors affecting such a study.

Extreme lack of conscience is seen in *antisocial* personalities. Individuals with this personality disorder have been called "sociopaths" or "psychopaths." "Antisocial" in this context does not mean introverted, but rather that the individual has little social regard for others. These individuals tend to be sensation-seekers who do not appreciate the potential consequences of their actions for themselves or others. The antisocial personality type is often seen among criminals and among individuals with a history of traffic violations and crashes. Thus, hiring individuals with criminal backgrounds poses safety and security concerns (Knipling 2009a).

In a large poll of more than 700 general population drivers, West et al. (1993) related "social deviance" to self-reports of speeding while driving and crashes. Socially deviant individuals were characterized as being selfish, focused on immediate gratification, and having a disregard for the law and for other people. Questionnaires were used to assess socially deviant attitudes and behaviors. Questionnaires were also used to assess subjects' "thoroughness" and their driving histories and behaviors. Figure 3 summarizes correlations seen among these personal characteristics and histories. Negative correlations indicate an inverse relationship. Although none of the correlations was particularly high (probably reflecting the difficulty of precisely measuring these traits), the highest seen were between social deviance and speeding, and between social deviance and crashes.

Several project interviews mentioned an "attitude of compliance" as an important safety-related characteristic of good commercial drivers. One bus company safety director believed that drivers who were "passive" and nonassertive in traffic were the safest drivers because they avoided conflicts with other vehicles. A truck company safety director regarded ex-service members as a good bet for success as commercial drivers because they were used to complying with rules and orders.

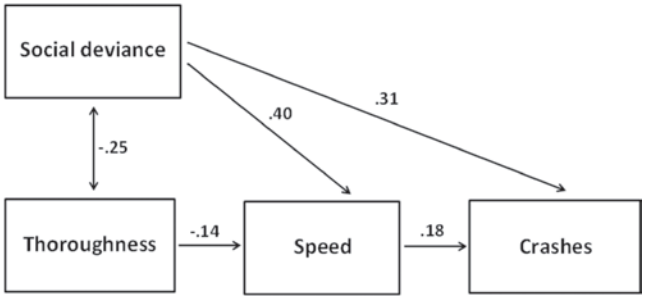

FIGURE 3 Correlations among social deviance, thoroughness, speeding, and crashes. (*Source*: Redrawn from West et al. 1993.)

Neuroticism

Neuroticism is a personality trait characterized primarily by anxiety and stress. Other characteristics include irritability, discontent, self-consciousness, and moodiness. The opposite of neuroticism is termed *emotional stability*. Moen (2007) found that highly anxious people had lower self-assessments of their driver skill and higher stress levels during driving. This was reflected in higher crash rates. Driving stress is also related to anger while driving. As noted earlier, Dahlen and White (2006) found that DAS scores were predictive of unsafe driving behaviors and high crash histories.

Personal stress and unhappiness can be caused entirely by one's life situation rather than by internal, constitutional factors. There is, however, clear evidence that chronic stress level can also be a true personality trait like others described above. Moreover, many people's adverse life situations, such as family and financial problems, are long term. Thus, from the perspective of motor carriers seeking to hire low-risk drivers, applicant stress level might be seen as an enduring personal characteristic. The positive opposite is unstressed emotional stability.

Individual stress level may be related to *locus of control*. A person with *internal* locus of control believes that he or she has mastery, or at least strong influence, over life events and outcomes. One with *external* locus of control believes that personal efforts to control events are futile. External locus of control is associated with greater stress and anxiety. Knipling et al. (2004) reviewed several studies indicating that external locus of control is associated with higher crash risk. For example, Jones and Foreman (1984) classified bus driver applicants with two or more moving violations as high-risk and those with no moving violations as low-risk. On a personality profile, 79% of the high-risk group scored high on external locus of control, versus only 31% of the low-risk group.

A nondriving study of 283 hospital workers compared individual "safety locus of control" to their on-job accidents (Jones and Wuebker 1993). Thirty-eight percent of the low safety consciousness group was involved in one or more

major accidents during the study period, compared with 28% of the medium safety and 21% of the high safety consciousness groups.

Attitudes

Interwoven with the concept of human personality is the concept of *attitude*. An attitude is an individual's positive or negative evaluation of a particular thing, where "thing" can be any object of thought. Attitudes toward particular driving behaviors, including both positive behaviors (e.g., safety belt use) and negative behaviors (e.g., speeding), are of greatest interest.

Attitudes have two internal components: cognitive (knowledge and beliefs) and emotional (Dewar and Olson, 2002). Attitudes are revealed in individual statements and, most important, in behavior. Extreme behaviors like aggressive driving strongly reflect negative attitudes, such as a general hostility toward society and rules. Less extreme behaviors also reflect attitudes, although situational factors also affect such behaviors. For example, a driver with a negative attitude toward safety belt use may still wear one if there is a strong company belt-use policy and clear negative consequences for non-use.

People tend to attribute their own behavior to external circumstances (e.g., "I didn't have time to react to the signal change.") while attributing the behavior of others more to their character or personality ("red-light runner"). This difference in how individuals view their own behavior versus that of others is called the *attribution bias* (Dewar and Olson 2002). The truth lies somewhere in between. People do have persistently different personalities and attitudes, and thus these are "fair ground" in driver selection. However, the environment can change specific behaviors and even specific attitudes. For example, individuals forced to comply with a rule (e.g., safety belt policy) will often develop more positive attitudes toward the rule and required behavior over time. Social norms are an important part of the human environment; a company driver will be more likely to buckle up if he or she believes that all the other drivers are doing so.

One can conceptualize a loose causal relationship connecting individual personality, attitudes, intentions, and behaviors. This is illustrated as:

personality - - - → attitudes - - - → intentions - - - → behavior

The Theory of Planned Behavior (TPB; Ajzen 1991) has been formulated to explain how attitudes and other factors combine to become behavioral intentions, and then behavior. At any given time, an individual's *attitudes* (the positive or negative value of a behavior) combine and interact with *subjective* norms (social norms as perceived by the person) and *perceived behavioral control* to determine intentions, which in turn become behaviors. Perceived behavioral control is related to a person's expectations of rewards or punishments associated with the behavior, and the degree to which they control those consequences. Figure 4 shows this schematically.

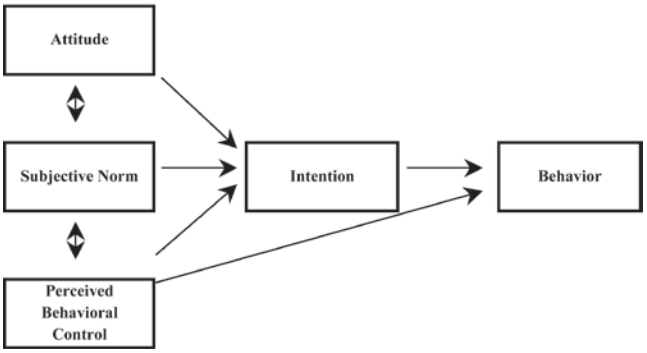

FIGURE 4 Simple schematic of the Theory of Planned Behavior. (*Source*: Ajzen 1991.)

The TPB is a theoretical framework for studies of individual factors in driving safety. Numerous studies have related attitudes, subjective norms, or perceived behavioral control to intentions and to behavior. All three have been shown to be predictors of dangerous driving behaviors (Parker et al. 1998; Thiffault 2007, 2011; Poulter et al. 2008). Chapter three will discuss how "slack" driver attitudes toward rule violations (e.g., speeding) are related to both a relative lack of concern about crashing and to violation frequency (Ma et al. 2010).

Several of the personality traits discussed in the previous section are intertwined with safety attitudes. Conscientious individuals, for example, value morality and safety highly, are strongly influenced by safety-related social norms, or perceive controls on their behavior to be strong. An "attitude of compliance" appears to characterize many of the most conscientious and reliable commercial drivers.

In Britain, Poulter et al. (2008) tested the application of the TPB to truck driver safety. Based on past studies, they identified two principal driver factors associated with crash involvement: (1) driving behavior and (2) driver compliance with driver- and vehicle-related regulations. Driver behavior is reflected by moving traffic violations, whereas driver compliance is reflected by driver-related (e.g., hours of driving) and vehicle-related (e.g., overloading, mechanical problems) roadside violations. The researchers recruited 232 truck drivers from several companies and other sources to complete a questionnaire assessing attitudes toward both specific driving behaviors and specific regulatory violations. In subject comparisons, they found positive interrelation-

ships among all of the TPB elements shown in Figure 4. The intention to observe traffic laws had the greatest association with driving behaviors, whereas behavioral control had the greatest association with regulatory compliance.

A key point for driver selection is that well-constructed questionnaires can assess persistent individual differences in safety attitudes and that such attitudes can be predictive of driving behaviors. However, one should not view all safety-related attitudes as fixed. They may change based on new knowledge, experience, and maturation. Although they are outside of the realm of driver selection, Behavior-Based Safety programs (e.g., Hickman et al. 2007) often result in positive changes in driver safety attitudes even though their focus is on specific behaviors.

Psychomotor Skills and Cognitive Functions

Dynamic Skills in Driving

Perceptual:

Static Visual Acuity

Dynamic Visual Acuity

Visual Contrast Sensitivity

Peripheral Vision/Field-of-View

Detection of Objects in a Visual Field

Depth Perception

Cognitive (Mental):

Information Processing/Thinking

Decision Making

Selective Attention

Attention Sharing (multitasking)

Psychomotor Coordination:

Reaction Time

Multilimb Coordination

Precision Control

Tracking (following a target or path)

Range-of-Motion

Adapted from Llaneras et al. 1995.

Driving is a demanding sensory-motor task that requires keen perception, quick thinking and decisions, and precise execution of responses. In some respects, it is like a computer or video game, and indeed many such games involve driving or similar maneuvering. Sensorimotor and cognitive (mental) skills are of paramount importance for high performance in video games but not generally for safe driving. If they were, then teenagers and young adults would be the best drivers, and safe performance would decline in later adulthood along with sensorimotor and quick reaction skills. Instead, middle-age and "young old" drivers up to their late 60s or even older are generally the safest drivers (Knipling 2009a).

Driving involves many dynamic skills. The Trucking Research Institute (Llaneras et al. 1995) analyzed the dynamic perceptual, cognitive, and psychomotor (sensorimotor) skills involved in driving. The text box lists these skills. Tests on a group of commercial drivers compared these dynamic skills to performance on an interactive truck driving simulator. Dynamic or "neurocognitive" skills most predictive of simulator performance included depth perception, peripheral vision/field-of-view, field independence/dependence, attention sharing, and range of motion. The tests showed that many dynamic skills generally declined with age, but that age alone was not a good predictor of performance. Even if age did reliably predict dynamic skills, it appears "that *behavior* usually trumps *performance* in driving safety" (Knipling 2009a). Although dynamic performance generally declines for older commercial drivers in their 50s and 60s, these drivers are among the best when it comes to crash rates and likelihood of being at fault in crashes.

Dynamic skill tests are not likely to be highly predictive of crash rates across the wide range of drivers, but they may be useful to identify those with significant deficits. This might include the assessment of some serious medical conditions or impairments from drug or alcohol use (Llaneras et al. 1995). They might also be useful to provide baseline performance measures for later comparisons should drivers undergo significant health changes or show other signs of possible increased risk.

Most perceptual information in driving is visual. A common estimate is that 90% or more of the information a driver receives is visual, though this estimate is not based on rigorous studies (Dewar and Olson 2002). Driver licensing tests to measure visual acuity screen out most of those with bad vision, but otherwise they are not known to be predictive of driving safety.

The visual skill apparently most related to safe driving is not a static skill but rather a dynamic one related to peripheral vision. It is called Useful Field-of-View (UFOV) and has been studied mostly in older drivers. UFOV can be described as an "occupational visual field" test, in contrast to a clinical visual field test using flashing peripheral lights in an ophthalmologic setting. Young adult fixed-head field-of-view is about 180°, but this generally declines by age 70 to about 140° (Dewar and Olson 2002). Head and eye move-

ments allow a wider field, of course. The UFOV test flashes peripheral lights while a subject focuses on a center target. Subjects' ability to see and react to the peripheral lights determines their UFOV. The UFOV test is different from the standard ophthalmological vision tests because it measures the central processing speed at which visual information is analyzed. It includes subtests that evaluate speed of information processing, ability to divide attention, and susceptibility to distraction. The test expresses the patient's UFOV as a percentage reduction from the ideal (Crabb et al. 2004).

Studies among older drivers and those with known attention or mental impairments find that UFOV is predictive of crash rates, especially for intersection crashes. The UFOV is much less predictive for younger and unimpaired drivers (Dewar and Olson 2002). In driving, UFOV varies inversely with speed; that is, the higher the speed, the less the angle of the useful visual field. This may be one reason why many drivers drive slower as they age.

Clay et al. (2005) completed a cumulative meta-analysis on the relationship of UFOV and driving performance in older adults. A meta-analysis combines previous studies' results as data to analyze the same research questions. Among older drivers, the UFOV correlation with safety is robust across multiple indices of driving performance and several research laboratories. This convergence of evidence from numerous studies using different methodologies confirms the importance of the UFOV assessment as a valid index of driving competence and safety (Clay et al. 2005).

Sumer et al. (2005) administered computer-based cognitive and psychomotor tests to 716 professional and nonprofessional drivers. Tests included traffic monotonous attention, selective attention, visual pursuit/tracking, eye-hand coordination, reaction time, and peripheral perception. Scores on these tests were compared with self-reported driving behaviors, skills, violations, and inattention errors. The peripheral perception test, similar to the UFOV test, was found to have the strongest positive correlations with driving and safety skills, as well as the strongest negative correlations with driving violations and inattention errors.

The Trail-making test and WayPoint are two similar psychomotor tests of visual attention and task switching. The Trail-making test task requires a subject to "connect the dots" of 25 consecutive targets using paper and pencil or a computer screen. Scoring is based primarily on speed but also on errors. Two versions are available. Version A is simpler: The targets are simply numbered (1, 2, 3, etc). Version B requires the subject to switch from numbers to letters (1, A, 2, B, 3, C, etc.). WayPoint is similar to Trail-making Version B, but adds distractors in some parts to make the task more difficult. Trail-making is used primarily to diagnose brain damage (Corrigan and Hinkeldey 1987), but scores on these tests may be related to driving behavior across a larger proportion of the population. Chapter three discusses WayPoint's use in selecting safe fleet drivers.

Medical Status and Conditions

The past decade has seen increasing interest, research, and regulatory activity relating to the issue of commercial driver health and medical conditions. This activity has reflected concerns about driver wellness and longevity, and also concerns about driving safety. Two previous synthesis reports (Orris et al. 2005; Krueger et al. 2007) have addressed commercial driver health issues. Commercial drivers as a group compare unfavorably to other Americans in measures of personal health (Roberts and York 2000; Krueger et al. 2007). FMCSA's medical program acknowledges these concerns. The following is a characterization of U.S. commercial drivers, excerpted from the FMCSA *Medical Examiner Handbook*:

> The Average Driver. The [commercial] driver population exhibits characteristics similar to the general population, including an aging work force. Aging means a higher risk exists for chronic diseases, fixed deficits, gradual or sudden incapacitation, and the likelihood of comorbidity. All of these can interfere with the ability to drive safely, thus endangering the safety and health of the driver and the public (FMCSA 2010).

The following is the profile of the average truck or bus driver:

- Male
- More than 40 years of age
- Sedentary
- Overweight
- Smoker
- Poor eating habits.

The following is the medical profile:

- Less healthy than the average person
- More than two medical conditions
- Cardiovascular disease prevalent.

Although a detailed review of the safety relevance of specific medical conditions is beyond the scope of this report, medical conditions can reduce driver and fleet safety in three primary ways (Knipling 2009a). The first two relate to driving performance and crash risk while driving, whereas the third relates to more to the long-term stability of a carrier's driving workforce:

- *Chronic performance decrements.* Medical conditions could affect driver safety by causing general decreases in psychomotor skill and cognitive functions. Such chronic performance decrements might include decreases in flexibility, decreases in alertness, or

increases in reaction time. Psychomotor/cognitive performance has a weak relationship to crash risk unless a driver has significant deficits. Therefore, predicting crash risk based on medical conditions causing such deficits has been difficult. Moreover, most physicians do not have the time or the tools to assess functional impairments associated with illness.

- *Catastrophic performance failures.* Medical conditions can cause episodic losses of the ability to control a vehicle, usually by loss of consciousness. Medical crises such as heart attacks, seizures, or diabetic insulin shock are significant proximal causes of serious large truck crashes. Sleep disorders such as obstructive sleep apnea are often a root cause of asleep-at-the-wheel crashes. In the LTCCS, truck driver physical failures, primarily falling asleep and heart attacks, were the CR of 12% of truck at-fault crashes and 6% of all truck crashes (Starnes 2006). The major purpose of commercial driver medical qualifications is to prevent such crises. Medical screenings beyond the minimum qualifications can help carriers to reduce the risk of such crashes and associated losses.
- *Absenteeism and reduced employment longevity.* This effect on fleet safety is less obvious and dramatic, but may be comparable in its long-term effects on carrier and industry safety. Chronic medical conditions are the most obvious signs of the poor health of many commercial drivers. Many of these individuals would be high-performing and reliable long-term employees were it not for their health problems. In the LTCCS, commercial drivers aged 51+ were 17% less likely than younger drivers to be at fault in multivehicle crashes, and yet these drivers are those most like to have reduced service owing to chronic medical conditions.

Cardiovascular Illness

Cardiovascular illness, the number-one cause of death in the United States, includes hypertension (high blood pressure), arteriosclerosis, coronary artery disease, angina (heart pain), heart attacks, and congestive heart failure. Cardiovascular illness is associated with both catastrophic performance failures while driving (principally heart attacks) and with shortened careers among middle-aged commercial drivers.

In the 1990 NTSB study of 182 fatal-to-the-driver truck crashes, 17 (9%) were found to involve a heart attack or other cardiac incident as the primary cause. In the LTCCS, about 6% of large truck single-vehicle crash involvements and 3% of all involvements had a CR of heart attack or other physical impairment (not including asleep-at-the-wheel). A 2007 report by the FMCSA Medical Review Board reviewed eight prior studies and estimated the relative crash risk of drivers with cardiovascular disease (all types combined) to be 1.43, or a 43% increase over other drivers.

Obstructive Sleep Apnea

Obstructive sleep apnea (OSA) is a medical condition of great concern to motor carriers and many others involved in truck and bus safety. It is a common illness among middle-aged males, the principal commercial driver demographic. OSA is a breathing disorder that disrupts sleep and causes often-severe daytime drowsiness. OSA is associated with obesity, which is prevalent, and perhaps the norm, in the U.S. commercial driver population (FMCSA 2010).

The increase in crash risk associated with OSA is probably substantial. Various studies of noncommercial drivers with OSA put the increase in crash likelihood from two- to sixfold. A case control study by Young et al. (1997) placed the increase at fourfold. However, a case control study of commercial drivers found no increased crash risk among truck drivers with OSA (FMCSA 2004). This unexpected finding is questionable because the study involved mostly short-haul drivers and had unverified mileage exposure data.

In the 10 safety manager interviews conducted for the report case studies, OSA was the most frequently cited driver medical concern. Carriers know that OSA is not always detected through the medical qualifications process and that it can be a cause of major crashes with high human and financial consequences. Chapter five describes several carrier medical programs addressing OSA and other driver health problems.

Individual Differences in Fatigue Susceptibility

OSA and other sleep disorders are major causes of individual differences in susceptibility to drowsiness while driving. However, these differences are also seen among drivers without known sleep disorders (Knipling 2005). For example, sleep-deprived healthy adults show wide variations in their progressions of performance deterioration and in overall degree of performance impairment (Van Dongen et al. 2004). Moreover, these differences are consistent over time and, based on twin and family studies, have a partial genetic basis (Van Dongen et al. 2005). Many different patterns and features of human sleep, wakefulness, and sleepiness seem to vary widely among individuals. Moore-Ede (2007) has introduced the term *chronotype* to refer to an individual's vulnerability to drowsiness and other sleep- and alertness-related characteristics.

Although there appears to be a partial genetic basis, environmental and lifestyle differences also play a role. They include differences in the sleep setting (e.g., room quietness and darkness, bed comfort) and in sleep hygiene habits. Although such differences may persist over time, they are potentially changeable.

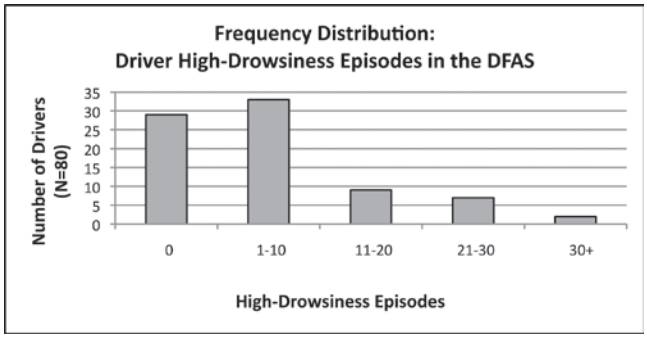

FIGURE 5 Frequency distribution of long-haul truck driver high-drowsiness episodes among 80 drivers. (*Source*: Wylie et al. 1996.)

The Driver Fatigue and Alertness Study (Wylie et al. 1996) is one of many to show wide variations in driver fatigue susceptibility. Eighty long-haul commercial drivers in the United States and Canada were monitored over a week of driving. Video segments were scored for drowsiness based on drivers' eyelid droops, facial expressions, and facial muscle tones. Eleven of the 80 drivers (14%) were responsible for 54% of all observed drowsiness episodes. At the other extreme, 29 of the drivers (36%) were never judged to be drowsy. Figure 5 shows the skewed frequency distribution of drowsiness episodes among the 80 drivers, plotted with five frequency bins. Notice the classic skewed shape of the frequency distribution, characteristic of differential driver risk. The two drivers in the far right bin had 78 total drowsiness episodes, which was more than the total number of drowsiness episodes exhibited by the best 51 drivers in the study. Two driver subjects among the 80 were diagnosed with OSA, but they were not the two highest-risk drivers.

Behavioral History

Psychologists widely regard past behavior as the best single predictor of future behavior (Ajzen 1991; Parker et al. 2001). Behavioral history, sometimes called *biodata* (which might also include medical data), includes both driving events and nondriving events and indices relevant to safety behavior. This section reviews both areas.

Driving Behavioral History

There are at least two reasons to expect drivers' past driving behaviors and events to be predictive. The first is the "metaprinciple" of behavioral consistency over time. The second, of less interest here, is that driving environments and mileage exposure levels tend also to be consistent.

A driver's history of crashes, violations, and other incidents is a well-documented predictor of future crash involvements, and also whether the driver will be at fault in future crashes. Using a sample of more than 200,000 drivers (mostly noncommercial), Chandraratna and Stamatiadis (2004) were able to predict the at-fault driver in crashes with 88% accuracy based on past crash involvements and violations. Having *recent* at-fault crash was one factor that made drivers more likely to be at fault in another crash.

Miller and Schuster (1983) followed 2,283 drivers in California and Iowa for 10 years or more. They found that past traffic violations were a better predictor of future crashes than were past crashes. Past traffic violations seem to be a better predictor of future crashes (1) because they are more numerous and thus more statistically reliable than crashes, and (2) because violations clearly imply misbehavior and fault, whereas a driver may not been at fault in past crashes.

Murray et al. (2005) analyzed the records of more than 500,000 U.S. commercial drivers to determine factors most predictive of future crash involvements. Principal data sources were the Motor Carrier Management Information System (MCMIS) and the Commercial Drivers License Information System (CDLIS). Three driver history risk indicators were roadside inspection violations, traffic violation convictions, and crashes. Rates of involvement in these behaviors over a 3-year period were correlated with future crash involvement. Table 1 shows the percentage increase in driver crash likelihood associated with the top behavioral predictors. Note in the table that six different violation and conviction types were more predictive than were past crashes themselves. This finding likely reflects the two advantages noted earlier. It is not surprising that an egregious violation like reckless driving is predictive of future crashes, though the strength of the relationship may surprise some.

TABLE 1
INCREASES IN CRASH LIKELIHOOD ASSOCIATED WITH PAST DRIVER BEHAVIORS

Behavioral Predictor	Increase in Crash Likelihood
Reckless driving violation	325%
Improper turn violation	105%
Improper or erratic lane change conviction	100%
Failure to yield right-of-way conviction	97%
Improper turn conviction	94%
Failure to maintain proper lane conviction	91%
Past crash	87%
Improper lane change violation	78%
Failure to yield right-of-way violation	70%
Driving too fast for conditions conviction	62%
False or no log book violation	56%
Any conviction	56%
Speeding > 15 mph over speed limit	56%

Source: Murray et al. (2005).

Although violation history appears to be better than crash history as a predictor of future crashes, a history of one par-

ticular crash type might be considered a "red flag" for future crash risk. This crash type is single-vehicle crashes. Single-vehicle crashes generally occur as a result of a catastrophic loss of vehicle control, resulting in a road departure, rollover, or jackknife. In contrast, multivehicle crashes are usually triggered by a traffic interaction mistake such as "looked but did not see" or false assumption. Thus, single-vehicle crashes suggest a more profound failure of driving safety. In the LTCCS (Starnes, 2006; Knipling, 2009b), truck single-vehicle involvements were much more likely than at-fault multivehicle involvements to involve asleep-at-the-wheel, driver physical failure (e.g., a medical event), excessive speeds, aggressive driving (as associated factor), response execution errors, and vehicle maintenance failures (for which drivers are responsible). Further, single-vehicle crash involvements seen in driver records almost always imply culpability, whereas multivehicle crash involvements may not have involved any fault by the commercial driver (i.e., the other driver was at fault). The text box shows LTCCS truck/truck driver CR comparisons between single-vehicle crash involvements and multivehicle involvements. The latter includes both at-fault and non-at-fault involvements, consistent with driver records that show crash involvements but not necessarily principal fault or cause.

Truck/Truck Driver CR Percentages for Single- vs. Multi-Vehicle (SV vs. MV) Involvements in LTCCS

- Asleep-at-the-wheel (CR):
  SV: 12.8%; MV: 0.4%
- Other physical failure (CR):
  SV: 7.5%, MV: 0.9%
- Too fast for conditions or curve (CR):
  SV: 28.7%; MV: 5.4%
- Aggressive driving:
  SV: 2.1%; MV: 0.2%
- Response execution error (CR):
  SV: 8.2%; MV: 1.1%
- Vehicle failure (CR):
  SV: 12.7%; MV: 2.9%

Note: Includes all MV involvements.

Nondriving Behavioral History

This section focuses on nondriving biographical information that might predict driving safety, including criminal record, credit history, past bankruptcies, workers' compensation claims, or other predictive behavioral indicators. Although these are not personal *traits*, they could be valid predictors of risk. The principle of behavioral consistency suggests that people will tend to behave similarly across different types of situations. Comparing people's lifestyles to their driving styles—or, more specifically, their personal problems and transgressions to their driving mishaps—may predict driving safety.

Criminality and personality traits like aggressiveness and impulsivity are related to unsafe driving. In his book *Traffic Safety*, Leonard Evans (2004) reviews studies showing greatly elevated crash risks—twofold or more—associated with nondriving criminality. In Australia, Brace et al. (2009) reviewed studies linking criminal history and road safety. The study looked at a variety of criminal behaviors (e.g., assault, theft, drug offenses, and fraud) and different driving safety outcomes. It explored psychological theories explaining this relationship, including Kohlberg's Stages of Moral Development (Kohlberg 1969). In this theory, moral behavior is not just related to knowledge of laws and consequences of violating them, but also related to individuals' internalization of social responsibilities and universal moral principles. Among the many studies cited was one by Chenery et al. (1999) in Britain where the vehicle status and driver histories of vehicles parked illegally in handicapped spaces were compared with those of nearby legally parked vehicles. The study found that 20% of illegally parked vehicles "would warrant immediate police attention," compared with just 2% of legally parked vehicles. The driver comparisons were similar: 33% of the owners/drivers of illegally parked vehicles had criminal records, versus 2% of controls.

A recent Society for Human Resources Management survey (cited in Perry 2010) found that 60% of employers check credit reports for at least some of their prospective employees, up from 42% in 2006. However, only 13% check all potential employees. Federal law requires that employers obtain written permission from applicants before running a credit check on them. Cited in the same article was a 2008 survey by the Association of Certified Fraud Examiners which found that employee workplace fraud was often associated with personal debt and credit difficulties.

Chapter three shows that employers must be careful not to overreach in the use of assessments like credit checks in their hiring. Selection tests must be validated in relation to job performance criteria. Credit history may be more directly relevant to driving jobs involving financial responsibilities (e.g., owner-operators who must make payments on their vehicles) than to those without such responsibilities.

Cognitive (Mental) Abilities

Intelligence is the ability to engage in complex thought. General level of intelligence is a persistent characteristic of individuals that shows up in many different kinds of judgments, choices, and behaviors. Level of general intelligence ("IQ score") is as effective as other major individual char-

acteristics, such as socioeconomic status and personality, in predicting major life outcomes, such as mortality and occupational attainment (Roberts et al. 2007). Driving is one of the areas in which intelligence can be associated with safe performance (Knipling 2009a).

There are a number of reasons to believe that intelligence might affect driving outcomes. Intelligence may be associated with greater patience, greater consistency in choice, and a more accurate assessment of risk, all of which may contribute to safer driving (Burks et al. 2009). Higher intelligence may also be associated with quicker and more accurate evaluations of hazardous situations, and quicker and more effective responses to them.

Burks et al. (2009) studied 1,065 truckload (TL) driver-trainees and found that their general cognitive ability level was correlated with their patience and the accuracy of their evaluation of risks in small-stakes monetary games used to assess risk-taking. This study also found correlations between general cognitive ability level and consistency in choice tasks, and with social awareness as measured by the willingness to help someone else at a monetary cost. In addition, basic cognitive ability was the strongest single predictor of staying for a full year of service after training in a setting in which early exit carried a significant financial penalty. Because inexperienced drivers have higher accident risk (Staplin et al. 2002; Knipling 2009a), this is one way in which general cognitive ability indirectly affects safety. Nonetheless, there is little evidence of a direct link between general cognitive skills and safer driving. Kim and Bishu (2004) suggest that this is because the real relationships may involve specific cognitive abilities rather than broad traits such as IQ. The role of these narrower traits has not been studied carefully in hazardous settings, as opposed to normal driving situations.

In summary, as Knipling (2009a) points out, the clearest relationship is that between very low general intelligence and higher accident risk. Criminality is also higher for individuals with very low IQ, which may explain much of the relationship (Evans 2004). Associations with safety may be weak for those above a minimum level of general intelligence, for whom persistent traits such as personality characteristics matter more.

MAJOR RETENTION-RELATED PERSONAL TRAITS

Retention has a clear relationship to safety performance. New-to-the-industry drivers are likely to have higher accident rates until they acquire experience. Retained drivers are more knowledgeable on safety goals of the company, more stable in their career path, and more likely to follow company safety rules. They have learned from the training they have received and can put that training in use over a longer period. They also tend to be older drivers, an added association with safety (Staplin et al. 2002; Knipling 2009a).

Turnover is a management problem many firms face, but it is especially difficult in some segments of the trucking industry. TL carriers that provide medium- and long-haul service have a more significant turnover problem than do carriers in parcel or less-than-truckload (LTL) operations. Until the deep economic recession that began in 2008, the annualized turnover rate at large TL firms (more than $30 million in revenue per year) had never dropped below 100% per year. Smaller TL firms did slightly better. The annualized turnover rate at large TL firms hit an all-time low of 39% in the first quarter of 2010, and began to rise again from that point (Watson 2010).

TL drivers are paid by the mile, and the rate is modest because the highly competitive nature of the segment prevents raising prices in order to raise wages. TL drivers often have irregular work schedules, work long hours per week, and have uncertain and limited time at home. From the driver's point of view, the number of miles a TL driver can complete depends on many factors besides the driver's own effort. This can be frustrating for new drivers. An experienced driver can earn substantially more than the U.S. median household income (approximately $50,000 per year in recent years). New drivers normally make significantly less than this, and many do not stay long enough to become experienced. Jobs at parcel and LTL carriers tend to be better on all of these dimensions, because of the organization of the work around fixed company terminals at which freight is handled. Firms in these segments historically have lower turnover rates than do TL carriers (Burks et al. 2008).

Management can control some aspects of the job in ways that lead to better retention. Some of these aspects include a clear career path, performance-based promotions, and perceived driver equality. These factors can foster attitudes toward management, dispatchers, and other companies that increase job attachment. These are all components of job satisfaction that have been shown to be effective predictors of turnover (Tett and Meyer 1993; Griffeth et al. 2000). However, for any given level of pay and set of working conditions, some drivers are more likely to leave than others. The focus here is on the persistent personality characteristics of individuals that affect their likelihood of quitting.

The "Big Five" Personality Traits

The "Big Five" personality traits are *extraversion, openness to experience, conscientiousness, agreeableness*, and *emotional stability*, and cognitive skills. Zimmerman (2008) recently conducted a major meta-analysis of the relationship of these personality factors to turnover, examining studies by 86 authors at a large number of different firms in different industries. Burks et al. (2009) studied the relationship between cognitive skills and retention among TL drivers.

Conscientiousness involves self-discipline, planning, and dutifulness. Zimmerman (2008) hypothesized that those high in conscientiousness are less likely to quit because they are more likely to perceive a contractual or moral duty to stay. Another connection is that those high in conscientiousness are more likely achieve success at the job and therefore have higher job satisfaction. A third linkage is to the traits of impulsivity and risk-taking owing to their higher accident risk. Impulsivity and risk-taking are likely to be low in those with high conscientiousness, who are better able to control short-term impulses to leave.

Extraversion is the trait of seeking social relationships. Extraverts may experience more positive emotions and perceive their surroundings positively. Zimmerman (2008) hypothesized that high extraversion would lead to lower voluntary turnover because it would be associated with a greater level of job satisfaction and more social ties within the firm. This is not as clearly relevant to drivers, however, as drivers often do most of their work alone. Many of their interactions are with customers who may change from day to day, not with a stable group of coworkers.

Openness to experience is the trait of seeking variety, new experiences, and being curious and imaginative. Zimmerman (2008) hypothesized that those high in this trait are more likely to quit in order to try out new job opportunities. This is also the trait most closely connected with cognitive skill and intelligence, which can be thought of as the capacity to analyze and make use of new experiences. However, cognitive skill is strongly associated with job success and job attachment among truckers.

Agreeableness is the trait of being compassionate and caring toward others, as well as optimistic about human nature. Zimmerman (2008) hypothesized that those high in agreeableness are less likely to leave because they will be more understanding of the negative aspects of a job, have more successful relationships with coworkers, and be more likely to see a contractual obligation to stay. In addition, people high in agreeableness are less likely to be impulsive and therefore less likely to quit on an impulse.

Emotional stability (known in its negative form as *neuroticism*) is the trait of having positive emotions and being calm. Those low in this trait frequently experience anger, anxiety, or depression. Zimmerman (2008) hypothesized that those low in emotional stability (that is, high in neuroticism) are more likely to quit because they have more negative views of their job, and have higher doubts and more stress about being able to do it. They would be more likely to avoid stressful situations, including stressful jobs. The trait of aggressiveness/anger/hostility is also likely to be associated with low emotional stability (i.e., high neuroticism).

Zimmerman (2008) found the following relationships between the Big Five personality factors and voluntary exits. Agreeableness had the strongest correlation with turnover: −0.25. Conscientiousness had a −0.20 correlation, and emotional stability a −0.18 correlation. Openness (the trait most directly connected to cognitive skills) was positively related, with a correlation of 0.10. However, to the extent that openness is associated with cognitive skill, this relationship is likely to be reversed for truck drivers. Extraversion showed a small but inconsistent relationship to turnover.

Predicted self-reported intentions to quit versus predicted actual quits varied with the personality trait levels. Low emotional stability was most closely connected to employees' intentions to quit, whereas low conscientiousness and agreeableness best predicted actual turnover decisions. Zimmerman (2008) developed a path model that showed important direct effects from personality to intentions to quit and turnover behaviors that were not captured through job satisfaction or job performance. Employees with low emotional stability may intend to quit for reasons other than dissatisfaction with their jobs or poor job performance. Employees who are low on agreeableness or high on openness may engage in unplanned quitting. The data also showed that personality traits had stronger relationships with outcomes than did other measures of job complexity and job characteristics.

These five personality factors are not completely independent of each other, so it makes sense that they may have a systematic relationship. Several authors (Digman 1997; DeYoung 2006) have identified a higher order structure: Emotional stability, conscientiousness, and agreeableness have a common predictive power, and the "meta-factor" this identifies has been labeled *stability*. This is sensible when thinking about turnover, because Zimmerman (2008) found all three factors in this meta-factor to be moderately strongly negatively correlated with quitting. In addition, openness and extraversion share a common predictive power, and the meta-factor of these two factors has been labeled *plasticity*. This appears to be less important for the behavior of quitting, according to these results, and may be reversed in truckers to the extent that plasticity is associated with cognitive skill, according to the results of Burks et al. (2009).

Cognitive Ability

Burks et al. (2009) studied 1,065 new-to-the-industry TL driver trainees, measuring their personality traits, demographic characteristics, past job experience and job attachment history, and risk aversion and time preferences. These drivers received training at no upfront cost, but they all signed a credit contract that made them liable for the commercial cost of the training if they did not stay for 1 year of service. A major finding was that out of all the characteristics measured at study intake, the level of basic cognitive (mental) skills was the strongest single predictor of staying on the job for 1 year. Those in the top quarter of cognitive skill were almost twice as likely to complete a year as those in the bottom quarter.

The authors argued that the main reason for this finding was the need for on-the-job self-management by TL drivers. The runs that drivers are assigned typically vary over time, with many details of scheduling, routing, and deliveries. The ability to schedule oneself to meet the needs of shippers and consignees, while taking account of HOS rules and changing traffic and weather conditions, requires cognitive skill. From the driver's point of view, the number of miles a TL driver can complete depends on many factors besides the driver's own effort. This generates stress and frustration, especially for new drivers. When drivers are paid by the mile but cannot make enough miles, they are likely to quit. Burks summed up this finding by saying that "doing well financially requires a driver who is not only willing to work hard but also is able to work 'smart' in a competitive environment" (2009). Thus, higher mental skills are associated with stable employment among truckers.

CHAPTER THREE

REVIEW OF DRIVER SELECTION TESTS AND MEASUREMENTS

This chapter addresses the principal topic of this report: tests and measurements for selecting safe commercial drivers. The previous chapter reviewed basic requirements for commercial drivers and safety-important ways in which commercial drivers vary. These are enduring human characteristics relevant to general personal safety, social adjustment, and wellness. This chapter builds on that foundation and asks how knowledge of individual differences can be applied in a company hiring setting to select the safest drivers. The chapter begins with a brief review of "generic" carrier hiring processes as well as general employment test characteristics and requirements. Then it describes a series of specific instruments used for driver selection, many of which are commercially available products or services. Most of these instruments are oriented toward safe driving as the criterion job performance measure. Some attempt to predict driver retention, which is known to be correlated with safety.

OVERVIEW OF COMMERCIAL DRIVER SELECTION AND HIRING

Minimum Required Actions

Carriers must, at a minimum, take actions to ensure that any driver they hire (and keep under hire) meets general commercial driver qualifications. This means that carriers must maintain a qualification file for each employee. According to 49 CFR 391.51 and as summarized in FMCSA (2008), this qualification file must include the following:

- Driver's application for employment (completed and signed).
- Driver's motor vehicle report (MVR) of past crashes and violations from the applicable state agency for the preceding 3 years.
- Driver's road test certificate or the equivalent. A current CDL is evidence of road test completion.
- Annual review of driving record based on state agency inquiry and carrier review. Certification that driver meets minimum requirements is signed by the carrier.
- Annual driver's certification of violations.
- Medical examiner's certificate.
- Record of inquiry(ies) to previous employer(s) for past 3 years.

Overall Driver Selection and Hiring Process

The previous section specified the minimum actions and paperwork for hiring commercial drivers. In practice, these minimum actions are combined with voluntary company actions to form an overall system and sequence of steps for hiring. Figure 6 shows a flowchart of a systematic commercial driver hiring process. It outlines a *multiple hurdles approach* in which a candidate must pass all assessments in sequence to be employed. The flowchart is adapted from one provided by Daecher Consulting Group for *CTBSSP Synthesis 4* (Knipling et al. 2004). The current project focuses on test and measurement procedures that can be used to improve the selection process, especially those that can be administered to drivers as part of on-site screening. Cascio (2004) and Knipling (2009a) present four general rules for selecting the highest-quality possible drivers:

1. Target high-quality applicants
2. Attract as many applicants as possible
3. Use multiple, validated selection tools and methods
4. Be as selective as possible.

A high-quality applicant pool means that those selected will be the "best of the best." Attracting more applicants means that a smaller percentage of applicants will be hired, and thus that the process has been as selective as possible. The use of multiple validated selection tools and methods results in the most accurate possible selections. Good driver selection systems usually include multiple evaluation factors beyond minimum driver requirements, such as applicant education, driving history, nondriving history (i.e., criminal record), prior drug and alcohol tests, medical conditions, personality, and job attitudes. The ATA publication *SafeReturns* (ATA Foundation 1999a) recommended requiring age and experience minimums, conducting in-person interviews, screening for stable employment history, setting a top limit for moving violations using a point system, conducting driving tests, requiring a company physical examination, and reviewing the financial reliability (e.g., credit rating) of owner-operators. Many of these methods are discussed later in this chapter and in the chapter five carrier case studies.

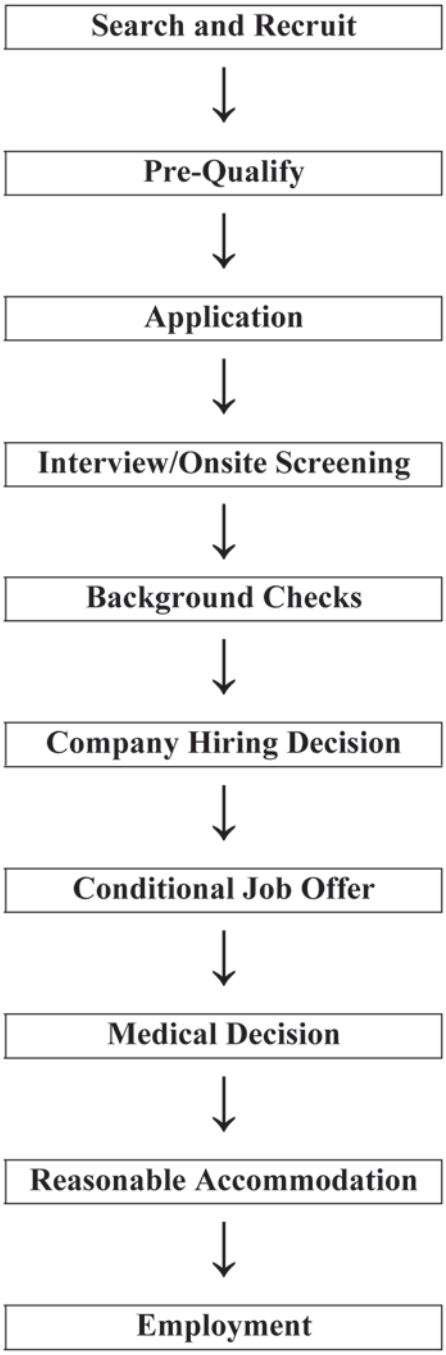

FIGURE 6 Systematic hiring process.

For any job, the *selection ratio* is the proportion (or percentage) of job applicants actually hired (Cascio 2004). Stated as a ratio, this is

$$\text{Selection Ratio} = \frac{\text{Number of Drivers Hired}}{\text{Total Number of Applicants}}$$

A low selection ratio leads to higher quality employees because a lower percentage of applicants have been chosen. Many high-performing motor carriers have selection ratios of 20% or even lower. Schneider National (Osterberg 2004; Knipling 2009a) uses a multilayer selection process that hires only about 13% of applicants and a much lower percentage (3%) of total driver inquiries. Figure 7 shows the Schneider numbers for 2004 at six steps of their process, beginning with recruiting calls received and ending with new hires.

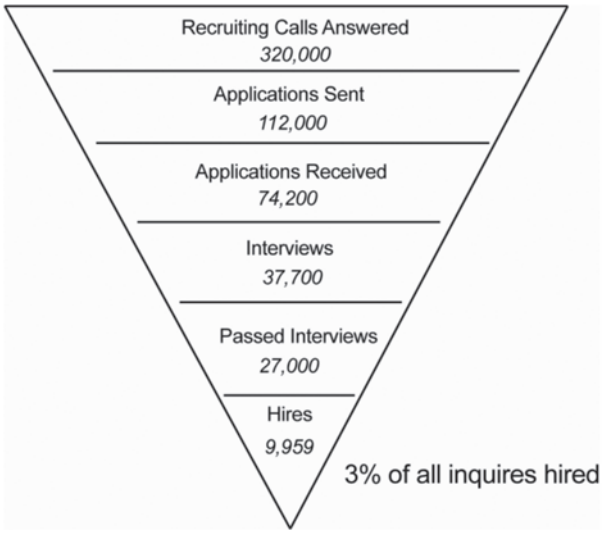

FIGURE 7 Selectivity of Schneider National driver hiring. (*Source*: Based on Osterberg 2004.)

TEST CHARACTERISTICS AND REQUIREMENTS

This section covers basic testing concepts, federal requirements, and principles for carriers to better assess their current and planned use of testing to hire safer drivers. Information on employment testing can also be found in various textbooks on industrial psychology and management. These include texts by Sonnentag (2001), Cascio (2003), and Spector (2008). The following information is intended to provide a basic understanding of employment testing and how it might be improved. It is not sufficient as a guide for conducting test validation studies or implementing major new selection procedures. For these, companies are advised to consult HR specialists in staffing and employment law.

Key Assessment Terms and Concepts

The following are some key terms and concepts in employee assessment:

- Job analysis
- Predictor(s)
- Job performance criterion (criteria)
- Test reliability
- Test validity:
  - Content validity
  - Construct validity

  - Criterion-based validity:
    - Predictive validity
    - Concurrent validity
- Success ratio.

One must fully understand a job to be able to accurately select the best employees for that job. *Job analysis* is the delineation of specific tasks and performance involved in a job. They may include job function or duties, work tasks, skills or competencies, work-related knowledge, work environment factors, decision-making authority, educational requirements, communication, training, and physical abilities. A job analysis is often necessary to validate the use of a selection procedure. This is especially true for any procedure that disadvantages groups of potential employees that are protected under the employment discrimination laws.

Appendix B provides a commercial driver job description developed and used by a medium-sized regional TL carrier in Canada. This carrier uses this document to provide its applicants and employed drivers with full information on their driver jobs and performance expectations. Although it is not a formal job analysis, it contains many of the same elements. A job analysis document helps a carrier to identify the most important and valid elements of its selection process. These selection elements are *predictors* of job performance. A *job performance criterion* is a measure of employee success on the job. Generally, any job has multiple performance criteria. Of particular concern are job safety performance criteria, which may include such measures as crash rate, rate of preventable crashes, violation rate, and rapid decelerations captured in onboard recordings. More sophisticated companies use driving *behavior* criteria such as hard-braking rate, speed compliance, and fuel economy.

The *reliability* of a test or measure is the degree to which it provides *consistent* measurements. Measurements like height and weight are almost perfectly reliable because repeated measures will provide exactly (or almost exactly) the same result. The test-retest reliability of height, expressed as a *correlation* between two successive measurements, is a perfect +1.00 or nearly so. Some tests of psychological traits, such as IQ and aptitude tests, often have test-retest or split-half reliabilities of +0.90 or more (Associated Content, 2010), but the reliability of tests of personality traits like impulsivity and sensation-seeking is lower. Subjectively scored interviews are likely to have even lower reliabilities. A test with a reliability of 0.00 would be worthless because it would reflect random answers or scoring. A U.S. Department of Labor publication (DOL 2000) classifies coefficients of +0.90 or above as excellent, +0.80 to +0.89 as good, and +0.70 to +0.79 as adequate. If multiple assessments are used, their combined reliability may be greater than any one test because multiple assessments capture more elements of performance and behavior.

Measurement reliability is a concern both for selection measures and for job performance measures. To the extent that measures are unreliable, they are confounded by random error. Random error in either a predictor measure or a criterion measure means that neither can be perfectly accurate (valid) as a measure.

Validity is the accuracy of a measure, or the degree to which it actually measures what it purports to measure. Selection test validity can be assessed in various ways. *Content validity* is the degree to which the content of a test corresponds to the content of a job. A road/range driving test, for example, has obvious content validity in relation to a commercial driver's job. *Construct validity* is more conceptual. Construct validation usually involves showing that a test measures specific personal characteristics that are known to be relevant to the performance of the job. Chapter two, for example, cites extensive evidence linking aggressive/hostile personalities to high crash rates. If a test provides reliable measures of personal aggressiveness that correlate well with other measures, then it could has construct validity in relation to this element of safe driving.

Criterion-based validity is the degree to which test scores correlate with actual job performance criteria. For a personality measure of aggressiveness, this might be its correlation with future crash rates of new hires (*predictive validity*) or with current/past crash rates of existing employees (*concurrent validity*). Criterion-based validity is the practical, "bottom line" validity of a test; that is, how well it actually performs as a test. Thus, a well-conducted criterion-based validation study is generally the strongest method to demonstrate the value of a test. Evidence attesting to content or construct validity is generally supportive rather than definitive.

Criterion-based validity also is expressed as a correlation coefficient. The term *v-score* is sometimes used. V-scores are almost always lower than test reliabilities because so many factors contribute to job performance and because performance is hard to measure. The U.S. DOL (2000) assesses v-scores as follows:

- 0.35 or higher: test is "very beneficial" in assessing likely employee success.
- 0.21–0.34: test "is likely to be useful" to the employer
- 0.11–0.20: test may be useful, depending on circumstances and whether other assessments are also used.
- 0.11 or less: test is "unlikely to be useful."

Understanding the overall concept of prediction is as important as familiarity with prediction statistics. Figure 8 is a simplistic model of employee selection (Cascio 2004). The horizontal x-axis represents the predictor (i.e., selection test) score and the vertical y-axis is the job performance criterion. Assume that higher scores are "good" for both scales. The slanted oval represents a hypothetical population of appli-

cants. It is slanted upward because of the assumption that the selection test has moderate validity as a predictor (i.e., a moderate positive correlation with job performance). The vertical line down the middle is the cutoff hiring score for predictor test scores. The horizontal line across the middle is the minimum satisfactory job performance. Assume, for the sake of the model, that everyone is hired so that their predictor scores can be compared with their job performance.

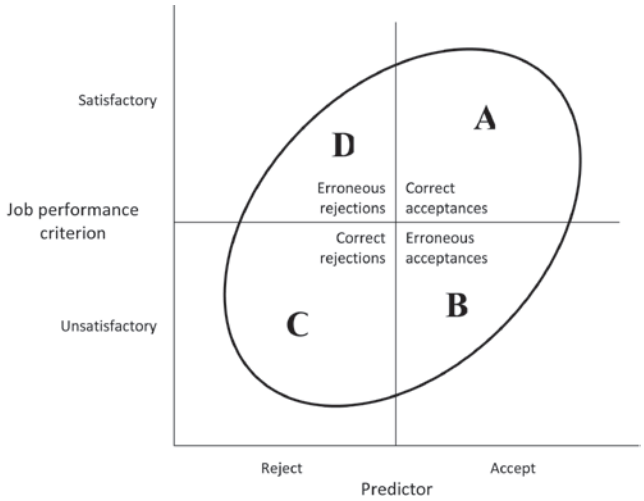

FIGURE 8 Simplistic model of the relation between predictor test scores and employee job performance. In this figure, higher is better for both dimensions. (*Source*: Based on Cascio 2004.)

The four areas of the oval are as follows:

A. Correct acceptances (high test score, and satisfactory job performance)
B. Erroneous acceptances (high test score, but unsatisfactory job performance)
C. Correct rejections (low test score, and unsatisfactory job performance)
D. Erroneous rejections (low test scores, but satisfactory job performance).

A successful selection system would have a high proportion of correct decisions; for example, hiring good drivers and rejecting bad drivers. In the model, zones A and C represent correct decisions, whereas zones B and D are bad decisions. The percent of correct decisions or *selection success ratio* is given by the following equation:

$$\text{Selection Success Ratio} = \frac{\text{Correct Decisions } (A+C)}{\text{Total Number of Applicants } (A+B+C+D)}$$

This model illustrates selection concepts rather than actual practice. It is simplistic because it considers only one predictor and one job criterion, and because it assumes that there is a sharp cutoff score for each. In the real world, almost every job involves multiple selection factors and multiple measures of job performance. Yet the same conceptual model of selection applies: The employer is trying to maximize zones A and C in the model and minimize zones B and D.

In the model, how would a highly valid selection test look different than one that was less valid? Other factors being equal, the difference would be in the shape of the oval. A highly valid selection test would generate a "skinny" oval. A poor test would generate a "fat" oval, and a completely worthless one would generate a circle or other shape in which the sum of A + C was no greater than the sum of B + D.

One can further break down a test's performance by its "hit" rate for identifying unsafe drivers and its "false alarm" rate for rejecting safe drivers. A valid test would have a high hit rate and a low false alarm rate. In the context of Figure 8, these two measures can be defined as follows:

$$\text{Unsafe Driver "Hit" Rate} = \frac{\text{Correct Rejection } (C)}{\text{Total Number of Unsafe Drivers } (B+C)}$$

$$\text{Safe Driver "False Alarm" Rate} = \frac{\text{Erroneous Rejections } (D)}{\text{Total Number of Safe Drivers } (A+D)}$$

None of these statistics can be calculated based on an actual selection process where some candidates are hired and others are not hired. Nonhired drivers would have no job performance criterion data with which to classify them as "safe" or "unsafe." A company could, however, norm a test against its *existing* driver force (i.e., determine concurrent validity). For example, the worst 15% of drivers in terms of crash rates, violation rates, complaint rates, or other metrics could be compared with the best 85%. A high hit rate for unsafe drivers and a low false alarm rate for safe drivers would indicate a valid and useful test.

Federal Requirements for Employment Tests

All employers have an ethical and a legal duty to treat applicants for employment fairly. Employers also have the same duty with respect to assessing current employees. Nongovernmental employers have a particular legal duty, but most state and local agencies and all federal agencies have similar requirements. The primary sources for this section are Cheeseman (2006) and Mann and Roberts (2006).

Several laws shape this legal duty, the most important of which is the Fair Employment Practices Act, or Title VII of the Civil Rights Act of 1964 as amended by the Equal Employment Opportunity Act of 1972. The basic requirement of this law is that employers shall not discriminate in hiring, promotion, wages, training, or any other term, condition, or privilege of employment, according to the *race, color, religion, sex*, or *national origin* of the affected persons. The italicized categories are the "protected classes" of individuals under the act. The text box lists this and four other laws that further define the duty of fair treatment.

Laws Defining the Fair Treatment of Applicants and Employees

1. The Fair Employment Practices Act (also known as Title VII of the Civil Rights Act of 1964, as amended by the Equal Employment Opportunity Act of 1972)
2. The Equal Pay Act of 1963 (EPA)
3. Title I of the Americans with Disabilities Act of 1990 (ADA)
4. The Age Discrimination in Employment Act of 1967
4. The Genetic Information Nondiscrimination Act of 2008 (GINA).

Cheeseman (2006), Mann and Roberts (2006)

Along with the other laws listed in the text box, the Fair Employment Practices Act is administered by a standalone federal agency, the Equal Employment Opportunity Commission (EEOC). The EEOC issues regulations that spell out the meaning of fair treatment, and accepts complaints from individuals who believe they have been unfairly treated in employment settings owing to their membership in one of the protected classes. The EEOC can bring suit in federal court to enforce its regulations or resolve complaints.

Very small trucking fleets (10 or fewer trucks) are not covered by EEOC regulations and enforcement because the regulations apply only to private employers who have had 15 or more employees. Further, to be covered, employees must have worked for at least 20 calendar weeks in the current or preceding year. For age discrimination issues only, the threshold is 20 employees. But this still leaves a large number of trucking firms covered.

The EEOC has issued uniform regulations governing the use of selection tests in hiring and promotion. These appear in the Code of Federal Regulations, items 29 CFR 1607.1 through 1607.18. The regulations provide uniform guidelines defining what constitutes an adverse impact on a protected class. Adverse impact would trigger federal scrutiny and a presumption that unfair treatment may be taking place. An adverse impact occurs when a protected group is selected at less than 80% of the rate at which nonprotected applicants are selected (29 CFR 1607.4). Thus, this trigger is called the "four-fifths rule."

Four-Fifths Rule Example

If a given procedure selects 91% of male applicants (screening out 9%), then the four-fifths guideline says that females, or any other protected class, must be selected for hiring at a rate of no less than 80% of that 91%, which is 73% ($0.8 \times 0.91 = 0.73$). Or to put it the other way around, no more than 27% of females may be screened out by a method that screens out only 9% of men.

If a method of selection discriminates numerically because it does not satisfy the four-fifths rule, it may still be legal to use if it can be shown to be valid with respect to the job for which applicants are applying. Validity means that the employer can show, with specific statistical evidence, that the selection method generates measurements that are demonstrably correlated with job performance. Or, the employer can show (typically by job analysis) that the selection method has *content* that is demonstrably representative of important parts of the job. There is also a third way to show validity, by showing that the method measures a related set of personal characteristics (a *construct*) that is important in successful job performance. However, the EEOC regulations note that this approach is less well documented in the academic literature. An employer taking this route might take some extra care in meeting the regulatory requirements.

There is a limitation to using validity to defend a selection method that is otherwise desirable because it selects safer drivers, but that has the side effect of numerically discriminating against a protected class. The employer must obtain and keep current statistical evidence of the method's impact on its own applicant pool. Generic information provided by the vendor of a test, for instance, will not be sufficient. Also, if the employer uses either the criterion or construct methods of showing the validity of a selection procedure, extra specific statistical evidence is required. The employer must show by specific statistical evidence from the job behavior of its employees that the criterion or construct used to select among applicants is statistically linked to safer driving performances. However, record keeping is permitted to be simpler if the employer has fewer than 100 employees.

The fact that a selection method has an adverse impact on a protected group may not by itself be a sufficient reason for not using it, if it is valid. Firefighters in Connecticut sued their employer, the city of New Haven, in 2006 on this issue. White and Hispanic firefighters who were selected for promotion by an exam that appeared to be valid objected when the city dropped the use of the exam because it discriminated against African American firefighters according to the four-fifths rule. In two connected cases on this issue, in 2009

the Supreme Court ruled that the city had illegally discriminated against the whites and Hispanics, and that because the test was valid, it should use the results in deciding who to promote (Ricci v. DeStefano 2009).

EEOC Links

1. The EEOC home page: http://www.eeoc.gov/
2. An overview of the EEOC and its regulations for employers: http://www.eeoc.gov/employers/index.cfm
3. A clear statement of the duty not to discriminate, and prohibited practices generally: http://www.eeoc.gov/laws/practices/index.cfm
4. Laws and regulations enforced by the EEOC: http://www.eeoc.gov/laws/
5. Regulations governing selection procedure impact and validity: http://www.access.gpo.gov/nara/cfr/waisidx_10/29cfr1607_10.html

Four other laws may be relevant to selecting drivers. The Equal Pay Act of 1963 (EPA) prohibits paying different wages to men and women if they do the same work in the same workplace. Title I of the Americans with Disabilities Act of 1990 (ADA) prohibits discrimination against qualified individuals who have disabilities. Further, it requires that employers reasonably accommodate the known physical or mental limitations of an otherwise qualified individual with a disability, unless doing so would impose an undue hardship on the operation of the employer's business. Of potential relevance for selecting drivers for safe driving performance is this exception to the ADA: "The ADA permits an employer to require that an individual not pose a direct threat to the health and safety of the individual or others in the work-place." Discrimination on the basis of age is prohibited by the Age Discrimination in Employment Act of 1967. The law applies only to discrimination against older workers, not younger ones, and the threshold for coverage begins at age 40. Finally, the Genetic Information Nondiscrimination Act of 2008 (GINA) prohibits discrimination against applicants based on genetic information about them or their family. All of these laws are administered by the EEOC, and in general the regulations issued by the EEOC with respect to the separate potential ways in which selection and hiring may be unfair are similar to those for the Fair Employment Practices Act. The EEOC offers a comprehensive set of web pages that provide clear linkage to the different issues and questions that may be of interest to employers who are concerned about selection procedures. The text box contains a few of the more useful links.

Principles for Improved Employee Assessment

Based largely on the previously mentioned concepts and laws related to employee selection and other assessments, the U.S. DOL has produced *Testing and Assessment: An Employer's Guide to Good Practices* (DOL 2000). The report describes and explains basic principles that employers should follow when considering and designing employee assessments. They include selection-related assessments of candidates as well as assessments of current employees for promotion, placement, or other actions.

The DOL guide is designed to help managers and HR professionals use tests and other assessments to improve employee and organizational performance. It helps employers to—

- Evaluate and select assessment tools that maximize chances for getting the right fit between jobs and employers.
- Correct administer and score assessment tools.
- Accurately interpret assessment results.
- Understand and follow professional and legal standards.

The guide presents and explains 13 principles for improved and legal employee assessment. These have also been summarized by Kahle (2010). Almost all of the principles follow from the testing concepts and laws discussed previously:

- Use assessment tools in a purposeful manner; that is, for the purpose for which they are designed. Misuse or improper use could be harmful or possibly illegal.
- Use the whole-person approach to testing; that is, consider all the information you have about the candidate. No test is perfect. Use a combination of assessments that give you as much information as possible about behaviors of greatest importance.
- Use tests that are unbiased and fair to all groups. Tests that deliberately or inadvertently discriminate prevent the employer from achieving the most qualified work group.
- Use tests that are reliable. Will the same person get the same results each time they take the test?
- Tests must be valid for the purpose they are being used. Validity is the most important criterion for selection of a proper test instrument. Validity determination may be based on content, criterion prediction, or constructs captured by the test. Criterion-based validity is the definitive test.
- Tests must be appropriate (e.g., content and difficulty) for the target population.
- Test instructions and other documentation must be comprehensive and easy to understand.
- Test proctors, administrators, and scorers must be properly trained. Some instruments require an extensive certification process for these roles.

- It may be necessary to provide consistent and uniform testing conditions to obtain consistent results.

1. Provide reasonable accommodations for people with disabilities. No group should be disadvantaged by the test or test conditions per se.
2. Maintain test security. For example, if specific test items on a knowledge test or inventory are not secure, applicants could memorize correct answers or otherwise "game" the test. On the other hand, for some job qualifications it may be advisable to publicize specific test items which must be passed. For example, case study Carrier C has a video on its website showing all of its physical ability test items.

- Maintain the security and confidentiality of test results.
- Interpret test results correctly. Make sure that decision makers understand the tests and what test results mean. Ensure that all test reports are easy to understand.

SAFETY-RELATED DRIVER EMPLOYMENT TESTS

Job Knowledge, Skill, and Training

Chapter two reviewed basic federal commercial driver qualifications and some of the records that carriers are required to keep of required checks made during selection and hiring. Carriers must ensure that their drivers meet these requirements. Many also make further efforts to assess driver job knowledge and skill. Carrier actions to do this are covered in the project survey results (chapter four) and in carrier case studies (chapter five).

New CDL Skills Test: Required Range Maneuvers

- Straight-line backing
- Offset backing to the right
- Offset backing to the left
- Sight-side parallel parking
- Conventional parallel parking
- Alley dock

Source: Brock et al. (2005)

Carrier assessment of driver knowledge and skill focuses first on drivers' training histories, especially for newer drivers. Entry-level drivers may receive formal training at community colleges, private truck driver training schools, or directly from carriers (FMCSA Medical Review Board 2007). This includes knowledge training in classrooms and skill training on ranges (restricted off-road lots) and on-road. New drivers must pass a CDL knowledge test to get their learners permits before behind-the-wheel training. Then they must pass a road and range driving skills test to get their CDL. A new CDL range testing regimen has been developed and is being gradually adopted by different states. The new test is intended to correspond more closely to real-world job requirements (Brock et al. 2007). The text box contains the six basic range maneuvers required in the new skills test (Brock et al. 2005).

Currently, there are no specific U.S. federal training requirements except for classroom instruction on four special topics not related directly to the driving task. The four topics are HOS compliance, drug and alcohol regulations, driver health and wellness, and whistleblower protection. Other countries have specific training requirements relating to duration and quality of training, and at this writing FMCSA is considering such requirements for the United States.

Carriers are obviously concerned about the quality of entry-level driver training. School quality is judged by reputation, school certifications, and carriers' own experiences. Duration of school training is apparently not a good predictor of driver success. Across six large fleets and nearly 17,000 entry-level drivers, the American Transportation Research Institute (2008) compared the duration and subject content of basic training with subsequent driver safety. Basic training contact hours ranged from 88 to 272, but training hours did not correlate significantly with subsequent driver crashes and violations. Hours of training in various specific topic areas did not correlate well either. This finding is not surprising, given the many driver individual differences largely unaffected by training, the many other factors affecting on-the-job safety, and the fact that, in general, differences in training do not have long-term effects on employee on-the-job performance (Brock et al. 2007; Knipling 2009a).

Driving Record

Obtaining driver records is not a "test" in the usual sense, but it functions in the same manner as a screening tool. Carriers are obliged to review State Motor Vehicle Records (MVR) for traffic violations and convictions. A new national program allows carriers to voluntarily access crash and roadside inspection data as well.

State Motor Vehicle Records

The FMCSRs (49 CFR 391.51) require motor carriers to obtain driver applicant MVRs covering the preceding 3 years from state agencies (FMCSA 2008). This includes every state in which a driver has been licensed during that

period. The MVR provides information on driver moving violations, other vehicle-related violations, involvement of crashes, and license suspensions. Crash preventability or "fault" is not specifically indicated, though traffic violations associated with crashes are shown. FMCSA (2008) provides a form letter for MVR requests to state agencies. After a driver is hired, carriers must obtain the driver's updated MVR annually, and the driver must prepare and furnish a list of driving violations for the previous year.

Commercial services such as HireRight (www.hireright.com; also called DAC Trucking) provide MVRs and other driver history reports on a fee basis. Such services may provide other applicant history information as well, including employment history, drug and alcohol testing history, workers compensation searches, criminal background checks, credit history, and education verification.

Pre-Employment Screening Program

The Pre-Employment Screening Program (PSP) is a new screening tool developed by FMCSA for voluntary use by carriers. PSP allows motor carriers and individual drivers to obtain driving records from the FMCSA Motor Carrier Management Information System (MCMIS). Once carriers enroll in PSP (www.psp.fmcsa.dot.gov), they can pay a $10 fee to request driver records online. PSP driver information contains the most recent 5 years of crash data and 3 years of inspection data; because it contains only information from MCMIS, it does not include traffic violation conviction data. PSP records state a driver's total number of crashes for the past 5 years and the number resulting in fatalities, injuries, towaways, and HAZMAT releases. Inspection data include the number of driver, vehicle, and HAZMAT inspections conducted and the number with out-of-service violations. Specific inspection violations and out-of-service violations are listed (e.g., brakes out of adjustment, flat tire/fabric exposed, driver log not current). The information on PSP was previously provided by the FMCSA Driver Information Resource.

Carriers are not required to use PSP, but it has been designed to be a convenient and inexpensive way to access driver records. PSP does not contain data from state DMVs such as non-safety-related license suspensions (e.g., relating to child support). Drivers can access their own PSP records without prior enrollment.

PSP is a new system just completed in 2010, so its use is not yet standard operating procedure for most carriers. Industry interest in the system is high, however, and its use is increasing rapidly. Of 65 safety manager respondents in the project survey, 45 planned to use the system, 15 were not sure, and only 5 indicated that they would not use it. As noted previously, the project survey sample was not based on structured sampling procedure and thus cannot be regarded as nationally representative. Even so, it appears that PSP use will become standard procedure for most safety-conscious carriers. Some progressive carriers plan to obtain PSP records on their current drivers to further refine and internally validate their selection of PSP data.

Medical Conditions and Physical Capabilities

Medical Conditions

Chapter two outlined the minimum commercial driver physical qualification standards per federal regulations (49 CFR 391.41) and provided a general background on the relation between medical conditions and driver crash risk. Extensive information on federal commercial driver medical qualifications and the latest rules and interpretations is available at http://www.fmcsa.dot.gov/rules-regulations/topics/medical/medical.htm. Medical evidence reports, medical expert panel recommendations, and agency medical review panel reports are available on the following safety-relevant health conditions:

- Diabetes mellitus (endocrine disease)
- Schedule II licit (prescription) medications
- Cardiovascular disease
- Seizure disorders
- Sleep disorders
- Renal disease
- Vision
- Musculoskeletal disease
- Hearing
- Psychiatric disease
- Stroke
- Multiple sclerosis and Parkinson's disease
- Substance abuse.

These and similar reports are intended to help the agency develop qualifications rules using an evidence-based approach. The agency does not necessarily adopt panel recommendations, but provides the reports online for the purposes of information sharing and transparency.

FMCSA provides guidance to medical examiners (and motor carrier companies) in an online handbook (http://nrcme.fmcsa.dot.gov/mehandbook/MEhandbook.htm), and also provides training specifications for medical examiners. Carriers' first obligations are to ensure that their driver hires meet these qualifications. A carrier's files on drivers must include a copy of the Medical Examiner's Certificate.

Many other health-related resources are available to carriers and drivers. The Healthy Trucking Association of America (http://www.healthytruck.org) publishes *Driver Health* magazine and sponsors various driver health initiatives. The American College of Occupational and Environmental Medicine (www.acoem.org) is oriented toward physicians and other medical professions serving industry. This non-

governmental organization provides books, instructional programs, and webinars on various occupational safety and health issues and practices. They include a guide to commercial driver medical certification (Hartenbaum et al. 2010), which focuses on the latest DOT regulations but also includes expanded interpretations from the medical literature and recommendations from the FMCSA Medical Review Board. This private sector information supplements that provided by FMCSA.

As discussed in chapter two, the medical profile of U.S. commercial drivers is generally poor. Compared with the general population, commercial drivers are more likely to be sedentary, overweight, have a cardiovascular condition, be smokers, and have poor eating habits (Krueger et al. 2007; FMCSA 2010). Medical conditions can reduce driver safety and employment success in three general ways:

- Chronic performance decrements
- Catastrophic performance failures (termed "critical non-performance" in crash causation studies)
- Absenteeism and reduced employment longevity.

Carriers are required by law to ensure that drivers meet medical qualifications, but meeting this requirement does not eliminate their concerns regarding crash risk and carrier liability. Whether a medical condition is identified as the direct cause of a crash or is merely suspected as an associated factor, carriers have high liability exposure when unhealthy drivers are involved in crashes. In some respects, carriers are caught between two needs. On the one hand, drivers meeting all legal medical requirements can still have medical conditions that contribute to crashes and cause liability. On the other hand, employee selection methods should be fair, criterion-based, and legally defensible in relation to all driver traits, including medical conditions. It is important that managers without medical training not be making medical decisions. Employers are given more leeway in regard to medical conditions than other traits, however, because the ADA does not apply to transportation safety-sensitive positions. Accommodations need not be made for commercial driver medical conditions with known linkage to safety risks.

In the project safety manager survey, the condition "poor general physical health" was given an average 5-point Likert scale rating of 3.6 by safety managers. This placed it about in the middle of 12 personal characteristics listed in terms of their perceived relation to crash risk. On the safety manager (SM) form, 43 of 65 respondents indicated that their driver candidates completed a medical history questionnaire during the selection process. Some top carriers have their own medical units, which perform a standardized medical examination of applicants. This exam may duplicate a driver's existing medical certification or may involve higher standards. Carriers interviewed seem most concerned about detecting OSA in their driver candidates. Another concern is cardiovascular illness. Both of these conditions have well-estimated associations with elevated crash risk or proximal crash causation (NTSB 1990; Young et al. 1997; Starnes 2006; Krueger et al. 2007; Knipling 2009a).

Physical Capabilities

Some companies require drivers to pass a physical activity test before hire. Such tests are not intended to detect specific medical conditions, but rather to assess drivers' and other employees' abilities to perform the physical tasks required in the job. For example, case study Carrier C tests driver abilities to carry, lift, climb, and crawl, all tasks performed around a truck and as part of the job. A principal motivation for conducting such tests is to reduce workers compensation claims associated with loading/unloading, vehicle entry and exit, and other potentially injurious tasks involved in truck and bus driving. The MediGraph Software Functional Capacity Evaluation (Medigraph FCE; www.functional-capacity-evaluation.com) is an objective procedure to test individual work capability. Its website claims that it has been scientifically peer reviewed. The full FCE requires an array of equipment, including an inclinometer/goniometer (for assessing head movement capability), treadmill, timer/stopwatch, adjustable-height shelving, lifting box, balance beam, assorted weights, and various smaller items. Specific scored tasks are performed on each. Performance scores on individual tasks generate assessments of capabilities in various areas, including standing/walking, lifting, pushing/pulling, balance, dexterity, and perception. Scale scores can be compared with a government defined job class and its associated strength requirements from the *Dictionary of Occupational Titles*. Like other physical and psychomotor tests, the FCE could identify some drivers with physical deficits inconsistent with safe driving. Beyond that, it is not intended to differentiate safe and unsafe drivers.

Commercially Available Safety-Relevant Selection Tests

This section presents commercially available selection tests marketed for use for selecting safe fleet drivers, or that could be promising candidates for such use. Tests are described in regard to the personal traits they seek to measure, how they are administered, test content, and key findings relating to their validity. The similarity of test items to job tasks determines its content validity. The degree to which the test captures conceptual human traits relevant to safety reflects construct validity. The degree to which test scores correlate with job performance criteria, especially in future predictions, is its criterion-related validity. Although test validity is a key concern, this project did not formally validate any selection instrument. Motor carriers wishing to use these or other selection instruments should seek more in-depth information on them, and also fully understand the legal requirements for selection test use.

Disclaimer

No selection test or other product or service was formally evaluated for this report. Specific products and services are described as examples for reader edification. No endorsement of any product or service by the authors or by TRB is implied or intended.

Much of the information on the following tests was obtained from product websites or, in some cases, direct discussions with test vendors. The authors strive to present only objective information here. When possible, supporting evidence from the scientific research literature has been cited. More basic scientific research presented in chapter two is also relevant. As the disclaimer also states, however, no endorsement of any product or service by the authors or publisher of this report is intended.

DriveABLE

The DriveABLE Cognitive Assessment Tool (DCAT, www.driveable.com) is a 30-40 minute computer-based test of dynamic performance (Dobbs, 2009). It was developed and validated in relation to other cognitive tests for the purpose of identifying drivers with cognitive or related sensorimotor deficits predictive of impaired driving. Most often it is used in the assessment of older drivers, and it is effective in capturing "competence" errors; that is, errors made by incompetent drivers but not by those within normal ranges. DCAT includes six kinds of tasks measuring reaction time, span of attentional field, decision making, executive functions, and hazard identification. DCAT presents the test-taker with six dynamic tasks:

- Motor speed and control task
- Span of attention field task (ability to notice events in the periphery of the visual field)
- Spatial judgment and decision-making task (judging space and time in driving maneuvers)
- Speed of attentional shifting task (among different hazards when driving)
- Executive function task (planning and executing maneuvers)
- Identification of driving situations task (recognizing crash threats as they arise).

DCAT is not a driving simulator. Most of its tasks resemble simple computer games where the user responds by means of push buttons or touch-screen responses, although the last task presents videos of actual driving situations. Automated test scoring provides normative scores for each task and an overall probability for success in the criterion test, an on-road evaluation. The DriveABLE website reports an overall DCAT prediction accuracy of 95%, with a sensitivity of 93% and a specificity of 82% in relation to an on-road evaluation. Here, sensitivity is defined as the percentage of subjects failing the road test given a test prediction of failure. Specificity is measured by the percentage passing the road test given a test prediction of passing. The test does not attempt to predict success for all subjects, however. No prediction is made for those scoring in the middle, where pass-fail predictions are more likely to be incorrect.

DCAT identifies individuals with cognitive impairments but is not predictive of safe driving across normal driving populations. The test may be useful, however, to obtain baseline measures of individual driver performance. These data may be useful if issues arise in the future about a driver's fitness, such as with school bus drivers, who may drive well into their older years.

The development and validation of DCAT (A. R. Dobbs, personal communication, 2010) involved performance comparisons among three groups of drivers: older cognitively impaired, older normal, and young normal. The two older groups averaged about age 70, versus 36 for the young group. Over a 2-day period, each subject performed 14 different timed cognitive tasks and took an on-road driving test. The six dynamic tasks were those most predictive of driving performance.

The purpose of DriveABLE is not to classify the full range of drivers but rather to identify those too cognitively impaired to drive safely. Classifying drivers in just two categories based on the test would result in too many incorrect classifications. Therefore, three prediction zones were established: a strong prediction of road test failure, and indeterminate "gray area," and a strong prediction of road text success. These were applied to 234 older drivers referred for testing by the Florida Department of Motor Vehicles and Highway Safety because they had possible indications of cognitive incapacity for driving. The following "truth table," organized similar to the Figure 8 selection model, shows the classification results. Although none of the predictions is perfect, drivers in the two extreme prediction groups had sharply different success likelihoods in the actual road test.

TABLE 2
DCAT VALIDATION "TRUTH TABLE"

Road Test Result	Predict Fail	DCAT Prediction No Prediction	Predict Pass
Passed Road Test	2%	24%	32%
Failed Road Test	18%	19%	4%

Dobbs (personal communication 2010) presents a fuller discussion of the validation methodology and results. Similar results are presented for a second validation group. Based on the research, a distinction is made between test and driving errors indicative of cognitive impairment (discriminat-

ing errors) and those simply indicative of bad driving habits (nondiscriminating errors). Normal subjects may make multiple nondiscriminating errors, perhaps indicative of careless driving. The more serious discriminating errors seen in cognitively impaired subjects are indicative of incapacity to drive safely.

Daecher Driver Profile

The Daecher Driver Profile (www.safetyteam.com) is an online inventory questionnaire taken by drivers to assess their beliefs, attitudes, personality, opinions, and other personal characteristics related to success as a professional driver. The Driver Profile is a 165-item questionnaire that consists of 117 true-false items relating to personality characteristics and 48 multiple-choice items on driver background and attitudes predictive of safe driving. Administration time is about 30 minutes for most respondents. The profile is automatically scored, with results (an algorithmically derived prediction of the applicant's probability of success) provided to the employer customer. Daecher's promotional materials state that the test is "effective in selecting commercial drivers who—

- Have a high level of safety awareness
- Follow rules and regulations
- Are responsive to customer problems
- Maintain a courteous and professional manner
- Are more likely to be seen by their supervisors as 'superior' employees."

Development of the profile was funded by a national insurer of commercial vehicle operators. Daecher's website states that the test has been independently validated using a concurrent criterion-related methodology. That is, working commercial drivers' profile responses and job ratings were compared and found to correlate significantly. Each of five subtest scores (corresponding to the driver characteristics listed above) correlated moderately with driver job performance ratings. According to the website, the study conformed to applicable EEOC guidelines for the validation of selection procedures and does not discriminate against minorities. The company also claims that it is difficult for drivers to falsely make themselves "look good" on the test. A 7-step summary of the Daecher validation process is provided in Appendix B. Their reported validation coefficient is +0.33, putting it in the "likely to be useful" range per the DOL guidelines discussed earlier.

The company also provides a Professional Driver Hiring Program guide for "recruiting, screening, and selecting the best candidates." Appendix F of *CTBSSP Synthesis 1* (Knipling et al. 2003) provides related driver selection information and materials contributed by the Daecher Consulting Group to that effort.

WayPoint®

WayPoint is a 4-minute Internet-based sensorimotor test, similar in some ways to the Trail-making Test Form B. Both tests were introduced in chapter two. Subjects alternately connect numbered and alphabetized boxes (i.e., 1, A, 2, B, 3, C) that are presented in random spatial patterns of increasing complexity. Increased complexity is achieved by adding distracting icons to the mix of letters and numbers. Figure 9 shows WayPoint screens with and without distracters. The dashed line shows the path of error-free performance.

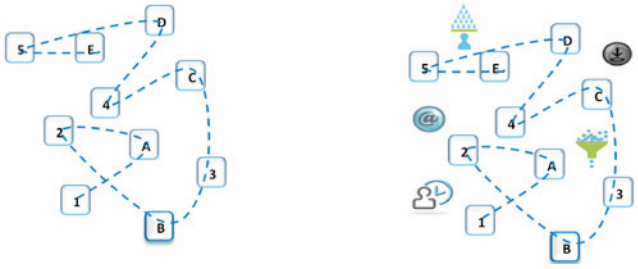

FIGURE 9 Plain and embellished WayPoint worksheets. (*Courtesy*: WayPoint.)

Haphazard, mistake-prone WayPoint performance suggests a similar approach to driving. When the icons are added to the test, a large decrement in performance suggests that the individual could be highly distractible; for example, by a billboard or a cell phone message. In contrast, according to company literature, little or no decrement in performance (undistractible) suggests that the individual has "tunnel vision" and might not notice peripheral or surprise crash hazards. Neither extreme of distractibility is associated with safe driving; the middle of the distractibility scale is said to be ideal.

This U-shaped relationship between distractibility and crash proneness was found in vendor validation studies involving drivers of both trucks and cars. In one study, 63 tractor-semitrailer drivers took the WayPoint assessment. When their test scores were compared with preventable collision data from company records, the safest drivers scored in the middle of the distractibility scale, whereas those at both extremes had higher risk. Similar results were reported for a much larger sample of noncommercial drivers. The WayPoint developer also provided unpublished data on 121 Metropolitan Atlanta Rapid Transit Authority transit bus operators. WayPoint scores for these operators followed the U-shaped function for preventable crashes, unpreventable crashes, customer complaints, and absent days. Median WayPoint scores were predictive of best performance per all four job criteria.

The concept of a U-shaped relationship between distractibility and crash proneness is by no means established as fact, but it could be consistent with existing information about proximal crash causes. In the LTCCS, 19% of truck

at-fault multivehicle crashes had a CR of inattention (i.e., distraction, daydreaming), whereas an equal 19% had a CR of "looked but did not see." "Looked but did not see" could be construed as "undistractibility" in this model of driver crash risk based on WayPoint.

Scheig Hiring and Performance System

The Scheig system (www.scheig.com) provides a three-phase hiring process based on a job analysis: (1) applicant assessment questionnaire; (2) applicant structured interview; and, for those hired, (3) performance evaluation. Scheig's description of its job analysis says that several hundred job-specific behaviors are generated for each job analyzed. Using these job behaviors, Scheig produces behaviorally based job descriptions and uses them to develop the assessment questionnaire. The assessment contains two sections, an "interest and willingness" checklist and a forced-choice questionnaire. The interest and willingness checklist lists around 100 behaviors, often with an embedded standard of acceptable performance (though one intended not to be obvious to the test-taker). An example behavior is "Seeks assistance, advice, or directions if unsure how to handle a task or situation." The applicants indicate two responses for each behavior: the degree of experience they have doing the behavior, and whether they are willing or unwilling to meet that condition of the job. The forced-choice questionnaire asks applicants to choose between two actual job behaviors. Both choices are intended to sound equally "good," though one choice actually indicates high performance and the other indicates low performance in the context of the job analysis. From the same job analysis data, Scheig says it develops a behaviorally based structured interview as a second screening step for those passing the questionnaire phase. The third phase, performance evaluation, is not part of hiring in itself but rather a check on the hiring decision for each new hire, an aid to new employee performance improvement, and a method of further validating and refining the whole selection process. Past clients include BASF and Chevron in chemicals, and SYSCO and Food Services of America in food preparation and distribution.

Virtual Risk Manager

Interactive Driver Systems (www.virtualriskmanger.net) incorporates various sources of information to assess individual driver risk, aggregate risk for a company, and provide risk-reduction training and interventions. Its service components include the following:

- RoadRISK: Online driver questionnaire intended to tap driver safety attitudes, hazard perception, behaviors, knowledge, and risk exposures.
- DriverINDEX: Predictive model to identify clients' most "at-risk" drivers.
- RiskFOUNDATION: Carrier safety policy and practices guide structured as a carrier-driver "safety contract" renewed every 12 months. Driver must affirm that he or she agrees to or will abide by 45 safety-related practices.
- RiskCOACH: Short training and other recommended interventions aimed at specific risks.
- BenchMARKING: Carrier self-audits in which they can anonymously benchmark their company's crash data and safety standards with other organizations and network with other fleet managers.

Virtual Risk Manager uses carrier and driver inputs from audits, crash data, risk assessments, training results, and electronic license checks. The company states that its products were developed based on research, trials, and user evaluations by two universities in the United Kingdom involving groups of 8,000, 16,000, and 26,000 drivers. It also asserts that one truck fleet reduced claims by 25% and driver at-fault incidents 75% over a 12-month period.

The company's website and promotional materials report a study on the RoadRISK application. Six different driving risk measures were compared with individuals' numbers of collisions. Subjects were mostly engineers and managers rather than commercial drivers. The six measures of risk were as follows:

- *Exposure* to risk, based on 26 questions about age, type of driving, and amount of driving
- *Attitudes* about driving, based on 10 multiple-choice questions
- Driving *behavior*, based on 10 multiple-choice questions
- *Knowledge* of the rules of the road, based on 10 knowledge questions
- *Hazard perception*, based on subject responses to the presentation of 15 pictures of potentially hazardous road situations
- *Total score*, a composite of the above.

All six scale scores were reported to vary with actual crash experience. The knowledge score was the weakest predictor, whereas the exposure, behavior, and total scores were the strongest predictors.

More detail on RoadRISK research was provided in a conference presentation by Rea et al. (2004). In one of several different research studies cited (the one involving 16,000 drivers), drivers with low (bad) RoadRISK scores were 2.2 times more likely to have three or more crashes during a 3-year period than those who scored high (good). The authors acknowledged that part of this effect was derived from exposure differences between the groups. Nevertheless, individual scales were each associated with crash risk. For example, the mean number of crashes over a 3-year period for three attitude-scale groups were as follows:

- Low (bad) attitude score ($N = 3,616$): 0.32 crashes
- Medium attitude score ($N = 6,200$): 0.25 crashes
- High (good) attitude score ($N = 16, 106$): 0.22 crashes.

MindData Attitude Index

MindData (www.minddata.com) offers a general-purpose employee selection test that is validated against a company's successful and unsuccessful employees. Its use for selecting drivers for a trucking company, for example, would require administration of the test to current drivers along with objective data on those drivers' safety or other measures of job performance quality. Its core test, called the MindData Attitude Index 100 (MD/100), is a personality profile that generates scale scores for 10 traits:

- *Aggressiveness*—the degree to which wants or demands are made known
- *Compassion*—the level of concern or disinterest in the needs of others
- *Compliance*—the tendency to resist or obey rules and regulations
- *Diplomacy*—the level of communication, from diplomatic to blunt
- *Concentration*—the ability to concentrate on a task despite distraction
- *Optimism*—the level of optimism or pessimism
- *Sensitivity*—how criticism will be handled
- *Commitment*—the extent to which promises may be reliably kept
- *Sociability*—the extent to which one enjoys or avoids dealing with others
- *Ethics*—a representation of one's value system.

A longer version of the index assesses 10 additional traits: adaptability, anxiety, decisiveness, determination, drive, initiative, meticulousness, organization, stamina, and trust. Some tested traits may be strongly related to driving safety, others moderately, and others not at all. Determination of the relevance of any one scale would be based on data from current employees, as well as other studies of personal traits relevant to safety. For example, traits like aggressiveness and compliance have both face validity (apparent validity) as safety predictors, as well as extensive corroborative evidence from various studies. Other traits like diplomacy, sensitivity, and sociability may be measured reliably by the text but have little or no predictive validity in relation to driving safety.

The MindData Attitude Index can be administered either online of offline. The original form of the test has been adjudicated and approved by a federal court as meeting EEOC validation guidelines, although the company's website does not indicate the specific jobs to which this validation applies. MindData markets its products as tools for both employee selection and promotion.

ProfileXT®

Like MindData, ProfileXT is a commercially available general-purpose employee selection instrument that is normed against a company's current employees. The 60-minute test is administered online and generates specific scale scores under the categories "thinking and reasoning," "behavioral traits," and "occupational interests." Improved employee selection is the principal use of this and similar assessment profiles, but they can also be used for employee placement, promotion, coaching, and job description development. Case Study F describes the use of ProfileXT by a medium-size private carrier to improve its driver hiring. The carrier administered the profile to current drivers, and found that prominent behavioral traits of successful drivers included "manageability" and "accommodatingness." Occupational interests associated with good drivers included "mechanical" and "people service." Some personal traits usually prized in employees, including assertiveness, decisiveness, and an occupational interest in enterprise, were not necessarily characteristic of successful drivers.

NEO Five-Factor Inventory

The NEO Five-Factor Inventory (NEO-FFI) is a 60-item questionnaire that classifies people on five scales: Neuroticism, Extraversion, Openness, Agreeableness, and Conscientiousness. Secondary scales derivable from NEO data can assess additional traits like impulsivity/impatience and Type A personality. As discussed in chapter two, these personality traits are relevant to personal risk perception and risk-related behaviors. The NEO-FFI is used extensively in research, psychological assessment, and personnel selection for non-driving jobs. Its use in selecting drivers or other safety-sensitive jobs is probably limited, but some studies have shown that specific NEO scale scores are related to driving safety and also to employee retention.

Strong safety evidence comes from a meta-analysis of 47 studies of the five NEO personality factors in occupational and nonoccupational settings (Clarke and Robertson 2005). The meta-analysis found that, across a number of different countries and jobs, individuals low in both agreeableness and conscientiousness were more likely to be involved in accidents. "The results revealed criterion-related validity for two personality dimensions, agreeableness and conscientiousness, of 0.26 and 0.27, respectively, indicating that individuals low in agreeableness and low in conscientiousness are more liable to be accident-involved." Another rationale for assessing these two personality traits is that they relate to other aspects of success as a commercial driver. Most notably, agreeableness relates to customer relations, and conscientiousness relates to load security and financial dealings. The study also found that neuroticism (anxiety level) was associated with number of accidents in occupational settings. Extraversion was also an accident predictor, but only in nonoccupational settings.

Driver Behavior Questionnaire

The Driver Behavior Questionnaire (DBQ; Parker et al. 2001) is a questionnaire that asks subjects to indicate on a six-point scale (from "never" to "all the time") how often they engage in faulty or dangerous driving behaviors. Example behaviors include speeding in residential areas, racing starts from traffic lights to beat other drivers, backing into other objects, skidding on a slippery road, and steering the wrong way into a skid. One version of the DBQ has 24 items and yields three measures of driver behavior—violations, errors, and lapses, defined as follows:

- Violations: deliberate deviations from rules
- Errors: mistakes; intended actions with unintended consequences
- Lapses: executions of unintended actions.

According to Sullman et al. (2002), only the "violations" score correlates significantly with past and future crash involvement. This relation has been found across many different samples and countries, however. Sullman et al. (2002) enlisted the cooperation of five New Zealand trucking companies to administer the test to 378 truck drivers. Their most common admitted aberrant behaviors were disregarding highway speed limits, sounding their horns in anger, and showing other forms of anger toward other drivers. Drivers with high DBQ violations were 50% more likely than other drivers to have been involved in a crash over the previous 3 years. They also tended to be younger and less experienced. The study noted that these significant associations emerged from the study, even though truck driver subjects might have understated their bad driving behaviors on the questionnaire. This suggests that the real associations may be even greater than those measured. Unfortunately, it also suggests that if driver applicants took the test, they would "see through" the intent of many questions and minimize any indications of misbehavior and risk.

A study conducted in China used a different version of the DBQ to explore relationships among risk perception, risk-taking attitudes, and behavioral history, including serious violations, ordinary violations, and crashes. Ma et al. (2010) administered the DBQ to 248 taxi and bus drivers in Wuhan, China. Subjects responded on a Likert scale to risk perception and risk-taking related items such as the following:

- "Worried for yourself being injured in a traffic crash?"
- "Many traffic rules must be ignored to ensure traffic flow."
- "If you are a good driver it is acceptable to drive a little faster."

Several statistical methods were used to distill the multiple answers into a smaller number of psychological scales:

- Risk perception scales:
  - Worry and insecurity (emotion-based)
  - Assessment of crash probability
  - Concern (cognition-based)
- Risk-taking attitudes:
  - Attitude toward rule violation and speeding
  - Attitude toward careless driving of others
  - Attitude toward drinking and driving.

Two statistical models, the Logit model and the Structural Equation Model, were used to identify "influential paths" of influence among the scales and driver behavioral history. Interrelationships were seen between violation history (serious and ordinary), crashes, and various risk perception and risk-taking measures. The scale "attitude toward rule violation and speeding" was found to have the strongest interrelationships with other risk perception and behavioral measures. Figure 10 shows these relationships. Thiffault (2007) also noted the associations of violations and attitudes about them with crash risk.

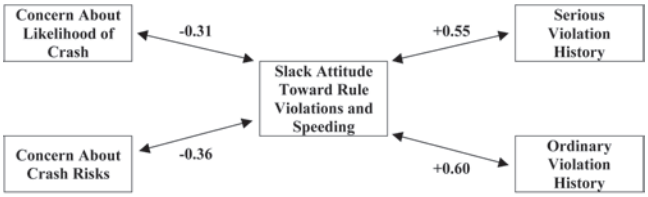

FIGURE 10 Correlations among key risk attitudes, risk perceptions, and behaviors. (*Source*: Based on Ma et al. 2010.)

Driver Stress Inventory

The Driver Stress Inventory (DSI; Matthews et al. 1996, 1997) assesses driver emotions about driving, including fear, anger, and boredom. The DSI is an experimentally validated questionnaire designed to assess an individual's vulnerability to stress during driving and to evaluate the coping methods employed in stressful driving situations. The DSI has two sections. The first section contains 12 items to evaluate driving habits and history, including the number of years a driver has been licensed, the typical number of days driven in a week, the typical roads traveled on, the number of miles driven annually, and the number and severity of accidents in the past 3 years. The second section consists of 48 Likert scale items describing attitudes and emotional reactions experienced while driving. These are designed to assess a driver on five dimensions of driver stress vulnerability: aggression, dislike of driving, hazard monitoring, thrill-seeking, and fatigue proneness. Sample items (each requiring a 10-point Likert scale response ranging from "Not at all" to "Very much.") include the following:

- Does it worry you to drive in bad weather?
- At times, I feel like I really dislike other drivers who cause problems for me.

- I become annoyed if another car follows very close behind my vehicle for some distance.

As cited in chapter two, DSI assessments of driver aggression and thrill-seeking have correlations in the +0.40 to +0.60 range with traffic violations and other driving misbehaviors. Like the DBQ, the DSI is well validated as a predictor of driving behavior and risk when used in research settings, but the intent of its questions would likely be too obvious to applicants for driving jobs.

Wonderlic Mental Ability Tests

Companies have at least two reasons and justifications for incorporating mental ability testing into their driver hiring procedures. First, unrelated to safety, the commercial driver job involves basic math and other mental skills such as map-reading, distance calculations, and keeping logs and other records. For companies that use onboard safety monitoring, it is important that drivers understand statistics on their driving such as hard-braking rates and fuel economy. The other rationale is evidence, suggesting that more intelligent drivers (as measured by IQ tests) tend to be more patient and make more rational risk choices. There is also compelling evidence that newly hired drivers scoring low on IQ tests are bad retention risks.

Wonderlic (www.wonderlic.com/hiring-solutions/products.aspx) is among companies marketing mental ability tests for employee selection. The company's website states that "cognitive ability or general intelligence [is] the strongest single predictor of employment success." This claim is made in relation to employees and jobs in general, not in relation to driving jobs. Among tests available from Wonderlic are the Wonderlic Personnel Test and the Wonderlic Basic Skills Test (WBST). The WPT-R is a 12-minute test that can be administered online or on paper (with answers faxed to Wonderlic and scored). Sample questions include the following:

1. Three individuals form a partnership and agree to divide the profits equally. X invests $9,000, Y invests $7,000, Z invests $4,000. If the profits are $4,800, how much less does X receive than if the profits were divided in proportion to the amount invested?

2. A boy is 17 years old and his sister is twice as old. When the boy is 23 years old, what will be the age of his sister?

3. PRESENT/RESENT. Do these words:
   a. Have similar meanings
   b. Have contradictory meanings
   c. Mean neither the same nor opposite.

In the project safety manager survey, respondents generally considered "low intelligence/mental abilities" to have a moderate association with driving safety. On the five-point Likert scale, responses were concentrated around "3" (Moderate Association). Ten of 65 respondents actually used a mental ability test (e.g., of math, reasoning) as part of their selection procedures. Three of the 10 companies profiled in the chapter five case studies use mental ability testing for selection. Safety directors using these believed that their use did contribute to hiring safe drivers. One of them believed strongly, however, that drivers' mental abilities were far less important than their safety attitudes.

TESTS FOR RETENTION LIKELIHOOD

To some extent, personal characteristics associated with driving safety overlap with those associated with employment longevity. In addition to this trait overlap, there is a causal link: Unsafe driving can lead directly to termination. This section describes a few employment tests used to predict employee retention. Test research shows that both mental abilities and personality factors are predictive of employee retention/turnover. Some of the same personal traits known to be associated with safe driving have also been found to contribute to employment longevity.

Raven's Standard Progressive Matrices and Advanced Progressive Matrices

Distributed by Pearson Assessment (formerly known as Harcourt Assessment; http://www.pearsonassessments.com/pai/), the Standard Progressive Matrices (SPM) is a long-used test of nonverbal reasoning ability. Subjects select which small image best completes a gap in a larger image by matching the pattern of each small image to the pattern in the large image. The Advanced version is suitable for subject groups who have above-average intelligence. The SPM test was first introduced in 1936 by J. C. Raven. The authors of the current version say it measures the abilities to think clearly, to make sense of complexity, and to store and process information (Raven et al. 2003).

The Truckers and Turnover Project (Burks et al. 2008) gave the SPM version of the Raven's test to 1,065 driver trainees who were new to the trucking industry and studying to acquire their CDLs at a school run by an LTL motor carrier. Drivers in this group signed a credit agreement to pay back the market price of their training if they did not complete 1 year of service after training. Only about 35% of trainees starting the program made it through the first year. Investigators found that drivers who scored in the top quarter on the Raven's were almost twice as likely to complete the year of work as those in the bottom quarter (Burks et al. 2009). The authors suggest that those with higher cognitive skills are better able to manage their time and effort in the face of conflicting and changing demands, such as traffic and weather, hours of service, and customer time limits.

The Adult Test of Quantitative Literacy

This test of mathematical reasoning or *quantitative literacy* (also called *numeracy*) is distributed by the Educational Testing Service (ETS) of Princeton, New Jersey. ETS is widely known as the distributor of the Scholastic Aptitude Test, one of the most widely used standardized tests for high school students who wish to go to college. According to ETS (2010),

> *Quantitative literacy* measures how well you can use numbers found in ads, forms, flyers, articles or other printed materials. Quantitative literacy is a little different from prose and document literacy because in addition to using a text to identify needed information, you also have to add, subtract, multiply, divide or do other math to get the information you need.

ETS gives several examples, including keeping score for a bowling team or calculating a 15% tip at a restaurant. The Truckers and Turnover Project (Burks et al. 2008) also gave this test to the same 1,065 driver trainees discussed above. As with the Raven's, those drivers who scored in the top quarter on the Adult Test of Quantitative Literacy were almost twice as likely to complete the year of work as those in the bottom quarter (Burks et al. 2009). The authors attributed this effect to the same relationship between cognitive skills and job performance as discussed previously.

NEO Five-Factor Inventory

As number of the Big Five personality traits are relevant to personal risk perception and risk-related behaviors. The NEO-FFI is used extensively in research, psychological assessment, and personnel selection for nondriving jobs. A large meta-analysis of 86 empirical studies (Zimmerman 2008) found significant evidence of a relationship between personality factors and voluntary turnover (quit) decisions. Many studies also controlled for other factors, such as job satisfaction and job performance. All five factors had some correlation with quit decisions in the expected direction, with three standing out as being particularly strong:

- Neuroticism: +0.18
- Agreeableness: −0.25
- Conscientiousness: −0.20.

That is, employees were more likely to quit if the test indicated that they had neurotic (high anxiety) tendencies, were disagreeable, and were less conscientious than other employees tested. A "path model" developed by the author showed direct relationships between these personality traits and intentions to quit and turnover behavior that were not captured through job satisfaction or job performance measures. In addition, "Personality traits had stronger relationships with outcomes than did non-self-report measures of job complexity/job characteristics" (Zimmerman 2008).

CHAPTER FOUR

SURVEY METHODS AND RESULTS

Chapters two and three reviewed research and trade literature on driver individual differences and selection tests and measurements, respectively. An additional vehicle for obtaining information for this study was project surveys. Two similar survey forms were used for two different respondent groups. Most important was a survey of current CMV fleet safety managers. The safety manager survey asked respondents their opinions on driver risk factors, what selection practices they used, and their ratings of the effectiveness of these practices. Survey opinions are not taken as empirical *facts*, but rather as indicators of industry thinking on safety management questions. Of secondary importance, but still of interest, was a survey of other experts in motor carrier safety. This survey form addressed the same general topics, but was limited to opinions because the respondents were not current practitioners. The two survey forms are provided in Appendix A. This chapter describes the survey approach and specific methods, and provides principal results for each respondent group. Results for the two respondent groups are presented separately because of their different perspectives on the problem and because the two forms differed somewhat in their questioning approaches and content.

A general caveat is that most of the survey responses represent subjective responses to subjective questions. A few questions were objective (e.g., asking safety managers whether they use a particular safety management practice), but most called for subjective judgments by respondents. Another caveat is that both samples must be regarded as convenience samples of interested, knowledgeable individuals, not as representative samples of larger populations. Conceptually, both the safety manager and "other expert" populations are amorphous and not captured by any list. In addition, the safety manager population is extremely large (in the hundreds of thousands in the United States), diverse, and problematic from the sampling perspective.

OVERVIEW OF SURVEY APPROACH, ANALYSIS, AND INTERPRETATION

Sampling Concept

The conceptual *population* for the safety manager survey was North American motor carrier (truck and bus) carrier safety managers. This population is somewhat amorphous, as there is no consistent definition or criterion for "carrier safety manager." Also, there is no central potential respondent list on which to base systematic sampling.

The safety manager sample consisted of individuals participating in trade associations or national meetings relating to motor carrier safety. The e-mail addresses of these individuals were known to the project team, or paper survey forms were distributed directly to them in trade association meetings. The sample is presumed to be strongly biased toward organizations and individuals with more experience, past success, safety sophistication, and safety conscientiousness than the overall population.

Those returning the survey (whose responses are presented here) are the respondents. Just as the sample space was likely a biased slice of the population, the sample was likely a biased slice of the sample space, because those responding tend to be more committed and interested in the topic than those not responding. Moreover, they tend to be more educated and verbal (Walonick 2010). Both sources of bias operated strongly in the present safety manager survey and to a lesser extent in the "other expert" survey.

A larger study focusing on the survey per se might be better able to capture the larger population, increasing the size and representativeness of the sample space and obtaining a higher survey response rate. Study resources did not permit a more extensive, rigorous, and layered subject sampling approach. The sample obtained, even if it represents a skewed sample of the most knowledgeable and safety-conscious respondents, still provides valuable information and accomplished the following objectives:

- It tapped the views and practices of industry leaders.
- It provided information on subjects' relative opinions on the various traits and practices presented (e.g., which personal traits are rated most safety-relevant by respondents).
- It provided contacts for follow-up interviews with safety managers on the practices of safety-active companies.

Data Analysis and Interpretation

There were three general types of questions on the surveys: questions about respondent opinions, questions

about specific carrier practices (safety managers only), and questions about respondents themselves and their organizations. Opinion questions were subjective and called for subjective, judgmental responses, mostly in the form of Likert scale ratings. It is important that these responses not be misinterpreted as objective facts. Questions about specific carrier practices used (yes-no) were on the safety manager survey forms only. Questions about the respondents themselves (e.g., years of experience) were also objective. All of the caveats on sample representativeness apply to all questions on both forms. Thus, none of the survey results on either form can be generalized to larger respondent groups or populations such as "North American carrier safety managers" or "experts in motor carrier safety." The value of the survey results is not based on representativeness to larger populations, but rather on respondents' answers to specific questions relative to other, similar questions (e.g., Which personal traits were rated most relevant to crash risk? Which safety practices were rated as most effective?).

Nonuse of Response Percentages

Per CTBSSP policy, the survey results tables in this chapter, and survey results cited elsewhere in this report, do not include results percentages. Instead, raw numbers are cited. This practice reduces the likelihood that survey results will be misinterpreted or incorrectly cited as representing larger respondent populations. Readers may generate their own percentages, but it is important that they be stated as being representative of larger groups.

Likert Scale Means

Likert scales are numeric rating scales, often with five choices numbered from 1 to 5. Likert scales usually have word descriptors for each choice, or "anchor" choices at the ends and perhaps the middle. Two different Likert scales were used in project surveys:

- A five-point scale relating driver personal/psychological traits to crash risk. Choices ranged from "little or no association (1)" to "very strong association (5)."
- A five-point scale rating the effectiveness of driver hiring practices. Choices ranged from "highly ineffective (1)" to "highly effective (5)."

Results are provided in the form of respondent counts for each choice along with the weighted arithmetic mean of all choices. TRB's online survey service provided these statistics automatically in survey reports. For paper surveys, the survey statistics were obtained from Excel spreadsheets used to enter and reduce the data.

MOTOR CARRIER SAFETY MANAGER SURVEY METHODS

This section describes methods specific to the safety manager surveys. Safety managers were the respondent group of greatest interest for the study. These individuals have company titles such as Safety Manager, Safety Director, Director of Compliance, and Vice President for Safety (and/or Compliance). A few have titles relating to HR management or operations. The respondent pool (sample space) consisted of individuals participating in national industry groups supporting safety, or who had attended safety meetings and whose contact information was available to the project team. As discussed in the previous section, this pool may be characterized as representing safety-conscious carrier safety and HR managers who are willing to participate in such research. All of the sampling and data analysis issues discussed in the previous section apply to the safety manager survey.

Questionnaire Design and Content

The safety manager survey questionnaire is provided in Appendix A. It consisted of the following general sections:

- A brief statement of the study and survey purpose, with a confidentiality assurance
- Two related five-choice questions on general factors affecting safety and crash risk (used on paper form only)
- Two related five-choice questions on carrier practices affecting driver crash risk
- Twelve driver personal/psychological traits, each rated on a one- to five-point Likert scale for association with crash risk
- Thirteen carrier driver hiring practices, with a two-part answer for each:
  - Yes-no for whether the practice was used by the manager's fleet
  - If yes, a one- to five-point Likert scale to rate the practice's safety effectiveness
- A single question on the carrier's planned use of the Pre-Employment Screening Program (PSP)
- An open "comments" space
- Four questions on respondent's professional experience and fleet characteristics
- A space for an optional e-mail address to which to send the project report PDF file
- A space to volunteer for a paid interview on innovative carrier practices for the project case studies.

The paper version of the questionnaire (administered principally at a truck and a bus trade association meeting) contained all of the previously mentioned sections. The online version was streamlined slightly by omitting the initial two questions on crash risk factors.

Questionnaire Distribution and Analysis

Two CMV trade associations, the Truckload Carriers Association (TCA) and the Bus Industry Safety Council (BISC), assisted the study by distributing paper survey forms for this project and MC-22 (Safety Management in Small Motor Carriers) at national meetings. The National Private Truck Council (NPTC) assisted the effort by e-mailing the online survey solicitation to its Safety Council members with its endorsement.

Paper surveys were formatted on a single front-and-back sheet where answer choices were circled or penciled in. At the TCA meeting, approximately 100 survey forms (for each of the two projects) were distributed, and 20 were returned. Two other truck forms were obtained through personal contacts. At the BISC meeting, approximately 50 forms were distributed, and 26 were returned. At the latter, meeting attendees included a significant proportion of non-safety managers (e.g., government officials, trade association officials, vendors, consultants) for whom the survey was not intended. The exact number of carrier safety managers in the room is not known.

An additional effort to obtain safety manager respondents was made using TRB's online survey service. The online survey had the same content as the paper survey, except for the omission of the first two questions relating to general crash risk factors. These two questions were "thought questions" that required more time for response than others on the survey. They were omitted from the online version to streamline the survey and perhaps increase response rates.

E-mail requests were sent to 105 respondents believed to be current motor carrier safety managers based on their business cards and contact information gathered at various recent motor carrier safety conferences. An additional solicitation was sent from an NPTC official to NPTC Safety Council members. Twenty-one people took the online survey, which brought the total safety manager survey sample to 69.

Paper survey answers were entered into an Excel spreadsheet for analysis. Online survey tabulations were generated and added to the Excel sheet totals.

This experience suggests that both methods are viable. Handing out paper surveys at trade association meetings with the support of the organizers likely yields a higher return than sending e-mail solicitations. Carrier officials are often the targets of product marketing and other promotions, and thus may tend to be wary of responding to external e-mails in general. They may have confidentiality concerns, even if confidentiality statements are prominent in survey materials. Walonick (2010) provides a more extensive discussion of the difficulties of obtaining survey data from various respondent groups.

In spite of the challenges of obtaining a robust survey sample and the acknowledged unrepresentativeness of the sample in relation to all safety managers, the 69 responses provided sufficient data for analysis as well as many useful comments. In addition, a number of respondents volunteered for follow-up structured interviews.

Follow-Up Structured Interviews

The last question of the safety manager survey form asked respondents if they would be interested in participating in a paid follow-up interview to discuss innovative fleet practices. The question included the assurance, "Responses will be confidential; no interviewees or carriers will be identified unless desired." The key purpose of the interviews was to gather information and opinions for project case study write-ups. If respondents did volunteer, and had a relatively large number of "yes" responses under carrier practices (indicative of more developed driver hiring systems), they were contacted to schedule an interview. These interviews covered both this project and MC-22. A total of 20 respondents were contacted, usually both by e-mail and by phone, of whom 10 agreed to participate. These 10 provided substantial information on innovative carrier approaches and practices for hiring better drivers. This information is presented in chapter five.

MOTOR CARRIER SAFETY MANAGER SURVEY RESULTS

Factors Affecting Safety and Crash Risk

Questions 1 and 2 addressed factors affecting safety and crash risk. These were also the first two questions of the MC-22 survey, as the two questions were pertinent to both studies. The same five choices were presented in each. Question 1 asked for the respondent's choice of *up to two* factors having the *greatest* effect, whereas Question 2 asked for the *one* factor with the *least* effect. Table 3 presents responses. Note that Questions 1 and 2 were omitted from the online version of the survey in order to reduce survey length and increase response rates.

As expected, choices for the two opposite questions (greatest and least) were more or less inversely related. Driver-related choices (a) and (b) were regarded as having the greatest effect on crash risk. The other three choices (vehicle, roadway, and weather) were all regarded as having much smaller effects. Choice (a) has the greatest relevance to driver selection, because driver selection procedures attempt to discern persistent personal traits predictive of crash risk. Both (a) and (c) are fundamentally driver assessment activities, whereas the other three choices are primarily behavior change interventions. Figure 11 presents a histogram of the safety manager Question 1 "Most" votes for the five crash risk factor categories.

TABLE 3
SAFETY MANAGER RESPONSES RELATING TO FACTORS AFFECTING SAFETY AND CRASH RISK

(1) Factors Affecting Safety and Crash Risk: Consider the entire fleet of North American commercial vehicles (trucks and buses). Across all these drivers and vehicles, which factors have the greatest association with crash risk? Pick up to two of the factors below which, in your opinion, have the greatest association with crash risk. (2) In your opinion, which one factor has the least association with crash risk?	(1) Most	(2) Least
(a) Enduring/long-term driver traits (e.g., age, physical abilities, medical conditions, personality, behavioral history)	29	5
(b) Temporary driver states (e.g., moods, daily circadian rhythms, effects of recent sleep, effects of recent food and fluids, effects of environmental conditions in cab)	29	4
(c) Vehicle characteristics (e.g., configuration, safety equipment, load) and mechanical condition (e.g., brakes, tires)	7	11
(d) Roadway characteristics and traffic conditions (e.g., undivided vs. divided highways, construction zones, traffic density, speed limits, lane restrictions)	9	15
(e) Weather and roadway surface conditions (e.g., wet vs. dry, road surface friction, visibility, wind)	10	9
Total Responses:	84	44

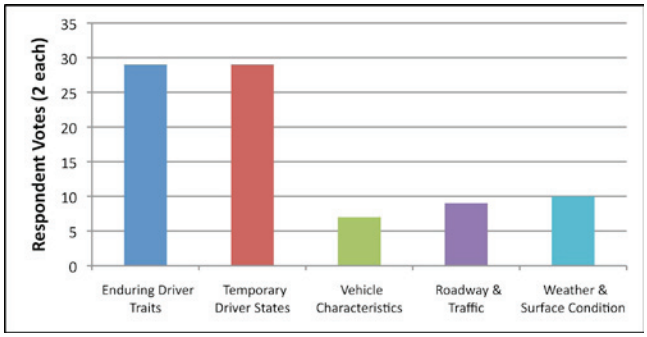

FIGURE 11 Safety manager "most" votes for the five crash risk factor categories.

Most Important Carrier Practices

Questions 3 and 4, and all subsequent questions, were included on both the paper and online versions of the survey. Questions 3 and 4 addressed the importance of five different areas of carrier safety management. The same five choices were presented in each. Question 3 asked for the respondent's choice of *up to two* practices having the *greatest* importance, whereas Question 2 asked for the *one* practice with the *least* importance. Table 4 presents responses.

Again, choices for the two opposite questions (greatest and least) were more or less inversely related. Choice (d) *driver evaluation* was rated overall as most important, followed by choice (b) *driver selection*. Selection and evaluation are related in that both are forms of driver assessment aimed at identifying good and bad drivers. Choice (a) *driver preparation* and (e) *rewards/discipline* were rated as having relatively low importance. Figure 12 presents a histogram of the safety manager Question 3 "Most" votes for the five types of carrier practices.

TABLE 4
SAFETY MANAGER RESPONSES RELATING TO GENERAL CARRIER PRACTICES

(3) Most Important Carrier Practices: All elements of driver training and companies' safety management practices are important, but some may be more important than others. Pick up to two of the carrier practices below which, in your opinion, have the greatest effect on drivers' safety behaviors and safety records. (4) In your opinion, which one practice has the least effect on driver safety outcomes?	(3) Most	(4) Least
(a) Driver preparation; pre-hire CMV driving training and testing (e.g., basic school training and CDL testing)	14	22
(b) Driver selection and hiring; company driver recruiting, screening, selection, and hiring (include both mandatory and voluntary hiring practices)	34	4
(c) Company communications to drivers; driver orientation, finishing, safety meetings, refresher training, policy announcements, safety reminders	23	9
(d) Driver evaluation; company monitoring and evaluation of individual drivers (e.g., violation and incident tracking, ride-alongs, covert observations of driving, onboard computer monitoring)	38	2
(e) Company rewards and discipline (e.g., incentives, feedback, recognition, letters (both commendations and reprimands), bonuses, pay increases/decreases, other consequences imposed by management)	11	24
Total Responses:	120	61

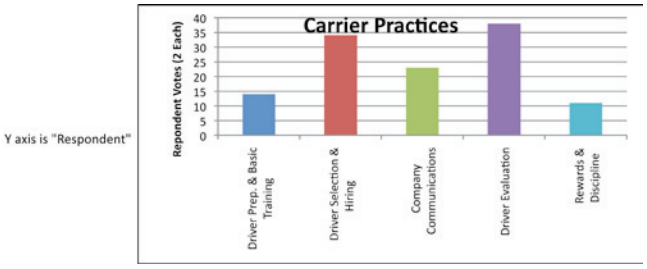

FIGURE 12 Safety manager "most" votes for the five types of carrier practices.

The tabulations indicate that respondents regarded driver traits as having paramount importance in relation to risk, and carrier practices to assess driver traits and behaviors to be the most important carrier safety practices. These findings are a testimony to the importance of the topics addressed in this study.

Driver Personal Characteristics

Questions 5–16 presented 12 driver personal traits or other characteristics and asked respondents to rate the association of each with crash risk on a five-point Likert scale, with the following instructions:

Driver Personal/Psychological Traits

What driver characteristics are most associated with risk? In general and across all drivers, HOW STRONG IS THE ASSOCIATION of each of these personal characteristics with DRIVER CRASH RISK? 1 = Little or no association. 5 = Very high association. Choose one number for each. If you are unsure or have no opinion, leave it blank.

The five Likert scale choices were as follows:

1. Little or No Association
2. Some Association
3. Moderate Association
4. Strong Association
5. Very Strong Association.

Table 5 provides the number of responses for each choice, the total number of responses (*N*), and the weighted arithmetic average or mean of responses (Avg.). Averages are rounded to the nearest tenth.

Three personal traits received average Likert scale ratings of more than 4.0: aggressive personality, risk-taking personality, and poor vehicle handling. Two received ratings of less than 3.0: introverted/unsociable and poor English language skills. Safety manager ratings for personality traits were generally consistent with research findings relating to individual differences discussed in chapter two. For example, aggressiveness/hostility has a strong relation to crash and other accident risk. At the other extreme, introversion as a personality trait is generally beneficial to safety, as these individuals tend to be non-sensation-seeking and generally conservative in their behaviors.

Hiring Practices and Tools

Questions 17–29 presented 13 carrier practices and first asked respondents to state whether or not they regularly used the practice (yes or no). Respondents answering "yes" on a question were then asked to rate the effectiveness of the practice on a five-point Likert scale, with the following instructions:

Which Driver Hiring Practices and Tools Do You Regularly Use to Select Safe Drivers?

For each of the hiring practices below, please circle **yes** or **no** as to whether your organization uses the practice. If **yes**, rate the effectiveness of the method using the 1–5 scale provided. If **no**, leave the ratings blank.

The five Likert scale choices were as follows:

1. Highly Ineffective
2. Ineffective
3. Not Sure/Neutral
4. Effective
5. Highly Effective.

Table 6 provides the number of respondents reporting using each practice. Table 7 shows the effectiveness ratings given by users of the practice. Nonusers were instructed to leave these

TABLE 5
SAFETY MANAGER LIKERT SCALE RATINGS FOR ASSOCIATIONS BETWEEN PERSONAL CHARACTERISTICS AND CRASH RISK

Rating or Statistic: Personal Trait	1	2	3	4	5	*N*	Avg.
(5) Aggressive personality	2	4	5	25	33	69	4.2
(6) Risk-taking personality	0	2	2	28	37	69	4.4
(7) Dishonest/untrustworthy	3	4	12	33	16	68	3.8
(8) Introverted/unsociable	19	23	17	7	1	67	2.2
(9) Low intelligence/mental abilities	5	13	28	17	5	68	3.1
(10) Poor English language skills	14	16	19	14	3	66	2.6
(11) Unhappy/personal problems	0	5	14	39	11	69	3.8
(12) Financial problems/in debt	0	12	16	27	12	67	3.6
(13) Dissatisfied with driver job/profession	0	6	20	28	14	68	3.7
(14) Poor general physical health	2	4	23	29	11	69	3.6
(15) Overweight/obese	6	13	22	18	9	68	3.2
(16) Poor vehicle handling (e.g., backing, parking)	0	1	7	23	38	69	4.4

items blank or, in the online version, were not presented with the questions. Statistics provided include the number for each Likert scale choice, the total number of responses (*N*), and the weighted arithmetic average or mean of responses (Avg.). Averages are rounded to the nearest tenth.

TABLE 6
SAFETY MANAGER RESPONDENT USE OF HIRING PRACTICE/TOOL

Rating or Statistic: Driver Hiring Practice/Tool	Yes	No	*N*
(17) Give on-road driving test	67	1	68
(18) Range/yard maneuvering test (e.g., backing, parking)	59	9	68
(19) Standardized interview (set list of questions)	44	23	67
(20) Check criminal record	63	4	67
(21) Check credit history and rating	20	46	66
(22) Determine likely safety belt use (by observation, interview, questionnaire, etc.)	41	24	65
(23) General medical history questionnaire	43	22	65
(24) Mental ability test (e.g., math, reasoning)	10	55	65
(25) English language test	12	54	66
(26) Any computer-based dynamic performance test (e.g., hand-eye coordination, tracking)	7	59	66
(27) Job satisfaction or job choice questionnaire	16	49	65
(28) Personality questionnaire (e.g., aggressiveness, risk-taking, attitudes)	21	43	64
(29) Questionnaire about driving behaviors (e.g., following distances, turn signal use)	19	45	64

Respondents used an average of 6.1 of the 13 practices listed. The most frequently used were road tests, range tests, and checking criminal records. The least frequently used were computer-based dynamic tests, mental ability tests, and English language tests. Hiring practices receiving the most favorable ratings included the road and range tests, computer-based dynamic tests (though used and rated by only seven respondents), personality questionnaires, and questionnaires about driving behaviors. Checking credit history and rating received the lowest average rating.

On paper forms, Question 30 in this section was a "write-in" item where respondents could write in another hiring practice and rate it. Few respondents answered this question. Two respondents mentioned physical tests given to applicants relating to job requirements like loading and unloading.

Additional Questions

Question 31 asked respondents if they planned to use the new FMCSA PSP. Answers were as follows: Yes (45), No (5), and Not Sure (15). Thus, the PSP will become a standard procedure for most carriers participating in the survey.

Question 32 asked respondents if they had any comments on the previous questions (or any related issue). Few comments were made. One respondent believed that a variety of driver personality characteristics "comes with the territory" and that, therefore, the primary focus should be on driving skills and behaviors.

TABLE 7
SAFETY MANAGER LIKERT SCALE RATINGS OF EFFECTIVENESS OF HIRING PRACTICE/TOOL

Rating or Statistic: Driver Hiring Practice/Tool	1	2	3	4	5	*N*	Avg.
(17) Give on-road driving test	0	0	5	44	18	67	4.2
(18) Range/yard maneuvering test (e.g., backing, parking)	0	0	2	39	18	59	4.3
(19) Standardized interview (set list of questions)	0	4	13	24	4	45	3.6
(20) Check criminal record	2	2	15	34	10	63	3.8
(21) Check credit history and rating	3	2	7	6	2	20	3.1
(22) Determine likely safety belt use (by observation, interview, questionnaire, etc.)	2	1	14	19	6	42	3.6
(23) General medical history questionnaire	0	0	15	18	9	42	3.9
(24) Mental ability test (e.g., math, reasoning)	0	2	3	5	1	11	3.5
(25) English language test	0	1	3	7	2	13	3.8
(26) Any computer-based dynamic performance test (e.g., hand-eye coordination, tracking)	0	0	1	3	3	7	4.3
(27) Job satisfaction or job choice questionnaire	0	0	8	7	1	16	3.6
(28) Personality questionnaire (e.g., aggressiveness, risk-taking, attitudes)	0	0	2	11	7	20	4.3
(29) Questionnaire about driving behaviors (e.g., following distances, turn signal use)	0	1	0	13	6	20	4.2

Information About Respondents and Their Fleets

Safety managers were also asked two questions about their professional experience and two questions about their fleet's characteristics. Question 33 asked their years of experience as a safety manager or human resource manager, and Question 34 asked their total years of experience in commercial truck/bus operations. Table 8 provides summary statistics of their answers (Note: SD = standard deviation).

TABLE 8
SUMMARY STATISTICS ON PROFESSIONAL EXPERIENCE OF SAFETY MANAGER RESPONDENTS

Statistic: Question	Range	Median	Mean	SD
(33) Number of years experience as carrier safety manager or human resources manager	2 to 36	10	11.8	8.1
(34) Total years experience in commercial truck/bus operations	5 to 55	22.5	22.8	11.9

The 69 safety manager respondents claimed a combined 793 years experience as safety managers and 1,551 years experience in CMV transport. As a group, they are highly experienced.

Question 35 asked respondents to state the approximate number of power units (i.e., tractors or trucks) currently in their fleets. Table 9 provides summary statistics of their answers.

TABLE 9
SUMMARY STATISTICS ON SAFETY MANAGER RESPONDENT FLEET SIZE

Statistic: Question	Range	Median	Mean	SD
(35) Approximate number of power units currently in fleet	8 to 15,000	143	827	2,016

There are no definitive population statistics to compare with the respondent individual and fleet statistics. Nevertheless, it is clear that survey respondents were generally more experienced than most individuals with motor carrier safety management responsibilities, and that their fleets were generally much larger than average. This reflects that larger fleets are overrepresented at virtually all national and regional safety conferences and as active members of national and state truck and bus transport organizations.

Question 36 asked respondents to select the truck or bus operation type that best characterized their fleet. The number of responses in each category is listed in Table 10. Although the question asked for "the" best characterization, many bus safety managers selected two choices (g and h). Therefore, that dual selection is listed as a separate choice.

TABLE 10
SAFETY MANAGER RESPONDENTS' FLEET OPERATION TYPES

Operation Type	No. Safety Managers
(a) For hire: long haul/truckload	24
(b) For hire: long haul/less-than-truckload (LTL)	0
(c) For hire: local/short haul (most trips < 100 miles)	2
(d) Private industry: long haul	8
(e) Private industry: local/short haul (< 100 miles)	8
(f) Passenger carrier: scheduled service	5
(g) Passenger carrier: charter	12
(g+h) Passenger carrier: both scheduled service and charter	8
(h) "Other"	1
Total (*N*):	68

"OTHER EXPERT" SURVEY METHODS

The secondary project survey was of other experts in motor carrier safety. These individuals were primarily professional associates of the principal project investigators. They were either known personally or selected on the basis of their job positions or other professional activities. They included professionals in government, industry trade associations, other industry roles (e.g., safety consulting), and research. Many of these individuals are actively involved in other TRB truck and bus safety activities. Even though these individuals are highly knowledgeable, they are regarded as secondary respondents because by definition they are not currently carrier practitioners. As a result, their survey forms included opinion items but not items on their practices related to driver hiring and selection. The data from this "other expert" survey were of interest, though, to (a) gauge expert opinion on questions, (b) indicate areas that may deserve more consideration, and (c) identify ongoing related research.

Questionnaire Design and Content

The "other expert" survey questionnaire was similar to that for safety managers. The form is provided in Appendix A. It consisted of the following general sections:

- A brief statement of the study and survey purpose, with a confidentiality assurance
- Two related five-choice questions on general factors affecting safety and crash risk (used on paper form only)
- Two related five-choice questions on carrier practices affecting driver crash risk
- Nineteen driver personal/psychological traits rated on a one- to five-point Likert scale for association with crash risk

- An open "comments" space
- Two questions on respondent's years of motor carrier safety-related experience and on specific types of positions held.

Questionnaire Distribution and Analysis

The "other expert" survey was administered only online, through TRB's online survey service. The survey solicitation was sent by e-mail to 128 individuals, with a second e-mail reminder sent several weeks later. A total of 34 online surveys were completed (27%). Survey results were tabulated by the reports program.

"OTHER EXPERT" SURVEY RESULTS

Factors Affecting Safety and Crash Risk

Questions 1 and 2 addressed factors affecting safety and crash risk. The same five choices were presented in each. Question 1 asked for the respondent's choice of *up to two* factors having the *greatest* effect whereas Question 2 asked for the *one* factor with the *least* effect. Table 11 presents responses.

TABLE 11
OTHER EXPERT RESPONSES RELATING TO FACTORS AFFECTING SAFETY AND CRASH RISK

(1) Factors Affecting Safety and Crash Risk: Consider the entire fleet of North American commercial vehicles (trucks and buses). Across all these drivers and vehicles, which factors have the greatest association with crash risk? Pick up to two of the factors below which, in your opinion, have the greatest association with crash risk. (2) In your opinion, which one factor has the least association with crash risk?	(1) Most	(2) Least
(a) Enduring/long-term driver traits (e.g., age, physical abilities, medical conditions, personality, behavioral history)	19	2
(b) Temporary driver states (e.g., moods, daily circadian rhythms, effects of recent sleep, effects of recent food and fluids, effects of environmental conditions in cab)	24	3
(c) Vehicle characteristics (e.g., configuration, safety equipment, load) and mechanical condition (e.g., brakes, tires)	3	13
(d) Roadway characteristics and traffic conditions (e.g., undivided vs. divided highways, construction zones, traffic density, speed limits, lane restrictions)	11	6
(e) Weather and roadway surface conditions (e.g., wet vs. dry, road surface friction, visibility, wind)	6	10
Total Responses:	63	34

As expected, choices for the two opposite questions (greatest and least) were more or less inversely related. Driver-related choices (a) and (b) were regarded as having the greatest effect on crash risk, whereas vehicle-related choice (c) was regarded as having the least effect. This was followed by weather and roadway surface condition (e).

Questions 3 and 4 addressed the importance of five different areas of carrier safety management. The same five choices were presented in each. Question 3 asked for the respondent's choice of *up to two* practices having the *greatest* importance, whereas Question 2 asked for the *one* practice with the *least* importance. Table 12 presents responses.

TABLE 12
OTHER EXPERT RESPONSES RELATING TO GENERAL CARRIER PRACTICES

(3) Most Important Carrier Practices: All elements of driver training and companies' safety management practices are important, but some may be more important than others. Pick up to two of the carrier practices below which, in your opinion, have the greatest effect on drivers' safety behaviors and safety records. (4) In your opinion, which one practice has the least effect on driver safety outcomes?	(3) Most	(4) Least
(a) Driver preparation; pre-hire CMV driving training and testing (e.g., basic school training and CDL testing)	8	13
(b) Driver selection and hiring; company driver recruiting, screening, selection, and hiring (include both mandatory and voluntary hiring practices)	19	3
(c) Company communications to drivers; driver orientation, finishing, safety meetings, refresher training, policy announcements, safety reminders	10	10
(d) Driver evaluation; company monitoring and evaluation of individual drivers (e.g., violation and incident tracking, ride-alongs, covert observations of driving, onboard computer monitoring)	24	1
(e) Company rewards and discipline [e.g., incentives, feedback, recognition, letters (both commendations and reprimands), bonuses, pay increases/decreases, other consequences imposed by management]	6	7
Total Responses:	67	34

Again, choices for the two opposite questions (greatest and least) were more or less inversely related. Choice (d) *driver evaluation* was rated overall as most important, followed by choice (b) *driver selection*. The other three choices (driver preparation, company communications, company rewards and discipline) were all rated as having relatively low importance.

Driver Personal Characteristics and Potential Value of Testing

Questions 5–23 presented 19 driver personal traits or conditions and asked respondents to rate the association of each with crash risk on a five-point Likert scale. The specific instructions were as follows:

Driver Personal/Psychological Traits

What driver characteristics are most associated with risk? In general and across all drivers, HOW STRONG IS THE ASSOCIATION of each of these per-

sonal characteristics with DRIVER CRASH RISK? 1 = Little or no association. 5 = Very high association. Choose one number for each. If you are unsure or have no opinion, leave it blank.

The five Likert scale choices were as follows:

1. Little or No Association
2. Some Association
3. Moderate Association
4. Strong Association
5. Very Strong Association.

More trait-rating items were included on the "other expert" form than on the safety manager form because the "other expert" form was otherwise shorter. Also, several of the personal traits on the "other expert" form were worded slightly differently than similar items on the safety manager form, based on assumption that the "other experts" would be more familiar with the traits as personality dimensions (i.e., with high and low values along a scale). Table 13 provides the number of responses for each choice, the total number of responses (*N*), and the weighted arithmetic average or mean of responses (Avg.). Averages are rounded to the nearest tenth.

Personal dimensions rated as having the highest association with risk included aggressive personality and attitudes, risk perception and attitudes, sleep hygiene habits, and truck road driving as evaluated in a 30-minute ride-along. Those with relatively low-rated associations with risk included debt and credit history/rating, English language skills, cardiac health, and general medical history.

Additional Comments

Question 24 asked respondents, "Additional comments or suggestions regarding driver personal/psychological dimensions and/or tests to assess them?" The following are several responses. A few not provided here promoted commercial products or were unsubstantive. Some responses are edited for brevity.

TABLE 13
OTHER EXPERT LIKERT SCALE RATINGS FOR ASSOCIATIONS BETWEEN PERSONAL CHARACTERISTICS AND CRASH RISK

Rating or Statistic: Personal Trait:	1	2	3	4	5	*N*	Avg.
(5) Aggressive personality and attitudes	0	0	6	15	13	34	4.2
(6) Risk perception and attitudes	0	1	2	17	14	34	4.3
(7) Sensation-seeking	6	6	8	9	3	34	2.9
(8) Conscientiousness/honesty	0	6	11	15	2	34	3.4
(9) Personal/family adjustment and happiness	1	6	8	12	6	33	3.5
(10) Job satisfaction as driver	0	4	16	9	5	34	3.4
(11) Psychological match to the job (e.g., activity preferences, interests)	2	5	17	8	1	33	3.0
(12) Debt and credit history/rating	9	10	10	4	1	34	2.4
(13) Intelligence/mental abilities	1	11	17	3	1	33	2.8
(14) English language skills (e.g., reading, speaking)	7	14	8	3	1	33	2.3
(15) Dynamic sensory-motor performance (e.g., visual tracking, reaction time)	0	5	8	16	5	34	3.6
(16) Body-Mass Index (BMI)	3	12	11	8	0	34	2.7
(17) Sleep apnea (e.g., none, mild, moderate, severe)	0	2	11	10	9	32	3.8
(18) Sleep hygiene habits (e.g., amount and regularity of sleep)	0	2	6	15	10	33	4.0
(19) Cardiac health (e.g., blood pressure, cholesterol)	5	12	12	4	1	34	2.5
(20) General medical history	4	10	13	4	1	32	2.6
(21) Truck driving knowledge (written)	3	14	8	4	3	32	2.7
(22) Truck range maneuvering (e.g., backing, parallel parking)	2	9	8	9	5	33	3.2
(23) Truck road driving (e.g., speed and space management in 30-minute ride-along in traffic)	0	3	8	12	10	33	3.9

- The greatest association is the knowledge and skill of the driver instructor. The least association would be CDL test scores.
- Attitude and behavior are everything. Regardless of how much training you give someone, it they don't have a safety attitude and safe behavior habits they are probably never going to be safe.
- Drivers must not be preoccupied with work or family or personal hobby problems when they drive. They must be able to put things out of their mind, so they can focus entirely on the driving task.
- "Distractedness" is an important driver trait, with distractedness (aka field dependence, impulsivity) at one end and "un-distractedness" or "tunnel-vision" at the other. The least crash prone drivers are in the middle.
- It is a good practice to employ new drivers on a probationary basis and require at least 2 weeks of supervised driving where observations can be made about risk behavior, attitudes, knowledge, etc.
- Too few drivers are screened for moral and character attributes; yet, there is a direct correlation between increased risk and a driver's perception of moral and ethical responsibility. Additionally, drivers should be screened for their ability to comprehend their regulatory and ethical responsibilities.

Information About Respondents

The years of motor carrier safety experience of the 34 "other expert" respondents, addressed by Question 25, ranged from 7 years to 41 years. The mean was 20.8 years. These respondents were also asked in Question 26 to indicate their professional experience in areas relating to motor carrier safety. The breakdown is shown in Table 14. The percentages shown sum to well over 100% because most respondents gave multiple responses.

TABLE 14
OTHER EXPERT RESPONDENT EXPERIENCE AREAS

Operation Type	No. Safety Managers
(a) Government enforcement	8
(b) Other government (e.g., rulemaking, policy)	9
(c) Industry trade association	12
(d) Commercial driver	5
(e) Carrier safety director/manager	4
(f) Other carrier management position	5
(g) Safety consultant or vendor to fleets	11
(h) Accident investigation/data analysis	14
(i) Motor carrier safety research	24
(j) Journalist	0
(k) Driver trainer/training development	10
(l) Insurance for motor carriers	7
(m) Other	3
Average Number of Experience Areas/Respondent:	3.3

The results show that the experience base of the other experts was both extensive and varied, with heavy representation of individuals with backgrounds in government, industry trade associations, safety consulting, accident investigation/data analysis, motor carrier safety research, and training.

CHAPTER FIVE

CASE STUDIES

The 10 carrier case studies in this chapter are based on phone or face-to-face interviews with motor carrier safety managers or other carrier officials with similar job titles and responsibilities. Most companies and interviewees were identified through the project safety manager surveys, although some were already known to the report authors. Interviewees were selected based on their carriers' extensive and innovative practices (e.g., as indicated on surveys) relating to driver selection and hiring.

Interviewees were recruited from the survey questionnaires; respondents were asked if they wished to also participate in a phone interview on innovative carrier practices. Each interview followed the same general topic sequence, but specific questions varied in response to interviewee answers and carrier practices discussed. The sequence paralleled the survey questionnaire, but with emphasis on carrier practices. Usually this included practices or variations of practices not addressed in the questionnaire. The case studies summarize interviewee answers and highlight innovative driver selection practices for each carrier. In many cases, interview data were supplemented by a review of the carriers' website content relating to driver qualifications and hiring. Companies are identified only as "Carrier A," "Carrier B," and so on, unless the company explicitly requested to be identified by name.

The 10 companies interviewed included large fleets (>1,000 vehicles), medium fleets (100–1,000 vehicles), and small fleets (<100 vehicles). They are further classified as follows:

- Large for-hire TL carriers (A–D)
- Medium for-hire TL carriers (E–F)
- Large private truck fleet (G)
- Medium private truck fleet (H)
- Small bus fleets (I–J).

The authors believe that all of the case study carriers have excellent overall safety programs and employ valid and effective hiring practices. Nevertheless, project resources did not permit formal evaluation of safety program effectiveness or validation of any driver selection practice. Interviewees reported that the following highlighted practices were effective, but in only a few cases did they cite rigorous evaluations of the practices.

For consistency, all interviewees are termed safety managers (SMs), regardless of their actual specific job titles. Each case study includes a text box with five innovative driver selection practices. Practices were chosen for the text boxes based on the SMs' enthusiasm for them and to present the widest possible range of worthwhile practices. Note also that, within each case study, qualitative statements made (e.g., importance of certain driver traits, effectiveness of specific selection methods) reflect the opinions of the interviewee, and not the necessarily the conclusions of this report.

CASE STUDY A: LARGE TRUCKLOAD CARRIER

Five Carrier A Innovative Hiring Practices

- More than 20 minimum driver requirements listed on website
- Three-stage approval process before full hire
- Driving simulator used for road/range testing
- Graduated progression to "A-Seat" driver status
- In-house sleep lab for OSA testing

Carrier A is an LTL carrier providing refrigerated, flatbed, and tanker service. It recruits both experienced and entry-level drivers. For the latter, the company offers paid training and a graduated transition to full-service driving. After completing their training and obtaining a CDL, drivers are classified as "B Seat" for 60,000 miles of driving, and after satisfactory performance, are promoted to full "A Seat" status. The company's director of safety has decades of experience in carrier safety and operations, and is active in several national truck safety-related organizations.

Carrier A's website lists more than 20 minimum driver qualifications. For current CDL holders, driving history requirements for the past 3 years include no failed alcohol tests or alcohol-related driving charges, no reckless driving convictions or license suspensions for points, and no more

than four crashes or violations. The same requirements apply to new CDL candidates, except for the past crash/violation requirement, which is more strenuous. These applicants can have no more than three crashes or violations in the previous 3 years. Meeting minimum qualifications results in initial approval for hire, but candidates must then receive a "safety approval" following an in-house orientation, and an "operational approval" after they are on the job. Approximately 10% of drivers with initial approvals wash out for safety reasons in the final two approval steps. The most common reasons for these late rejections are medical.

In the study survey and in the follow-up interview, the director of safety stated the belief that driver factors (both enduring traits and temporary states) had greater effects on crash risk than did vehicle or roadway factors. Truck mechanical conditions causing crashes were considered rare. Roadway and environmental conditions may present challenges and force drivers to adjust, but the driver factor is still predominant in safety outcomes. This philosophy is reflected in the company's rigorous and multi-element driver selection, training, and orientation procedures.

Carrier A's selection process includes other cutting-edge procedures. In lieu of road and range tests for drivers, the company uses a driving simulator. Driving simulators are used primarily for training, but many of the advantages of simulation apply to applicant assessment as well. Simulators have the following advantages:

- Safety. No risk to the public and even dangerous maneuvers can be tested.
- Efficiency. More skill tests and scenarios can be presented in a given time.
- Standardization. Conditions and events can be controlled.
- Sophisticated measurement. Simulators offer more precise, quantitative analysis of performance.

The simulated driving test for applicants provides a printout of performance, but the test is not fully automated. Rather, an experienced safety professional watches the driver perform and takes notes on driver performance and behavior. These notes include hard-to-measure behaviors like driver visual scanning and tendencies toward "competitive" driving.

A second cutting-edge practice is the use of an in-house sleep lab to test both current drivers and applicants for OSA. Because of the time and expense of a sleep lab test, it is not used as part of initial screening but later in the process after the candidate has met other requirements. A medical questionnaire and physician exam prescreens candidates to determine which ones will require a sleep lab test. The prescreening is based on well-known OSA risk factors like body-mass index (BMI), neck circumference, and snoring. A sleep lab OSA diagnosis means that the driver must sign a treatment compliance agreement and pay for most of it. They are still allowed to drive, however, if they comply with the agreement.

CASE STUDY B: LARGE TRUCKLOAD CARRIER

Five Carrier B Innovative Hiring Practices

- Hires drivers in four different status/background categories
- Standardized form for scoring road and range tests
- Criminal and credit background checks
- Drivers must pass 3.5-day orientation before full hire
- Company drivers evaluated by comprehensive safety management system

Carrier B is a large refrigerated trucking company, hauling temperature-sensitive freight such as fresh produce, meat, dairy products, beverages, and chemicals. The company has national operations of several different types. The SM respondent and interviewee worked in the company's TL operation. Carrier B hires qualified individuals with no previous driving experience and trains them in its own schools. It also hires experienced drivers, independent contractors, and graduates from other truck driving schools. The company's website provides different information and guidance for these four types of applicants (inexperienced, student, experienced, independent contractors).

Carrier B's SM viewed driver enduring and temporary characteristics (traits and states) as having the biggest impacts on crash risk. "You can bring a 'B' driver up to 'A' standards, but not a 'C' or 'D' driver." In reference to temporary states, the SM believed that problems on a driver's mind often lead to inattentive driving and to crashes. Inattentiveness as well as tendencies toward aggressive or risk-taking driving are apparent in road and range tests, and thus Carrier B conducts these tests systematically and carefully. Instructor evaluators use a standard form to assess behaviors like space management, speeds, turning habits, and mirror use.

Carrier B conducts both criminal background and credit checks on their driver applications. Although the results of these checks have safety implications, they are more related to meeting DOT requirements and to load security. The company also administers an English language test, although the SM believed that English language skills generally had

little relation to safety. Other driver characteristics the interviewee regarded as having low correlation to safety were introversion, low intelligence, and obesity. "Drivers can have various problems and limitations and still be good drivers."

Applicant work history is a more important consideration in hiring. Too many or too few jobs are causes for concern. Prior military experience is desirable, because it usually means the applicant is willing to follow directions and comply with company rules. The SM would like to have a thorough psychological evaluation of each applicant, but regarded this as cost- and time-prohibitive. Experienced drivers with initial acceptances must attend a 3.5-day orientation session that covers company policies, procedures, and expectations. Applicants are not hired until they successfully complete this orientation.

Carrier B employs a comprehensive safety management system in its operations. This analytic system, provided under contract by a safety consulting firm, tracks about "3,000 data points" relating both to drivers and operational risk factors. The system is not used primarily to select drivers, but information gathered from drivers during selection and hiring is used in the system to help identify the 20% or so of drivers with potential safety issues.

CASE STUDY C: LARGE TRUCKLOAD CARRIER

Five Carrier C Innovative Hiring Practices

- Attractive pay and working conditions support high employee standards and low selection ratio
- Multielement physical abilities test keyed to job tasks
- Standardized road and range tests
- Company medical exams and health/wellness program
- Job satisfaction/job choice questionnaire

Carrier C is a large diversified carrier with primarily TL operations but also intermodal and logistics services. The company's TL business is itself diverse, including long-haul, regional, expedited, dedicated, and bulk operations. The SM interviewee is a corporate senior vice president who oversees safety, security, and driver training. The company assesses both candidate and employed drivers in multiple and sophisticated ways, reflective of the SM's belief that enduring and temporary driver factors are the principal determinants of crash risk. Driver selection and evaluation are regarded as among the most important carrier safety management practices.

Carrier C hires both newly trained and experienced drivers. It also has cooperative agreements with driving schools to hire and train novice drivers. The company offers competitive medical, dental, retirement, leave, and financial benefits to its drivers. As a large company, Carrier C is able to offer advancement possibilities as well, such as becoming a driver trainer or seeking other company positions. The company's reputation, business success, and attractive pay and benefits for drivers have enabled it to be extremely selective in its hiring.

Experienced drivers joining the company's van divisions are required to complete a 4-day orientation program. The orientation for tanker truck drivers is much longer: 14 days. The orientation includes a prework screening, classroom training (including units on mobile communications and trip planning), testing for maneuvering skills on a driving simulator, a road test, and a DOT drug screen. Prework screening includes an intensive physical abilities assessment keyed to job requirements. In addition to basic physical (e.g., height, weight) and physiological measurements (e.g., blood pressure), the test includes graded active tasks such as repetitive stepping, squatting, front carrying (30 and 60 lb), floor-to-head lifting, crouching, kneeling, horizontal pushing and pulling, and floor-to-waist lifting. A video on the company website demonstrates these tests and briefly explains their job task relevance to potential applicants.

The Carrier C SM believed that past driver behaviors are among the best predictors of future behaviors. Risky behavior patterns are persistent over time, whether the result of habit or personal disposition. This is largely true irrespective of company interventions like training and expectation-setting. The company checks applicants' criminal records, and the SM regarded this as highly effective as a screening procedure. Risky or antisocial behaviors of any kind can be indicative of driving risk.

The SM also believed there was a strong relation between crash risk and driver health and, in particular, between crash risk and obesity. Truck driving requires both long hours and constant attention to driving. Drivers with these conditions are therefore at risk. This concern is addressed by an aggressive company driver health and wellness program. Carrier C has been recognized nationally for its driver health and wellness program, especially in the area of OSA. The company provides OSA diagnostic screening, treatment (including free OSA treatment machines provided to drivers), and ongoing monitoring. This program has resulted in significant driver health care cost savings and reduced involvement in fatigue-related crashes.

Carrier C has conducted extensive driver-related research programs, both internally and in conjunction with federally

funded studies. They have included research on driver factors predictive of both crash involvement and retention. Based on this research, the SM is considering adding a cognitive skills test to the company's selection procedures. Company research suggests that an optimal test would include basic quantitative literacy ("numeracy") and planning skills.

CASE STUDY D: LARGE TRUCKLOAD CARRIER

Five Carrier D
Innovative Hiring Practices

- Accident Potential Index as quantitative applicant assessment
- Collaborative agreement with driver training provider
- Standardized road/range testing and scoring
- Hair testing for drug use over past 90 days
- Internal validation studies of driver selection procedures

Carrier D is a large common and contract carrier specializing in TL quantities of general commodities. The company is located in the central United States and runs primarily medium-distance dry van and flatbed hauls. Carrier D hires experienced driver employees, teams, owner-operators, newly trained CDL holders, and untrained drivers. Untrained drivers are recruited, trained, and qualified in collaboration with a chain of driver training schools. Carrier D's SM interviewee is involved primarily in tracking fleet and driver compliance and safety metrics. The SM has also been involved in other aspects of fleet safety, including driver selection. Driver traits noted as having higher associations with crash risk included aggressive and risk-taking personalities, low intelligence/mental skills, driver personal and financial problems, and poor vehicle handling. These traits were related to drivers tending to "push rules" and being less conscientious and precise in their driving. Driver personal problems create mental states and moods not conducive to careful driving. Driver traits unfavorable to safety tend also to be unfavorable to retention.

Because it is a large carrier hiring drivers with various backgrounds, much of the focus of Carrier D's selection and hiring system is on ensuring that drivers meet all DOT requirements, including medical qualifications. Carrier D adds various practices to go beyond meeting those requirements. It uses a quantitative Accident Potential Index (API) to evaluate both driver applicants and employed drivers. The API, a proprietary formula provided by Carrier D's insurance carrier, is based on driver age, number of moving violations, number of crashes, number of previous employers, and other factors. Applicants must meet an API threshold to be hired. Carrier D has done its own internal company research to validate the API, in addition to that done by the insurance company.

All drivers hired by Carrier D must be 22 years old, have no drug or alcohol-related driving offenses in the past 5 years, and have no more than one such offense in a lifetime. Other criteria relating to past moving violations and preventable crashes apply. Driver applicants at each evaluation location must complete a standardized road and range driving test, which is evaluated based on a checklist and score sheet. There is also a standardized interview and questionnaire process, which includes questions on driving experience, behavior, and medical conditions.

In addition to conducting controlled substance and alcohol urine testing, Carrier D conducts hair testing on a random sample of applicants. Hair testing supports a 90-day detection window for five categories of illicit drugs: opiates, cocaine, methamphetamines, amphetamines, and marijuana. Any positive test finding is a disqualifier. Applicants are informed of the random hair testing at the beginning of the process, which causes most drug users to drop out at that time.

The SM predicted that CSA 2010 would increase driver turnover because it would force some drivers with bad records out of the industry. Also, drivers might become strongly motivated to switch to carriers with better maintenance and other safety management programs so they are not "dinged for company sins." This will put more focus on the need for improved driver selection methods and also on closely monitoring the driving of new hires. A more holistic approach to driver selection would go beyond minimum requirements to look more at driver personality and in-vehicle performance. Safe driving performance might be assessed using driving simulators or other dynamic tests.

CASE STUDY E: MEDIUM-SIZED REGIONAL TRUCKLOAD CARRIER

Carrier E is a medium-sized TL carrier in eastern Canada. The company owns several hundred tractors and more than 1,000 trailers. Its driver pool consists of about 80% company employees and 20% owner-operators operating under contract. The company offers logistics and warehousing services in addition to TL haulage. TL capabilities include refrigeration and Hazmat. Most runs are regional trips of less than 500 miles (one way) between Ontario and northeastern U.S. states or the upper Midwest.

Five Carrier E Innovative Hiring Practices

- Attractive benefits and pay practices
- Website "self-test" for potential applicants
- Multidimensional scoring of applicants based on driving history
- Detailed driver job description and expectations published on website
- Three-hour road/range test with quantitative scoring

Company Website "Self Test" for Potential Applicants

- Are you over the age of 21?
- Do you have a valid Canadian commercial driver's license?
- Do you have clean legal and driving records?
- Are you legally eligible to work in Canada?
- Can you cross the border into the United States?
- Are you willing to be tested for drug and alcohol use on a random basis?
- Are you able to travel for 5 to 6 days at a time most weeks of the year?
- Does your family support your decision to be on the road?
- Will your family be able to cope with your frequent absences?
- Are you okay with unpredictable schedules and working conditions?
- Are you interested in primarily short haul (less than 500 miles one way)?
- Can you commit to working a minimum of 1 year?

Carrier E recently received International Standards Organization (ISO) certification under ISO Standard 9001:2008 encompassing its transportation, warehousing, and logistics operations. The company also received the Shipper's Choice Award from *Canadian Transportation and Logistics Magazine* based on a poll of shippers. Evaluation areas for the award include "On Time Performance," "Equipment and Operations," "Information Technology," "Competitive Pricing," "Customer Service," "Problem Solving," and "Value-Added Services."

Carrier E participates in a consortium of 18 Canadian motor carriers striving to improve their safety and reduce losses. The group meets quarterly to share best safety practices and materials, including those related to selection of safe drivers. Five years of participation in this group has resulted in steady declines in the company's loss ratios.

On its driver recruiting web page, Carrier E touts driver benefits exceeding those typically seen for U.S. companies. They include accidental death and dismemberment insurance, long-term disability insurance, health insurance, prescription drug coverage, vision and dental care, a retirement savings plan similar to a U.S. 401(k), and a profit-sharing plan. Driver pay is based primarily on mileage (full or empty), but also includes supplemental payments such as layover, breakdown, pick up/delivery, New York City premium, "hand bombing" (loading/unloading), trailer switch pay, and "driver float" pay (expense advances). Drivers are provided fuel cards.

The company prefers to hire drivers with a minimum of 1 to 2 years of experience, but also hires newly licensed applicants from reputable driving schools. The company's website contains a 12-item, yes-no self-test to help applicants decide whether they are really ready to seek employment. These questions are shown in the text box. All answers should be "yes" for Carrier E applicants. The effectiveness of the self-test as a filter is not known, but the SM noted that the driver recruiting web page gets many hits that do not result in applications submitted. This implies that the website itself functions as a prescreen. The site also provides, under Driver Expectations, a four-page driver job description delineating tasks and stating standards of acceptable performance. This Professional Transport Operator Job Description, provided in Appendix B, states more than 80 specific responsibilities, physical demands, and job working conditions.

Qualified applicants are invited to come in for in-person screening. Carrier E uses a multidimensional driving and behavioral history scoring system to rate each applicant. This "Driver Points Evaluation Form" is provided in the following text box. Applicants also take a written job knowledge test that includes a math/mental abilities test and an English language test. The company's recruiting manager conducts a structured interview consisting of more than 60 scripted questions (provided in Appendix B). The structured interview covers applicant knowledge of the company, train-

ing and qualifications, experience, driving record, driver's license and other documentation, lifestyle, job expectations, prospective earnings, work history, driving behaviors and attitudes, other work behaviors and attitudes, sources of motivation and job satisfaction, and specific steps and requirements for becoming a full-fledged company driver.

One of two in-house trainers then takes each candidate on a standardized, 3-hour driving road and range test. Road/range test scoring is based on a checklist with rating scales. As many as 50% of applicants can fail the road/range test, although this percentage is lowered by more rigorous prescreening. Although Carrier E devotes a lot of time and resources to driver selection, the effort is considered worthwhile because "Hiring the wrong people causes so much grief."

In reflections about the elements of commercial driver success or failure, Carrier E's SM believed that key risk factors include aggressiveness, risk-taking tendencies, and personal family and financial problems. The SM conducts most investigations of company crashes, and often concludes that driver personal problems contributed to crash causation by taking

Carrier E Driver Points Evaluation Form

Name: Date:

Driving School Name: Graduation Date:

Instructions: This is the primary step but not the only step (driving tests, medical, prior employment references etc.) in the initial evaluation of a prospective driver employee. This points evaluation must be used on all driver applicants. If the prospective driver has a driver evaluation score in excess of 4, serious consideration should be given to qualifications prior to hiring.

1.	Length of time at residence		
	0 to 1 year	2	☐
	1 year to 5 years	1	☐
	Over 5 years	0	☐
2.	Length of previous related employment		
	0 to 1 year	2	☐
	1 to 5 years	1	☐
	Over 5 years	0	☐
3.	Number of preventable accidents (within last 3 years)		
	None	0	☐
	1 or 2	1 per occurrence	☐
	3 or over	2 per occurrence	☐
4.	Major moving violations (within last 3 years)		
	Driving while intoxicated	Reject	☐
	Driving while under the influence of drugs	Reject	☐
	Driving while under suspension	Reject	☐
	Careless	Reject	☐
	Racing or Excessive Speed	Reject	☐
5.	Other moving violations (within past 3 years)		
	1 or more	1 per occurrence	☐
	None	0	☐

Total: _____

Grading:

Best	Average	Questionable	Reject
0-2	3-4	5	6 (or over)

Approved/Disqualified by: _____

drivers' minds off their driving. Driver personal adjustment is more important than education or mental ability. The latter are not so important as long as the driver's "attitude is right."

All new hires receive a 3.5-day classroom orientation and an in-cab training period with an experienced driver trainer. Sixteen senior company drivers are formally designated as driver trainers. They compete for this designation, receive train-the-trainer instruction, and receive extra pay for training duties. Inexperienced drivers receive 6 weeks of on-road mentoring before they become full-fledged company drivers. Canada permits a 90-day probationary period for all new employees, during which employees may be terminated without cause. Few new drivers wash out during this period; when they do, it is usually owing to an inability to adjust to the on-the-road trucking lifestyle.

CASE STUDY F: MEDIUM-SIZED TRUCKLOAD CARRIER WITH HAZMAT OPERATIONS

Five Carrier F
Innovative Hiring Practices

- Minimum driver qualifications exceed DOT requirements
- Credit checks on owner-operators
- Road and range testing
- Several methods to check for safety belt use
- Medical questionnaire focusing on OSA and medications used

Carrier F is a TL carrier primarily serving the Midwest and eastern United States. Based in Liberty, Missouri, the company has several hundred trucks and hauls both Hazmat and non-Hazmat cargo. Its website states that its performance and safety follow ISO processes. The ISO approach includes regular statistical process analysis, including internal and external audits. According to its website, the company's safety culture is "by the book" but also strives to exceed regulatory requirements. The company's director of safety, interviewed for this project and case study, was recently recognized as Safety Director of the Year by the Missouri Motor Carriers Association.

Carrier F hires both carrier drivers and lease/contract drivers. Minimum requirements on its website include the following:

- Minimum 23 years of age
- One year tractor-trailer experience with truck driver school training, or 2 years experience without schooling
- No alcohol- or drug-related driving violations or felony convictions in the past 10 years
- No DOT preventable accidents in the past 3 years
- Meet DOT requirements and be able to pass DOT physical and drug screen tests, both paid by the company.

Appendix B includes the driver application form, which the company provided for this report. The application form states 12 minimum qualifications and requirements, and lists 11 physical tasks which must be performed on the job. It also includes behavioral biodata questions, most relating to driving history. It includes questions on work history (covering the past 10 years of employment) and an affidavit that the information provided is true.

The SM chose driver selection and driver evaluation as the two most important carrier practices related to safety outcomes. The SM believed that driver safety differences were more likely to be the result of short-term states than to long-term traits. Personal stress was mentioned as a factor that may affect driver performance directly or indirectly. Personal financial or family problems may prevent drivers from focusing fully on their jobs and on driving. During crash investigations, the SM tries to determine whether personal concerns played a role in the crash.

Because owner-operators have greater financial and other responsibilities relating to their trucks, they are subjected to credit checks before hire. This reduces the number of lease/contract drivers with financial problems affecting their performance. Nevertheless, the SM believed that driver employees and lease/contract drivers (owner-operators) perform about equally overall.

Like others interviewed, the Carrier F SM believed that road and range tests were essential steps in hiring and highly indicative of potential driver problems. The SM pointed out that these tests generate stress for driver applicants, but that dealing with stress was necessary for commercial drivers. Safety belt use was of course part of the road test observation, but the company also assessed belt use by (a) asking the driver directly during the interview, and (b) reviewing past roadside inspection reports to see if it showed up as a violation.

Carrier F uses a medical history questionnaire focused mainly on OSA. Applicants must also provide information on all prescription medicines used. If given more resources and time with applicants, the SM would add a psychological profile test to current methods, although this was considered impractical at present.

CASE STUDY G: LARGE RETAIL CHAIN PRIVATE FLEET

Five Carrier G Innovative Hiring Practices

- Stable, well-paying driver jobs permit low selection ratio
- Seven different background checks
- Standardized road and range tests using commercial rating form
- Standardized interview scored numerically
- Interview and other assessments designed to identify aggressive, temperamental, and noncompliant drivers

Carrier G is the private fleet serving a large national retail chain store. The company is served both by its own private fleet and for-hire carriers. The SM interviewed is the national manager of safety and compliance for the private fleet, which in turn consists of regional divisions. Each division makes local (<100 mile) and regional (>100 mile) deliveries within its area. The SM's job responsibilities encompass qualifications and safety, operations, and risk analysis and control. Carrier G is a recent recipient of the ATA President's Award for Best Overall Safety Program for fleets in its size category. It has also been recognized for its low crash rate and low driver injury rate.

Like most survey respondents and interviewees, the Carrier G SM considered driver traits like aggressiveness, risk-taking, dishonesty, and poor vehicle handling to be major risk factors. In contrast, traits like introversion and low intelligence are not necessarily related to safety. Even drivers with limited mental abilities can be good if they take pride in their driving and their jobs. Personal problems can markedly degrade a driver's safety. The SM told of two previously crash-free drivers who had two different crashes during the same period of several months while they were involved in acrimonious divorce proceedings. Any distractions from driving are dangerous, and such personal crises cause chronic distraction.

Carrier G has the advantage of being a private fleet with sought-after jobs and a low driver turnover rate of about 6%. This allows the company to be selective in its hiring (i.e., to have a low selection ratio). Driver hires who last more than a few months with the company usually become long-term employees. Carrier G drivers deliver high-value goods, which puts a premium on driver honesty and dependability. Carrier G's HR department performs seven different background checks on candidates, including local and state criminal checks and a Social Security check. There is no check of applicants' credit ratings, as the SM believed it was not directly related to performance as a driver. Often drivers have made unwise financial decisions and thus have credit problems, but nevertheless are reliable employees, perhaps in part because they need the income.

Driver candidates are initially given standardized road and range driving tests. Carrier G uses a standard, proprietary evaluation form produced by J. J. Keller. Candidates must pass these driving tests before proceeding to other assessments.

Carrier G's drivers also unload their trucks and have some amount of customer contact. Therefore, they must be presentable and personable in addition to being safe. Carrier G has developed a structured driver interview form in which individual items are scored from 0 to 3 based on the driver response. The interview form includes personality-related questions designed to reveal traits like aggressiveness, a short temper, or resentment. For example, interviewees are asked to rate themselves on questions like, "I sometimes lose my temper," or "The dispatcher always screws me." Two companion questions ask what candidates most like and dislike about themselves. An answer to the latter such as, "I sometimes lose my temper" suggests safety concerns. A low score is given for any answer that suggests a job-related safety or other performance concern. Because the company can be selective in its hiring, the interview is intended to "look for a profile" indicative of driving risk.

The driver interview and orientation includes clear delineation of company rules drivers must follow, which include safety belt use and electronic logs. Interviewers gauge interviewee reactions to hearing the rules to discern any possible driver resistance.

CASE STUDY H: MEDIUM-SIZED PRIVATE AND FOR-HIRE FOOD AND GENERAL CARGO CARRIER

Carrier H is a medium-sized, short- and medium-distance transporter and logistics service provider servicing the Mid-Atlantic, Northeast, and Southeast United States. The company specializes in temperature-controlled food shipments but also hauls other types of cargo, including live animals. It functions largely as a private carrier because its primary operations are under a long-term dedicated contract with a food producer and shipper. It is also a licensed carrier with TL and scheduled LTL operations. The interviewee's title is general manager, with duties encompassing driver hiring, training, supervision, equipment, and operations.

Five Carrier H Innovative Hiring Practices

- Criminal and credit background checks
- On-road driving test by experienced driver/trainer using standardized checklist
- On-site occupational health staff performs company physical examination
- Special focus on OSA in driver medical screening
- Validation of general-purpose employee profile instrument specifically to hire successful drivers

The company's HR department recruits drivers and performs initial screening, including MVR checks and other required hiring procedures. The company has added use of PSP to its hiring procedures. The HR department also obtains candidate criminal and credit checks. These checks are motivated primarily by security, "company culture," and customer relations concerns. The SM believed their relevance to driving safety was secondary to these other important concerns. The company has promoted a former driver to a safety trainer position, with additional duties related to compliance records and assurance. The safety trainer gives each driver candidate an on-road driving test using a checklist for assessing strengths and weaknesses. Each candidate is personally interviewed without a structured format. The SM considered personal adjustment-related traits like personal unhappiness, financial problems, and job dissatisfaction to be important driver risk factors that might reflect either a driver's personality and long-term lifestyle or temporary situations.

Carrier H ProfileXT Mean Scale Scores for Top Drivers

- Behavioral traits:
  - Manageability: 6.4
  - Accommodating: 6.9

Carrier H has a dedicated on-site occupational health unit, which is responsible for performing a standardized preemployment physical examination of all driver candidates, regardless of their medical qualifications status. OSA is the driver medical condition of greatest concern to the company, and its standardized physical exam contains physical measurements and questions for assessing driver OSA risk.

Carrier H has taken the initiative to validate a general-purpose employee profile assessment instrument in relation to both its nondriving employees and its drivers. ProfileXT is a commercially available assessment tool designed to test the match of candidates' thinking and reasoning styles, behavioral traits, and occupational interests to successful company employees. It is not focused on either transportation or safety, but like other general profiles can be used to match candidates to various types of jobs and job performance criteria. Carrier H first used and validated ProfileXT in relation to its office and other nondriving employees. When found to be successful with these employees, the instrument was also normed against company drivers. The company selected 24 current drivers and rated their performance encompassing both driving safety and nondriving criteria like reliability and customer relations. ProfileXT scale scores relating to traits like manageability and "accommodatingness" were found to be most related to success as a company driver. In contrast, traits like assertiveness and decisiveness were not predictive of driving success, even though such traits might be prized for other jobs in areas like sales and management. The scale also tapped occupational interests. Carrier H's best drivers scored high on "mechanical" and "people service," but tended to score low on "enterprising" and "creative." The text box shows average ProfileXT behavioral and occupational interest scores for nine of Carrier H's highest-rated drivers. In discussing these results, the SM pointed out that it 'was not necessary for candidates to have maximum scores for the desired traits; average to above-average profile ratings were generally sufficient.

CASE STUDY I: SMALL CHARTER BUS SERVICE

Carrier I is a small, family-owned charter bus service in New York State. Most of its trips are to New York City and other major attractions in the region. Its SM, interviewed for this case study, has 20 years experience in the position and 15 prior years experience as a driver. The SM regarded driver enduring traits and roadway/traffic characteristics to be the biggest crash risk factors. The concern about driver enduring traits and safety drives the company's driver selection practices.

Like the vast majority of truck and bus companies surveyed, Carrier I conducts both an on-road and range maneuvering driving test for each applicant. The SM also conducts a standardized interview. These tests reveal information on candidate knowledge, skill, and attitudes. They also reveal personality traits regarded as safety-critical such as aggressiveness, high risk-taking, and dishonesty. Dishonesty as a driver trait is not just a moral concern or one related to financial matters. Rather, these "moral" traits relate to compliance with rules, including traffic laws, HOS, and other safety regulations. The company uses a video incident-capturing system in its buses. Based on reviews of many incident clips, the SM regards driver traits like aggressiveness, impulsivity, and lack of compliance to be a principal source of mishaps.

Five Carrier I
Innovative Hiring Practices

- Credit checks
- Road and range testing using New York State evaluation form
- Observe candidates in their own cars for belt use and other safety signs
- New York State medical history form
- Math/mental ability test relevant to required job skills

New York State motor carriers must comply with several state practices in their hiring in addition to meeting federal requirements if they are interstate carriers. They include a health history, structured road test (with point scoring), and a defensive driving observation conducted along with the road test. Appendix B provides the road test and defensive driving forms, which might be considered for voluntary use by non-New York carriers. The Carrier I SM considers these to be worthwhile requirements.

The Carrier I SM considers driver medical conditions and health habits to be strongly related to driver safety. The point was made that a correlation to unsafe driving may be the result of both short-term and long-term effects of poor health habits. An example of a short-term effect would be the soporific effects of eating large meals. Charter bus groups often eat at buffets or other lavish restaurants. Drivers with bad eating habits might be especially vulnerable to drowsiness or other reduced performance after such meals. The SM was concerned, however, that the use of health questionnaires in hiring might lead to lawsuits or EEOC complaints if items were not validated against driving safety. The company had to defend against a discrimination complaint based on other grounds, and wants to avoid any future similar disputes.

Other company selection procedures include a credit check motivated by concerns about trustworthiness, as discussed earlier. The SM added that drivers with credit problems may have even bigger personal problems that come to light during inquiry. The SM tries to observe driver candidates arriving at the facility to see if they are wearing a safety belt in their personal cars, or to reveal other safety-significant behaviors. The company uses a math/mental ability test to ensure that applicants can read maps, fill out logs, and perform other mental tasks required on the job. This is viewed as having only a weak, indirect relation to driving safety. The company tried one of the driver profile tests described in chapter three but did not find it helpful in assessing driver risk. More effective was direct interaction with the driver, both in the bus and in the interview.

CASE STUDY J: SMALL CHARTER/SCHEDULED BUS SERVICE

Five Carrier J
Innovative Hiring Practices

- Three managers evaluate each applicant
- Road and range testing
- Use driver profile questionnaire
- Medical questionnaire from health services provider
- Hiring not complete until after 5 weeks of training

Carrier J operates about 50 motor coaches in the Midwest. These buses carry 29 to 56 passengers and originate from three company terminals. Services include charters, tours, shuttles, airport transfers, casino runs, and daily scheduled routes. The company carries more than 750,000 passengers annually. The company's SM and interviewee for this summary holds the dual title of director of safety and training.

In the study survey, the SM selected driver characteristics (both enduring traits and temporary states) as the factors having the greatest influence on crash risk. "Everything else is constantly changing, but the driver stays the same." A relatively small number of drivers generate 50% or more of a carrier's risk. Applicants for motor coach jobs tend to be older than those seeking truck-driving jobs, so their enduring personal traits are even more important. By middle age, individual personality, attitudes, and habits are generally established. "You can teach anyone to control a vehicle, but you can't change their style and personality." What's important is "who they are, not what their current skills are."

The SM regards aggressive personalities, risk-taking personalities, and poor vehicle-handling skills as prominent risk indicators. Safe motor coach operators should be "passive, not assertive" in their driving. They must be patient and accept the dynamic limitations of their vehicles. They do not have to be highly educated or especially friendly with customers as long as they are deliberate in their driving.

Carrier J uses multiple driver selection tools, with emphasis on road and range testing. Three different company managers observe each candidate's driving, and each writes an

informal summary of observations, concerns, and conclusions. “Driving is a habit. People cannot change their habits, even when they are being observed.” A person can mask driving habits for 10 minutes or so, but not longer. Driver selection and employment are not finalized until candidates have completed 5 weeks of training, including ride-alongs on charter trips. About 10% of candidates wash out for safety reasons during the training. The Smith System, which emphasizes proactive and defensive driving, is used in training. Evaluators focus on the degree to which driver candidates understand and embrace the system.

Driver physical assessment beyond minimum qualifications is provided by a medical service contractor. Carrier J also uses the Daecher Driver Profile described in chapter three. The SM considers the test to be “fairly accurate,” although the company has performed no statistical validations. Applicants must also take the Wonderlic mental ability test to ensure that they can perform mental tasks of the job such as HOS log completion and other record keeping. If given one additional selection instrument, the SM would choose a driving simulator so that specific driving tasks and crash threat scenarios could be presented to candidates.

CHAPTER SIX

CONCLUSIONS

This report has reviewed the academic, commercial, and industry literature on tests, measurements, and other procedures used by motor carriers to select safe commercial drivers. It documented the large individual differences in driver crash risk, based on a previous synthesis (*CTBSSP Synthesis 4*) and more recent findings. It presented evidence relating to individual driver traits relevant to safety, and described ways that those differences are being assessed as part of hiring decision making. The study determined that personal and psychological dimensions related to safety can include—

- Demographics (e.g., age and gender)
- Driving knowledge and skills
- Personality (e.g., aggressiveness, sensation-seeking, stress levels)
- Risk perception and attitudes
- Psychomotor skills (e.g., reaction time)
- Medical status and conditions, including fatigue susceptibility
- Behavioral history
- Mental abilities.

Individual differences in safety have been recognized as creating the need for valid employee assessments and selection procedures in particular. A variety of assessment procedures have been included under the rubric "tests and measurements" for purpose of improved driver hiring. These include resume evaluations, application forms, questionnaires, driving observations, review of driving and other public records, biodata, interviews, mental ability tests, physical ability tests, personality and attitude inventories, medical histories, and medical examinations. This report reviewed the nature, use, and safety-effectiveness of these selection procedures. Surveys and interviews with carrier safety managers, and surveys of other experts were used to obtain information from motor carriers on underlying driver characteristics relevant to risk and how best to assess them. The project surveys were convenience samples of available individuals sufficiently motivated to take the time to participate; they should not be regarded as being representative of larger populations.

The following sections synthesize findings and draw major conclusions relating to driver individual differences, available and actual industry practices to improve driver selection, suggested practices, and research and development (R&D) needs for greater knowledge and more useful driver assessment tools.

DRIVER INDIVIDUAL DIFFERENCES AND SAFETY

Chapter two described driver characteristics and personal dimensions with known relationships to safety-related behavior and especially to driving crash risk. This section highlights some major conclusions from that chapter. Selected, major citations are provided here; additional citations are found in chapter two.

Two psychological "metaprinciples" are related to individual differences and to behavioral consistency. These metaprinciples can be considered two sides of the same coin, because people differ greatly in safety-relevant ways and many of these differences are enduring. They are underlying rationales for emphasizing driver selection in motor carrier safety management.

Federal minimum qualifications for commercial drivers encompass driver basic skills, driving and other personal history, and medical conditions, but do not address all personal characteristics relevant to driving safety. Large individual differences in driving safety exist within almost any group of drivers, including those meeting all legal requirements for commercial driving.

Literature indicates that people differ from each other along many different dimensions related to heredity, developmental environments, chronic life conditions, or a combination of these. By and large, the root causes of individual differences are not of primary interest to employers because their effects already exist when employees present themselves for hire. Evidence points to the following human trait categories as being most relevant to driving safety, and thus of greatest potential interest for commercial driver assessment:

- Personality, including behavioral tendencies and attitudes
- Psychomotor skills and cognitive functions
- Medical status and conditions
- Behavioral history
- Mental ability.

Personality includes any persistent tendency or consistency in a person's behavior or psychological makeup. Personality traits are consistent tendencies in emotional adjustment, interpersonal relations, motivation, attitudes, and behavioral "style." They are "deep individual characteristics, most often biologically rooted, that determine the broad emotional and behavioral orientations of the person" (Thiffault's *Towards a Strategy Targeting Human Factors in the Motor Carrier Industry in Canada*). Psychological consistencies extend in two dimensions: consistency over time and consistency across diverse situations. Personality affects road safety through a person's driving "style" and through specific behaviors and abilities. Few personality traits can be diagnosed as definitively as physical traits or medical conditions. Rather, they are descriptive constructs that may overlap. Those most relevant to safety include impulsivity/risk-taking, sensation-seeking, aggressiveness/hostility, Type A personality, conscientiousness, agreeableness, and emotional stability. The first four have negative implications for safety, whereas the last three have positive implications. Along the extraversion-introversion continuum, introversion is generally associated with lower risk.

Personality contributes to attitudes—positive or negative evaluations of particular objects of thought, such as specific safe driving behaviors. Ajzen's "The Theory of Planned Behavior" suggests that attitudes combine and interact with perceived social norms and behavioral control to determine intentions, which become behaviors. Well-constructed questionnaires can assess individual differences in safety attitudes, and thus can be predictive of driving safety.

On the surface, one might expect psychomotor skills to be highly predictive of driving success. Driving is an active sensorimotor task that requires accurate perception, quick thinking and decisions, and precise execution of maneuvers. Yet dynamic psychomotor abilities are not highly predictive of crash rates across the wide range of drivers. Safe driving appears to primarily reflect behavioral habits, choices, and temporary states rather than performance capabilities. The current survey findings were consistent with this conclusion. Psychomotor skills and cognitive functions are bigger concerns when drivers have serious medical conditions or impairments from past drug or alcohol use, or when their age raises the question of whether they will be subject to significant health or psychomotor changes.

Medical conditions can affect driving safety in several ways, most obviously through catastrophic performance failures while driving. In the Large Truck Crash Causation Study (LTCCS), truck driver physical failures, primarily asleep-at-the-wheel and heart attacks, were the Critical Reason (proximal cause) of 12% of truck at-fault crashes and 6% of all truck crashes. Sleep apnea and circulatory disease appear to be the driver medical conditions of greatest concern in commercial transport. There are marked individual differences in susceptibility to drowsiness, related in part to sleep disorders.

Behavioral history includes past driving events and nondriving events. A driver's history of crashes, violations, and other incidents is a well-documented predictor of future crash involvements and whether the driver will be at fault in future crashes. Past traffic violations seem to be a better predictor of future crashes than are past crashes themselves, because the former are more numerous (and thus more statistically reliable) and because they more clearly imply misbehavior and fault. Further, attitude inventory studies show that a slack attitude toward road rules and violations is strongly associated with poor driving behaviors and relative unconcern about crash risks.

In regard to past crash involvements, there are reasons for considering single-vehicle crash involvements a clearer sign of risk than multivehicle crash involvements. In the LTCCS, truck single-vehicle involvements were much more likely than at-fault multivehicle involvements to involve driver asleep at the wheel, physical failure (e.g., a medical event), excessive speeds, aggressive driving (as an associated factor), response execution errors, and vehicle maintenance failures (for which drivers are responsible). In contrast, many multivehicle crashes are triggered by a less egregious error, such as "looked but did not see."

Histories of nondriving criminality are associated with elevated crash and violation risk. Commercial drivers with criminal backgrounds also create security issues for carriers. The association of criminality and unsafe driving may be the result of the antisocial personalities and social deviance of some people with criminal histories. This behavior disorder is strongly associated with risk. The relation of poor credit history to crash risk is unclear. Motor carriers performing credit checks on their drivers justify the practice based primarily on security concerns.

Intelligence and component mental abilities like spatial and mathematical reasoning appear to have some association with safety. Associations are more apparent at the extremes than across the middle ranges of mental abilities. More intelligent drivers appear to make more rational risk choices, better manage their time, and better balance the demands of their jobs.

One method for carriers to improve their safety is to improve their driver retention. For a variety of reasons, drivers with longer company tenures tend to be safer. Many of the personal traits associated with safe driving are also associated with retention. They include higher mental abilities, and conscientiousness and agreeableness.

DRIVER SELECTION TOOLS AND PRACTICES

This study used three major sources of information on current driver selection tools and practices in the truck and bus transport industries: the literature and product review

of driver selection tests and measurements (chapter three), the project safety manager survey (chapter four), and the case studies based on follow-up safety manager interviews (chapter five). This section highlights some major conclusions from these chapters. Selected major literature citations are provided here; previous chapters contain additional citations.

Carriers must, at a minimum, take certain actions to ensure that any driver they hire meets federal qualifications. These actions, and required records of them, are specified in 49 CFR 391.51 and summarized in the 2008 FMCSA *A Motor Carrier's Guide to Improving Highway Safety*. In practice, these minimum actions are combined with voluntary company actions to form an overall system for hiring. Often this takes the form of a sequence of steps or multiple hurdles approach. The following are four generic rules for selecting the highest quality employees:

1. Target high-quality applicants.
2. Attract as many applicants as possible.
3. Use multiple, validated selection tools and methods.
4. Be as selective as possible.

Job analysis is usually the basis for valid selection tests. A job analysis document helps carriers to identify the most important and valid elements of their selection process. These selection elements are predictors of job performance. Validity is the degree to which a test actually measures what it purports to measure. A test's validity is determined in contexts such as content validity, construct validity, and criterion-based validity (predictive or concurrent). Documenting a test's predictive validity, or its validity coefficient in relation to job performance, is the best way to legally justify its use.

Employers have an ethical and a legal duty to treat applicants for employment fairly. Several laws shape this legal duty, the most important of which is the Fair Employment Practices Act, also known as Title VII of the Civil Rights Act of 1964, as amended by the Equal Employment Opportunity Act of 1972. This law requires that employers not discriminate in hiring, promotion, wages, training, or any other term, condition, or privilege of employment, according to the race, color, religion, sex, or national origin of the affected persons. These categories are the "protected classes" of individuals under the act. Adverse impact on a protected class occurs when a protected group is selected at less than 80% of the rate at which nonprotected applicants are selected. When this happens, employers must be prepared to examine, document, and defend their selection tests and other assessment procedures. A 2000 DOL guide helps employers to develop and use assessment tests fairly and legally.

Obtaining commercial driver records is not a "test" in the usual sense, but it functions in the same manner as a screening tool. Carriers are obliged to review state MVRs for traffic violations and convictions. The new federal PSP allows carriers to voluntarily access crash and roadside inspection data as well.

Carriers are required by law to ensure that drivers meet medical qualifications, but meeting this requirement does not eliminate their concerns regarding crash risk and carrier liability. Whether a medical condition is identified as the direct cause of a crash or is merely suspected as an associated factor, carriers have high liability exposure when unhealthy drivers are involved in crashes. Sleep apnea and cardiac conditions, both associated with physical failures (nonperformance) while driving, are among the primary health concerns about drivers.

This report described a number of commercially available tests marketed for use for selecting safe fleet drivers, or that could be considered candidates for such use. Tests were described in terms of the personal traits they seek to measure, how they are administered, test content, and key findings relating to their validity. However, no selection test or other product or service was formally evaluated for this report. Specific products and services were described as examples for reader edification. No endorsement of any product or service by the authors or by TRB is implied or intended. The following section, however, does suggest consideration of several types of selection tests.

This project included convenience sample surveys of both current carrier safety managers and other experts in truck and bus safety. Survey findings cannot be considered representative of larger subject populations such as "all motor carrier safety managers" because the sample spaces consisted of individuals already involved in national safety organizations and because only a minority of potential respondents actually completed the surveys. Thus, survey findings reflect only the self-selected, safety conscious individuals who responded. Nevertheless, survey data reveal the relative opinions of respondents on various driver risk factors and driver selection practices. Moreover, respondents were highly experienced; they had an average of 12 years experience as safety managers and 23 total years experience in CMV transport.

Respondents viewed both enduring and temporary characteristics of drivers as stronger determinants of crash risk than nondriver factors, including vehicle characteristics, roadways, and weather. Their views on the most important carrier practices were even more telling vis-à-vis the topics of this report. Carrier safety managers regarded driver assessment activities, including driver selection and postselection evaluation, to have greater effects on safety outcomes than other nonassessment management activities. The latter

included driver preparation (prejob training), company communications (e.g., safety meetings), and company rewards and discipline.

Safety managers rated 12 driver personal or psychological traits with regard to their perceived association with crash risk. Traits receiving the highest scale ratings included aggressive personalities, risk-taking personalities, and poor vehicle handling. Two with low perceived associations with crash risk were introverted/unsociable and poor English language skills. The ratings of other expert respondents were in general similar to those of safety managers. One factor rated by other experts as having a high association with crash risk (but which was not included on the safety manager form) was driver sleep hygiene habits.

Safety managers were also asked about their use of various selection practices beyond those legally required. The average respondent used 6 of the 13 practices listed. Hiring practices receiving the most favorable ratings included the road and range driving tests, computer-based dynamic tests (though used by only a few respondents), personality questionnaires, and questionnaires about driving behaviors. Checking credit history and rating received the lowest average rating.

Ten follow-up structured interviews were conducted with volunteer respondents. Each was summarized in a carrier case study write-up focusing on successful, innovative driver selection practices. Chapter five provided these narratives. Five innovative practices were highlighted for each carrier, with other successful practices also described. Many of these are incorporated into the following section.

REPORTED EFFECTIVE CARRIER PRACTICES

This report focused on carrier practices in the areas of driver selection and evaluation. Driver assessment activities interact with other carrier safety activities such as training, communications, and behavioral safety management. Newman et al. in "Safety in Work Vehicles: A Multilevel Study Linking Safety Values and Individual Predictors to Work Related Driving Courses" measured both the safety values of individual drivers and the supervisory practices applied to all drivers in test fleets. They found that individual driver attitudes (e.g., toward rule violations) were predictive of safety, but that "across-the-board" effects were associated with fleet manager and first-line supervisor behaviors. Drivers reported fewer accidents when they were motivated by company practices to drive safely. This motivation was related to both fleet manager and direct supervisor behaviors and perceived safety values. Effective fleet management practices seem to bring out the best and minimize the worst in drivers.

Perhaps the simplest way to maintain a high-quality driver pool is to create a positive, professional, and rewarding work environment where driver jobs with the company are valued. This produces the situation in which driver recruitment efforts attract a large number of highly qualified applicants, which in turn allows a carrier to be highly selective in its hiring. A low selection ratio (i.e., hiring a small percentage of applicants) almost always ensures high-quality employees, although another essential element is selection accuracy. Selection accuracy means using a regimen of valid selection procedures that truly capture the persistent driver characteristics most relevant to safety.

Test characteristics such as reliability and validity underlie the legal requirements tests must meet. Treating employees fairly in selection and other assessments is not just a matter of ethics. It is the law, and guidelines promulgated by the EEOC must be followed if companies want to avoid a discrimination lawsuit from the government or affected parties. Rigorous record keeping is essential, especially for companies with more than 100 employees. To help companies correctly design and use selection tools, the U.S. DOL (2000) has promoted 13 principles and best practices, described in chapter three. The value of these principles and practices extends beyond employee selection; they also related to post-hire assessments (e.g., for promotions) and employee training and development.

Selection and hiring of commercial drivers starts with ensuring that they meet all legal requirements of the FMCSRs. The process includes required hiring procedures and record keeping as well as certification that hired drivers meet licensing and medical qualifications. The project review of individual differences (chapter two), selection tests (chapter three), surveys (chapter four), and case studies (chapter five), as well as past reviews, suggests the following as common and beneficial carrier practices:

- Using multiple assessments to try to capture a variety of safety-relevant characteristics; trying to assess the "whole person."
- Using the new FMCSA PSP service.
- Conducting a fresh and updated carrier assessment of driver medical condition, regardless of driver medical qualifications status. This may involve follow-up tests such as sleep studies.
- Reviewing driver records with special focus on egregious violations (e.g., reckless driving).
- Checking criminal background as it is relevant to both security and safety.
- Assessing past crashes in regard to preventability and, when possible, specific causes.
- Conducting a road and range driving test of every applicant using a standardized checklist or rating form.
- Conducting a standardized interview designed to tap key driver safety-related traits.

- Assessing, through interviews or questionnaires, driver personality traits such as aggressiveness, impulsivity, conscientiousness, agreeableness, manageability, and attitudes toward risk.
- Treating signs of driver hostility and anger toward the law or toward rules as red flags.
- Selecting for retention as well as for safety. Driver employment longevity is generally associated with safe driving, in part because personal characteristics associated with these two outcomes overlap.
- Putting as much information on company websites as possible about driver requirements and specific hiring procedures.
- Maintaining a detailed and comprehensive assessment file for each driver.
- Requiring a probationary period for new hires.
- Conducting internal studies to document and validate selection procedures and their relevant to employment success.

In addition to these established practices, this project has reported research, survey, and interview evidence of the potential value of the following:

- Testing physical ability to perform job component tasks (e.g., carrying, lifting, climbing).
- Testing "baseline" dynamic performance using a simulator or computer-based test when long-term driver functional capacity is a concern (e.g., when many older drivers are hired).
- Validating inventory questionnaires (e.g., on attitudes, values, and behaviors) on existing drivers and then using them in new driver selection.
- Understanding that some desirable human traits like decisiveness, assertiveness, and high-energy level may not be necessary for success as a driver.
- Using a job satisfaction/job choice inventory, particularly if validated against current employees.
- Observing or otherwise discerning driver safety belt use as a supplemental assessment of driver risk-taking tendencies.
- Giving extra scrutiny to single-vehicle crashes seen in crash records. In general, single-vehicle crashes suggest a greater risk of driver medical problems, fatigue susceptibility, and misbehaviors.
- Using a mental abilities test as a supplement to other assessments, particularly if also relevant to nondriving tasks (e.g., record keeping, trip planning). Drivers with higher mental abilities tend to be safer and better bets for longer retention.
- Joining or forming a consortium of similar carriers who meet regularly to share information about improving safety and reducing losses. In such consortia, carriers can share documentation and validation information on improved selection methods.

RESEARCH AND DEVELOPMENT NEEDS

Research finds new knowledge; development creates new tools. The literature review, survey, and case studies done for this synthesis have revealed opportunities for R&D to contribute to better commercial driver selection and higher quality drivers on the road. Most research would seek to define more sharply driver traits with relationships to safety. Most development would be on tests and other assessments usable by carriers or others to screen drivers for hire or for specific duties after hire. The latter might include driving tanker trucks or longer combination vehicles, which require greater skill and are generally higher paying. The relative lack of assessment R&D relating specifically to commercial drivers is a barrier to carrier use of many promising selection methods.

One study already under way is the FMCSA-funded *Commercial Driver Individual Differences Study*. This study, just beginning at the time of this writing, is using a case-control methodology. It will compare multiple characteristics of crash- or violation-involved drivers (cases) to other drivers without histories of unsafe driving (controls). Per the project request for proposal, the study includes medical examinations and a battery of psychological and behavioral history measures administered to 21,000 drivers to identify about 3,000 cases and 3,000 controls. Extreme groups based on risk will be investigated to maximize the contrast between groups and thus the likelihood of meaningful findings. The comparison of the highest-risk drivers to the lowest-risk ones will permit the derivation of odds ratios and other statistics quantifying the risks associated with various driver characteristics. Factors to be incorporated include driver age, gender, height/weight, waist and neck size (for calculating BMI), marital status, number of children, education, primary language, driving experience, carrier characteristics, driving exposure (day and night), safety belt use, crash and violation history, training, medical history, medication use, sleeping habits, caffeine intake, health-related lifestyle (smoking, alcohol, diet, and exercise), and life stress events.

Figure 8 in chapter three contains a basic model of employee selection and the conceptual relation between the selection ratio and employee quality; the smaller the percentage of applicants selected, the higher the general quality of employees selected. Currently, freight volumes are rising and carriers need more drivers. The commercial driver shortage could reach 350,000 in just a few years. The current gradual economic upturn and other factors are likely to keep the driver shortage high over the next decade. Unfortunately for safety, this may make it harder for most carriers to be highly selective in the hiring and, in the process, take advantage of available and emerging tools for selecting good drivers. Lack of selectivity is a strong supply-and-demand-based barrier to more rigorous employee selection. Research and

other innovation could demonstrate ways to make the commercial driver job more attractive, thus increasing applicant pools and lowering selection ratios. This in turn would raise the quality of drivers hired. There would be benefits for both individual carriers and the industry as a whole from such research on driver recruiting approaches. A sad irony is that the transport industry faces a growing driver shortage even though overall unemployment percentages are among the highest in recent history.

Research is needed to verify distractibility as a trait construct and to determine whether it can be discerned through testing. New naturalistic driving data on truck drivers verifies LTCCS evidence of the large role distraction plays in crash risk. WayPoint, discussed in chapters two and three, is a 4-minute Internet-based sensorimotor test in which subjects "connect the dots" amid some distracting visual icons. Based on findings with both truck and car drivers, the developer of WayPoint has suggested distractibility as a distinct driver trait with a U-shaped relation to driving safety. A large decrement in performance in the presence of the icons suggests that the individual is highly distractible by driving-related stimuli like billboards and cell phone conversations. At the other extreme, little or no decrement in performance (undistractible) suggests that the individual has "tunnel vision" and might not notice peripheral or surprise events. Both extremes are potentially unsafe, while the middle of the distractibility scale is said to be ideal. This hypothesis is interesting and timely given current national concerns about distracted driving. Distractibility as a human trait deserves further research. A small driving simulator study by Kass et al. (2010) explored individual differences in distractibility but not the WayPoint hypothesis. It assessed subjects' tendencies toward attention difficulties using a series of questionnaires and correlated the results with driving behaviors and crashes on the simulator. Although no crash effect was seen, the independent measures of distractibility did predict lane breaks and excessive speeds on the simulator.

The following R&D need and opportunity, based on sleep research and articulated in *CTBSSP Synthesis 4* on high-risk drivers, still exists today:

> There is a specific development opportunity relating to the identification of individuals with high susceptibility to fatigue while driving…. [T]here is compelling evidence of wide individual differences in fatigue susceptibility, and further evidence that these differences persist over time. Given the essential role played by vigilance in driving, it is likely that some individuals are simply constitutionally ill-suited to long-haul commercial driving because they cannot sustain alertness under the rigors of commercial transport operations. Conversely, there are low-susceptible individuals who are unlikely to be involved in fatigue-related incidents and crashes. Ideally, a diagnostic tool (e.g., a physiological or performance test) could be developed to efficiently and accurately assess a candidate driver's level of fatigue susceptibility. Such a tool would not diminish the importance and value of improved fatigue management by drivers and fleets; rather, the combination of driver selection and alertness-supportive management techniques would combine to dramatically reduce drivers' risks of attentional lapses and falling asleep at the wheel.

An ultimate R&D goal relating to assessing fatigue susceptibility would a test to identify a person's chronotype, as defined and discussed in chapter two. There would also be benefit from having simple but validated questionnaire on driver sleep-related habits, history, and attitudes. Validation would require correlation of questionnaire responses with driving outcomes using methodologies described in chapter three.

Many enduring human qualities affect the ability or the choice to drive safely. Six categories of such traits and many specific examples have been provided. Nonetheless, safety-related traits are not necessarily immutable. They change with maturation, and safety management techniques like Behavior-Based Safety can change driver attitudes as they change behavior. Beyond the scope of this report are the many temporary driver states affecting safety, such as recent sleep and moods. On surveys, these were rated about the same as enduring traits as forces affecting safety. Research is needed on the consistency of safety-relevant driver traits and ways they may change. Change may be the result of maturation, environmental factors, or management practices. Some characteristics may be more resistant to change than others, thus making them relatively more important for selection. Those amenable to change may be best addressed through supervisory practices.

This report has not delved into theories of personality and attitudes, but rather emphasizes research findings with practical applications to driver selection. However, theoretical research does have long-term practical benefits. Efforts to develop and apply instruments for selecting safe drivers would benefit from a better understanding of the structure of human personality and attitudes in relation to driving safety. The Theory of Planned Behavior is one framework to identify better predictors of safety behaviors and outcomes. These predictors could be measured by questionnaires assessing applicant personality traits, attitudes, perceptions of social norms, and perceived behavioral control. All of these personal attributes are relevant to safety.

Surveys done for this synthesis provided useful information on the relative views of respondents on various driver risk factors and driver selection practices. However, as emphasized, survey samples were convenience samples, not samples representative of larger populations. Development of more representative samples of motor carrier safety managers or other populations of interest would require more information about those populations and better ways of reaching them. The CTBSSP and other motor carrier research programs would benefit from the development of this capability. More structured surveys would pro-

vide more information on the practices of the overall CMV transport industry.

Chapters two and three described multiple studies relating various human traits, and measurements from various psychological tests, to driving safety. Most of these studies were not conducted on commercial drivers, and few provided all the validation evidence needed to justify legally and ethically the use of a test for hiring commercial drivers. More typically, they provided a rationale for resourceful carriers to try out the tests and attempt to validate them for their own fleets. Smaller carriers and others without the resources for fleet-based research are not likely to be able to perform such validation experiments. Therefore, more commercial driver selection test validation studies are needed, with results made available to the industry. Carriers could replicate these studies in their own fleets to further ensure fair and legal hiring. Questionnaires and other instruments for driver hiring would need to be designed to prevent driver applicants from "gaming the system" by providing socially desirable answers.

A barrier to more widespread and systematic use of selection tests and measurements is the technical and legal knowledge necessary for carrier managers to implement such methods. Topics include statistical measures and concepts, testing principles, employment law, driver individual differences, and crash risk analysis. The motor carrier industry needs educational offerings in these areas.

This report has been written primarily from the carrier management perspective, because driver selection is performed by managers. The driver perspective has been most evident in report discussions of test characteristics and requirements, such as test validity. To the extent that tests are valid, they are also fair to drivers, because they make an accurate selection recommendation based on driver traits linked to job performance. Nevertheless, drivers' perspectives on selection, other job assessments, and other carrier safety practices are important in their own right. Future safety studies might survey drivers directly or seek input from driver advocates such as union representatives with experience as drivers.

Because of the exorbitant harm traceable to high-risk drivers, much of commercial driver selection is about "finding the bad." Yet a positive model of the successful commercial driver—one who is competent, conscientious, agreeable, and manageable—also emerges from information gathered in this synthesis. These drivers may be asocial and autonomous, but they are not *anti*social. More research into driver selection is needed to formalize and fully validate this positive driver model, and to provide information to carriers on how to use biodata, questionnaire inventories, and other assessments to select these drivers.

ACRONYMS

API	Accident Potential Index
ATA	American Trucking Associations
BISC	Bus Industry Safety Counsel
BMI	body-mass index
CDL	Commercial Drivers License
CFR	Code of Federal Regulations
CMV	commercial motor vehicle
CR	Critical Reason
CTBSSP	Commercial Truck and Bus Safety Synthesis Program
DAS	Driving Anger Scale
DBQ	Driver Behavior Questionnaire
DCAT	DriveABLE Cognitive Assessment Tool
DOL	Department of Labor
DOT	Department of Transportation (federal, unless otherwise specified)
DSI	Driver Stress Inventory
EEOC	Equal Employment Opportunity Commission
ETS	Educational Testing Service
FMCSR	Federal Motor Carrier Safety Regulation
HOS	hours of service
LTCCS	Large Truck Crash Causation Study
LTL	less-than truckload
MVR	motor vehicle record
NEO-FFI	NEO (Neuroticism-Extraversion-Openness) Five-Factor Inventory
NPTC	National Private Truck Council
OE	other expert (respondents)
OSA	obstructive sleep apnea
PSP	Pre-Employment Screening Program
R&D	research and development
SM	safety manager (generic term including other, similar job titles)
ST	single-unit truck (straight truck)
SV	single-vehicle (crash)
TABP	Type A Behavior Patterns
TCA	Truckload Carriers Association
TL	truckload
TPB	Theory of Planned Behavior
UFOV	Useful Field-of-View
VMT	vehicle-miles traveled

GLOSSARY

Ability test—A test that measures the current performance or estimates future performance of a person in some defined area of cognitive, psychomotor, or physical functioning (DOL 2000).

Adverse impact—A situation in which members of a particular race, sex, or ethnic group have a substantially lower rate of selection in hiring, promotion, or other employment decisions (DOL 2000).

Assessment—Any test or procedure used to measure an individual's employment or career-related qualifications or characteristics (DOL 2000).

Associated factors (e.g., in the LTCCS)—Human, vehicle, or environmental conditions present at the time of the crash. Associated factors are not direct crash causes but are often viewed as contributing factors.

Attitude—An individual's positive or negative evaluations of a particular thing (person, topic, country, activity, etc.). Most important here are attitudes toward driving behaviors. Attitudes have cognitive (knowledge, belief) and emotional components, and are reflected in behaviors. Safety-related attitudes are persistent and thus are a potential basis for driver selection. On the other hand, attitudes may change based on new knowledge, experience, and maturation.

Attribution bias—The strong tendency of most people to attribute their own behavior to situational factors while attributing the behavior of others to internal factors (e.g., their character, personality, abilities).

Basic skills tests—Assessments of competence in reading, simple mathematics, and other skills that are widely required in training and employment settings (DOL 2000).

Biodata—Information on personal characteristics, including physical, medical, and behavioral history information.

Chronotype—A person's fatigue susceptibility and sleep- and alertness-related characteristics. Although the same general factors affect people's alertness levels, there are also significant individual differences, especially in vulnerability to drowsiness.

Construct—A concept or explanatory label for a personal characteristic that is not directly observable or that cannot be captured by a single observation or measure. For example, people skillful in reasoning and complex thought are considered high on the construct *mental ability*. Mental ability is not directly visible, but its manifestations and its significance for occupational success are easy to recognize.

Construct validity—The degree to which a measure of a specific personal characteristic (e.g., constructs such as "mental ability," "impulsivity," and "agreeableness.") is known to be relevant to the performance of a job.

Content validity—The degree to which the content of a test corresponds to the knowledge or behavior content of a job. For example, an on-road assessment has high content validity in relation to on-the-job driving.

Correlation—The degree of association or predictability between two variables within the same group of subjects (e.g., drivers). Examples include the correlation between sets of test scores, or between test scores and job performance measures.

Correlation coefficient—A statistic summarizing direction and degree of association. Correlation coefficients range from −1.0 (a perfect *inverse* relation) through zero (no statistical association) to +1.0 (a perfect *linear* relation).

Criterion—Any measure of work behavior or any outcome that can be used as the standard for successful job performance. Relevant examples include driver crash rate, violation rate, tenure with company, or supervisory ratings of performance as a driver.

Criterion-based validity—The degree to which test scores correlate with actual job performance criteria. Includes predictive validity (predicting future performance) and concurrent validity (correlates with current performance).

Critical Reason (CR)—In the LTCCS, the human, vehicle, or environmental failure leading to the critical event and thus to the crash. The immediate or proximal cause of a crash.

Differential driver risk—Persistent individual differences among drivers in crash risk. Related to various personal traits such as age, personality, character, medical conditions, other physical variations, and performance capabilities.

Inventory—A questionnaire or checklist that elicits information about an individual in such areas as work values, interests, attitudes, and motivation (DOL 2000).

Job analysis—Defining and describing a job in terms of the behaviors necessary to perform it. Includes job tasks and knowledge, skills, and attitudes necessary for successful performance.

Mean—The arithmetic average score in a group of scores, computed by adding all the scores and dividing the sum by the number of cases.

Median—The middle score in a group of scores. The point or score that divides the group into two equal parts. Also known as the 50th percentile.

Multiple-hurdles approach—An approach to personnel assessment that requires a candidate to pass all tests in sequence in order to qualify (DOL 2000).

Normal distribution—The "bell-shaped curve" characterizing the distribution of many human traits such as height (within either gender), IQ score, and manual dexterity. Driver risk is *not* normally distributed.

Normative score—A test score stated in relation to a peer group; for example, a percentile score in relation to other commercial drivers (DOL 2000).

Norms—Descriptive statistics that are used to summarize the test performance of a specified group, such as a sample of workers in a specific occupation. Norms are often assumed to represent a larger population, such as all workers in an occupation (DOL 2000).

Odds ratio—A statistic often used to quantify relative risk or occurrence of an outcome for two different situations or groups. An odds ratio greater than 1.0 implies overinvolvement (e.g., in driving incidents), whereas an odds ratio less than 1.0 implies underinvolvement.

Percentile score—The score on a test below which a given percentage of scores fall. For example, a score at the 65th percentile is equal to or higher than the scores obtained by 65% of the people who took the test (DOL 2000).

Personality—Individual behavioral or psychological consistency over time and across different types of situations. Style of interaction with other people and life situations. Examples include aggressiveness, impulsivity, sensation-seeking, extraversion-introversion, conscientiousness, and agreeableness.

Reference group—The group of individuals used to develop a test; for example, commercial drivers, commercial drivers meeting some performance criterion.

Reliability—The degree to which test scores are consistent, dependable, or repeatable.

Reliability coefficient—A correlation coefficient indicating the degree to which two sets of test scores are associated or repeatable.

Risk factor—Any prior factor—driver, vehicle, environmental, carrier—that affects the probability of a crash.

Risk perception—A complex cognitive process representing the level of perceived risk that drivers use to calibrate their risk-taking behaviours (Thiffault 2007).

Selection ratio—In hiring, the ratio of job hires to job applicants. Other factors being equal, a low selection ratio (i.e., more selective hiring) results in higher average on-job performance of new hires.

Selection success ratio—Conceptually, the percentage of correct decisions made in hiring. Specifically, this is the sum of the correct acceptances (hired employees who perform well) and correct rejections (nonhired who would have performed poorly) divided by all applicants. In practice, the success ratio cannot be calculated, but it is a useful concept for understanding employee selection.

Sensitivity (test)—The ability of a test to correctly identify and reject unsafe or otherwise unsatisfactory drivers. In other words, the probability of driver failure in a criterion measure (e.g., on the job) given a test prediction of failure.

Skewed distribution—A lopsided distribution in which there are more individuals at one end than the other. This is contrast to the normal distribution or "bell-shaped curve," which is symmetrical with most people in the middle. For drivers in general and within almost any subgroup (e.g., a fleet), there are typically many relatively low-risk drivers, some drivers of medium risk, and a few drivers of much higher risk.

Specificity (test)—The ability of a test to correctly identify and accept safe or otherwise satisfactory drivers. In other words, the probability of driver success in a criterion measure (e.g., on the job) given a test prediction of success.

Standard deviation—A statistic used to describe the variability within a set of scores. It indicates the extent to which scores vary around the mean or average score.

Standardized test—A test developed using professionally prescribed methods which provides specific administration requirements, instructions for scoring, and instructions for interpreting scores (DOL 2000).

Test—Any instrument or procedure that samples behavior or performance. A personnel or employment test is the general term for any assessment tool used to measure an individual's employment qualifications, capabilities, or characteristics (DOL 2000).

Traits vs. states—Traits are enduring personal characteristics (e.g., medical conditions, personality), whereas states are temporary characteristics (e.g., short illness, moods) that may reflect recent events.

Validity—The degree to which an assessment actually measures what it purports to measure. A test's validity is determined in contexts such as content validity, construct validity, and criterion-based validity (predictive or concurrent).

Validity coefficient—A numeric index that shows the strength of the relationship between a test score and a criterion, such as job performance. Expressed as a correlation between predictor(s) and job performance, and sometimes called a *V-score*.

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APPENDIX A

Project Survey Forms

APPENDIX A1 SAFETY MANAGER QUESTIONNAIRE

MOTOR CARRIER SAFETY MANAGER/HUMAN RESOURCE MANAGER SURVEY
Driver Selection Tests & Measurements Synthesis Study
Transportation Research Board CTBSSP Study MC-23

Participation in this survey is **voluntary**. All respondent answers will be treated as **confidential** and aggregated with other responses in the reporting. No survey responses will be attributed to an individual. Survey respondents will receive a link to the synthesis report when it is published. *Thanks for your participation and support!*

(1) ***Factors Affecting Safety & Crash Risk:*** Consider the entire fleet of North American commercial vehicles (trucks and buses). Across all these drivers and vehicles, which factors have the greatest association with crash risk? Pick **up to two (2)** of the factors below which, in your opinion, have the ***greatest association*** with crash risk. Circle the letter(s).

(a) Enduring/long-term *driver traits*; e.g., age, physical abilities, medical conditions, personality, behavioral history.

(b) Temporary *driver states*; e.g., moods, daily circadian rhythms, effects of recent sleep, effects of recent food & fluids, effects of environmental conditions in cab, etc.

(c) *Vehicle* characteristics (e.g., configuration, safety equipment, load) & mechanical condition (e.g., brakes, tires).

(d) *Roadway characteristics & traffic conditions*; e.g., undivided vs. divided highways, construction zones, traffic density, speed limits, lane restrictions, etc.

(e) *Weather & roadway surface conditions*; e.g., wet vs. dry, road surface friction, visibility, wind, etc.

(2) In your opinion, which **one** of the above has the ***least association*** with crash risk? Write letter here: _____.

(3) ***Most Important Carrier Practices***: All elements of driver training and companies' safety management practices are important, but some may be more important than others. Pick **up to two (2)** of the carrier practices below which, in your opinion, have the ***greatest effect*** on drivers' safety behaviors and safety records. Circle the letter(s).

(a) *Driver preparation*; pre-hire CMV driving training & testing; e.g., basic school training and CDL testing.

(b) *Driver selection & hiring*; company driver recruiting, screening, selection, & hiring (include both mandatory and voluntary hiring practices.

(c) *Company communications to drivers*; driver orientation, finishing, safety meetings, refresher training, policy announcements, safety reminders.

(d) *Driver evaluation*; company monitoring & evaluation of individual drivers; e.g., violation & incident tracking, ride-alongs, covert observations of driving, onboard computer monitoring.

(e) *Company rewards and discipline*; e.g., incentives, feedback, recognition, letters (both commendations and reprimands), bonuses, pay increases/decreases, other consequences imposed by management.

(4) In your opinion, which **one** of the above has the ***least effect*** on driver safety outcomes? Write letter here: _____.

Driver Personal/Psychological Traits

What driver characteristics are most associated with risk? In general and across all drivers, HOW STRONG IS THE ASSOCIATION of each of these personal characteristics with DRIVER CRASH RISK? 1 = Little or no association. 5 = Very high association. Choose one number for each. If you are unsure or have no opinion, leave it blank.

Personal Trait:	Little or No Association	Some Association	Moderate Association	Strong Association	Very Strong Association
(5) Aggressive personality	1	2	3	4	5
(6) Risk-taking personality	1	2	3	4	5
(7) Dishonest/untrustworthy	1	2	3	4	5
(8) Introverted/unsociable	1	2	3	4	5
(9) Low intelligence/mental abilities	1	2	3	4	5
(10) Poor English language skills	1	2	3	4	5
(11) Unhappy/personal problems	1	2	3	4	5
(12) Financial problems/in debt	1	2	3	4	5
(13) Dissatisfied with driver job/profession	1	2	3	4	5
(14) Poor general physical health	1	2	3	4	5
(15) Overweight/obese	1	2	3	4	5
(16) Poor vehicle handling; e.g., backing, parking	1	2	3	4	5

Which Driver Hiring Practices & Tools Do You Regularly Use to Select Safe Drivers?

For each of the hiring practices below, please circle yes or no as to whether your organization uses the practice. If **yes**, rate the effectiveness of the method using the 1-5 scale provided. Circle your answers. If **no**, leave the ratings blank.

Carrier Practices:	Do you regularly use?		If "Yes," please rate effectiveness:				
			Highly Ineffective	Ineffective	Not Sure/ Neutral	Effective	Highly Effective
(17) Give on-road driving test.	Yes	No	No	1	2	3	4
(18) Range/yard maneuvering test; e.g., backing, parking.	Yes	No	1	2	3	4	5
(19) Standardized interview (set list of questions)	Yes	No	1	2	3	4	5
(20) Check criminal record	Yes	No	1	2	3	4	5
(21) Check credit history & rating	Yes	No	1	2	3	4	5
(22) Determine likely safety belt use (by observation, interview, questionnaire, etc.)	Yes	No	1	2	3	4	5
(23) General medical history questionnaire	Yes	No	1	2	3	4	5
(24) Mental ability test (e.g., math, reasoning)	Yes	No	1	2	3	4	5
(25) English language test	Yes	No	1	2	3	4	5
(26) Any computer-based dynamic performance test; e.g., hand-eye coordination, tracking	Yes	No	1	2	3	4	5
(27) Job satisfaction or job choice questionnaire	Yes	No	1	2	3	4	5
(28) Personality questionnaire; e.g., aggressiveness, risk-taking, attitudes	Yes	No	1	2	3	4	5
(29) Questionnaire about driving behaviors; e.g., following distances, turn signal use.	Yes	No	1	2	3	4	5
(30) Other [specify]	Yes	No	1	2	3	4	5

(31) Does your carrier plan to use the new FMCSA Pre-Employment Screening Program? **Yes No Not Sure**

(32) Comments on any of the above questions:

Information about You and Your Fleet

(33) Number of years you have been a carrier Safety Manager or Human Resource Manager: _____

(34) Your total years experience in commercial truck/bus operations: _____

(35) Approximate number of power units currently in your organizations' fleet: _____

(36) Circle *the operation type that best characterizes your fleet:*

(a) For hire: long haul/truckload

(b) For hire: long-haul/less-than-truckload (LTL)

(c) For hire: local/short haul (most trips <100 miles)

(d) Private industry: long haul

(e) Private: local/short haul (most trips <100 miles)

(f) Passenger carrier: scheduled service

(g) Passenger carrier: charter

(h) Other: _____

(37) Provide your e-mail address if you would like to receive pdfs of the project report and presentation in 2011. This information will be used for no other purpose.

_____

(38) A few survey respondents will be asked to participate in a follow-up phone interview to discuss innovative fleet practices. Responses will be confidential; no interviewees or carriers will be identified unless desired. You would be paid $50 for a 45-minute interview, scheduled at your convenience. You would be initially contacted via e-mail. Are you potentially interested? **Yes No**

If **Yes**, provide e-mail and/or daytime phone:

_____

Thank you for completing this survey!

[Questions or additional comments? E-mail the project manager at tbsafety@aol.com]

APPENDIX A2 OTHER EXPERT QUESTIONNAIRE

MOTOR CARRIER SAFETY EXPERT SURVEY:
Driver Selection Tests and Measurements Synthesis Study
Transportation Research Board Study CTBSSP MC-23

Dear Motor Carrier Safety Expert,

The Transportation Research Board (TRB) is preparing a synthesis study on *Driver Selection Tests & Measurements*. This is being done for the Commercial Truck and Bus Safety Synthesis Program (CTBSSP). CTBSSP is sponsored by the Federal Motor Carrier Safety Administration and administered by TRB.

This project is reviewing the academic, commercial, and industry literature on tests, measurements, and other procedures used by motor carriers to select safe commercial drivers. Motor carrier safety managers and other experts are being surveyed in regard to selection procedures and tests and underlying driver characteristics relevant to risk.

This survey is being sent to being sent to safety professionals who are knowledgeable on this topic but who are not currently motor carrier safety managers. A separate survey form has been developed for that respondent group. If you are currently a carrier safety manager and wish to take the survey, please contact us.

Please compete and submit this survey by August 15, 2010. We estimate that it should take no more than 20 minutes to complete. If you have any questions, please contact our principal investigator, Dr. Ron Knipling at rknipling@verizon.net. Any supporting materials can be sent directly to Dr. Knipling.

Participation in the survey is **voluntary**. All answers provided by survey respondents will be treated as **confidential** and aggregated with other responses in the reporting. No survey comments or other responses will be attributed to an individual. Survey respondents will receive a link to the synthesis report when it is published.

QUESTIONNAIRE INSTRUCTIONS

1.**To view and print the entire questionnaire,** Click on this link, and print using "Control p".

2.To save your partial answers, or to forward a partially completed questionnaire to another party, click on the "Save and Continue Later" link in the upper right hand corner of your screen. A link to the partial survey will be e-mailed to you or a colleague.

3.**To view and print your answers before submitting the survey,** click forward to the page following question 25. Print using "control p".

4.**To submit the survey,** click on "Submit" on the last page.

Thank you for your help!

Factors Affecting Safety & Crash Risk

(1) *Factors Affecting Safety & Crash Risk:* Consider the entire fleet of North American commercial vehicles (trucks and buses) operating at any given time. Across all these drivers and vehicles, in your opinion which factors have the greatest association with crash risk? Pick **up to two (2)** of the following factors which, in your opinion, have the ***greatest association*** with crash risk.

(a) *Enduring driver traits* such as age, chronic medical conditions, personality, etc.
(b) *Temporary driver states*; such as mood, changes in sleep, effects of environmental conditions in cab, etc.
(c) *Vehicle* characteristics (such as configuration, safety equipment, load) & mechanical condition (such as brakes, tires).
(d) *Roadway characteristics & traffic conditions*; such as undivided vs. divided highways, construction zones, traffic density, speed limits, etc.
(e) *Weather & roadway surface conditions;* such as wet vs. dry road surface, visibility, wind, etc.

(2) In your opinion, which **one** factor has the ***least association*** or correlation with crash risk across all vehicles and drivers at any given time?

(a) *Enduring driver traits* such as age, chronic medical conditions, personality, etc.
(b) *Temporary driver states*; such as mood, changes in sleep, effects of environmental conditions in cab, etc.
(c) *Vehicle* characteristics (such as configuration, safety equipment, load) & mechanical condition (such as brakes, tires).
(d) *Roadway characteristics & traffic conditions*; such as undivided vs. divided highways, construction zones, traffic density, speed limits, etc.
(e) *Weather & roadway surface conditions*; such as wet vs. dry road surface, visibility, wind, etc.

(3) *Most Important Carrier Practices*: All elements of driver training and companies' safety management practices are important, but some may be more important than others. Pick **up to two (2)** of the following practices which, in your opinion, have the ***greatest effect*** on drivers' safety behaviors and safety records.

(a) *Driver Preparation*; pre-hire CMV driving training & testing; e.g., school training and CDL testing.
(b) *Driver Selection & Hiring*; company driver recruiting, screening, selection, & hiring (include both mandatory and voluntary hiring practices).
(c) *Company Communications to Drivers*; driver orientation, finishing, safety meetings, refresher training, policy announcements, safety reminders.
(d) *Driver Evaluation*; company monitoring & evaluation of individual drivers; e.g., violation & incident tracking, ride-alongs, covert observations of driving, onboard computer monitoring.
(e) *Driver Performance Consequences*; company rewards and discipline; e.g., incentives, feedback, recognition, letters (both reprimands and commendations), bonuses, pay increases/decreases, other consequences imposed by management.

(4) In your opinion, which **one** carrier safety practice has the ***least effect*** on driver safety behaviors and outcomes?

(a) *Driver Preparation*; pre-hire CMV driving training & testing; e.g., school training and CDL testing.
(b) *Driver Selection & Hiring*; company driver recruiting, screening, selection, & hiring (include both mandatory and voluntary hiring practices).
(c) *Company Communications to Drivers*; driver orientation, finishing, safety meetings, refresher training, policy announcements, safety reminders.
(d) *Driver Evaluation*; company monitoring & evaluation of individual drivers; e.g., violation & incident tracking, ride-alongs, covert observations of driving, onboard computer monitoring.
(e) *Driver Performance Consequences*; company rewards and discipline; e.g., incentives, feedback, recognition, letters (both reprimands and commendations), bonuses, pay increases/decreases, other consequences imposed by management.

Driver Psychological Traits & Potential Value of Testing

Items 5-23 present personal driver dimensions which could be targeted by driver selection tests administered by a carrier. Each of these dimensions could be correlated (positively or negatively) with driver crash risk. In general and across all drivers, HOW STRONG IS THE ASSOCIATION of each of these personal characteristics with driver crash risk? 1 = No correlation. 5 = Very high association. (Note: correlations could be positive or negative depending on dimension.) Assume that the best available tests are used for each dimension. Choose one number for each. If you are not familiar with the dimension or have no opinion, leave it blank.

Personal Trait:	Little or No Association	Some Association	Moderate Association	Strong Association	Very Strong Association
(5) Aggressive personality & attitudes	**1**	**2**	**3**	**4**	**5**
(6) Risk perception & attitudes	**1**	**2**	**3**	**4**	**5**
(7) Sensation-seeking	**1**	**2**	**3**	**4**	**5**
(8) Conscientious/honest	**1**	**2**	**3**	**4**	**5**
(9) Personal/family adjustment & happiness	**1**	**2**	**3**	**4**	**5**
(10) Job satisfaction	**1**	**2**	**3**	**4**	**5**
(11) Psychological match to the job; e.g., activity preferences, interests	**1**	**2**	**3**	**4**	**5**
(12) Debt & credit history/rating	**1**	**2**	**3**	**4**	**5**
(13) Intelligence/mental abilities	**1**	**2**	**3**	**4**	**5**
(14) English language skills; e.g., reading, speaking	**1**	**2**	**3**	**4**	**5**
(15) Dynamic sensory-motor performance (e.g., visual tracking, reaction time)	**1**	**2**	**3**	**4**	**5**
(16) Body-Mass Index (BMI)	**1**	**2**	**3**	**4**	**5**
(17) Sleep Apnea (e.g., none, mild, moderate, severe)	**1**	**2**	**3**	**4**	**5**
(18) Sleep hygiene habits (e.g., amount and regularity of sleep)	**1**	**2**	**3**	**4**	**5**
(19) Cardiac Health (e.g., blood presssure, cholesterol)	**1**	**2**	**3**	**4**	**5**
(20) General Medical History	**1**	**2**	**3**	**4**	**5**
(21) Truck driving knowledge (written)	**1**	**2**	**3**	**4**	**5**
(22) Truck range maneuvering (e.g., backing, parallel parking)	**1**	**2**	**3**	**4**	**5**
(23) Truck road driving (e.g., 30-minute ride-along in traffic)	**1**	**2**	**3**	**4**	**5**

(24) Additional comments or suggestions regarding driver personal/psychological dimensions and/or tests to assess them:

_____

_____

_____

Information about You

(25) Approximately how many years of professional experience do you have relating to motor carrier safety? _____

(26) Please indicate **every** experience area below for which you have one year or more experience relating to motor carrier safety:

(a) Government enforcement
(b) Other government (e.g. rulemaking, policy)
(c) Industry trade association
(d) Commercial driver
(e) Carrier safety director/manager
(f) Other carrier management position
(g) Safety consultant or vendor to fleets
(h) Accident investigation/data analysis
(i) Motor carrier safety research
(j) Journalist
(k) Driver trainer/training development
(l) Insurance for motor carriers
(m) Other

Thank you for completing this survey!

To submit your responses, click on “Submit” below.

The authors welcome any additional thoughts, research data, publications, or suggestions about this topic. Please send to Dr. Ron Knipling at: rknipling@verizon.net. Phone: (703) 533-2895.

APPENDIX B

Sample Company Tools for Improving Driver Selection

APPENDIX B1 DAECHER VALIDATION PROCESS

APPENDIX B2 KRISKA PROFESSIONAL TRANSPORT OPERATOR JOB DESCRIPTION

APPENDIX B3 KRISKA STRUCTURED DRIVER INTERVIEW FORM

APPENDIX B4 DRIVER APPLICATION: AMERICAN CENTRAL TRANSPORT

APPENDIX B5 NEW YORK STATE BIENNIAL BEHIND THE WHEEL ROAD TEST RATING FORM

APPENDIX B6 NEW YORK STATE REPORT ON ANNUAL DEFENSIVE DRIVING PERFORMANCE

APPENDIX B1 DAECHER VALIDATION PROCESS (PROVIDED BY DAECHER CONSULTING GROUP)

Validity of the Professional - Driver Hiring System (7 Stages)

The Professional Driver Hiring System was developed and validated to be used as part of the hiring process to assist in the identification of the safest and most reliable commercial transportation drivers. PRADCO, a psychological testing company with 36 years of experience in psychological assessment and management development, designed and conducted the validation study, using a concurrent criterion-related methodology. The study conformed to applicable guidelines from the Principles for the Validation and Use of Personnel Measures and E.E.O. Case Law regarding selection procedures, as well as to the professional testing principles of Standards for Educational & Psychological Testing.

The study involved seven stages. During the **First Stage** several premier trucking* and motorcoach companies* were contacted to participate in the validation study. Interviews were held with drivers and their supervisors and six overall job components were identified through a job analysis study. Five common major behavioral dimensions and personal attributes found in superior commercial transportation drivers were also identified in the job analysis study. This data was an essential source of information used to determine the content of both the test itself and the job performance rating scales that served as criteria measures to validate the test.

Developing a preliminary test was the focus of the **Second Stage.** The first section of the test consisted of 193 biographical and attitudinal questions related to many of the dimensions and personal characteristics identified during the job analysis study. The second section of the test consisted of a 480-item personality inventory that measures 20 personality dimensions.

The **Third Stage** was the identification of the appropriate measures of job performance to validate the effectiveness of the test. The job performance measurement consisted of 16 behaviorally anchored job performance rating scales. These included such things as learning ability, safety-consciousness, problem awareness, driving skills, customer services, etc. Archival data was gathered to include moving violations, number of accidents, disciplinary action and workers' companies.

The **Fourth Stage** included 329 drivers who participated in the administration of the test and job performance rating phase of the project. The results of the test were evaluated and rated by the safety managers and dispatchers from the different companies.

Stage Five analyzed the test data and manager/dispatcher input which led to the creation of a final test. Test scales included Planning and Problem Solving, Responsibility, Reliability, Learning Quickly, and Service to the Customers.

The **Sixth Stage** assessed the validity of the test. A significant relationship developed between drivers' test scores and their job performance measurement as collected during the initial data¬gathering phase. The test was evaluated to assure validity of each company. Validity assessment required investigating the relationship of scores on each of the five subtest scales to drivers' overall job performance, as rated by their supervisors. Across all the companies, the obtained correlations ranged from .20 to .37. All these correlations were significant at the .05 probability level. Results show that drivers who scored in the top third on each of the subtest scales received a higher job performance rating from their supervisor than did workers who scored in the middle or bottom third on the subtests. Better performers on the job scored higher on the test than did lower performers. It was noted that the correlation between overall test scores and overall job performance is 0.33. The correlation is statistically significant at the .05 level of significance. This indicates that higher test scores are associated with better job performance. In other words, the overall test score can be used to predict a driver's probable level of job performance. Superior commercial transportation drivers will be able to be identified by their high test scores.

Professional Transport Operator Job Description

Operator Name: _____

POSITION TITLE: Professional Transport Operator

REPORTS TO: Safety and Compliance & Operations

POSITION SUMMARY:

The Professional Transport Operator is responsible for the safe operation of a transport truck and trailer to move freight on schedule for our customers. The PTO conducts this service in compliance with all applicable Ministry of Transport/Department of Transportation (MOT/DOT) regulations, minimizing on-the-road costs and avoiding damage to equipment or cargo, and with respect for his/her own personal safety and the safety of others on the road according to established health and safety policies and procedures. He/she ensures customer service commitments and company service targets are achieved and protects the integrity and security of the customer's product at all times. Conducts all tasks and responsibilities according to established Health and Safety Policies and Procedures.

RESPONSIBILITIES:

The Professional Transport Operator is responsible for safely moving freight for our customers.

- ☐ Carefully inspects empty trailer equipment prior to presentation to the customer, terminal or maintenance facility. Trailers for presentation to customers should be clean (swept), dry, odor-free and maintenance free.
- ☐ Plans his/her trip and manages his/her road time to ensure loads are picked up and delivered according to schedule as assigned (based on normal transit times).
- ☐ Communicates with Operations to maintain accurate and up-to-date ETA.
- ☐ Advises Operations immediately by satellite (or phone) when conditions change and an assigned load cannot be picked up or delivered on schedule.
- ☐ Completes all paperwork (i.e. Bill of Lading, Customs Documents, etc.) as required to ensure it is sufficient for customs clearance.
- ☐ Provides hand-bombing assistance as required.
- ☐ Provides supervision of loading / unloading (pallet counts, damage inspection) where required.
- ☐ Supports our image with the customer by maintaining a neat, clean personal appearance and adopting a professional and courteous manner with customers and staff.

The Professional Transport Operator is responsible for maintaining his/her ability to provide driving services throughout Canada and the USA at all times.

- ☐ Understands and complies with all customs regulations and has no restrictions in his/her ability to enter or exit the USA because of legal or immigration issues.
- ☐ Ensures that AZ or Class 1 license [Canadian equivalent of CDL] is valid at all times.
- ☐ Ensures all required safety documentation such as Dangerous Goods card is valid.
- ☐ Meets all medical requirements to operate a commercial truck in Canada or the USA under MOT/DOT regulations.

- ☐ Is eligible for, and has applied for/obtained, clearance for existing Customs Self-Assessment (CSA) (CDRP) and Fast and Secure Trade (FAST) programs, and any future Customs/Immigration programs that should become necessary to provide reliable service to our cross border customers.
- ☐ Is available at all times (within hours of service) for dispatch to all cities/states in the USA or any destination in Canada.

The Professional Transport Operator is responsible to manage his/her personal utilization to achieve or exceed minimum company period mileage targets on the assigned power unit over the year.

- ☐ Manages "available time" to be available for duty 5-6 days in a 7 day period. While Kriska has expected time frames for booking vacation time, any absence for shorter time periods (i.e. a day off for appointments) Kriska request a minimum of 24 hours prior notice.
- ☐ At completion of working period, confirms return to work time for start of next working period (after vacation or time off, confirms 24 hrs prior to return).
- ☐ Practices effective road time management to meet average utilization standards of 460-500 miles per day.
- ☐ Maximizes personal income by regularly achieving mileage bonus.

The Professional Transport Operator is responsible for managing his/her assigned equipment to minimize fleet operating costs and maximize availability.

- ☐ Manages idle time to minimize fuel consumption.
- ☐ Follows assigned routes and minimizes any off-route miles.
- ☐ Monitors service and safety inspection requirements of assigned tractor and trailers.
- ☐ Co-ordinates with Fleet Support and Operations to ensure equipment is presented for service on time and in compliance with MOT/DOT requirements and Preventative Maintenance Programs.
- ☐ Minimizes maintenance costs by grouping non-urgent repairs into regularly scheduled service.
- ☐ Manages on-road supply costs (washes, fluids, load bars, etc.)
- ☐ Manages fuel cards and passes in his/her possession.

The Professional Transport Operator is responsible for practicing safe vehicle operation at all times. He/she recognizes that large truck equipment is very visible on the road and, by his/her responsible actions, is perceived to be a safe and courteous Kriska employee by the driving public.

- ☐ Follows all safety procedures and rules in compliance with Kriska policies and procedures, Canada Labour Code Part II and any other applicable safety legislation.
- ☐ Immediately reports all potential and actual hazards to Safety & Compliance.
- ☐ Uses or wears the protective equipment, protective devices or clothing required by Kriska.
- ☐ Practices effective driving techniques, and adheres to company speed policies.
- ☐ Provides immediate verbal report to Safety & Compliance on all accidents, while at the scene wherever possible. Provides a complete written report within 24 hours.
- ☐ Complies with all company safety programs and attends regularly scheduled refresher training.
- ☐ Ensures all pertinent certification is kept up-to-date (Transportation Dangerous Goods, WHMIS, etc).
- ☐ Is knowledgeable of, and complies with, company regulations prohibiting unauthorized passengers.
- ☐ Obtains a passenger waiver before transporting any non-company personnel in the vehicle.
- ☐ Ensures that non-company personnel are FAST approved (if required) and legally able to enter and exit the United States.

The Professional Transport Operator is responsible to manage him/herself and his/her equipment on the road in compliance with all MOT/ DOT moving regulations.

- ☐ Is knowledgeable of all applicable DOT / MOT regulations for equipment operation. Operates legally with respect for these regulations at all times.
- ☐ Is knowledgeable of any special permitting requirements and pro-actively acquires any such permits as required.
- ☐ Is knowledgeable of, and complies with, all requirements for paperwork and placards involving shipments which contain Dangerous Goods.
- ☐ Is knowledgeable of all Canadian and US weights, dimensions and bridge laws. Always scales each load at pick up (if weight is in question) to ensure it is in compliance with weight regulations to destination.
- ☐ Legalizes marginal loads where possible by repositioning fifth wheel and axles and balancing/ managing fuel.
- ☐ Is knowledgeable of, and complies with, all requirements for spill reporting in the event of a fuel or cargo spill.
- ☐ Immediately and completely reports any driver safety and compliance infractions (both on the job & in a personal vehicle) so as to minimize any risk to Company Commercial Vehicle Operator Record (CVOR) standings [equivalent to U.S. SafeStat or CSA ratings] and the Operator's personal driving privileges.
- ☐ Is knowledgeable of, and complies with all applicable Hours of Service regulations.
- ☐ Maintains legal log book at all times. Provides log copies weekly with trip sheets.
- ☐ Reports hours of service each day on a timely basis using the appropriate satellite macro.
- ☐ Maintains a clean driving record and up to date personal license. Provides current abstract upon request.
- ☐ Follows safe work practices, including bending, lifting and carrying procedures and slip and fall prevention. In the event of an injury, reports the injury to Human Resources, Safety & Compliance or the Operator Associate immediately.
- ☐ Follows all customer rules and regulations while on their premises.

The Professional Transport Operator is responsible to ensure the equipment he/she is assigned is roadworthy, fit for use and in compliance with DOT/ MOT mechanical regulations at all times.

- ☐ Always completes a thorough pre and post trip inspection on assigned equipment.
- ☐ Completes Tractor and Trailer inspection as per DOT requirements.
- ☐ Monitors heaters, reefers, fuel levels and leaves any heater or reefer spotted with full fuel.
- ☐ Reports any defects immediately through Fleet Support.
- ☐ Always clears a trailer being picked up with Operations prior to departure to ensure there are no maintenance holds on the equipment.
- ☐ Takes professional pride in care of assigned tractor and trailer equipment. Keeps vehicle clean and litter free.

The Professional Transport Operator is responsible to protect the integrity of cargo at all times and to minimize the risk of claims against the company by effectively managing potential cargo claim events.

- ☐ Ensures trailers are clean, dry, leak free and odor-free prior to loading.
- ☐ Always seals loads and maintains the integrity of seals at all times. Immediately notifies Safety & Compliance at any time that a seal is breached by customs or law enforcement proceedings.
- ☐ Always gets clear signatures and acknowledgement of damage free delivery.
- ☐ In the event of an over, short or damage (OS&D) on a delivery, reports immediately to Operations while the delivery is in progress.
- ☐ In the event of a claim or potential claim, obtains complete information on the extent of claim (number, description, type of damage, pictures if possible) and obtains appropriate signatures.

- ☐ In the event of a claim or potential claim, maintains custody of any non-deliverable product and obtains direction from Operations as to disposition and records to assist recovery.

The Professional Transport Operator facilitates the efficient completion of tasks by other company PTO's and internal staff by ensuring paperwork and satellite transactions are completed in an accurate and timely manner.

- ☐ Completes Kriska Bill of Lading (BOL) for the trip (including all drops on a multiple drop) at the point of origin. Ensures possession of all required customer paperwork for each stop, including border crossing.
- ☐ Completes all paperwork (i.e. BOL, Customs, etc) as required for settlement of the freight billing to our customer and submits all paperwork upon arrival at a terminal.
- ☐ Ensures all required paperwork accompanies the load when it is dropped in transit and that all paperwork is returned neatly in the trip envelope at completion of delivery to the customer.
- ☐ Understands standard company satellite macros. Sends macros in proper sequence and format while completing assignment.

PHYSICAL DEMANDS:

A professional transport operator requires physical agility and stamina for pre- and post-trip inspections, hand-bombing and manual adjustments to equipment, and mental concentration for long periods of sitting and driving. Other physical demands include:

- ☐ Sitting (constant for driving truck).
- ☐ Walking (occasional short distances in yard or truck stop or to perform truck and trailer inspections)
- ☐ Lifting (occasional for personal luggage/various tractor supplies). May also require more strenuous lifting motion in physical assist of load movement from trailer to dock area. This may include a wide variety of goods with varying weights (10 – 50 pounds per item). Some items may be moved by hand cart/dolly while others may require the actual "hands on" movement (hand-bombing). Hand-bombing requires physical strength in arms, shoulders, back and legs.
- ☐ Carrying (as per lifting).
- ☐ Bending (occasional to complete vehicle/trailer inspections, lifting and lowering trailer landing gear, securing hoses from truck to trailer).
- ☐ Crouching (occasional to complete vehicle and trailer inspections).
- ☐ Kneeling (occasional to complete vehicle and trailer inspections).
- ☐ Forward reaching (constant for driving truck, occasional for completing inspections).
- ☐ Above shoulder reaching (occasional for overhead truck controls, opening/closing trailer or cab doors, reaching for grab bars).
- ☐ Pushing/pulling (occasional for trailer doors, brakes, accelerator, gear shift).
- ☐ Climbing (in and out of truck, in and out of trailer, onto back deck of truck to connect lines or hoses).

QUALIFICATIONS AND WORKING CONDITIONS:

- ☐ Maintain a current and valid AZ license.
- ☐ Current CVOR abstract (within 30 days).
- ☐ Current driver abstract (within 30 days).
- ☐ Current criminal search (within 90 days).
- ☐ Oral, written and comprehension skills in English at a minimum Grade 10 level.

- ☐ Operation of satellite communication equipment.
- ☐ 70 hour work weeks away from home with constant shift changes.
- ☐ Sleep in confined space with disturbance.
- ☐ **Subject to extremes of weather, possible odors and hazardous materials.**
- ☐ Entered into consortium for random drug & alcohol testing – zero tolerance.

HAZARD PREVENTION PROGRAM

- ☐ See Job Hazard Analysis Attached

Date: _____

Signed: _____

Printed Name: _____

Driver Applicant Interview Questions

Candidate Name: _____ Date: _____

Interviewer: _____

Note: Questions are essentially asked in the following order although the sequence may be altered given the flow of the conversation. Each candidate must be asked all questions that apply to their position, and the answers must be documented for the file.

Company Knowledge

1. How did you hear about us? If referral, by whom? If through advertising, which one?
2. What made you contact us for a driving position
3. Have you visited our website?

Training and Qualifications

(Priority is given to partnered schools graduates. Partnered schools include Crossroads, Transport Training Centres, Adanac, Humber College, Tri County, OTTA)

1. Which driving school did you graduate from, and when? (Copies of certificates and transcripts indicate test scores must be included for file. If graduated more than 30 days ago, proof of upgrade must be included).
2. Why did you select this particular school?
3. Which parts of the Ministry of Transport (MTO) road test did you find challenging? Which parts of the road test did you excel at?
4. Please describe the types of equipment you were trained on-tractor and transmission, length of trailer and weight.
5. Please describe other skills and qualifications that would make you a good candidate for this position.
6. Do you have a FAST card?
7. Do you have a valid passport?

Level of Experience

1. How much AZ experience do you have?
2. How much experience was over the road?
3. Please describe the types of equipment you have operated-tractor type and transmission
4. Do you know how to bond a load [for customs clearance]? Do you have experience with any of the following: PARS, PAPS, FDA [clearance procedures]?
5. Do you have satellite experience? If so, which systems?

Driving Record

1. In the previous 3 years have you had any accidents? Personal or commercial, chargeable or non-chargeable, preventable or non-preventable?

2. In the previous 3 years have you had any violations (other than parking tickets)for which you have been convicted?

Personal Identification

During our orientation program you will be required to provide a combination of the following documents. Please indicate which documents you possess-

a. Free and Secure Trade (FAST) card

b. Valid Passport

c. Birth Certificate

d. Permanent Resident Card

e. Citizenship card

f. Health card

Lifestyle Info

1. Please tell me why you choose to enter this industry

2. Please describe what you expect your average day on the road to be like.

3. Have you ever held a position that took you away from home? What was difficult about this position? How did you adapt?

4. Have you ever held a position that required you to work shiftwork? What was difficult about this position? How did you adapt?

5. Have you ever held a position that required that you to work unpredictable schedules? What was difficult about this position? How did you adapt?

Expectations

1. Please describe the kind of work you are looking for, including requirements for home time (how long can you be away and how many days would you like to spend at home before being dispatched again), lanes and types of freight.

2. What challenges do you expect to face as a new driver? How will you handle them?

3. What will be the biggest adjustment for you? How will you handle it?

4. What is the biggest sacrifice you will need to make in order to work for Kriska?

5. Our industry historically has a high level of turnover. If you were to leave Kriska, what would your options be?

6. What are your expectations of the training program? What can you do well? What do you need additional training in?

7. What would you like to be doing at Kriska in 2 years' time?

Earnings

Kriska drivers are compensated on a mileage basis. This means that a driver's income is determined by how available the driver is, and how they plan on balancing their home life and work life. Income is also affected by when the driver is prepared to take time off…for example taking time off during the week instead of on the weekend. Earnings are also impacted by the driver's level of experience and competence. Newly licensed drivers must expect that their first year in the industry will have the steepest learning curve, and how quickly they learn will affect their income. Drivers must also understand that because the volume of work changes from pay period to pay period, their income level will vary from pay period to pay period.

1. A reasonable range of gross income for an entry level driver who has completed one full year of service with Kriska is $45,000 to $55,000. Does this number meet your expectations? Do you have any questions about how you can expect your income to change in your first year

Previous Work History

1. Please describe the type of work you were doing for your previous employer. Why did you leave? Did you give notice? What do you think they will say about you? (ask for each previous employer)

Behaviour Based Questions

1. Drivers are frequently required to meet specific appointment times. Can you give me an example of a time when you were required to meet a deadline.

2. On occasion a driver is prevented from meeting an appointment because of circumstances beyond his or her control. How would you handle a situation when you knew you could not meet an appointment?

3. Kriska believes that everyone has a role to play in safety. Please give an example of something you would do to make sure that keep your work environment safe.

4. Drivers are our most visible representatives and the way a driver handles a situation can reflect on the entire company. Please describe a situation in which you needed to deal with an irate or dissatisfied customer. What happened and what did you do?

5. Please describe the best supervisor you have ever worked for. Why do you feel this way?

6. Please describe the worst supervisor you have ever worked for. Why do you feel this way?

7. Please describe the best position you have ever held. Why do you feel this way?

8. Please describe a situation in which you witnessed conflict at work. What happened, and what did you do?

9. Kriska's operation will often require that a driver run through the night to meet a delivery deadline. Please describe any challenges you would have with night driving and how you will deal with them. Please describe the possible advantages to driving at night.

10. Kriska drivers face new challenges on a daily basis. Please describe a situation in which you felt intimidated by a new challenge at work. What happened and how did you deal with it?

11. Satellite systems are an important communication tool between the driver and the company. Do you have experience with computers or any form of electronic messaging? If so please describe.

General Questions

1. What is the best part about being a highway driver? What do you think is the most challenging aspect of being a highway driver? Why?

2. What do you believe is the most important part of a professional driver's job? Why?

3. How do you deal with change and stress? For example, you are reassigned to a different load, traffic is worse than you expected, a shipper or receiver is rude?

4. Tell me about a time you felt most satisfied with something you accomplished on the job.

5. What are you ideally looking for from a potential employer?

6. Why should we hire you?

Discussion Points

1. Verification of employment. The Professional Drivers Bureau conducts all verification on our behalf and will issue a report to us outlining your previous 10 years of history including references from all employers in the past 5 years. This report will also contain any information previously on file. Do you have any questions about this process or is there anything that you would like to add to your application at this time?

2. Road testing procedure and timeline. The purpose of our pre-hire road evaluation is to assess your level of skill and ability. The road evaluation will take approximately 2.5 hours to complete and follows a set course. Road evaluations are conducted in 10-speed manual transmission bunk tractors with loaded (approximately 45,000lbs) 53' trailers. Do you have any questions about our road testing process?

3. Orientation timeline and pay. Orientations are typically scheduled two weeks apart and are usually held on a Wednesday, Thursday and Friday. Classes start at 8 am and end around 4:30. We provide lunches on each day and pay $75 per day for attendance. Do you have any questions about our orientation program?

4. Over the road training program timeline expectations and pay. The over the road training program is all one-on-one with a qualified trainer. The training program is 6 weeks long with each work week varying between 4 and 6 days. Training is paid at $100 per day. Do you have any questions about our training program?

5. Apprenticeship program. Kriska's training program has been approved by the Ministry of Colleges Training and Universities under the new Tractor Trailer Commercial Driver Apprenticeship Program. Kriska automatically registers all new drivers as apprentices under this program. Do you have any questions about the apprenticeship program?

6. Trucks cannot go home!

7. We operate 24 hours per day 7 days per week 365 days per year.

8. Service area-regional operation 400 mile radius or less.

Interviewer Comments and Recommendations:

Driver Application

ADVERTISING SOURCE: _____ DRIVER

REFERRAL: _____

CHECK ONE OF THE FOLLOWING:

- ☐ **Company Driver**
- ☐ **Owner Operators**
- ☐ **Lease**

Name: _____

(First) (Middle) (Last)

Social Security No.: _____

Phone: (_____) _____

Emergency Contact: (_____) _____ Relationship: _____

Current Address: _____

_____

City: _____ State: _____ Zip Code: _____

How Long: Years _____ Months: _____

Previous Address: _____

_____

City: _____ State: _____ Zip Code: _____

How Long: Years _____ Months: _____

Previous Address: _____

_____

City: _____ State: _____ Zip Code: _____

How Long: Years _____ Months: _____

DRIVER SELECTION STANDARDS

American Central Transport, Inc. selection standards and requirements for hiring drivers include:

1. Must live within the ACT hiring area.
2. Must be at least 23 years old and have at least 24 months verifiable experience.
3. Must have CDL License with Hazardous Material endorsement issued by the state in which you reside.
4. Must be able to meet all applicable D.O.T. regulations
5. Pass D.O.T. physical administered by ACT company doctor at ACT expense.
6. No license suspension for moving violations in the past 3 years.
7. No B.A.Cs, D.U.I.s or D.W.Is in the past ten (10) years.
8. Must pass pre-employment drug test.
9. Must have and maintain neat, clean appearance.
10. Must be able to meet all legal requirements to drive a commercial truck in both USA and Canada.
11. Must be able to meet ACT work attendance/availability requirements.
12. With regard to preventable motor vehicle accidents and moving violations, ACT reserves the right to judge each applicant on an individual basis.

The following tasks are required to perform the essential responsibilities of this position. Please answer the following:

Yes ☐ No ☐ Get in and out of a semi-truck?

Yes ☐ No ☐ Get in and out of a semi-trailer?

Yes ☐ No ☐ Get under unit to perform duties, such as checking brakes and visual inspection of equipment?

Yes ☐ No ☐ Raise and lower trailer dollies when under a load?

Yes ☐ No ☐ Apply enough pressure to release fifth wheel pin?

Yes ☐ No ☐ Apply enough force to open and close semi-trailer doors?

Yes ☐ No ☐ Repeatedly lift and carry cargo weighing up to 70 lbs. per item?

Yes ☐ No ☐ Sit stationary in a driver's seat for long periods of time?

Yes ☐ No ☐ Apply enough pressure to trailer tandem lever to release locking pins when sliding tandems?

Yes ☐ No ☐ Be on duty the maximum hours allowed by D.O.T. Hours of Service Regulations?

Discontinuation of the qualification process will be enforced if you fail the drug screen or falsify this application.

I have read and agree to the standards presented above.

SIGNATURE _____

DATE _____

Are you 23 years or older?

- ☐ Yes
- ☐ No

Do you have a legal right to live and work in the U.S.?

- ☐ Yes
- ☐ No

Are you a US Citizen?

- ☐ Yes
- ☐ No

Have you ever been convicted of a Felony?

- ☐ Yes
- ☐ No

Are you familiar with the Motor Carrier Safety Regulation?

- ☐ Yes
- ☐ No

Do you have at least a total of 2 years of over the road experience or completed driving school with 1 year over the road experience?

- ☐ Yes
- ☐ No

Have you ever had your driver's license suspended?

- ☐ Yes
- ☐ No

If yes, when? _____

Have you ever had your driver's license revoked?

- ☐ Yes
- ☐ No

If yes, when? _____

Have you ever tested positive on a drug or alcohol test?

- ☐ Yes
- ☐ No

If yes, when? _____

Have you ever refused a drug or alcohol test?

- ☐ Yes
- ☐ No

If yes, when? _____

Have you worked ACT company before?

☐ Yes

☐ No

If yes, when? _____

Have you previously applied for employment with ACT?

☐ Yes

☐ No

If yes, when? _____

Have you ever been denied a license, permit, or privilege to operate a motor vehicle?

☐ Yes

☐ No

If yes, when? _____

Have you ever been convicted of any alcohol related driving offense?

☐ Yes

☐ No

If yes, when? _____

Have you ever been convicted for possession, sale, or use of a narcotic drug, amphetamine, or other controlled substance?

☐ Yes

☐ No

If yes, when? _____

LICENSE

List all drivers licenses held in the past three (3) years.

STATE	LICENSE NUMBER	CLASS/ENDORSEMENTS	EXPIRATION DATE

TRAFFIC CITATIONS

Preventable and Non-preventable traffic convictions and forfeitures for the past three (3) years

Truck and Car (other than parking violations; if none, write “none”)

DATE	LOCATION (STATE)	CHARGE	PENALTY

MOTOR VEHICLE ACCIDENTS

Motor Vehicle Accident Record for last 3 years. List all involvement with truck and car including property damage, regardless of fault (if none, write none)

DATE	TYPE VEHICLE	NATURE OF ACCIDENT	WHO WAS AT FAULT	FATALITIES	INJURIES

DRIVING EXPERIENCE

CLASS OF EQUIPMENT	TYPE OF EQUIPMENT (Van, Tank, Flat, Etc.)	DATES From / To	APPROX. NO. OF MILES (Total)
Straight Truck			
Tractor and Semi-Trailer			
Tractor Two-Trailers			
Other			

New York State Department of Motor Vehicles

DS-875 (3/09)

ARTICLE 19-A BIENNIAL BEHIND THE WHEEL ROAD TEST

www.nysdmv.com

INSTRUCTIONS TO CERTIFIED EXAMINER

- **This test shall not be conducted on the same day as the annual defensive driving performance observation.** The test should be taken without passengers in the vehicle.
- If the driver fails the test, he/she is disqualified from driving under Article 19-A. He/she may make a request to the carrier for a reexamination.
- Examiner will circle the point value of those items not properly performed. Driver is disqualified if 40 or more points are circled or, if a DISQUALIFICATION (DQ) item is circled, or if any two 10-point items are circled.

DRIVER INFORMATION

Driver's Last Name	First	M.I.	Date of Birth (Month/Day/Year)

Street Address	City	State	Zip Code

Client/License ID Number (from Driver License)	State	Class of Driver's License	Endorsements	Restrictions	Expiration Date

Driver Signature

CARRIER INFORMATION

Carrier/DBA Name	Legal Name (if different)	Federal ID Number	19-A Business ID Number

Street Address	City	State	Zip Code

VEHICLE INFORMATION

Type of Vehicle	Adult Seating Capacity	GVWR	Vehicle Plate Number	State

1. PRE-TRIP TEST	Point Value
A. Failed to check wheels, tires	5
B. Failed to check validation of required vehicle stickers	5
C. Failed to check lights	5
D. Failed to check windshield, wipers, horn, and steering	5
E. Failed to check emergency equipment: fire extinguisher, and emergency reflectors	5
F. Failed to check seats and restraints when equipped.	5
G. Failed to check passenger entry and emergency exits	5
H. Failed to check all gauges, heater, and defroster	5
I. Failed to check all mirrors and adjust as needed	5
J. Failed to perform static brake check	5
K. Failed to properly use seat belt	5
L. Failed to perform 50 ft. brake test	10
2. DEPARTING	
A. Failed to signal	5
B. Failed to observe	10
C. Failed to use caution	10
3. EN-ROUTE	
A. Failed to properly signal	5
B. Failed to observe	10
C. Failed to demonstrate proper judgment approaching/at intersection; speed, turning, stopping, observing, etc.	10
D. Failed to make proper lane changes; signals _____, observes _____, procedure _____	5
E. Failed to regularly check mirrors while driving	5
F. Failed to stop properly at RR crossing	DQ
G. Failed to use proper clutch/engine control	5
H. Failed to use proper judgment in traffic	10
I. Failed to demonstrate proper following distance	DQ

EN-ROUTE (Continued)	Point Value
J. Failed to use proper speed - impedes traffic	5
K. Failed to use proper steering control	5
L. Failed to use proper braking	5
M. Failed to use proper acceleration	5
N. Failed to use proper speed for conditions	DQ
O. Failed to anticipate and/or identify hazards	5
P. Failed to yield right-of-way	DQ
Q. Failed to use proper lane/s	10
R. Failed to properly use transmission	5
S. Failed to observe traffic control devices	DQ
4. PARKING AND BACKING	
A. Failed to leave the vehicle to check rear before backing (no observer)	10
B. Failed to observe (backing)	DQ
C. Unable to park	DQ
D. Failed to properly position the vehicle	5
E. Stopped too far away from, or hit, curb	5
F. Excessive maneuvers in parking	5
5. SIMULATED PROCEDURES FOR RECEIVING/ DISCHARGING PASSENGERS	
A. Failed to use caution at approaching/departing, receiving/discharging points	DQ
B. Failed to properly activate warning lights/devices *(where applicable)*	DQ
C. Lacked knowledge of proper crossing procedures as required by NYS Education Department *(where applicable)*	DQ
D. Failed to observe pedestrians/passengers or other hazards at receiving and discharge points	DQ

EXAMINER'S CERTIFICATION

SCORING: Total Points Circled Above _____ Disqualification (DQ) Circled Above ☐ YES ☐ NO Two 10-point items Circled Above ☐ YES ☐ NO

RESULTS: ☐ QUALIFIED ☐ DISQUALIFIED

CERTIFIED EXAMINER'S COMMENTS: (write or type on reverse side)

Certified Examiner's Name				Client/License ID Number (from Driver License)

Certificate Number	Certification Class	Endorsements	Restrictions	Expiration Date

Certified Examiner's Signature	Date of Test

DS-873 (3/09)

New York State Department of Motor Vehicles

REPORT ON ANNUAL DEFENSIVE DRIVING PERFORMANCE FOR DRIVER UNDER ARTICLE 19-A

www.nysdmv.com

INSTRUCTIONS TO CERTIFIED EXAMINER:

- Regular observation of a driver's defensive driving performance must be conducted while the driver is operating the vehicle with passengers.
- **This observation shall NOT be conducted on the same day as the biennial behind-the-wheel road test.**
- Discuss performance with driver, complete rating, driver acknowledgement, and examiner certification.

SECTION 1 - DRIVER INFORMATION

Driver's Last Name	First	M.I.	Date of Birth (Month/Day/Year)

Street Address	City	State	Zip Code

Client/License ID Number (from Driver License)	State	Class of Driver's License	Endorsements	Restrictions	Expiration Date

SECTION 2 - CARRIER INFORMATION

Carrier/DBA Name	Legal Name (if different)	Federal ID Number	19-A Business ID Number

Street Address	City	State	Zip Code

SECTION 3 - VEHICLE INFORMATION

Type of Vehicle	Adult Seating Capacity	GVWR	Vehicle Plate Number	State

SECTION 4 - OBSERVATION (may be conducted inside or outside the vehicle)

Observation Conducted: ☐ Inside ☐ Outside

	Satisfactory	Unsatisfactory		Satisfactory	Unsatisfactory
1. Observation	☐	☐	7. Obeys Traffic Signs, Signals and Road Hazard Signs	☐	☐
2. Traffic Lane Use (include center line violation)	☐	☐	8. Observes Proper Following Distance	☐	☐
3. Speed	☐	☐	9. Procedures for Receiving and Discharging Passengers	☐	☐
4. Properly Signals Intention	☐	☐	10. Traffic Interaction	☐	☐
5. Turning	☐	☐			
6. Vehicle Control	☐	☐			

Comments: (*required if Unsatisfactory checked above*) _____

SECTION 5 - DRIVER ACKNOWLEDGEMENT

I acknowledge discussion of my defensive driving performance with the examiner who observed and rated my performance.

✍ _____ _____

(Driver Signature) (Date)

SECTION 6 - EXAMINER CERTIFICATION

Certified Examiner's Name	Client/License ID Number (from Driver License)

Certificate Number	Certification Class	Endorsements	Restrictions	Expiration Date

I certify that the above report is, to the best of my knowledge, true and correct, that I personally observed the above driver's defensive driving performance, and that I currently hold a valid examiner certification as required in accordance with Article 19-A of the New York State Vehicle and Traffic Law.

Certified Examiner's Signature

✍

Date of Observation

Abbreviations and acronyms used without definitions in TRB publications:

AAAE	American Association of Airport Executives
AASHO	American Association of State Highway Officials
AASHTO	American Association of State Highway and Transportation Officials
ACI–NA	Airports Council International–North America
ACRP	Airport Cooperative Research Program
ADA	Americans with Disabilities Act
APTA	American Public Transportation Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATA	Air Transport Association
ATA	American Trucking Associations
CTAA	Community Transportation Association of America
CTBSSP	Commercial Truck and Bus Safety Synthesis Program
DHS	Department of Homeland Security
DOE	Department of Energy
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
HMCRP	Hazardous Materials Cooperative Research Program
IEEE	Institute of Electrical and Electronics Engineers
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITE	Institute of Transportation Engineers
NASA	National Aeronautics and Space Administration
NASAO	National Association of State Aviation Officials
NCFRP	National Cooperative Freight Research Program
NCHRP	National Cooperative Highway Research Program
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
PHMSA	Pipeline and Hazardous Materials Safety Administration
RITA	Research and Innovative Technology Administration
SAE	Society of Automotive Engineers
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005)
TCRP	Transit Cooperative Research Program
TEA-21	Transportation Equity Act for the 21st Century (1998)
TRB	Transportation Research Board
TSA	Transportation Security Administration
U.S.DOT	United States Department of Transportation

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